Java Beginner to Builder Bootcamp

Replay 2026 - San Francisco

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Beginner to Builder Bootcamp - Java

- **00. About this Workshop**
- 01. The Basics of Temporal
- 02. Improving Your Temporal Application Code
- 03. Using Timers in a Workflow Definition
- 04. Understanding Event History
- 05. Understanding Workflow Determinism
- 06. Signals, Queries, and Workflow Updates
- 07. Timeouts and Retry Policies
- 08. Recovering from Failure
- 09. Conclusion

During this workshop, you will

- Learn the basic architecture of the Temporal platform
- Develop and execute Workflows and Activities using the Java SDK
- Use the Web UI to gain insight into current and previous executions
- Define, send, and handle Workflow Signals and Queries
- Understand how Temporal handles crashes, timeouts, and failures
- Customize a Retry Policy for Activity Execution
- Observe how Activity Heartbeating detects failure in a long-running Activity
- Apply the Saga pattern to recover from a failure in a Workflow Execution

Logistics

- Schedule
- Asking questions
- Getting help with exercises
- Course conventions ("workflow" vs. "Workflow")
- Introductions

About the Instructor

Marcus Merrell

Greenbrae, CA, USA

Current: **Staff Developer Advocate** at Temporal Technologies Inc.

Past: Vice President of Technology Strategy, Sauce Labs

Principal SDET, RetailMeNot, inc

Software Test Architect at Peoplefluent

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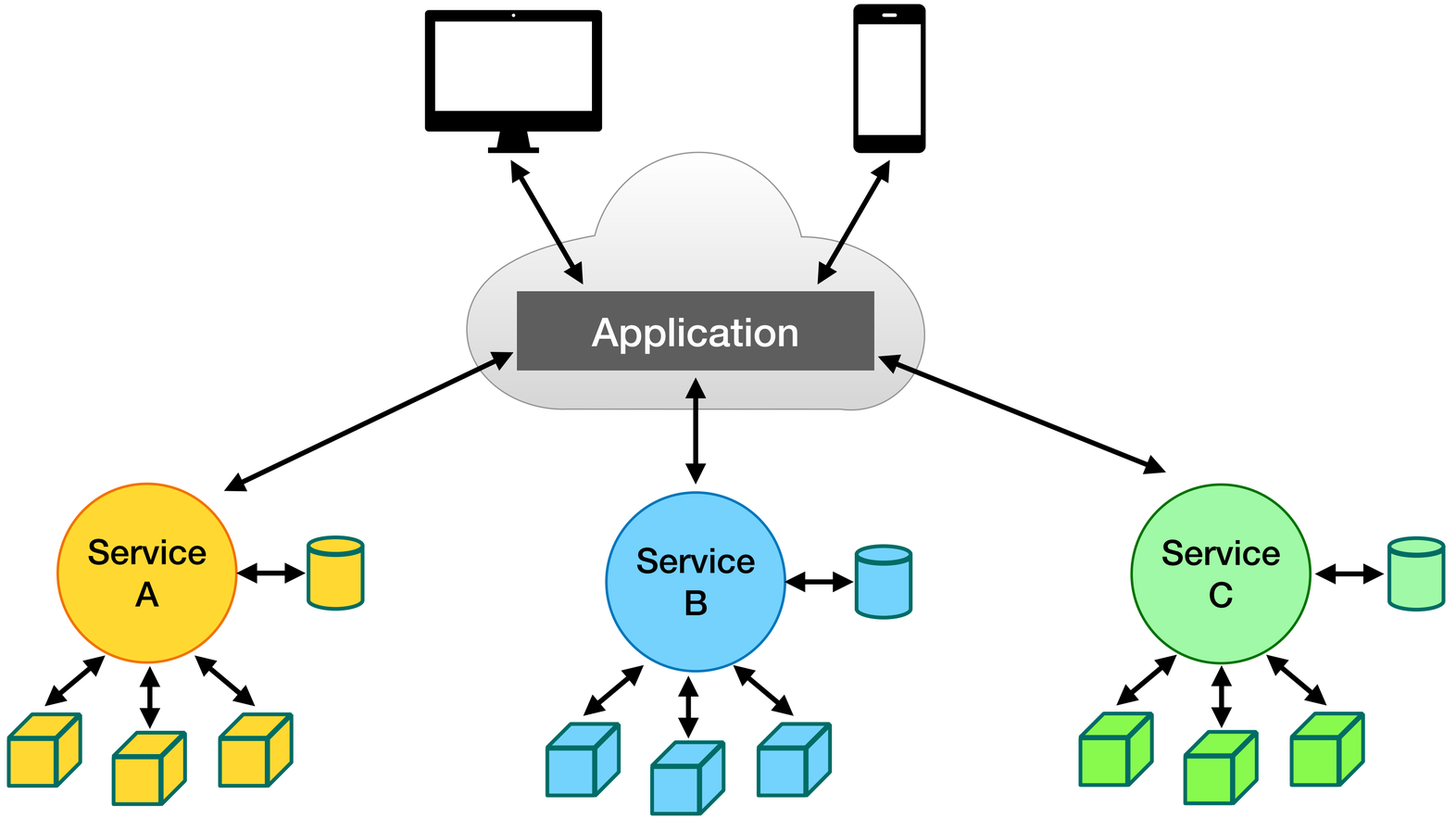
What Is Temporal?

Let’s Begin with “Why Temporal Exists”

Modern Applications Are Distributed Systems



More potential for scalability, but more opportunities for failure

This Is a Distributed System

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public String moneyTransfer(PaymentDetails data) {
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    String confirmation1 = bank.withdraw(data.getSourceAccount(), data.getAmount());
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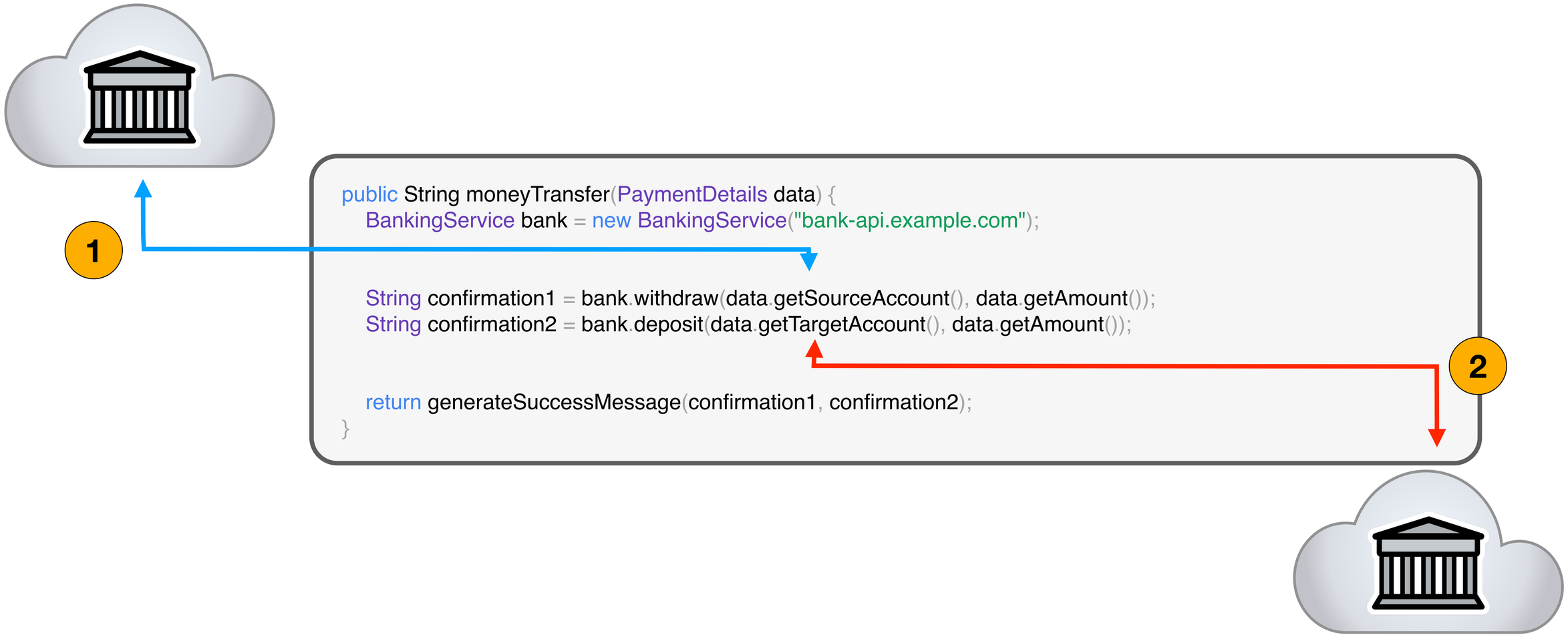
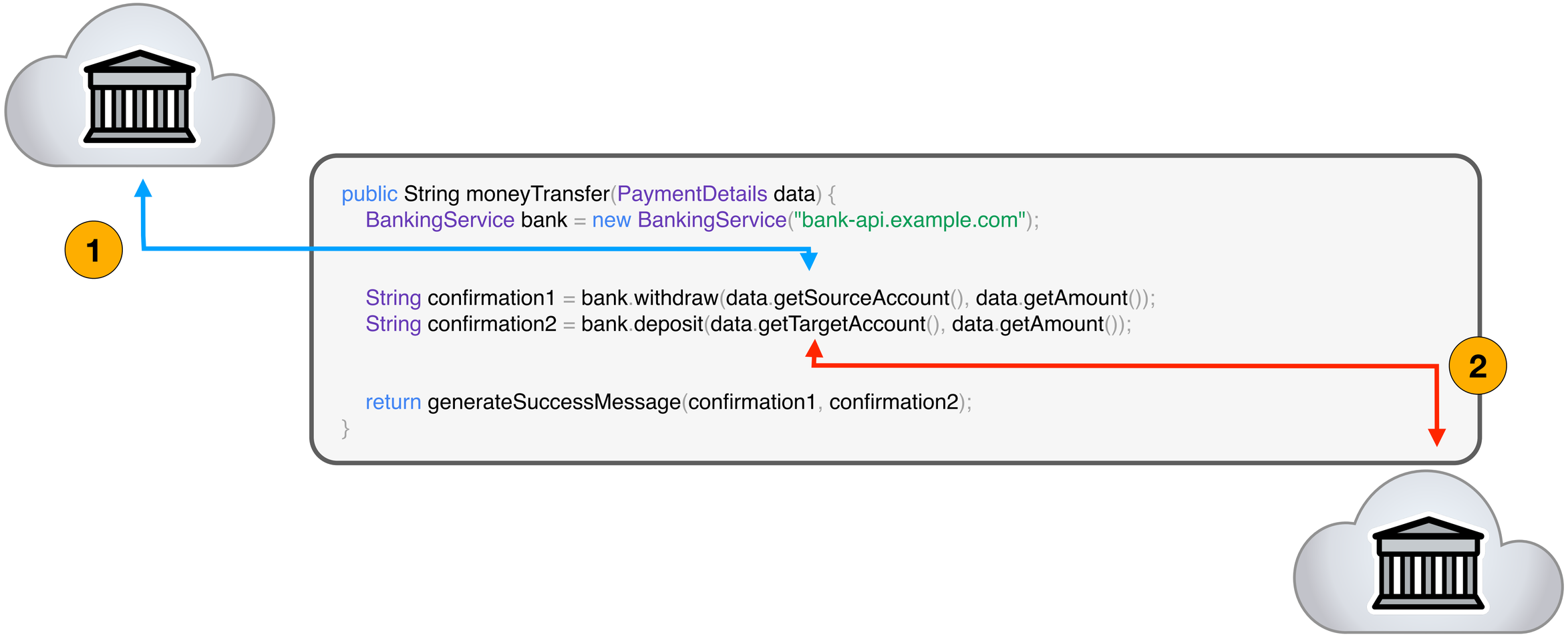


There is a Big Problem Here



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Correctness requires exactly-once execution

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  - It will fundamentally change how you design software

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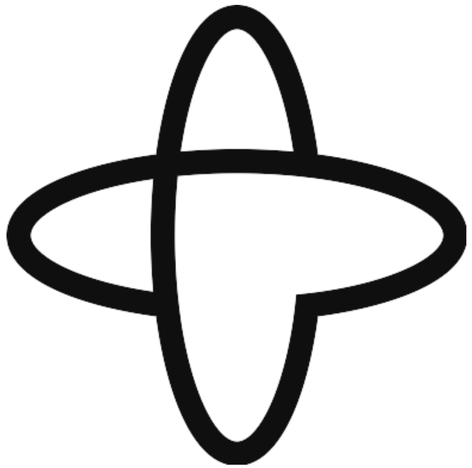

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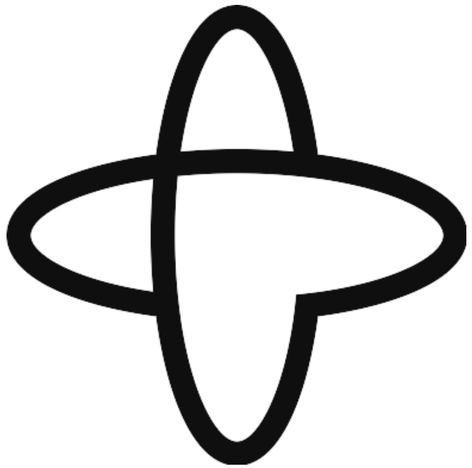

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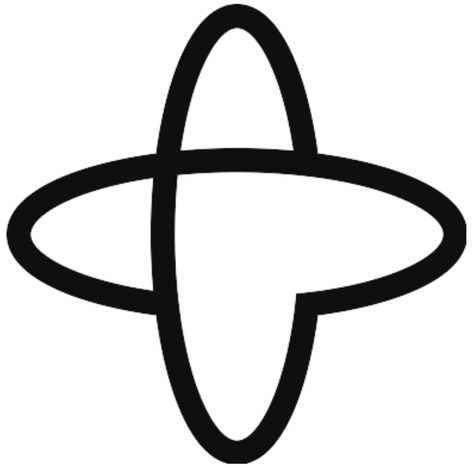

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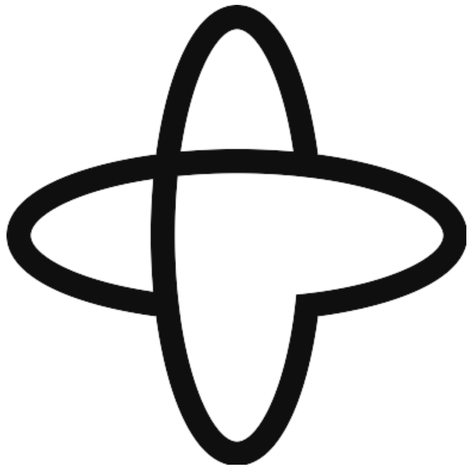

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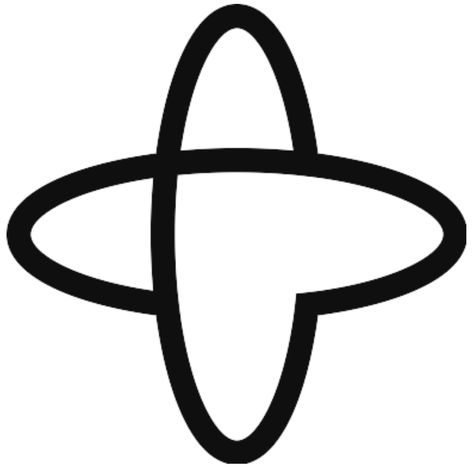

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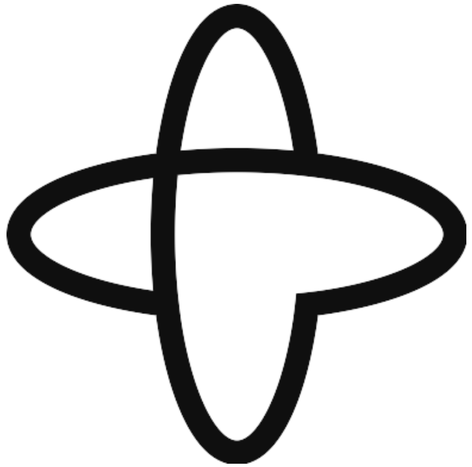
  - Improves developer productivity by making applications easier to develop, scale, and support



Architectural Overview

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  - Temporal requires that Workflows are *deterministic*

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  - A *Temporal SDK* provides support for using Temporal in a specific language
  - Temporal currently offers seven SDKs…with an eighth (Rust) currently in development

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  - You can use the naming convention you prefer.

Writing a Workflow Definition

Writing a Workflow Definition

- **Three steps for turning a Java Interface/Implementation into a Workflow Definition**

Interface

```
package greeting;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;

@WorkflowInterface
public interface GreetingWorkflow {

    @WorkflowMethod
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Implementation

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package greeting;

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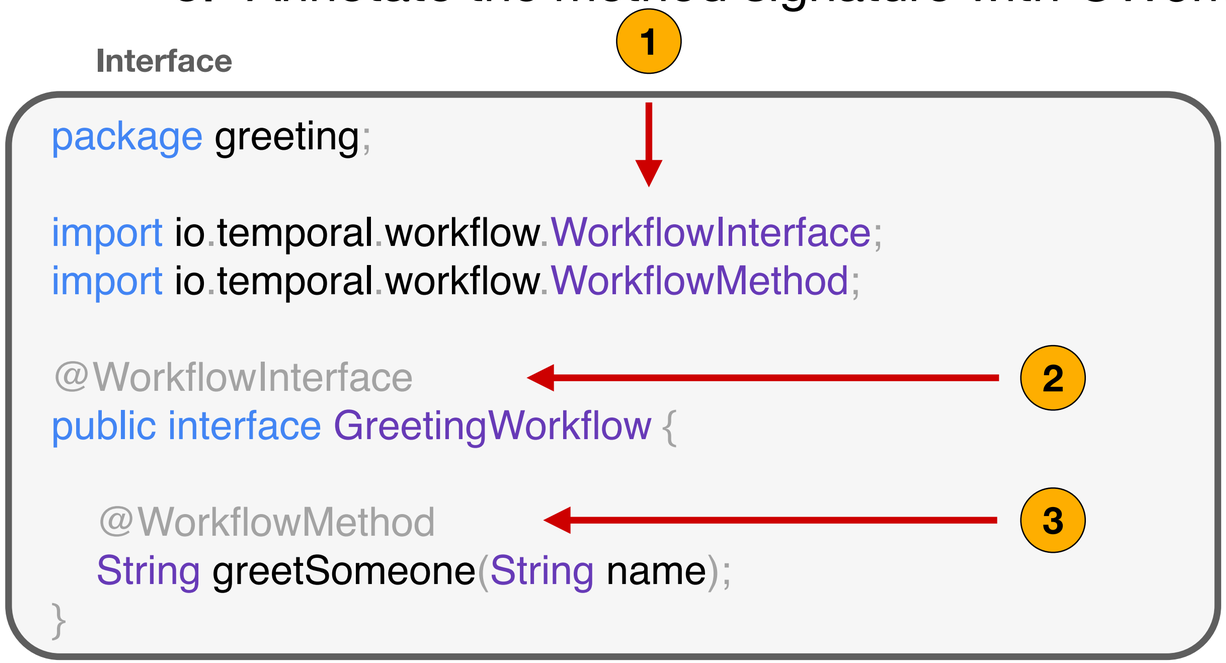


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- **Data Confidentiality**
  - All data is stored in the Event History, so encryption is required to ensure confidentiality

Temporal Activities

< / > Workflow Definition

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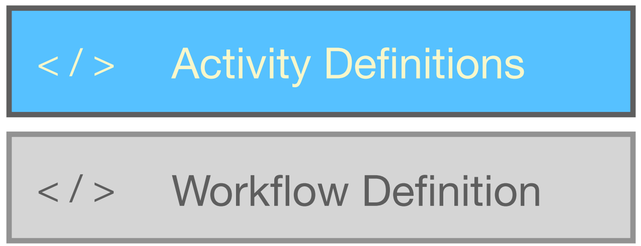

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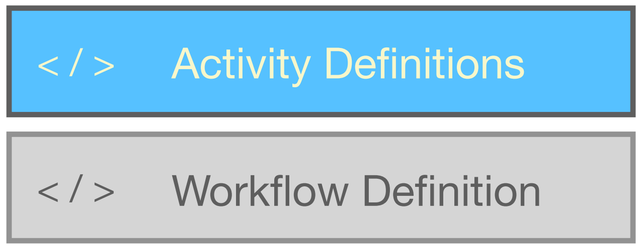

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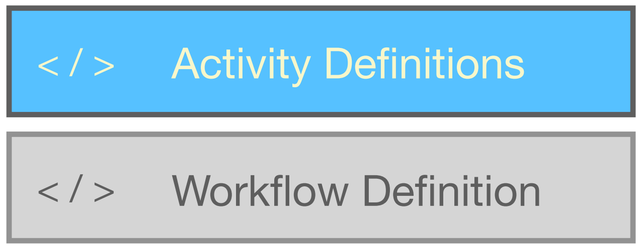

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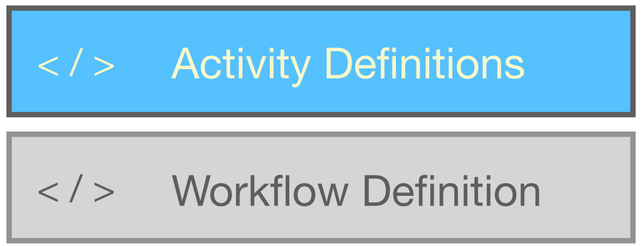

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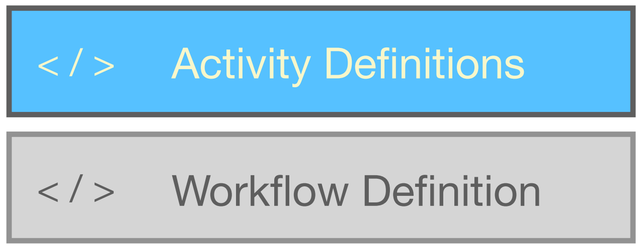

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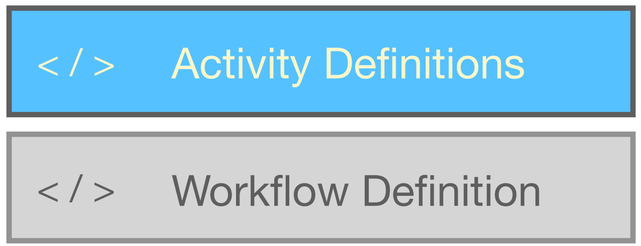
    - Protect against scenarios where re-running an Activity results in duplicate records or other undesirable side-effects.



Executing Activities

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import io.temporal.workflow.Workflow;

import java.time.Duration;

public class GreetingWorkflowImpl implements GreetingWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities = Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
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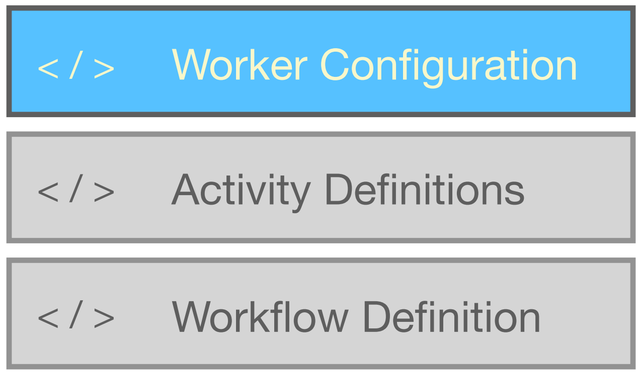
Temporal Application Overview: Workers

< / > Activity Definitions

< / > Workflow Definition

Temporal Application Overview: Workers

- **Workers are responsible for executing Workflow and Activity Definitions**



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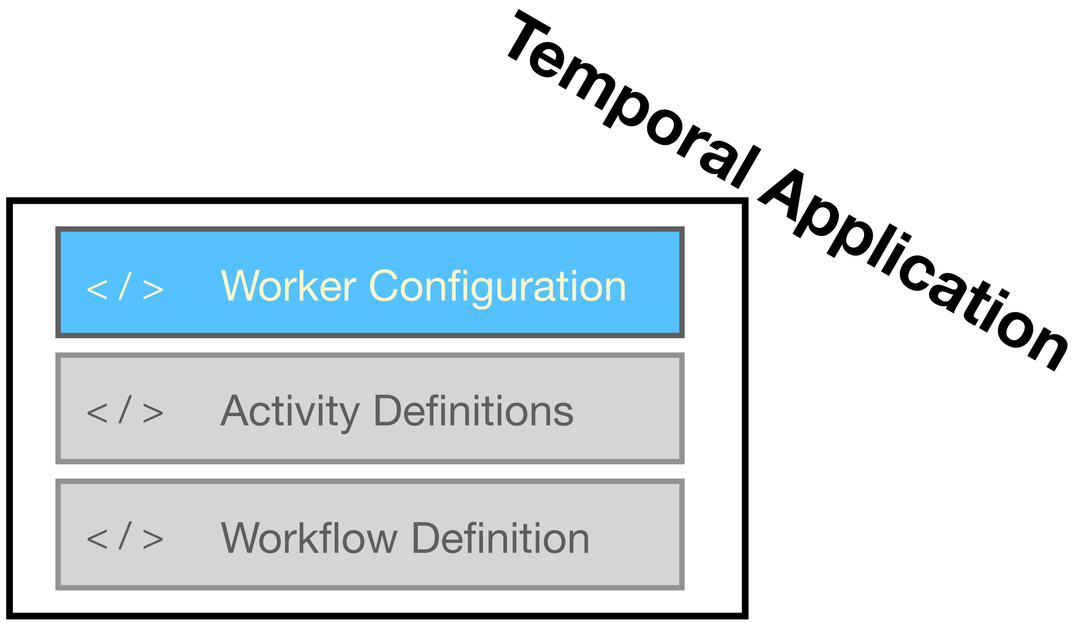

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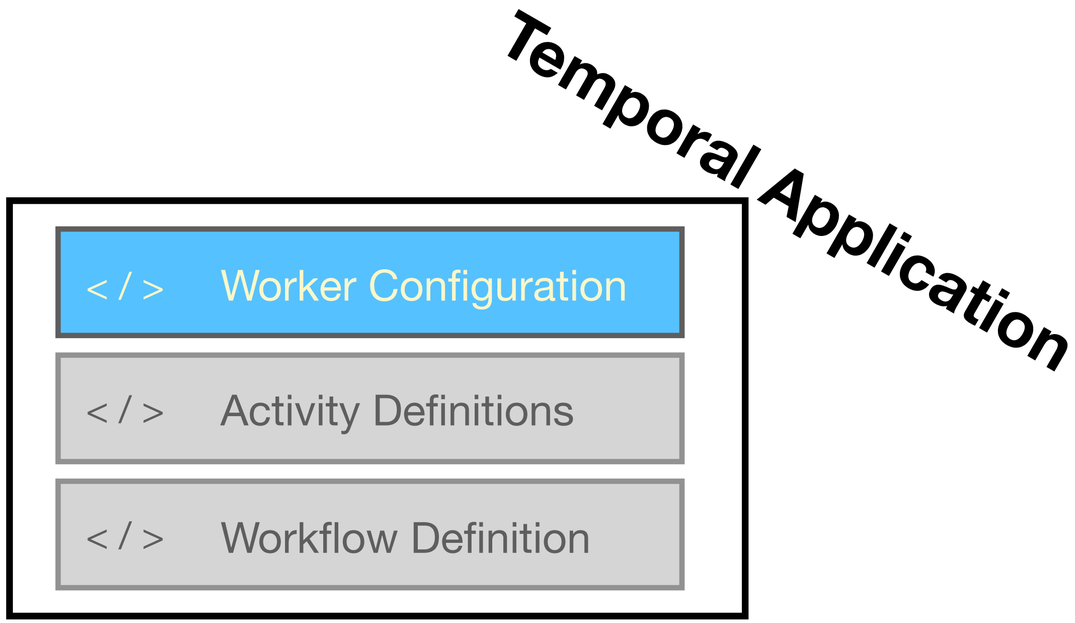

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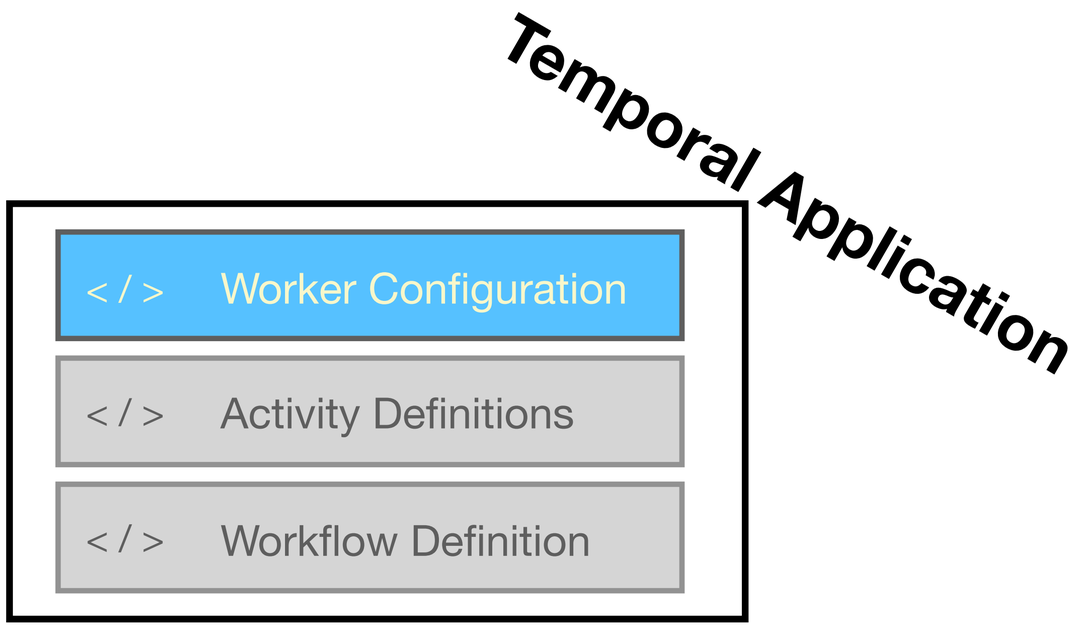

Temporal Application Overview: Workers

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- **The Worker implementation library is provided by the Temporal SDK**
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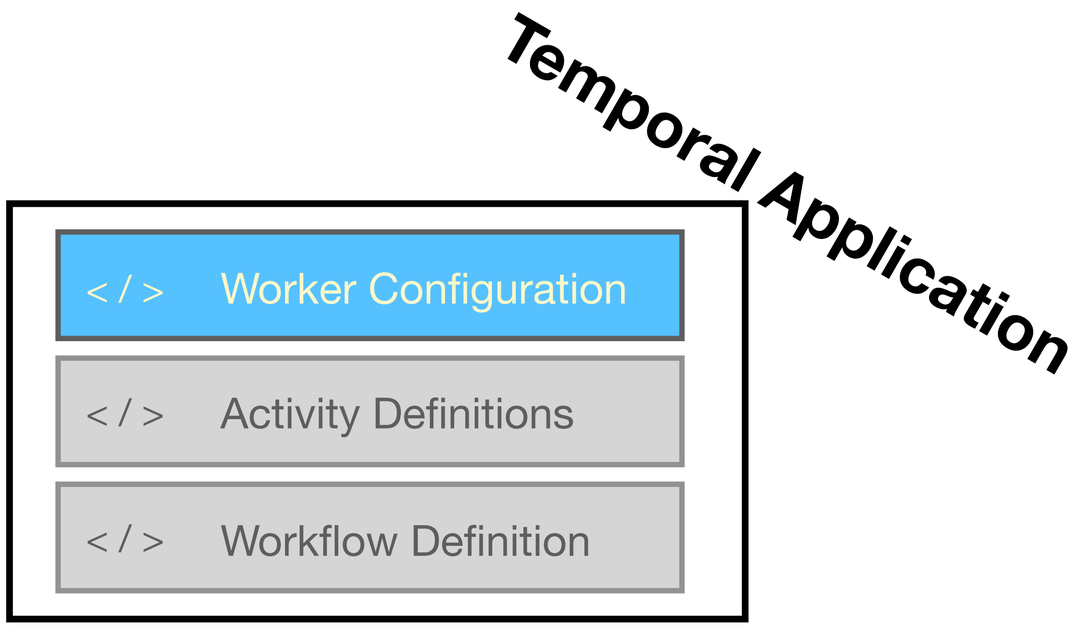

Configuring the Worker

```java
package greeting;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

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    WorkflowClient client = WorkflowClient.newInstance(service);
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    Worker worker = factory.newWorker("greeting-tasks");

    // Specify which Workflow implementations this Worker will support
    worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

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```

Configuring the Worker

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Specify the Task Queue

Configuring the Worker

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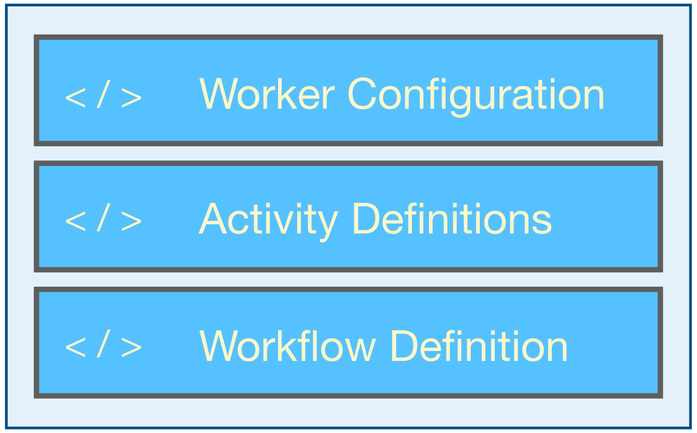
2 Specify the Task Queue

4 Begin polling the Task Queue

This Is the Code that You Develop



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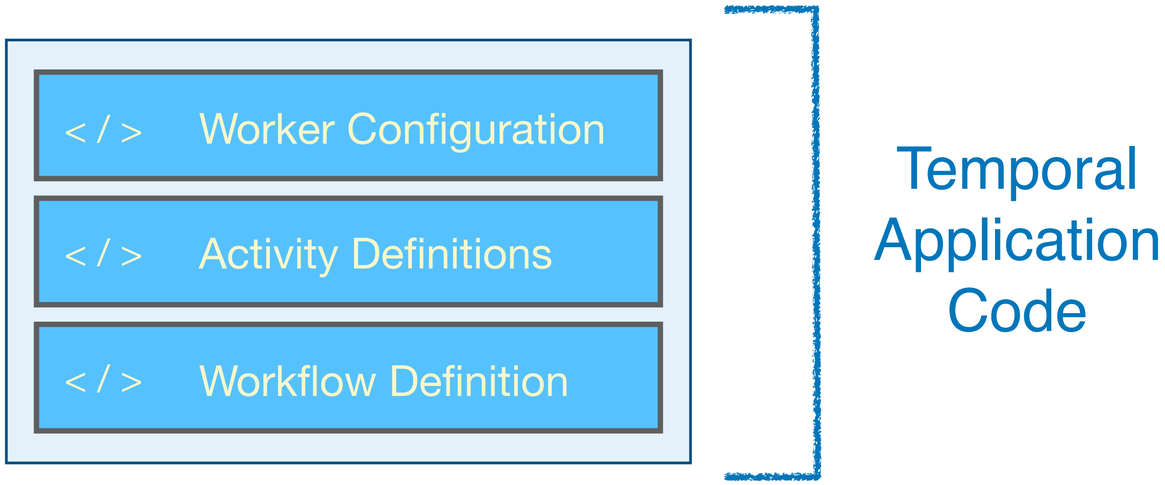
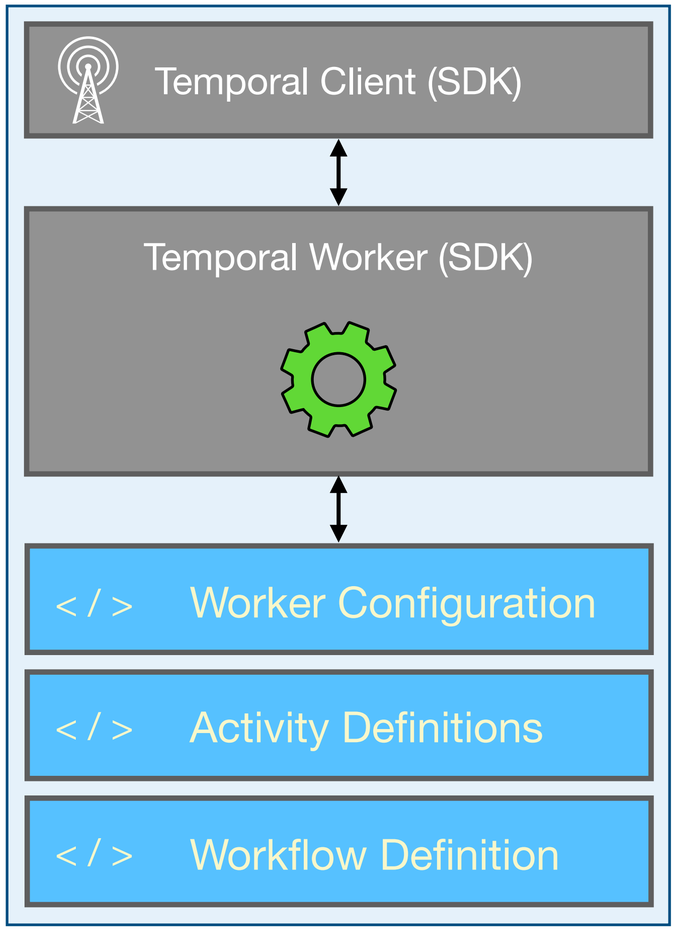


A Complete Temporal Application



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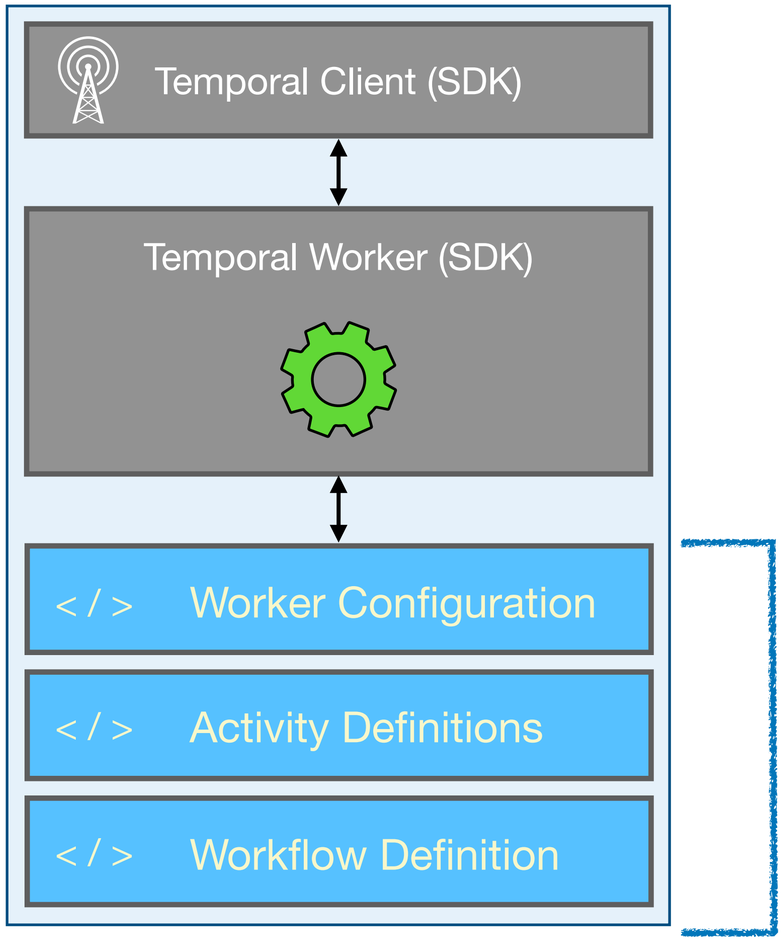

You develop

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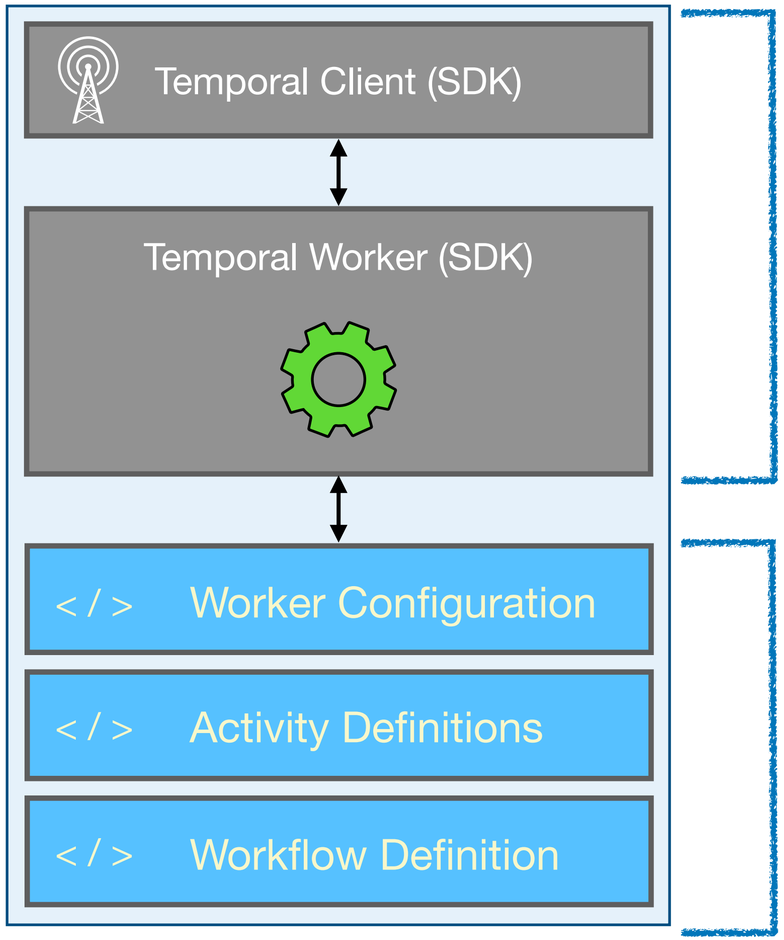
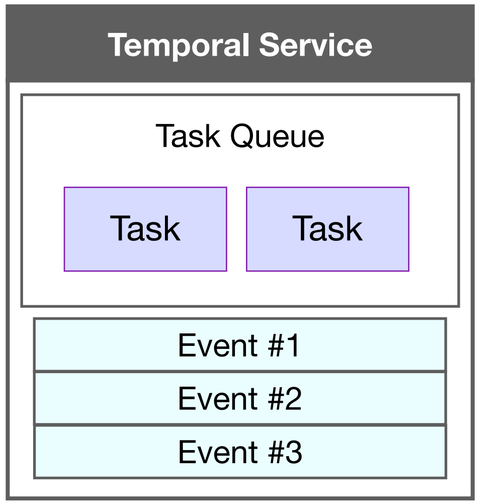


The Temporal Service

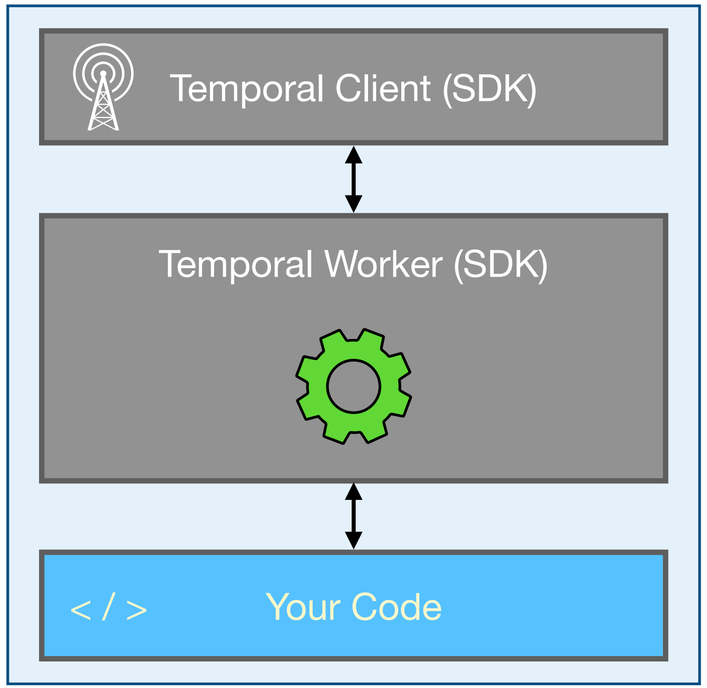


Manages tasks and history

- A backend system that *orchestrates* Workflow Executions (it does not execute your code!)
- Creates tasks that instruct Workers on when and how to run Workflow and Activity code
- Maintains Event Histories that detail progress made by a given Workflow Execution

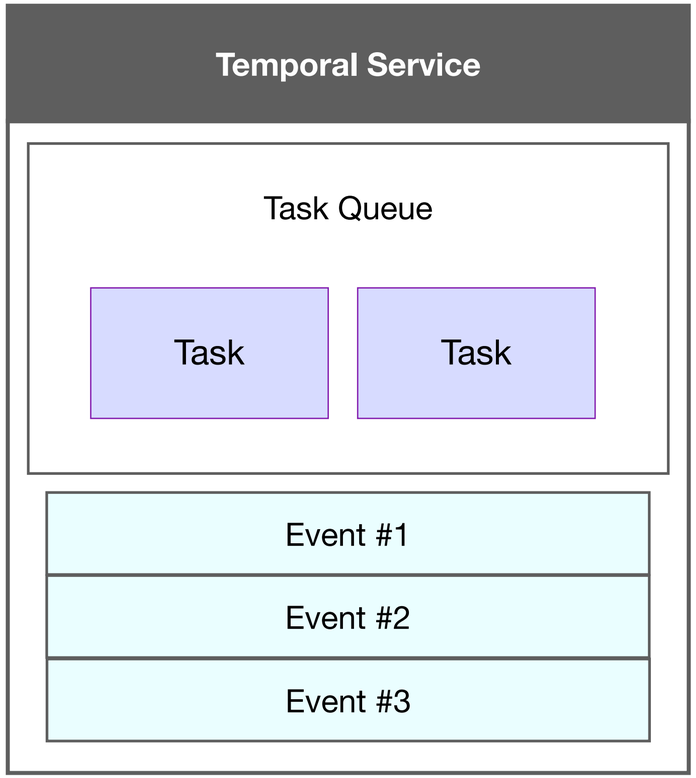
Applications Are External to the Temporal Service

Temporal Application



gRPC via TCP port 7233

Temporal Service



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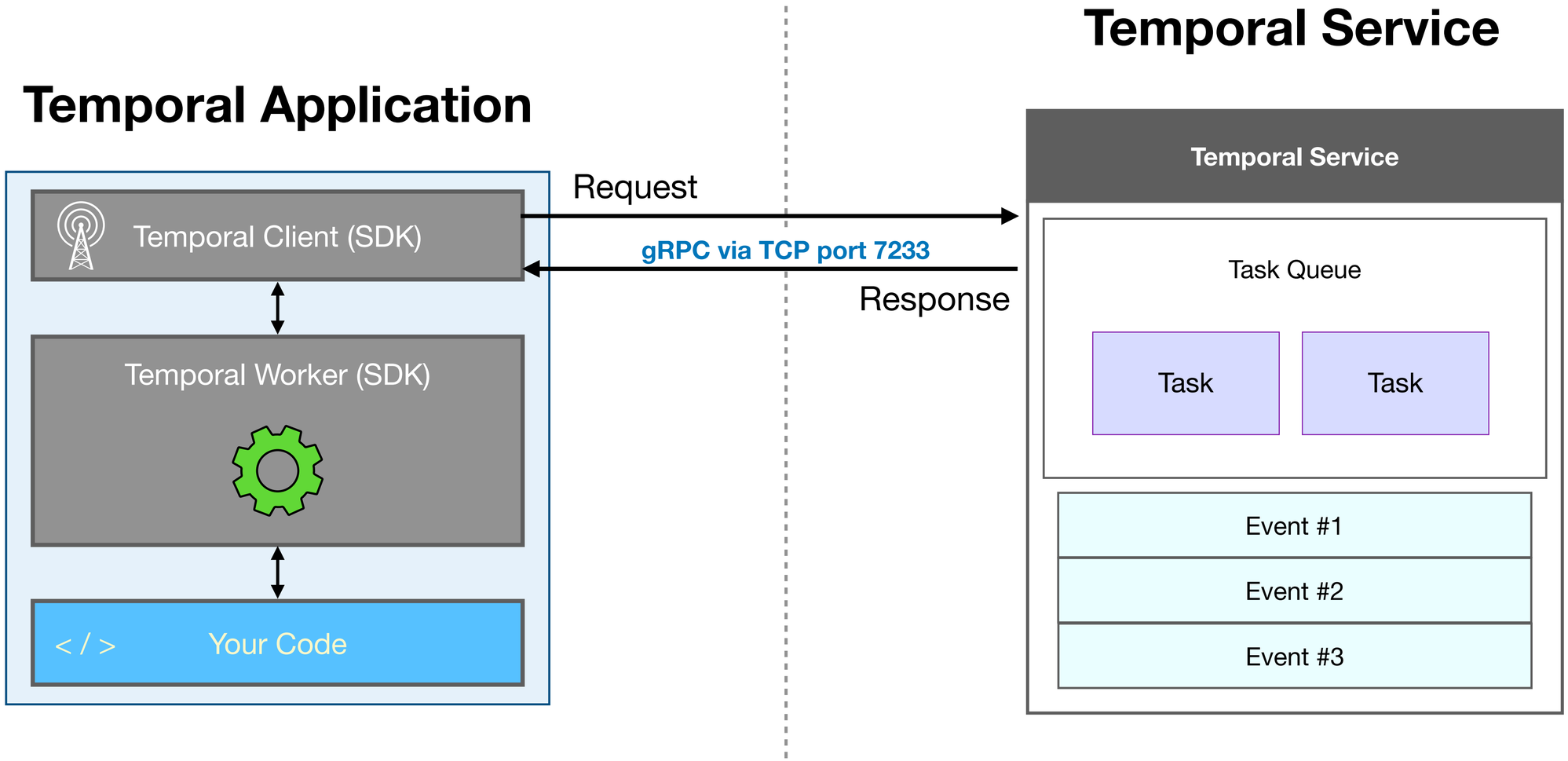

Putting It All Together

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Tools

Temporal Command-Line Interface

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a local Temporal Service, start Workflow Executions,
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and more.

* Start a local development service:
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Usage:
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Available Commands:
  activity    Complete or fail an Activity
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```
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```

  - Start a development cluster (specifying path for durable storage and a custom Web UI port)

```
$ temporal server start-dev \
    --db-filename /Users/mmerrell/dev/mycluster.db \
    --ui-port 8080
```

Viewing History from Web UI

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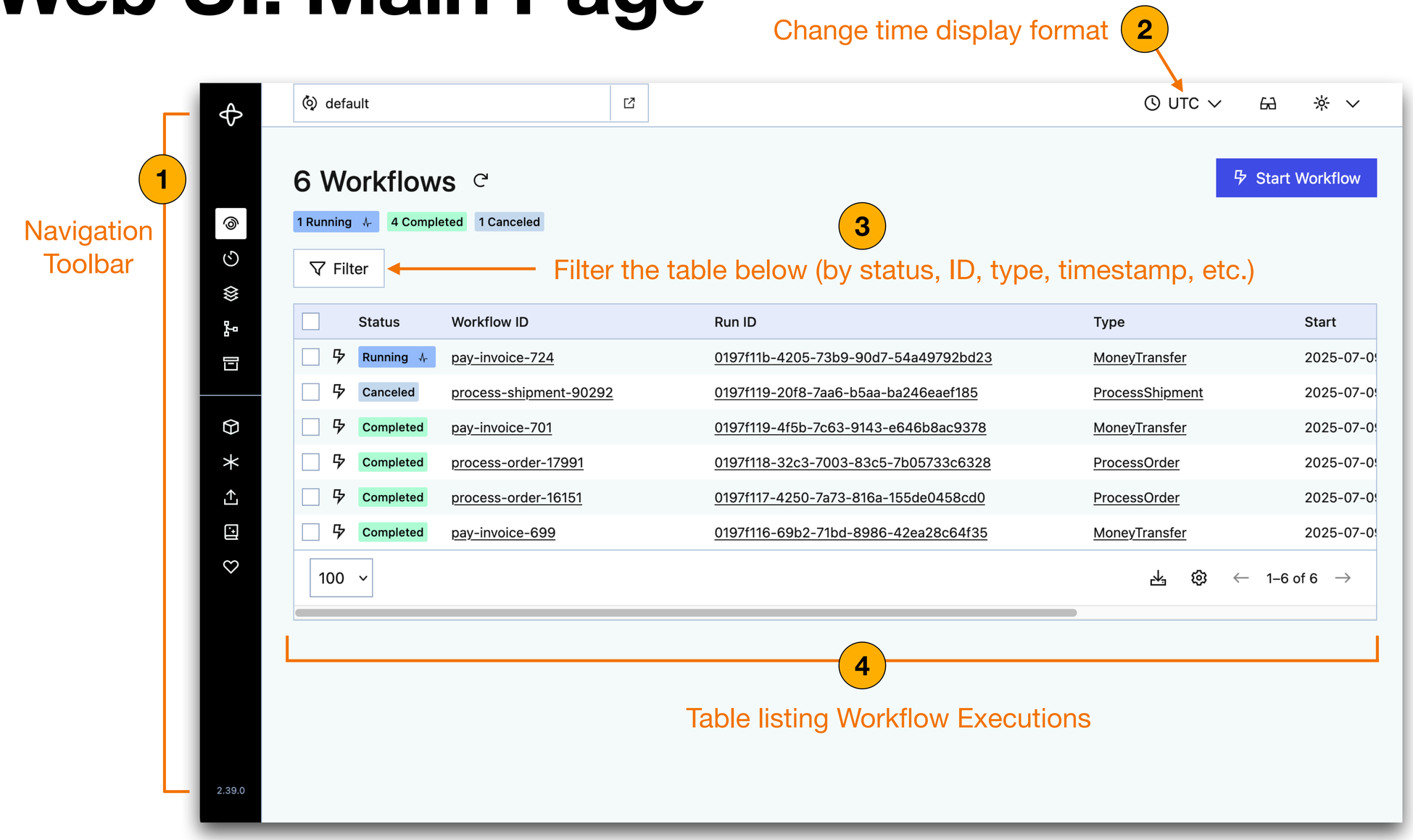
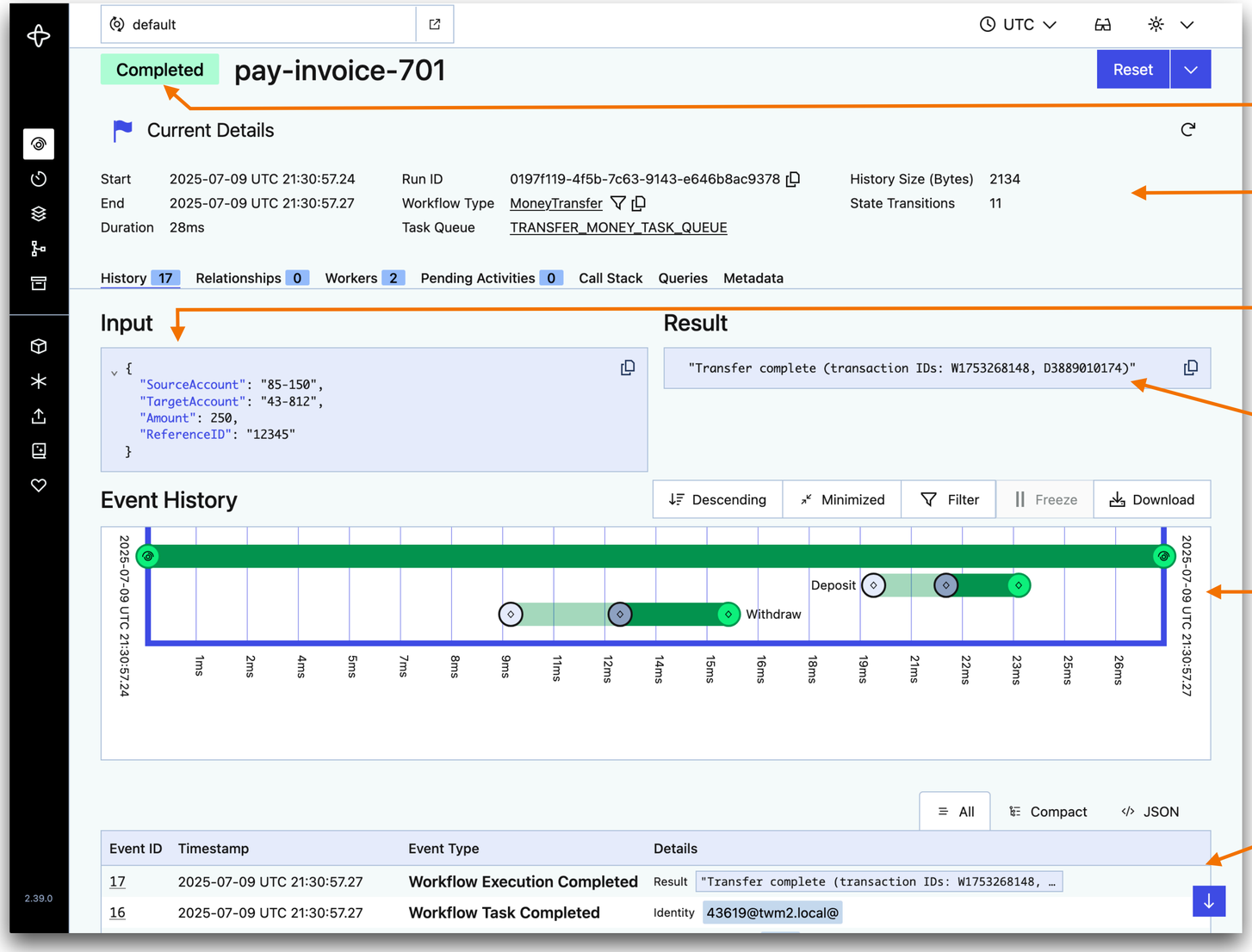
    - You can override the port number with a command-line option (example: --ui-port 8080)

Web UI: Main Page



Web UI: Detail Page



1. Status
2. Workflow Execution details
3. Input data passed to Workflow Execution
4. Output data returned by Workflow Executio
5. Timeline display
6. Event History table

Executing a Basic Workflow

Executing a Workflow from the Command Line

Executing a Workflow from the Command Line

- One way to start a Workflow is with `temporal workflow start`

```
$ temporal workflow start \
    --type GreetSomeone \
    --task-queue greeting-tasks \
    --workflow-id my-first-workflow \
    --input '"Mason"'

Running execution:
  WorkflowId  my-first-workflow
  RunId       ab62c808-44d7-4b3e-97ef-777493c4da09
  Type        GreetSomeone
  Namespace   default
  TaskQueue   greeting-tasks
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Executing a Workflow from Application Code (1)

```
package greeting;

import io.temporal.client.WorkflowClient;
import io.temporal.client.WorkflowOptions;
import io.temporal.client.WorkflowStub;
import io.temporal.serviceclient.WorkflowServiceStubs;

public class Starter {
  public static void main(String[] args) throws Exception {

    WorkflowServiceStubs service =
          WorkflowServiceStubs.newLocalServiceStubs();

    WorkflowClient client = WorkflowClient.newInstance(service);

    WorkflowOptions options = WorkflowOptions.newBuilder()
              .setWorkflowId("my-first-workflow")
              .setTaskQueue("greeting-tasks")
              .build();

    Greeting workflow = client.newWorkflowStub(GreetingWorkflow.class,
                                               options);

    // code continued on next slide
```

Executing a Workflow from Application Code (1)

- **An alternative to using temporal is to execute the Workflow from code**

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    WorkflowServiceStubs service =
            WorkflowServiceStubs.newLocalServiceStubs();

    WorkflowClient client = WorkflowClient.newInstance(service);

    WorkflowOptions options = WorkflowOptions.newBuilder()
                .setWorkflowId("my-first-workflow")
                .setTaskQueue("greeting-tasks")
                .build();

    Greeting workflow = client.newWorkflowStub(GreetingWorkflow.class,
                                                    options);

    // code continued on next slide
```

Executing a Workflow from Application Code (1)

- **An alternative to using temporal is to execute the Workflow from code**
  - This provides a way of integrating Temporal into your own applications

```
package greeting;

import io.temporal.client.WorkflowClient;
import io.temporal.client.WorkflowOptions;
import io.temporal.client.WorkflowStub;
import io.temporal.serviceclient.WorkflowServiceStubs;

public class Starter {
  public static void main(String[] args) throws Exception {

    WorkflowServiceStubs service =
            WorkflowServiceStubs.newLocalServiceStubs();

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Executing a Workflow from Application Code (1)

- **An alternative to using temporal is to execute the Workflow from code**
  - This provides a way of integrating Temporal into your own applications
  - You can do this in three steps
    - Import Client APIs from the SDK

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package greeting;

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public class Starter {
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Executing a Workflow from Application Code (1)

- **An alternative to using temporal is to execute the Workflow from code**
  - This provides a way of integrating Temporal into your own applications
  - You can do this in three steps
    - Import Client APIs from the SDK
    - Create and configure a Client

```
package greeting;

import io.temporal.client.WorkflowClient;
import io.temporal.client.WorkflowOptions;
import io.temporal.client.WorkflowStub;
import io.temporal.serviceclient.WorkflowServiceStubs;

public class Starter {
  public static void main(String[] args) throws Exception {

    WorkflowServiceStubs service =
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    Greeting workflow = client.newWorkflowStub(GreetingWorkflow.class,
                                                options);

    // code continued on next slide
```

Executing a Workflow from Application Code (2)

```
        WorkflowOptions options = WorkflowOptions.newBuilder()
                .setWorkflowId("my-first-workflow")
                .setTaskQueue("greeting-tasks")
                .build();

        Greeting workflow = client.newWorkflowStub(GreetingWorkflow.class, options);

        String greeting = workflow.greetSomeone(args[0]);

        String workflowId = WorkflowStub.fromTyped(workflow).getExecution().getWorkflowId();

        System.out.println(workflowId + " " + greeting);

    }
}
```

Executing a Workflow from Application Code (2)

- Use the API to request execution

```
        WorkflowOptions options = WorkflowOptions.newBuilder()
                .setWorkflowId("my-first-workflow")
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                .build();

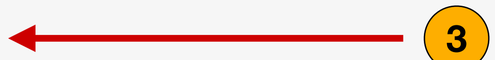
        Greeting workflow = client.newWorkflowStub(GreetingWorkflow.class, options);

        String greeting = workflow.greetSomeone(args[0]);

        String workflowId = WorkflowStub.fromTyped(workflow).getExecution().getWorkflowId();

        System.out.println(workflowId + " " + greeting);

    }
}
```



Executing a Workflow from Application Code (2)

- Use the API to request execution
- We will use similar code to run Workflows in later exercises

```
        WorkflowOptions options = WorkflowOptions.newBuilder()
                .setWorkflowId("my-first-workflow")
                .setTaskQueue("greeting-tasks")
                .build();

        Greeting workflow = client.newWorkflowStub(GreetingWorkflow.class, options);

        String greeting = workflow.greetSomeone(args[0]);

        String workflowId = WorkflowStub.fromTyped(workflow).getExecution().getWorkflowId();

        System.out.println(workflowId + " " + greeting);

    }
}
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Making Changes to a Workflow

Making Changes to a Workflow

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  - We recommend that your Workflow uses a class as the only input parameter
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- **You must also ensure that your Workflow is *deterministic***
  - Each execution of a given Workflow must produce the same output, given the same input
  - Handle non-deterministic operations using SDK-provided alternatives and Temporal features

Making Changes to a Workflow

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- **You must also ensure that your Workflow is *deterministic***
  - Each execution of a given Workflow must produce the same output, given the same input
  - Handle non-deterministic operations using SDK-provided alternatives and Temporal features
  - Restart Workers after making changes for consistency in Workflow Executions.

Exercise Environment Orientation

- You’re just about to begin the first hands-on exercise
- Follow the link below to access the Instruqt environment
- We will explain and demonstrate the exercise environment

https://t.mp/replay26-workshop-java

Exercise #1: Hello Workflow

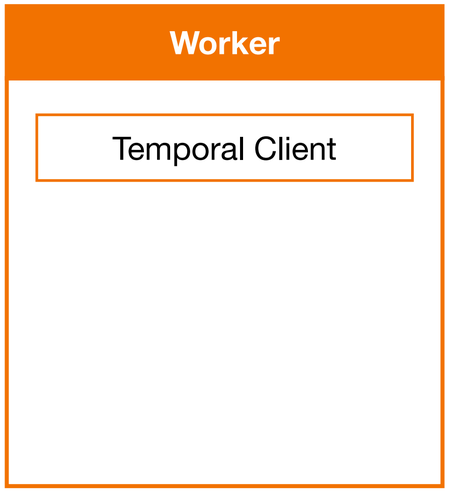
https://t.mp/replay26-workshop-java

- **During this exercise, you will**
  - Review the business logic of the provided Workflow Definition to understand its behavior
  - Modify the Worker initialization code to specify a Task Queue name (**greeting-tasks**)
  - Run the Worker initialization code to start the Worker process
  - Use **temporal** to execute the Workflow from the command line, specifying your name as input
- **Refer to the README.md file in the exercise environment for details**
  - The code is below the **exercises/hello-workflow** directory
    - Make your changes to the code in the **practice** subdirectory (look for TODO comments)
    - If you need a hint or want to verify your changes, look at the complete version in the **solution** subdirectory

Understanding Workflow Execution

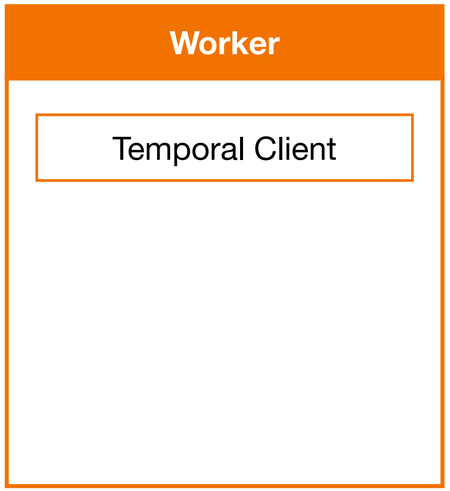
Actors in this Workflow Execution Scenario

Actors in this Workflow Execution Scenario



Executes the code

Actors in this Workflow Execution Scenario



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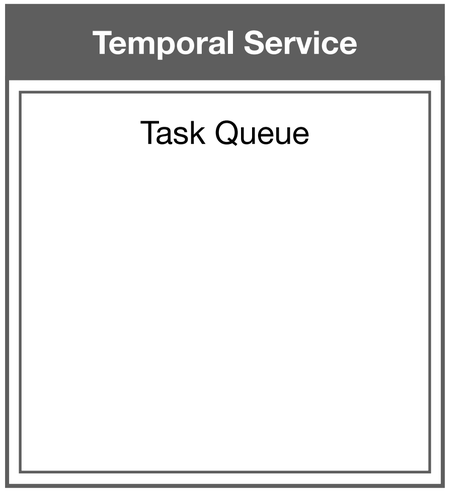
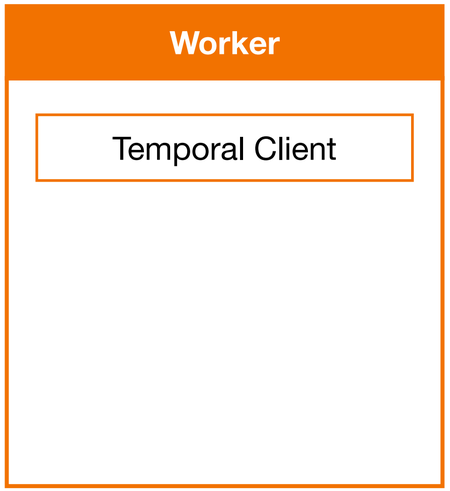


Orchestrates code execution

Actors in this Workflow Execution Scenario



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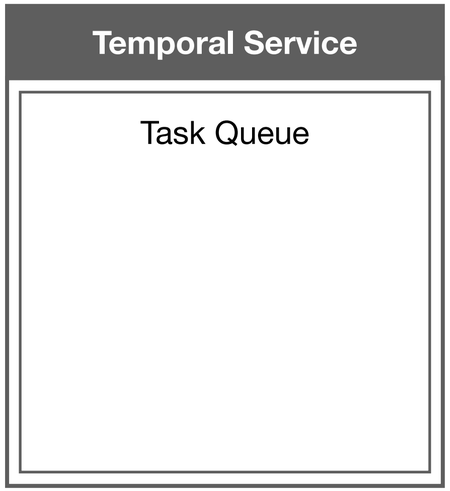

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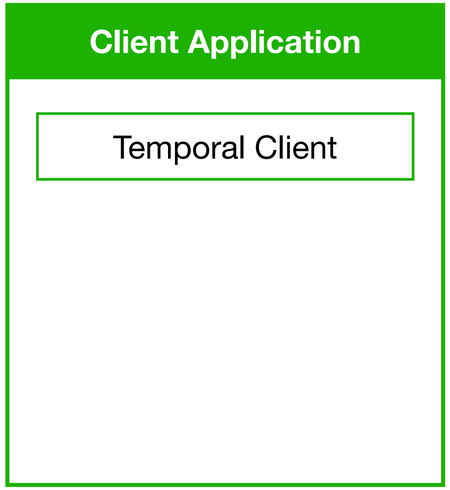


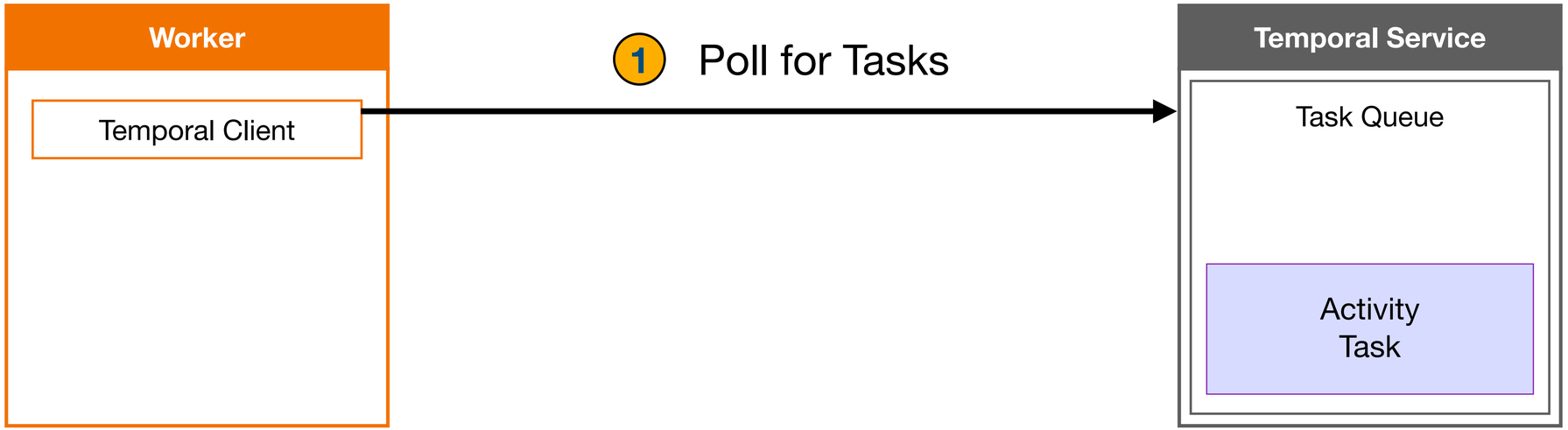
Requests code execution
and retrieves the result

Workers and Tasks

Workers and Tasks

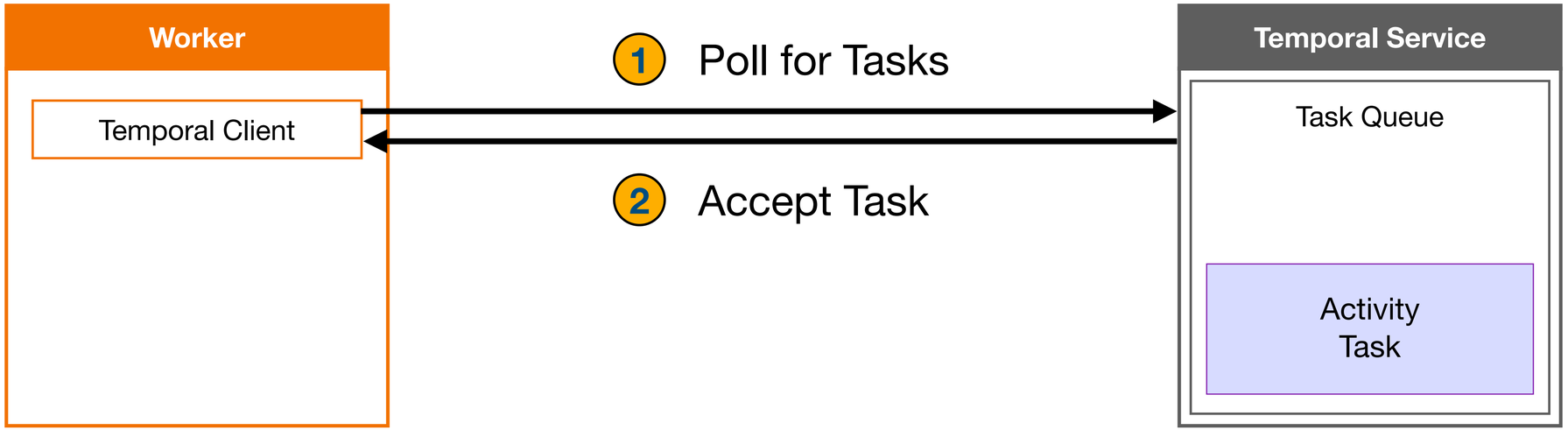
- Temporal does not assign tasks to Workers

Workers and Tasks



- Temporal does not assign tasks to Workers
- Workers continuously poll, accepting tasks when they have spare capacity

Workers and Tasks



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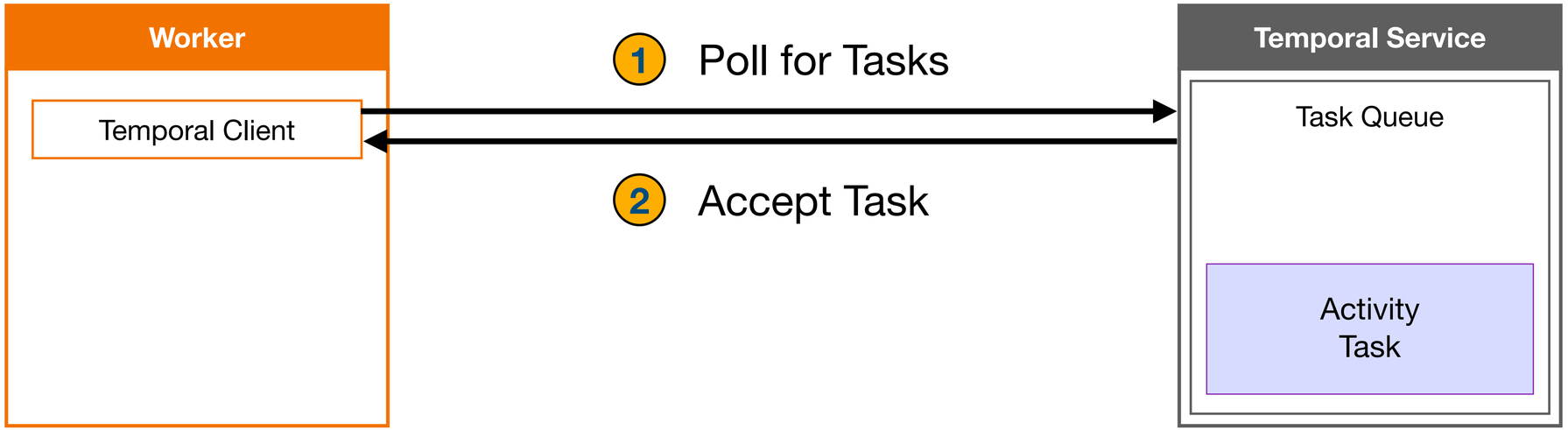
Workers and Tasks



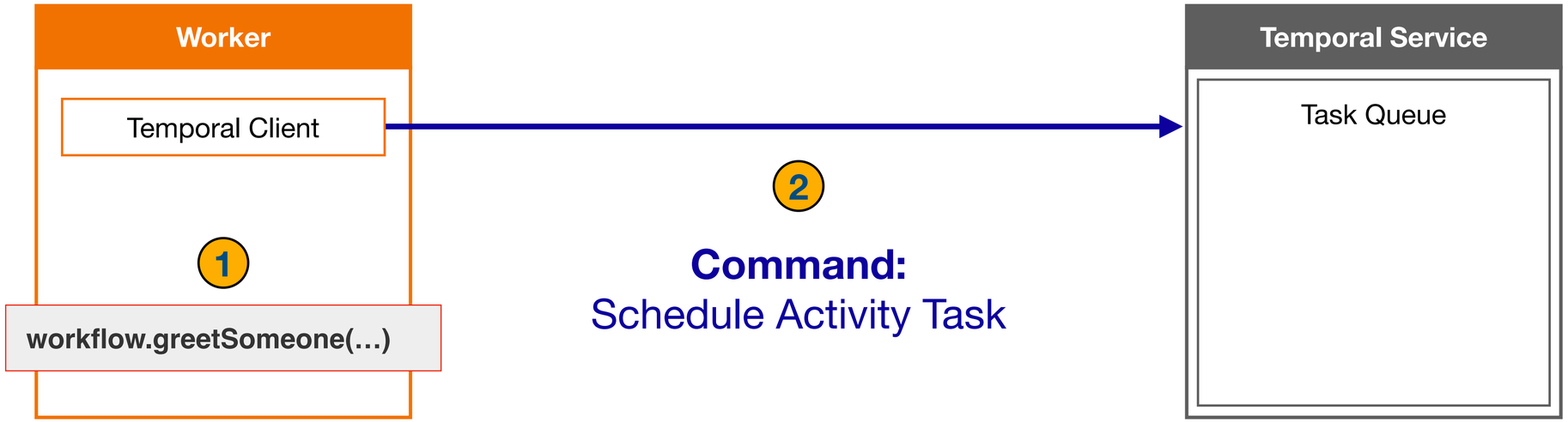
- Temporal does not assign tasks to Workers
- Workers continuously poll, accepting tasks when they have spare capacity
- You can increase throughput and scalability by adding Workers

Commands

Commands

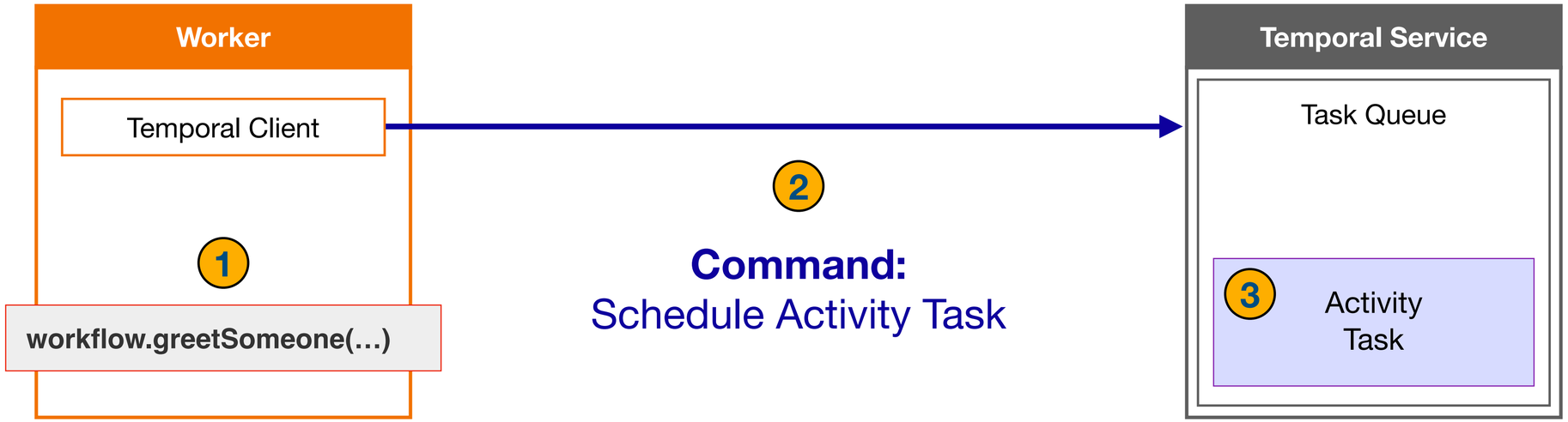
Worker
Temporal Client
1
workflow.greetSomeone(…)
Temporal Service
Task Queue

Commands



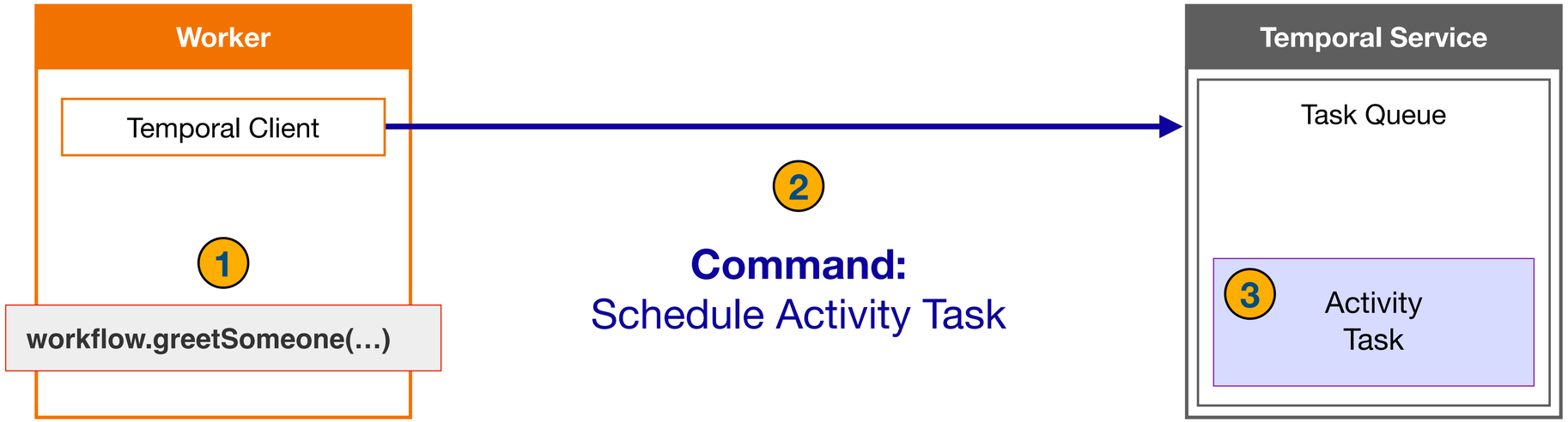
- Certain API calls result in the Worker issuing a Command to the Temporal Service

Commands



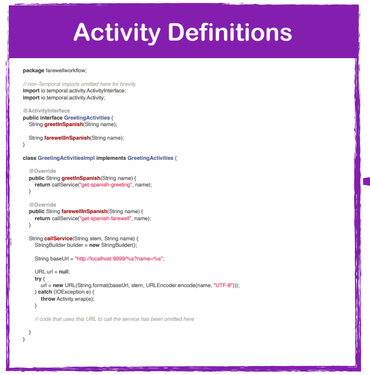
- Certain API calls result in the Worker issuing a Command to the Temporal Service
- The Service acts on these Commands, but also stores them

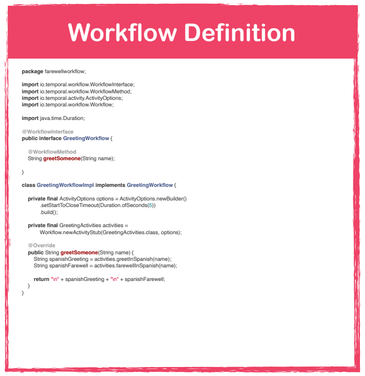
Commands

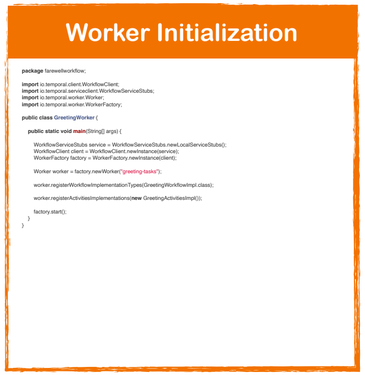


- Certain API calls result in the Worker issuing a Command to the Temporal Service
- The Service acts on these Commands, but also stores them
- This allows the Worker to recreate the state of a Workflow Execution following a crash

Activity Definitions








```java
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
    String greetInSpanish(String name);

    String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        try {
            url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
        } catch (IOException e) {
            throw Activity.wrap(e);
        }

        // code that uses this URL to call the service has been omitted here

    }
}
```

This is just a utility method for calling the microservice and is not specific to Temporal

Workflow Definition

Activity Definitions

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package farewellworkflow;

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import io.temporal.activity.ActivityInterface;
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@ActivityInterface
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  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ru/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
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}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
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import io.temporal.worker.Worker;
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public class GreetingWorker {

  public static void main(String[] args) {

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      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
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          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
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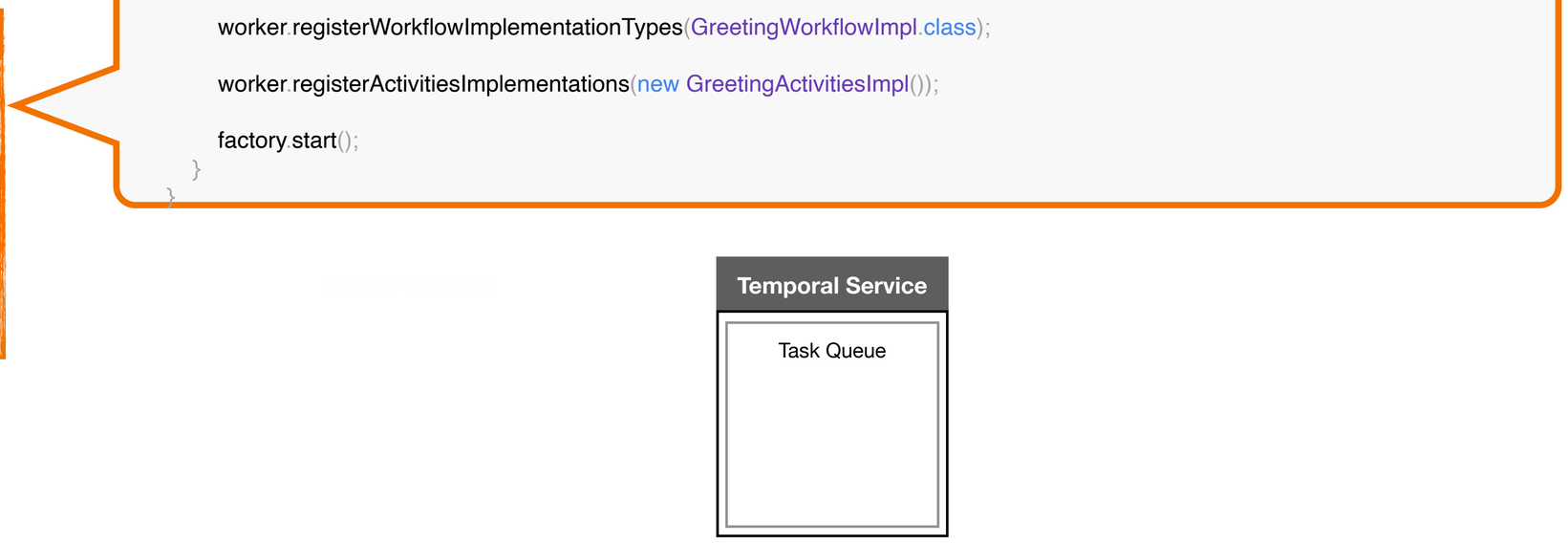
      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

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  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Launch

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Worker Process

Temporal Service

Task Queue

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

    public static void main(String[] args) {

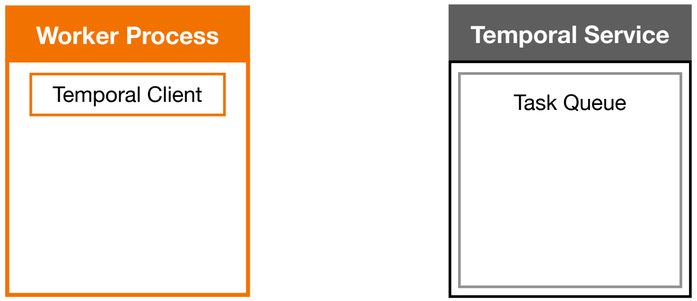
        WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
        WorkflowClient client = WorkflowClient.newInstance(service);
        WorkerFactory factory = WorkerFactory.newInstance(client);

        Worker worker = factory.newWorker("greeting-tasks");

        worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

        worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

        factory.start();
    }
}
```



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

    public static void main(String[] args) {

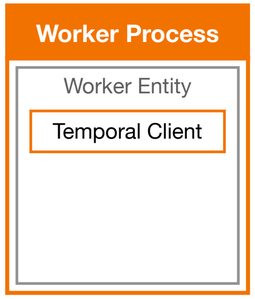
        WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
        WorkflowClient client = WorkflowClient.newInstance(service);
        WorkerFactory factory = WorkerFactory.newInstance(client);

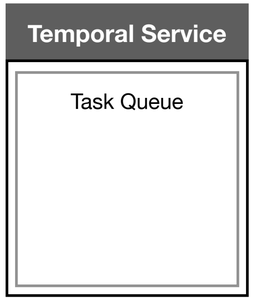
        Worker worker = factory.newWorker("greeting-tasks");

        worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

        worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

        factory.start();
    }
}
```





Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

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package farewellworkflow;

import io.temporal.client.WorkflowClient;
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public class GreetingWorker {

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        worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

        worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

        factory.start();
    }
}
```

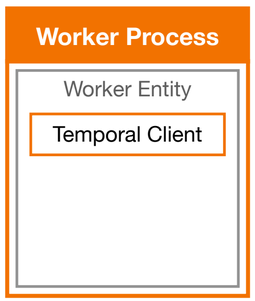

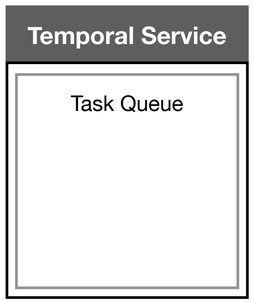

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
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@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

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}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/"+s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
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  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
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import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
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          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
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public class GreetingWorker {

    public static void main(String[] args) {

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        WorkflowClient client = WorkflowClient.newInstance(service);
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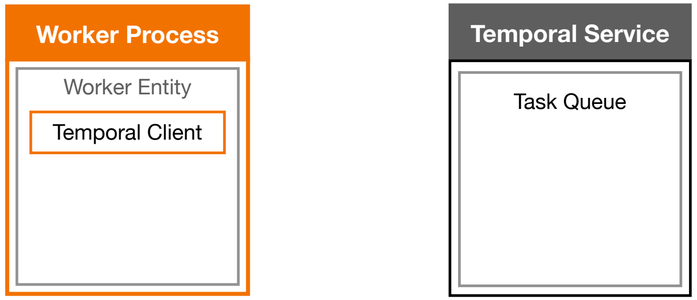

Activity Definitions

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  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
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          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
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Workflow Definition

```
package farewellworkflow;

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import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

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@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
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  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
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      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
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import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
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public class GreetingWorker {

    public static void main(String[] args) {

        WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
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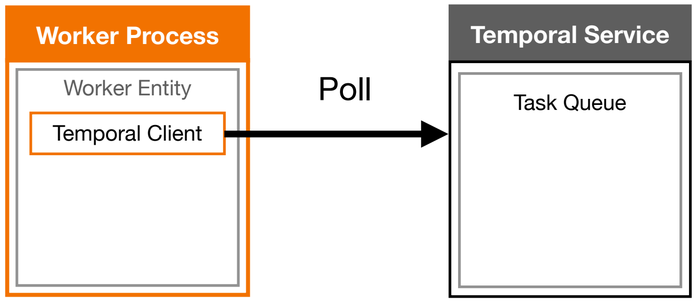
        worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

        factory.start();
    }
}
```



Launching from Command Line

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
    StringBuilder builder = new StringBuilder();

    String baseUrl = "http://localhost:9999/"+a?name=%a";

    URL url = null;
    try {
      url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
    } catch (IOException ex) {
      throw Activity.wrap(ex);
    }

    // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final GreetingActivities activities =
      Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

    WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
    WorkflowClient client = WorkflowClient.newInstance(service);
    WorkerFactory factory = WorkerFactory.newInstance(client);

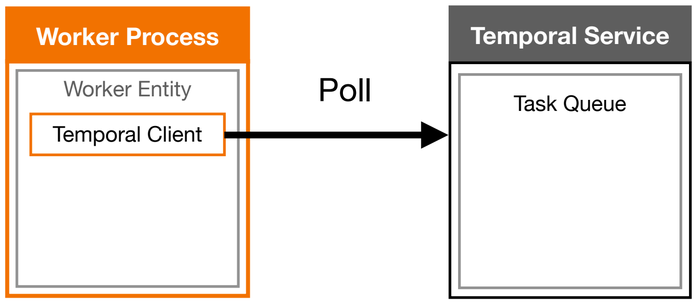
    Worker worker = factory.newWorker("greeting-tasks");

    worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

    worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

    factory.start();
  }
}
```

```
$ temporal workflow start \
    --task-queue greeting-tasks \
    --workflow-id greeting-workflow \
    --workflow-type GreetingWorkflow \
    --input '"Mason"'
```



Launching from Command Line

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
    StringBuilder builder = new StringBuilder();

    String baseUrl = "http://localhost:9999/%s?name=%s";

    URL url = null;
    try {
      url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
    } catch (IOException ex) {
      throw Activity.wrap(ex);
    }

    // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final GreetingActivities activities =
      Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

    WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
    WorkflowClient client = WorkflowClient.newInstance(service);
    WorkerFactory factory = WorkerFactory.newInstance(client);

    Worker worker = factory.newWorker("greeting-tasks");

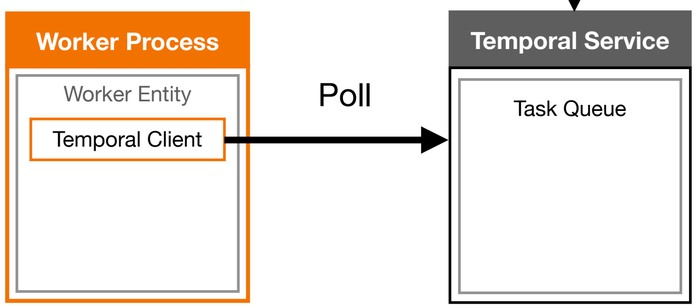
    worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

    worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

    factory.start();
  }
}
```

```
$ temporal workflow start \
    --task-queue greeting-tasks \
    --workflow-id greeting-workflow \
    --workflow-type GreetingWorkflow \
    --input '"Mason"'
```

Workflow Execution Request



Launching from Application Code

Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
    StringBuilder builder = new StringBuilder();

    String baseUrl = "http://localhost:9999/"+stem+"/";

    URL url = null;
    try {
      url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
    } catch (IOException ex) {
        throw Activity.wrap(ex);
    }

    // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tarewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

    WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
    WorkflowClient client = WorkflowClient.newInstance(service);
    WorkerFactory factory = WorkerFactory.newInstance(client);

    Worker worker = factory.newWorker("greeting-tasks");

    worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

    worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

    factory.start();
  }
}
```

```
// ... this is code within your own application (for example a web or mobile app)

WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
WorkflowClient client = WorkflowClient.newInstance(service);

WorkflowOptions options = WorkflowOptions.newBuilder()
        .setWorkflowId("greeting-workflow")
        .setTaskQueue("greeting-tasks")
        .build();

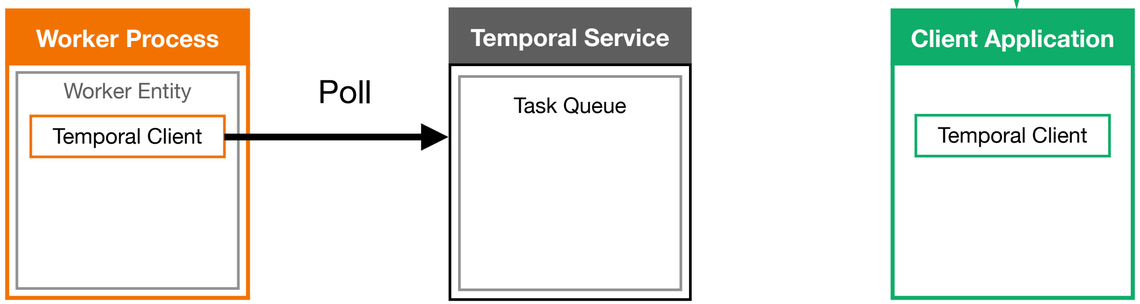
GreetingWorkflow workflow = client.newWorkflowStub(GreetingWorkflow.class, options);

String greeting = workflow.greetSomeone(args[0]);

String workflowId = WorkflowStub.fromTyped(workflow).getExecution().getWorkflowId();

System.out.println(workflowId + " " + greeting);

// ... other application-specific code might follow
```



Launching from Application Code

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
    StringBuilder builder = new StringBuilder();

    String baseUrl = "http://localhost:9999/rs/";name=%s";

    URL url = null;
    try {
      url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
    } catch (IOException ei) {
        throw Activity.wrap(ei);
    }

    // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

    WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
    WorkflowClient client = WorkflowClient.newInstance(service);
    WorkerFactory factory = WorkerFactory.newInstance(client);

    Worker worker = factory.newWorker("greeting-tasks");

    worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

    worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

    factory.start();
  }
}
```

```
// ... this is code within your own application (for example a web or mobile app)

WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
WorkflowClient client = WorkflowClient.newInstance(service);

WorkflowOptions options = WorkflowOptions.newBuilder()
        .setWorkflowId("greeting-workflow")
        .setTaskQueue("greeting-tasks")
        .build();

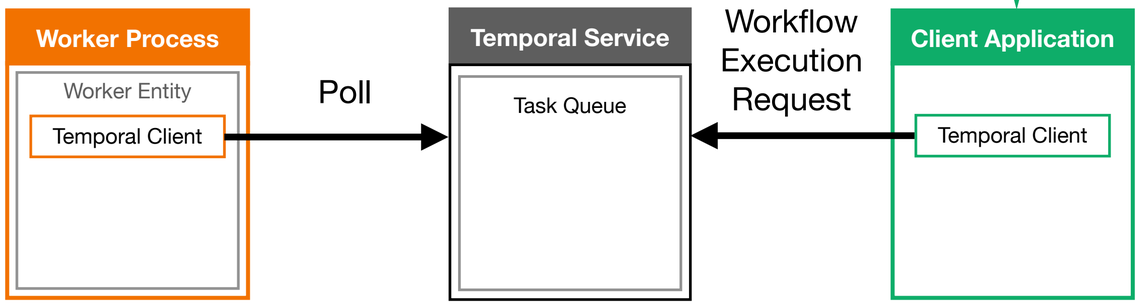
GreetingWorkflow workflow = client.newWorkflowStub(GreetingWorkflow.class, options);

String greeting = workflow.greetSomeone(args[0]);

String workflowId = WorkflowStub.fromTyped(workflow).getExecution().getWorkflowId();

System.out.println(workflowId + " " + greeting);

// ... other application-specific code might follow
```



Event History

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/"+s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "hi" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

    public static void main(String[] args) {

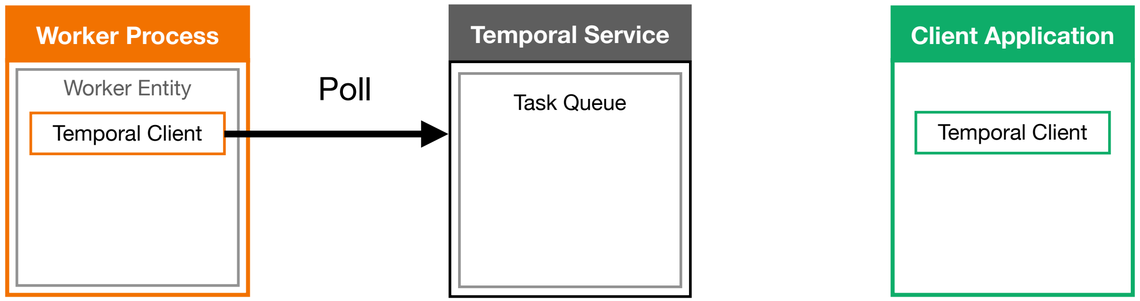
        WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
        WorkflowClient client = WorkflowClient.newInstance(service);
        WorkerFactory factory = WorkerFactory.newInstance(client);

        Worker worker = factory.newWorker("greeting-tasks");

        worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

        worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

        factory.start();
    }
}
```



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
    StringBuilder builder = new StringBuilder();

    String baseUrl = "http://localhost:9999/%s?name=%s";

    URL url = null;
    try {
      url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
    } catch (IOException ex) {
      throw Activity.wrap(ex);
    }

    // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final GreetingActivities activities =
      Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

    WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
    WorkflowClient client = WorkflowClient.newInstance(service);
    WorkerFactory factory = WorkerFactory.newInstance(client);

    Worker worker = factory.newWorker("greeting-tasks");

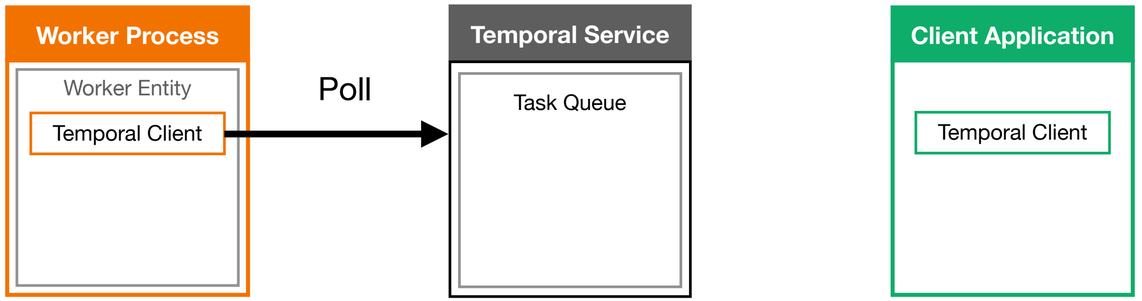
    worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

    worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

    factory.start();
  }
}
```

Event History

WorkflowExecutionStarted



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/?ui?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

    public static void main(String[] args) {

        WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
        WorkflowClient client = WorkflowClient.newInstance(service);
        WorkerFactory factory = WorkerFactory.newInstance(client);

        Worker worker = factory.newWorker("greeting-tasks");

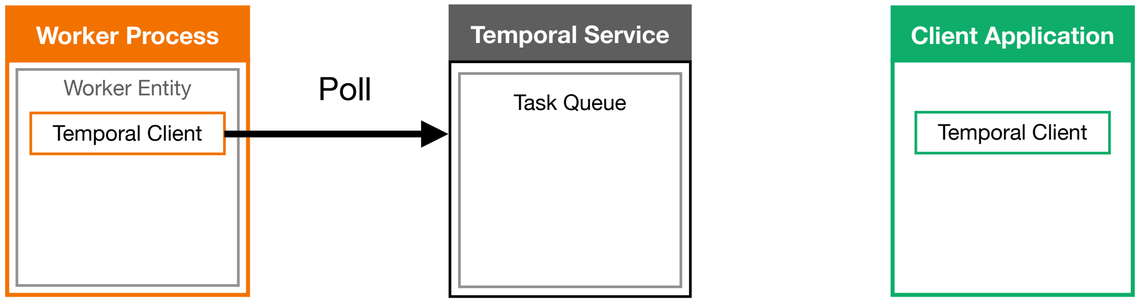
        worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

        worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

        factory.start();
    }
}
```

Event History

WorkflowExecutionStarted



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
    StringBuilder builder = new StringBuilder();

    String baseUrl = "http://localhost:9999/%s?name=%s";

    URL url = null;
    try {
      url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
    } catch (IOException ex) {
      throw Activity.wrap(ex);
    }

    // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final GreetingActivities activities =
      Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

    WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
    WorkflowClient client = WorkflowClient.newInstance(service);
    WorkerFactory factory = WorkerFactory.newInstance(client);

    Worker worker = factory.newWorker("greeting-tasks");

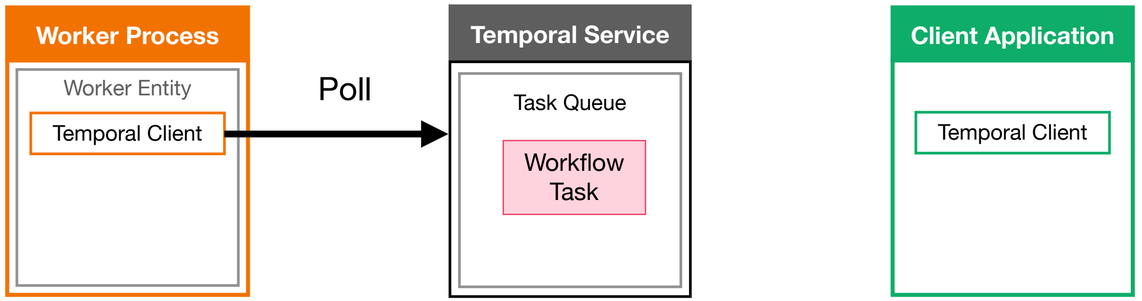
    worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

    worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

    factory.start();
  }
}
```

Event History

WorkflowExecutionStarted



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

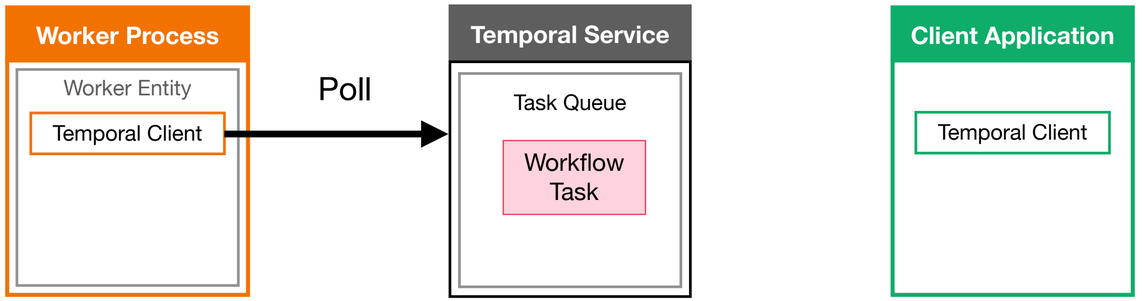
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted
WorkflowTaskScheduled

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
    String greetInSpanish(String name);

    String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        try {
            url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
        } catch (IOException ex) {
            throw Activity.wrap(ex);
        }

        // code that uses this URL to call the service has been omitted here

    }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

    @WorkflowMethod
    String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

    private final ActivityOptions options = ActivityOptions.newBuilder()
            .setStartToCloseTimeout(Duration.ofSeconds(5))
            .build();

    private final GreetingActivities activities =
            Workflow.newActivityStub(GreetingActivities.class, options);

    @Override
    public String greetSomeone(String name) {
        String spanishGreeting = activities.greetInSpanish(name);
        String spanishFarewell = activities.farewellInSpanish(name);

        return "\n" + spanishGreeting + "\n" + spanishFarewell;
    }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

    public static void main(String[] args) {

        WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
        WorkflowClient client = WorkflowClient.newInstance(service);
        WorkerFactory factory = WorkerFactory.newInstance(client);

        Worker worker = factory.newWorker("greeting-tasks");

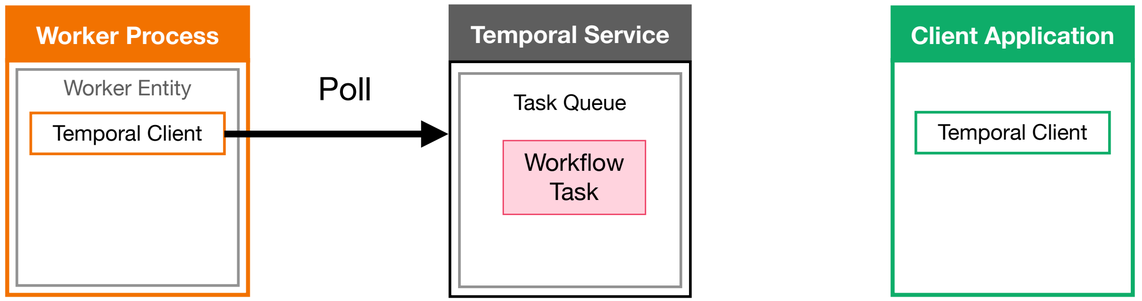
        worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

        worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

        factory.start();
    }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

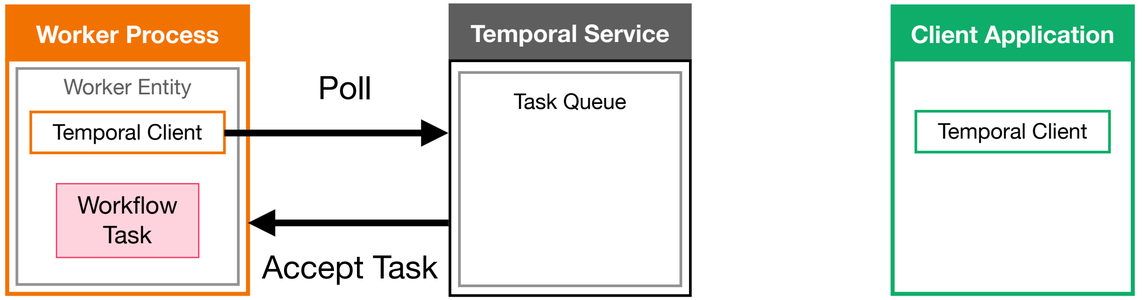
      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/?ui?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

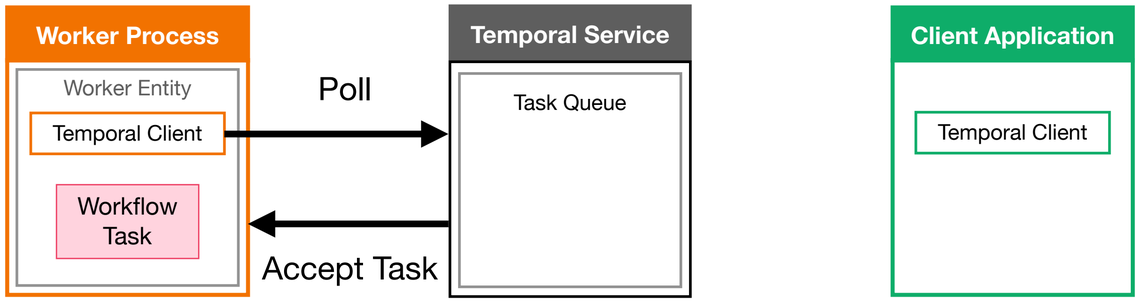
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

    private final ActivityOptions options = ActivityOptions.newBuilder()
            .setStartToCloseTimeout(Duration.ofSeconds(5))
            .build();

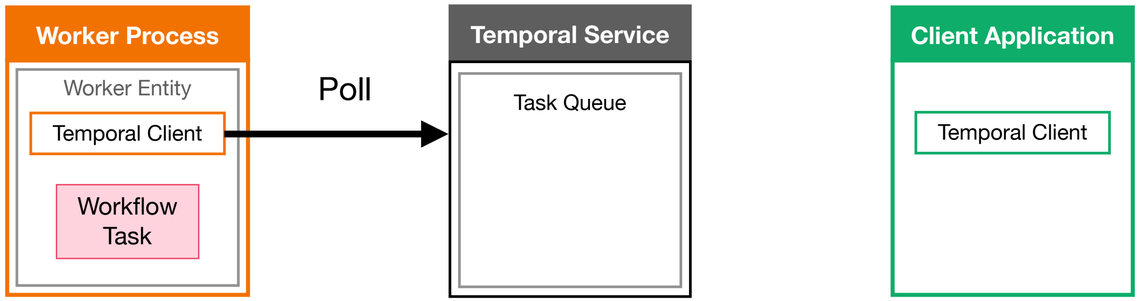
    private final GreetingActivities activities =
            Workflow.newActivityStub(GreetingActivities.class, options);

    @Override
    public String greetSomeone(String name) {
        String spanishGreeting = activities.greetInSpanish(name);
        String spanishFarewell = activities.farewellInSpanish(name);

        return "\n" + spanishGreeting + "\n" + spanishFarewell;
    }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

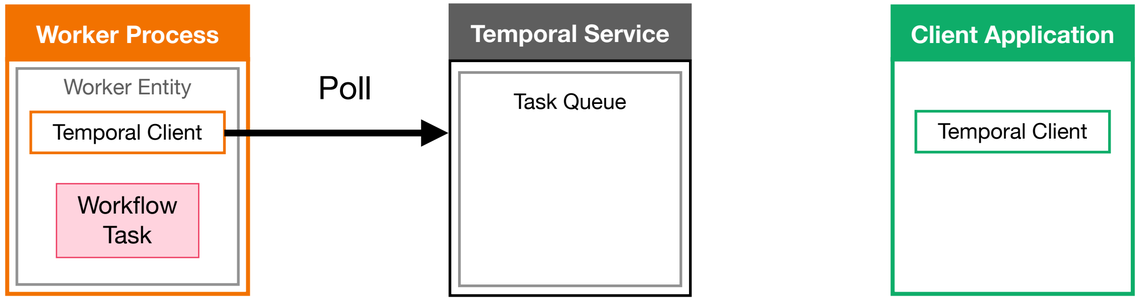
  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

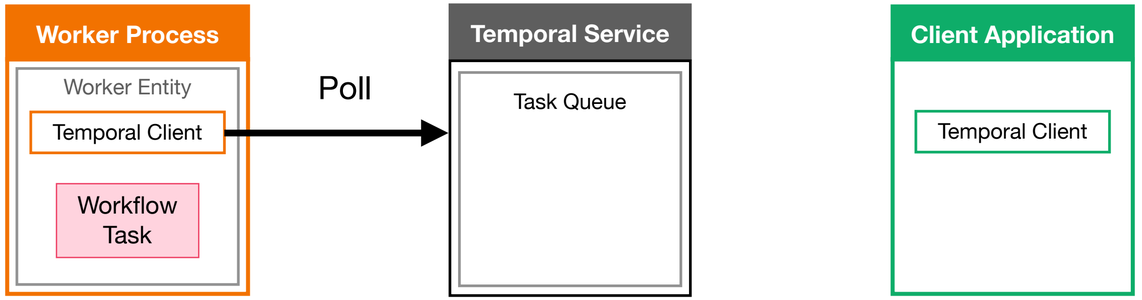
  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

    private final ActivityOptions options = ActivityOptions.newBuilder()
            .setStartToCloseTimeout(Duration.ofSeconds(5))
            .build();

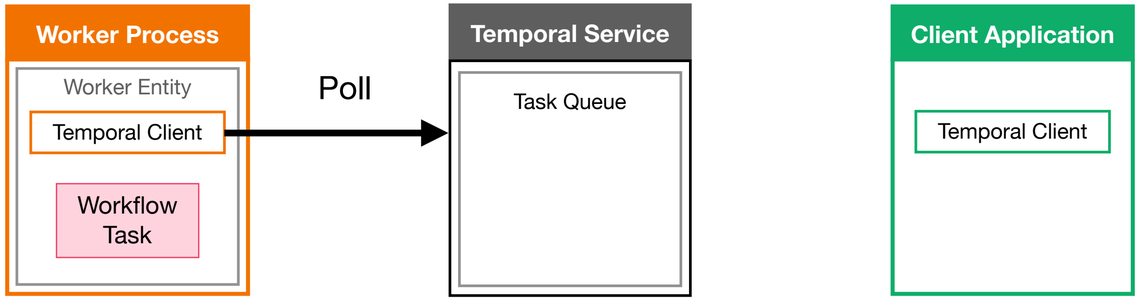
    private final GreetingActivities activities =
            Workflow.newActivityStub(GreetingActivities.class, options);

    @Override
    public String greetSomeone(String name) {
        String spanishGreeting = activities.greetInSpanish(name);
        String spanishFarewell = activities.farewellInSpanish(name);

        return "\n" + spanishGreeting + "\n" + spanishFarewell;
    }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

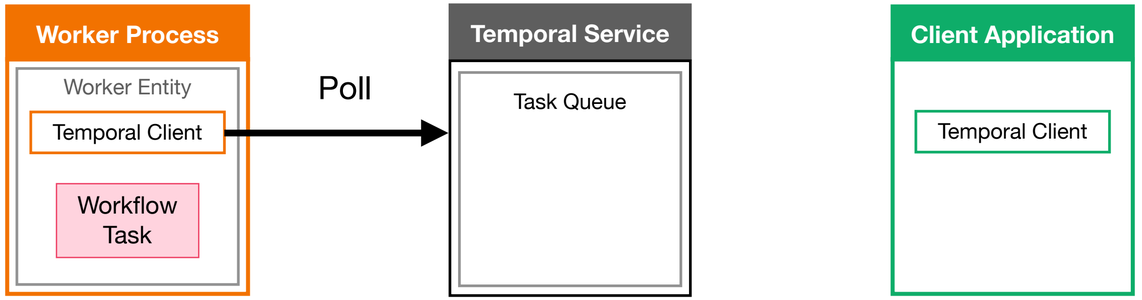
  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted



Activity Definitions

```
package tareweliworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tareweliworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tareweliworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

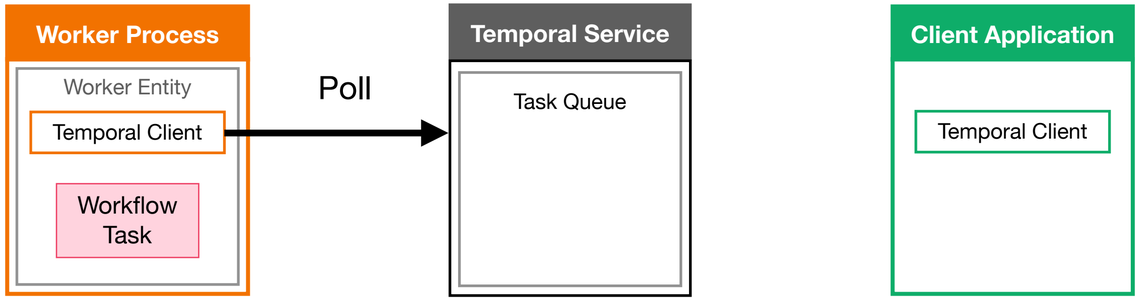
  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

    private final ActivityOptions options = ActivityOptions.newBuilder()
            .setStartToCloseTimeout(Duration.ofSeconds(5))
            .build();

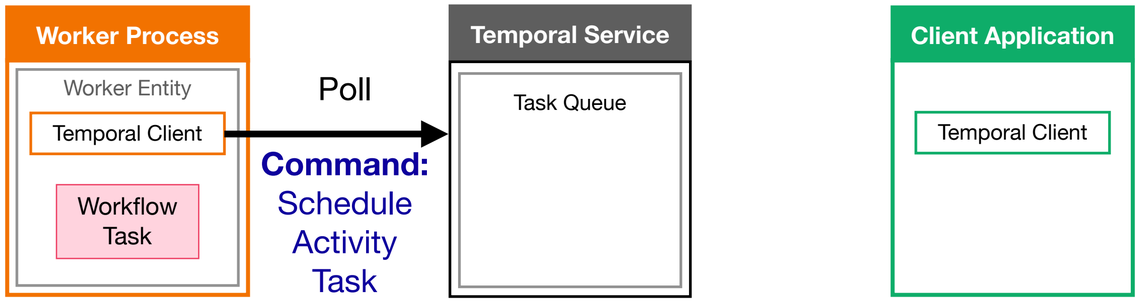
    private final GreetingActivities activities =
            Workflow.newActivityStub(GreetingActivities.class, options);

    @Override
    public String greetSomeone(String name) {
        String spanishGreeting = activities.greetInSpanish(name);
        String spanishFarewell = activities.farewellInSpanish(name);

        return "\n" + spanishGreeting + "\n" + spanishFarewell;
    }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

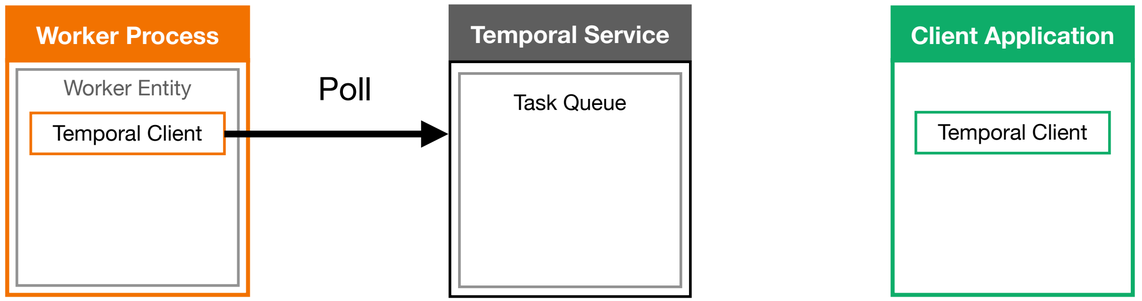
      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ru/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

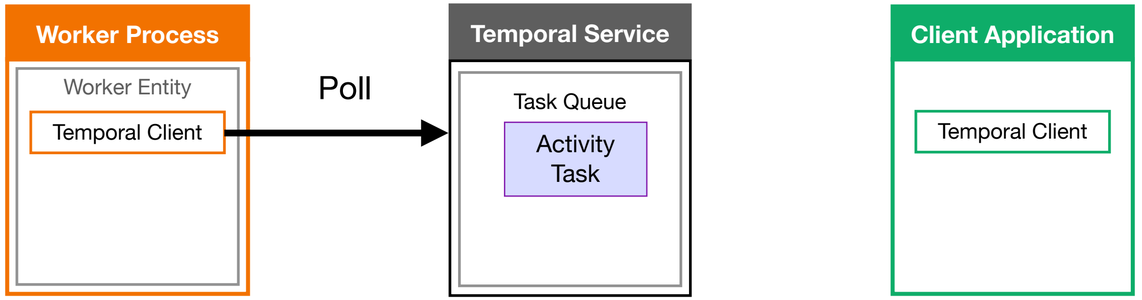
      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ha?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

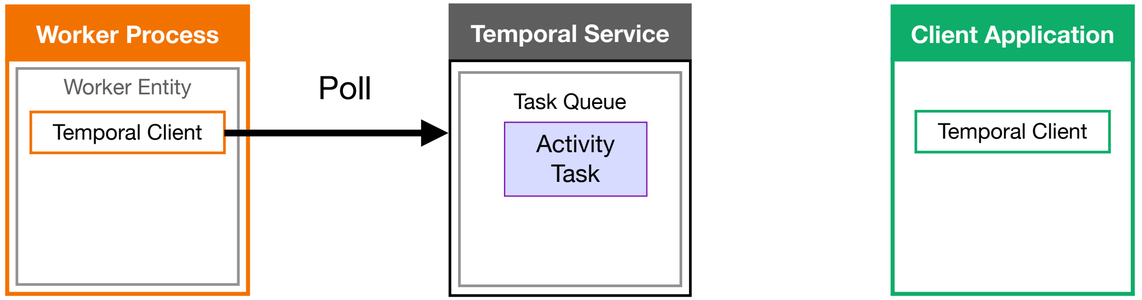
      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Event History

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled (Greeting)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ha?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

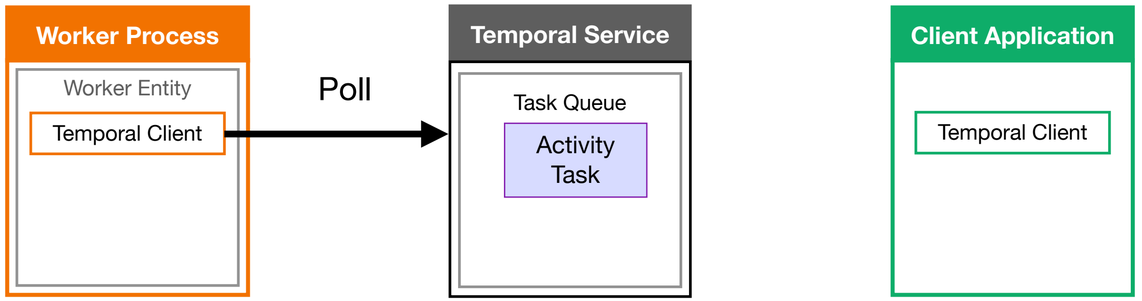
      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

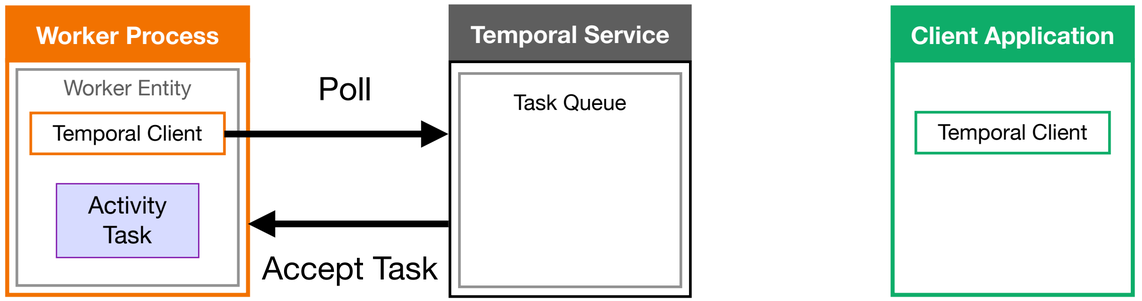
      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)



Activity Definitions

```
package tareweliworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

       // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tareweliworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tareweliworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
      return callService("get-spanish-farewell", name);
  }

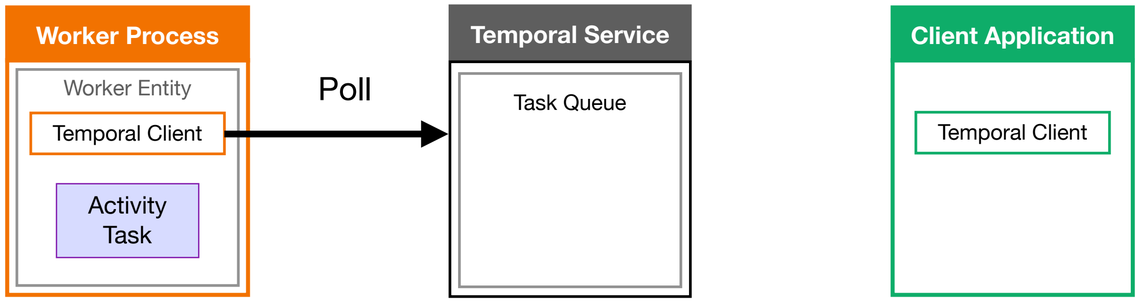
  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      // code that initializes this URL has been omitted here
       try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
          String line;
          while ((line = in.readLine()) != null) {
              builder.append(line).append("\n");
          }
      } catch (IOException e) {
          throw Activity.wrap(e);
      }
      return builder.toString();
  }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)



Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tarewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Translation

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

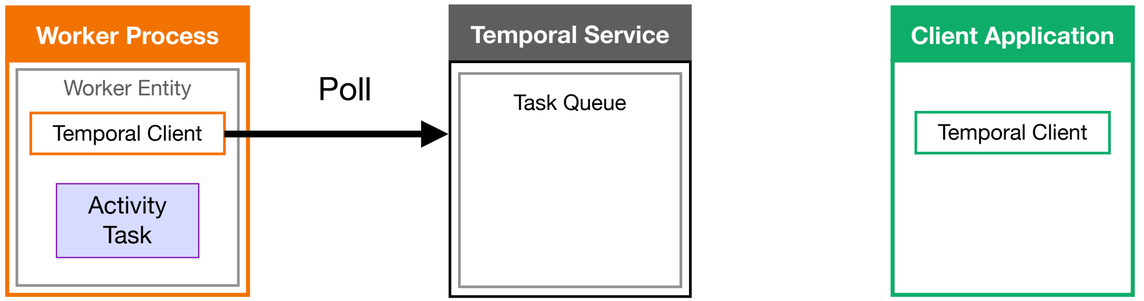
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Translation

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

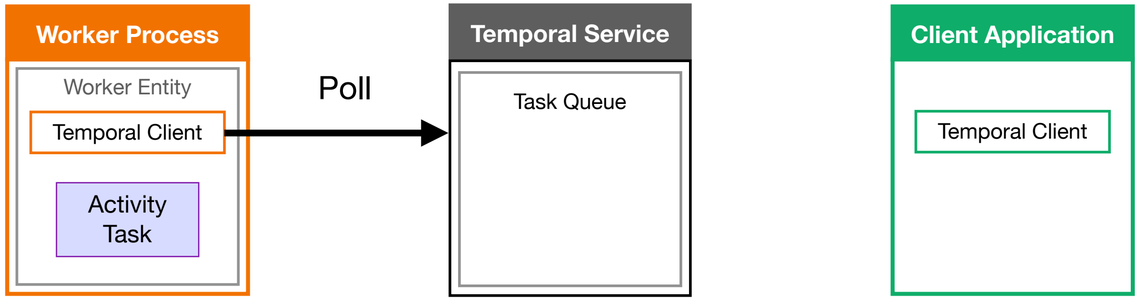
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

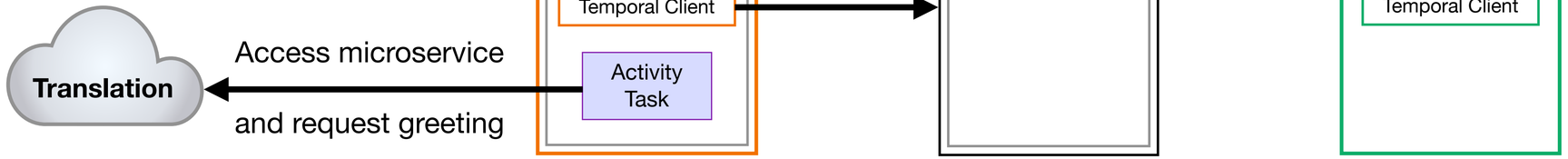
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)



Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tarewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Translation

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

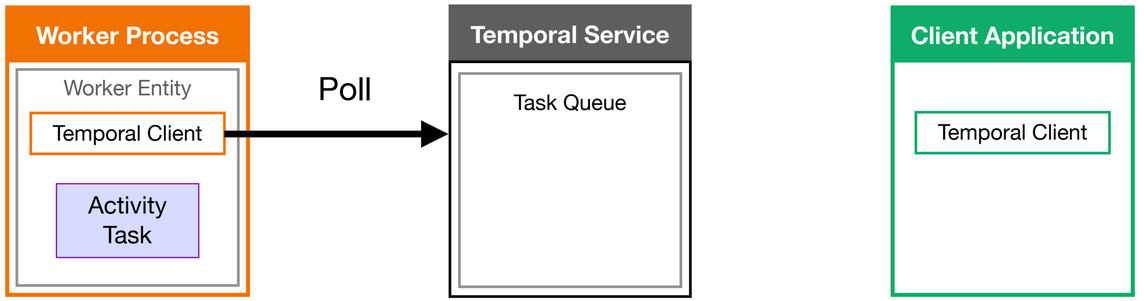
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)



Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tarewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

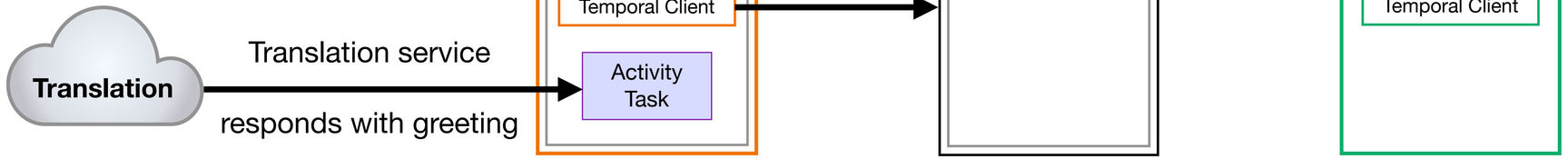
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)



Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tarewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

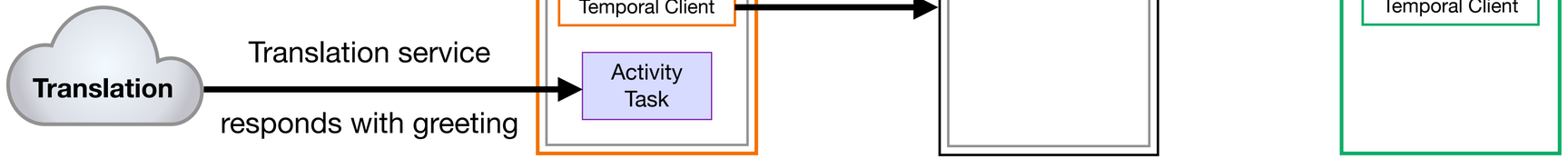
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)



Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tarewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

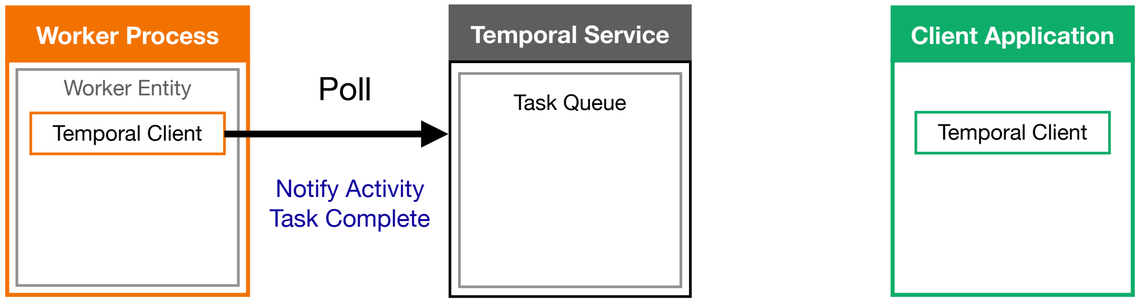
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)



Activity Definitions

```
package tareweliworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tareweliworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tareweliworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

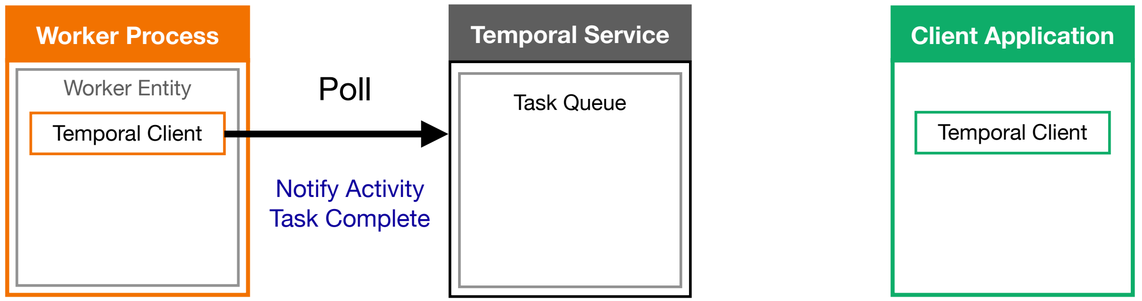
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ha?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

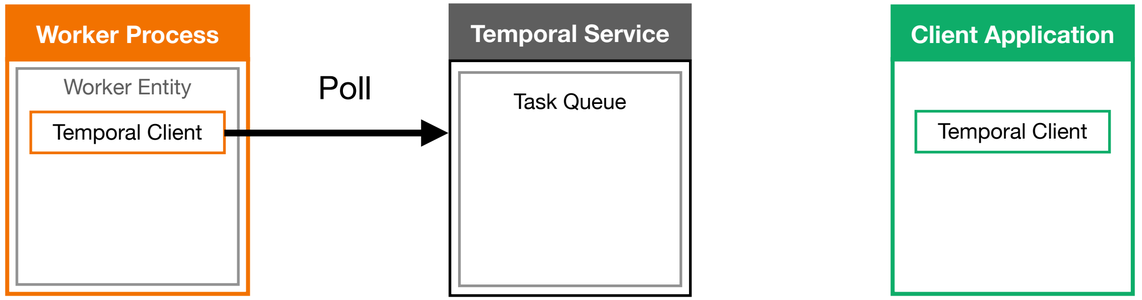
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ha?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

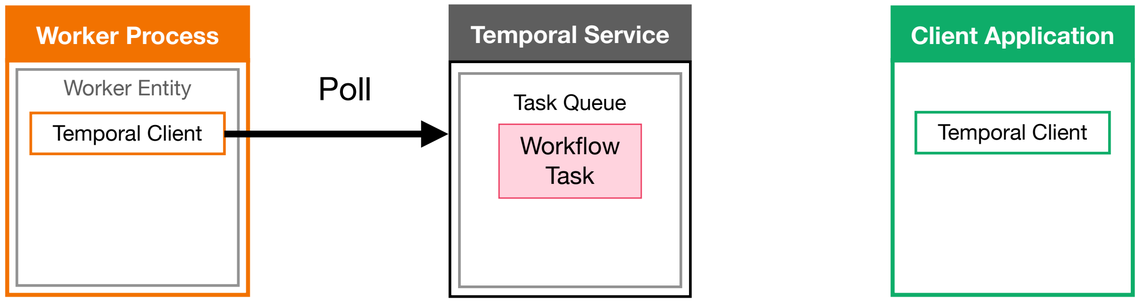
      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)



Activity Definitions

```
package tareweliworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ha?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tareweliworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tareweliworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

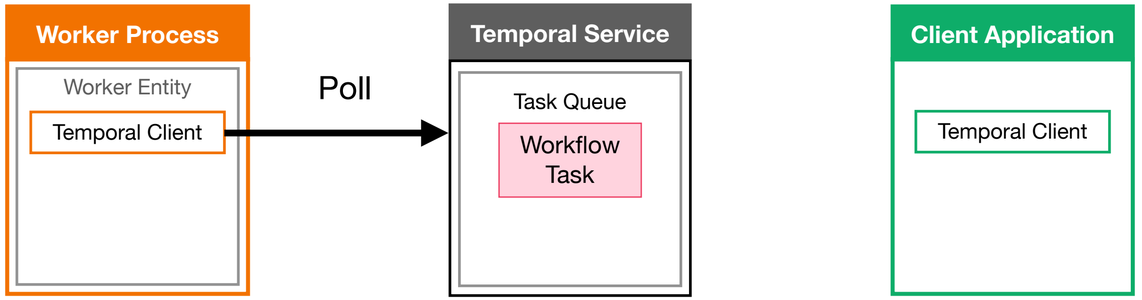
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ha?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

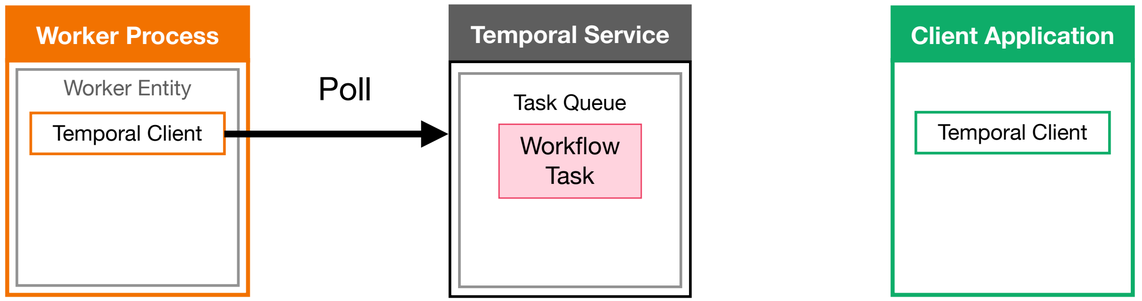
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ha?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

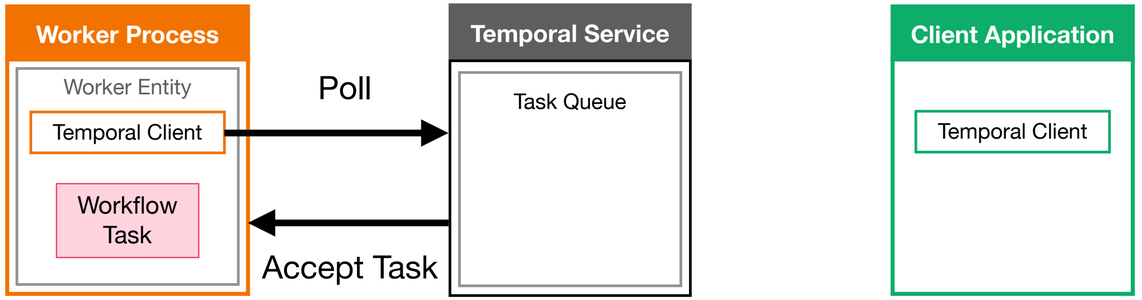
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ha?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

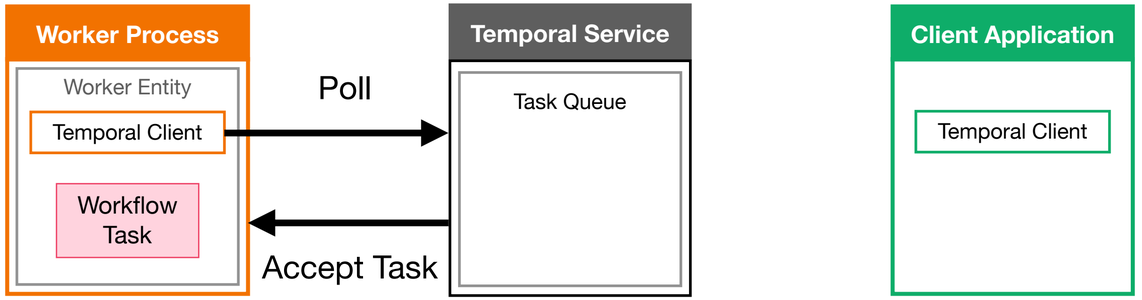
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	

Activity Definitions

```
package tareweliworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/";name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tareweliworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tareweliworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

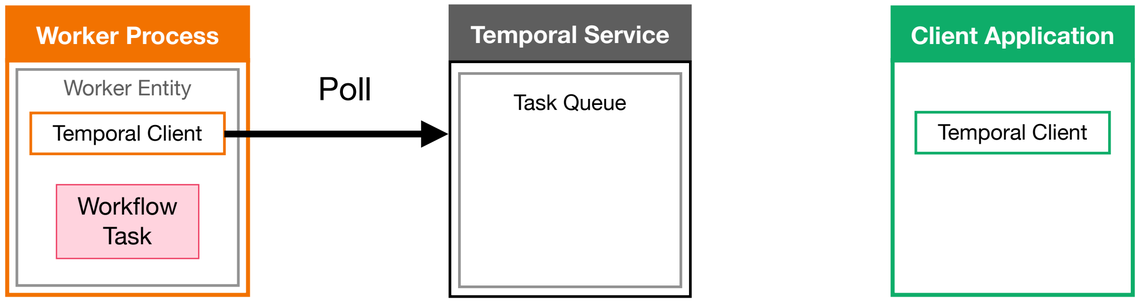
  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	



Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tarewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

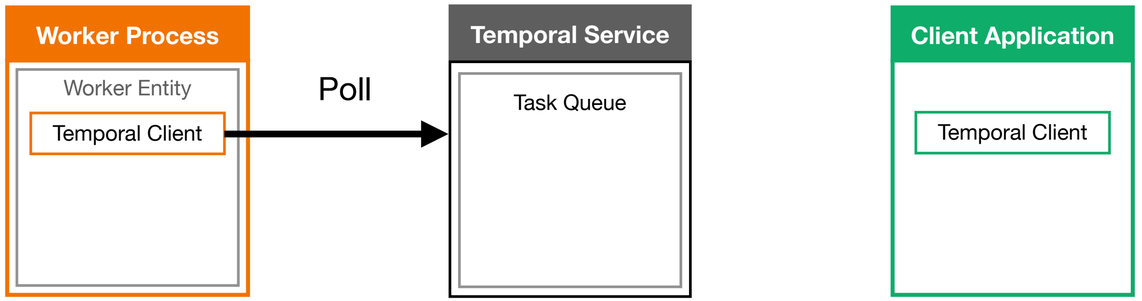
  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	



Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tarewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

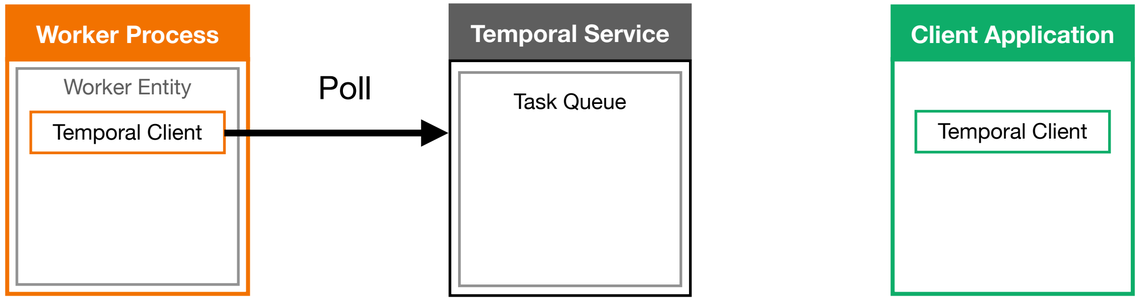
  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/";name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ei) {
          throw Activity.wrap(ei);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

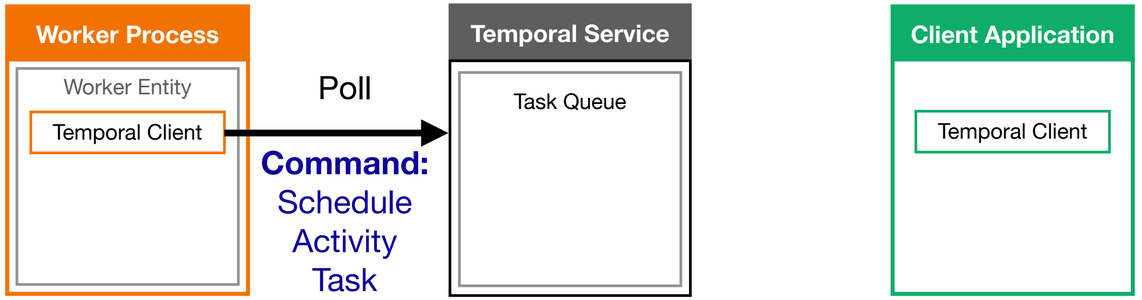
  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ua?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

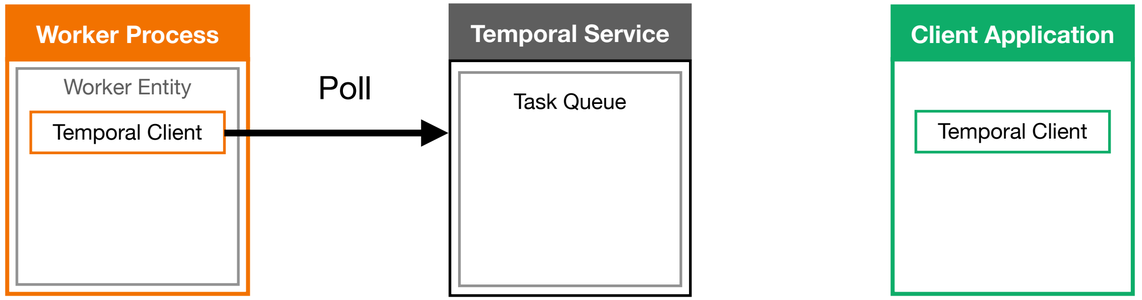
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ha?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);

}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

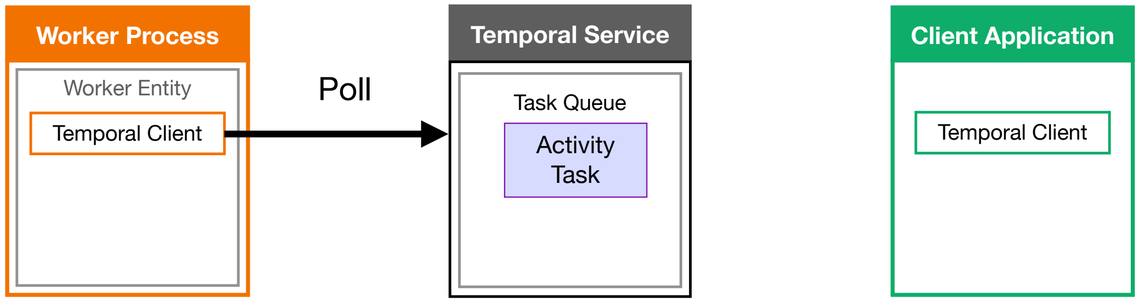
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/"+a?name=%a";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

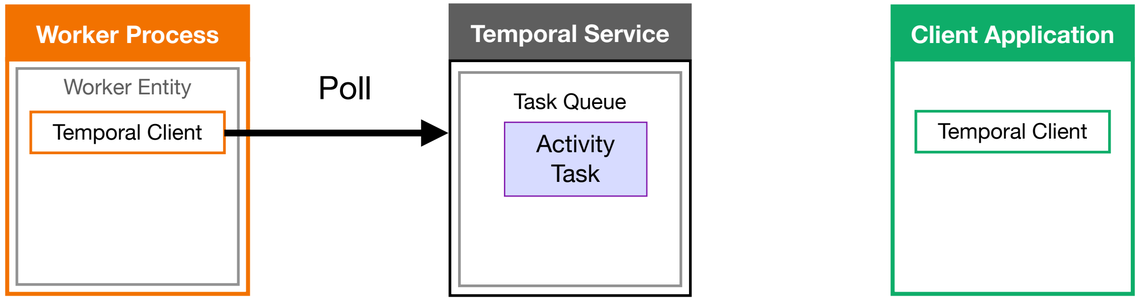
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

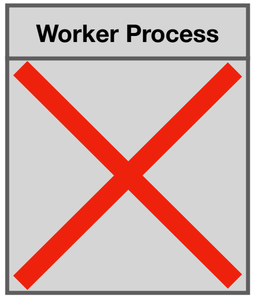
      Worker worker = factory.newWorker("greeting-tasks");

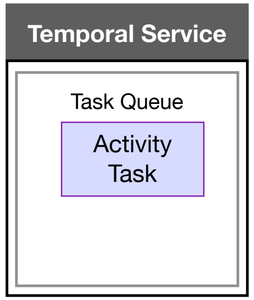
      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

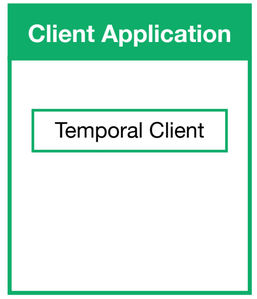
      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

What happens if the Worker crashes?







Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ua?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

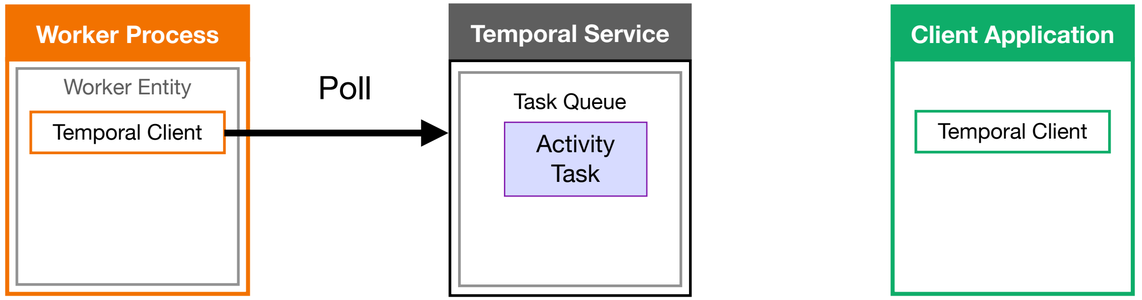
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ru?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

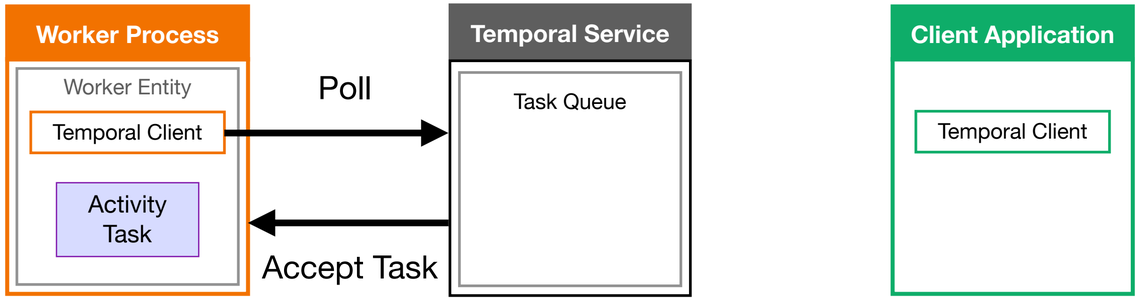
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

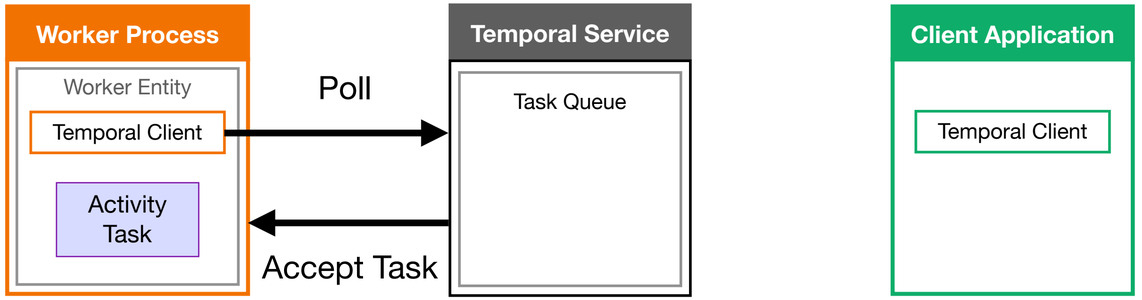
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

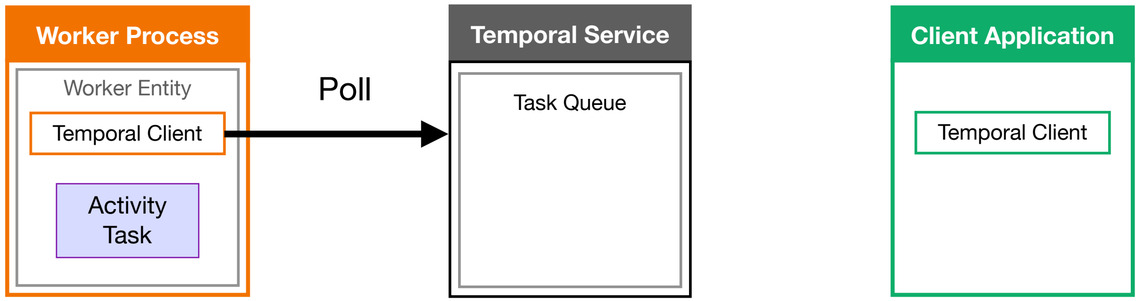
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Translation

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

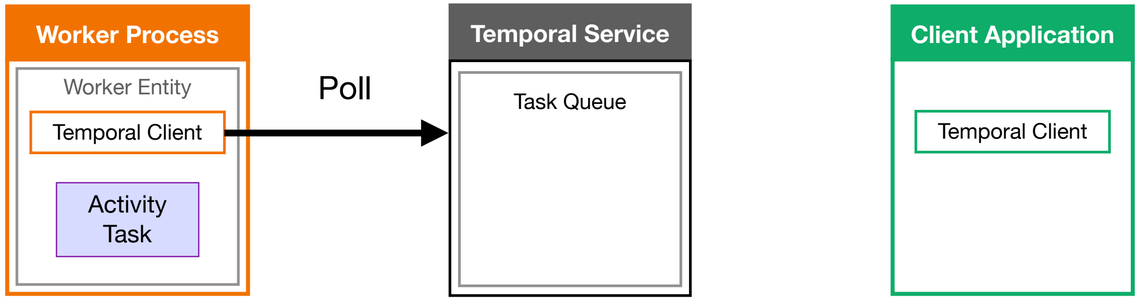
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tarewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Translation

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

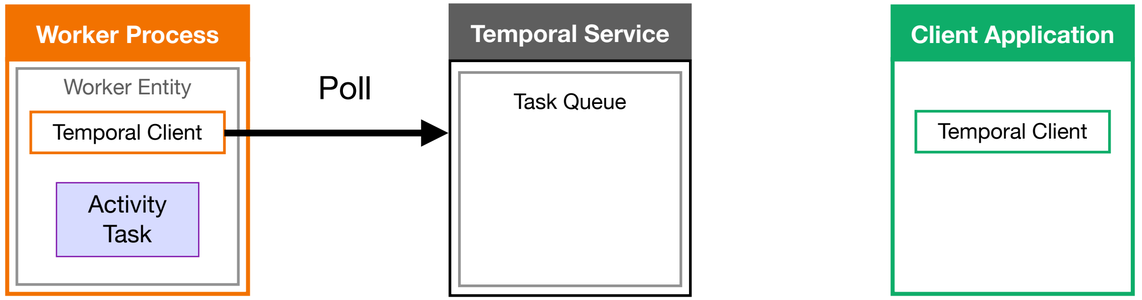
    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

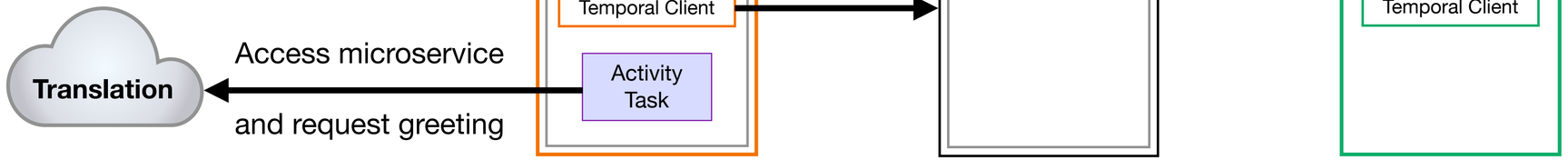
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

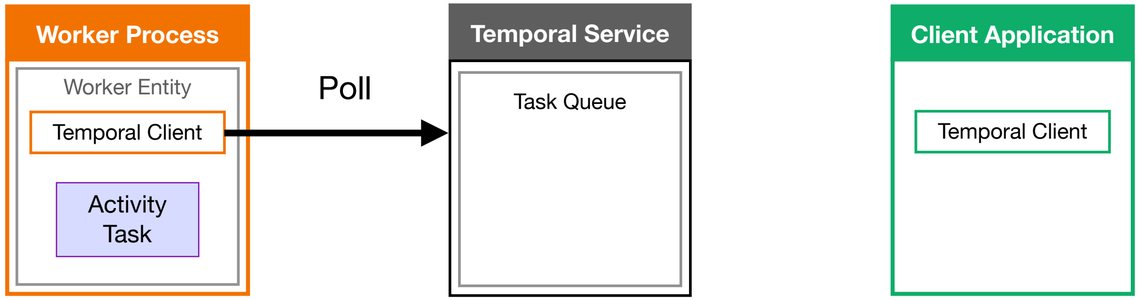
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Error

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Translation

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

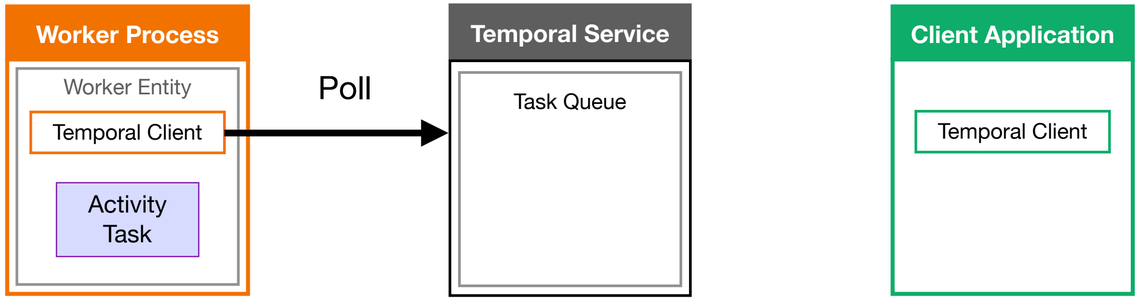
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Translation

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

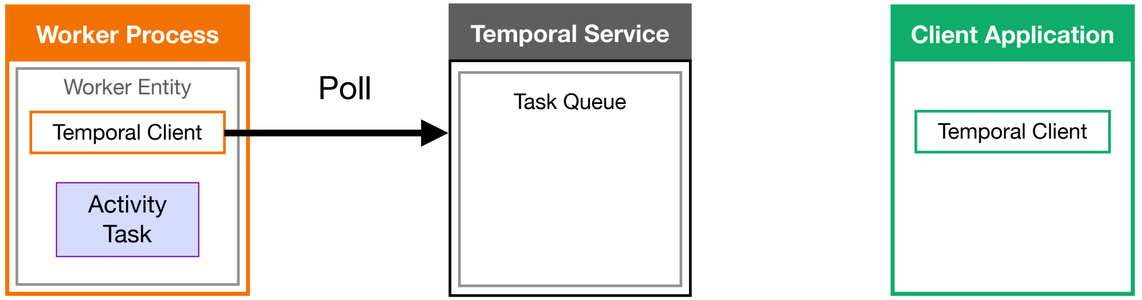
        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Activity is invoked again during retry

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

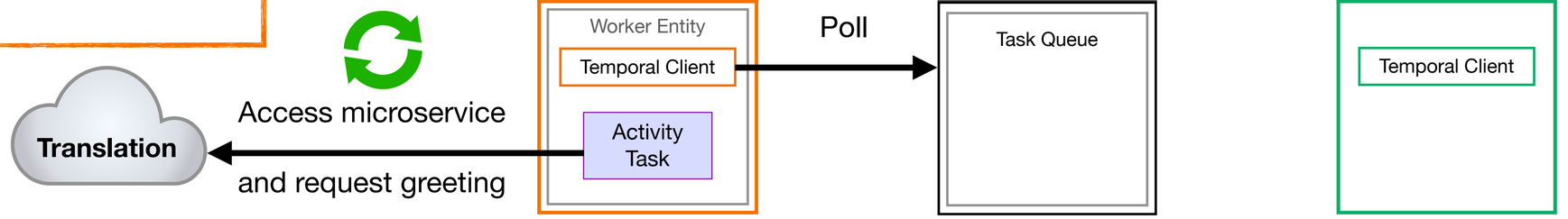
        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Activity is invoked again during retry

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

Translation

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

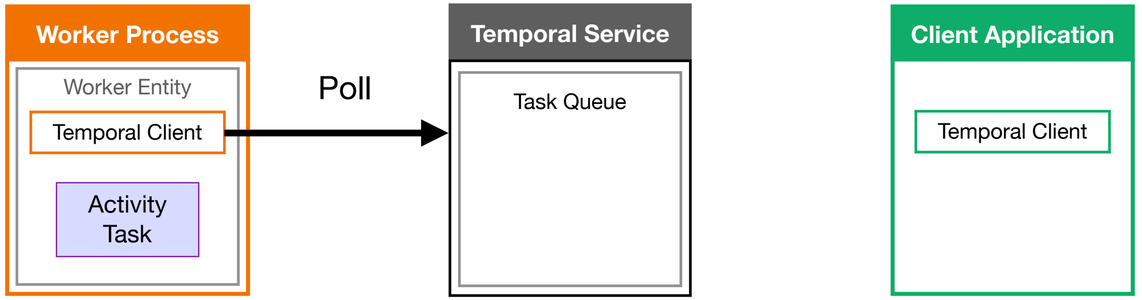
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

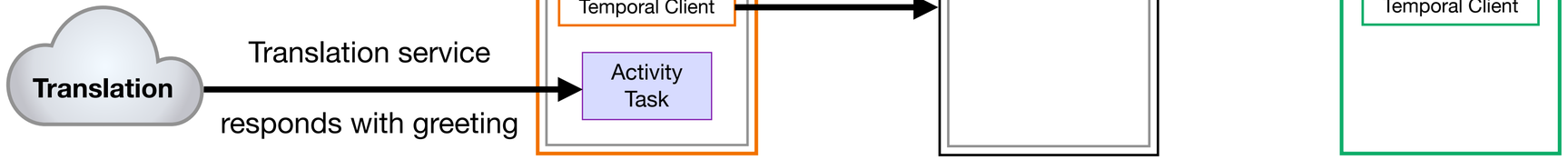
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

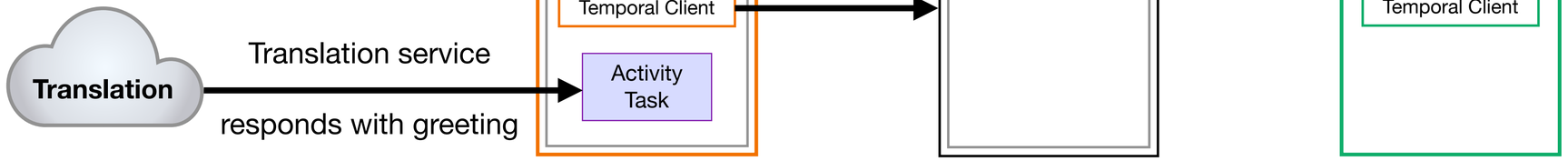
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

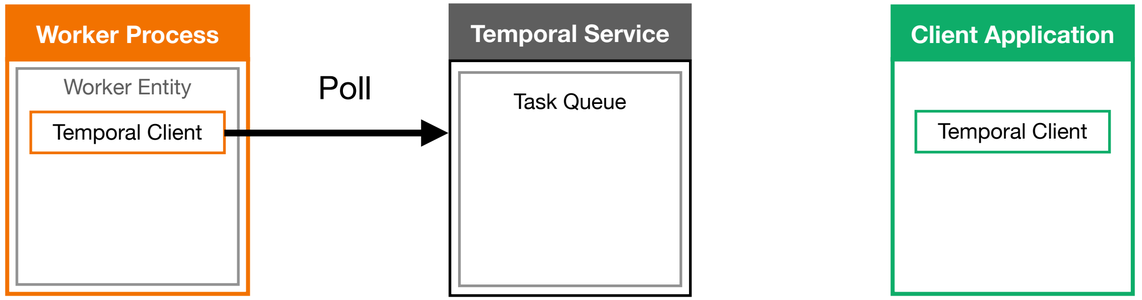
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          setStartToCloseTimeout(Duration.ofSeconds(5))
          build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
    String spanishGreeting = activities.greetInSpanish(name);
    String spanishFarewell = activities.farewellInSpanish(name);

    return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

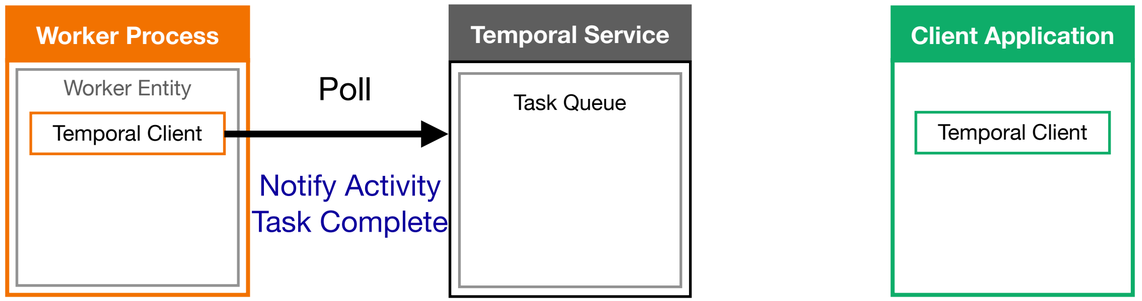
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingActivitiesImpl implements GreetingActivities {

    @Override
    public String greetInSpanish(String name) {
        return callService("get-spanish-greeting", name);
    }

    @Override
    public String farewellInSpanish(String name) {
        return callService("get-spanish-farewell", name);
    }

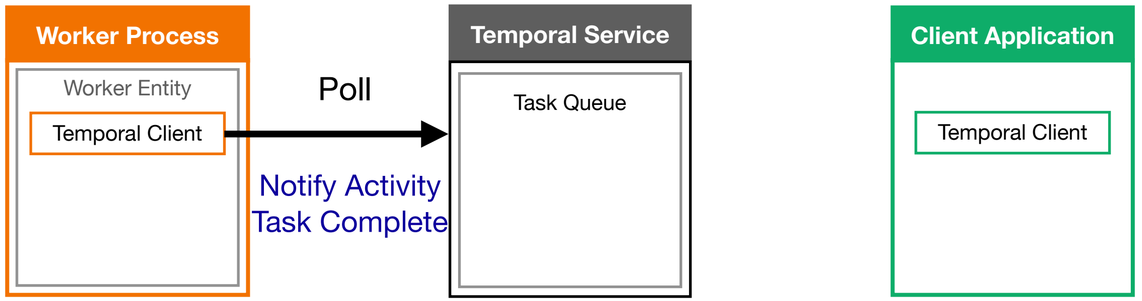
    String callService(String stem, String name) {
        StringBuilder builder = new StringBuilder();

        String baseUrl = "http://localhost:9999/%s?name=%s";

        URL url = null;
        // code that initializes this URL has been omitted here
        try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
            String line;
            while ((line = in.readLine()) != null) {
                builder.append(line).append("\n");
            }
        } catch (IOException e) {
            throw Activity.wrap(e);
        }
        return builder.toString();
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)



Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ua?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tarewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

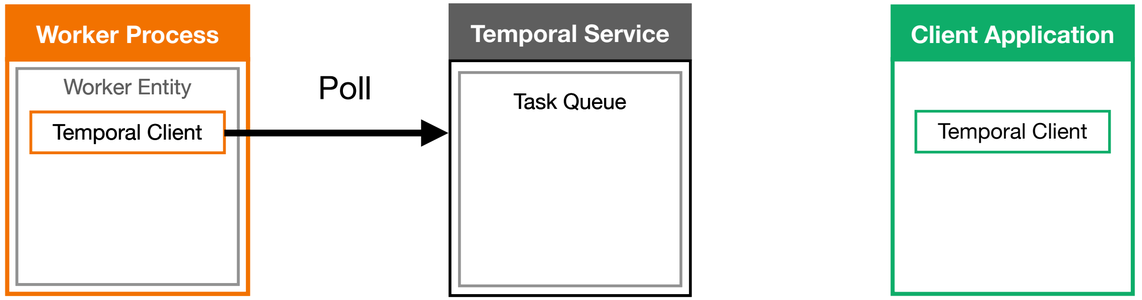
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)

Activity Definitions

```
package tareweliworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ta?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tareweliworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tareweliworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

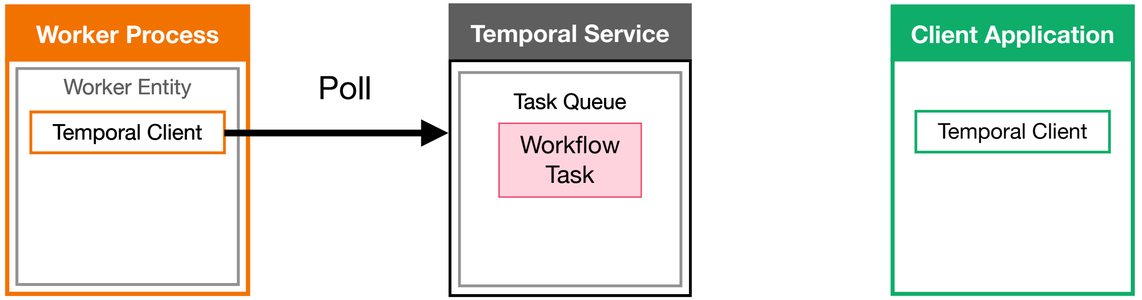
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)
WorkflowTaskScheduled	

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException ex) {
          throw Activity.wrap(ex);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

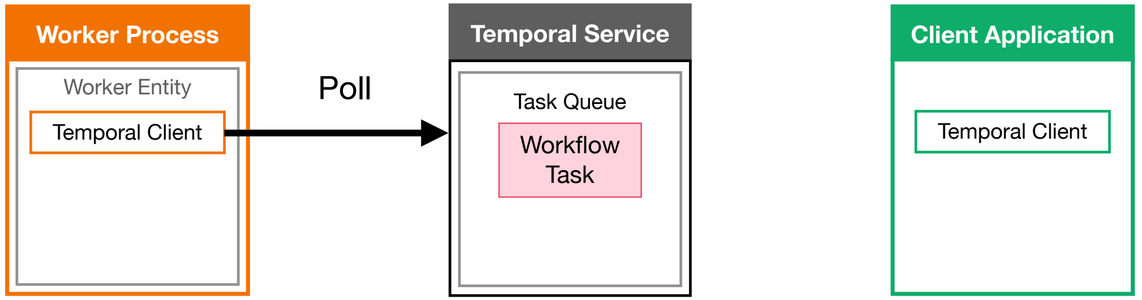
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)
WorkflowTaskScheduled	

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/ru?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

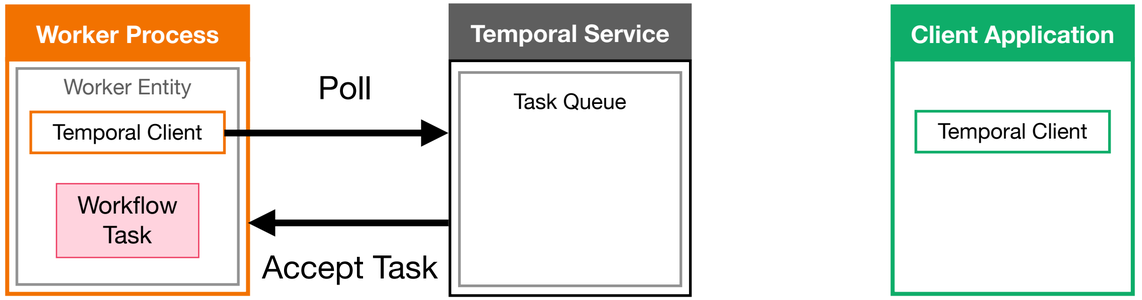
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)
WorkflowTaskScheduled	

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

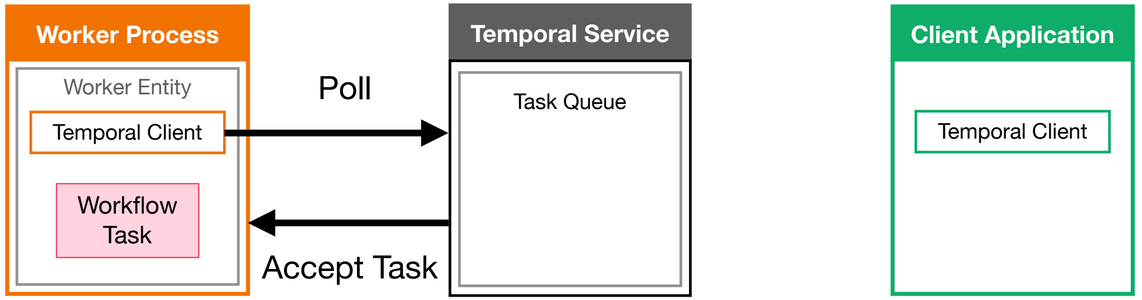
      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)
WorkflowTaskScheduled	
WorkflowTaskStarted	

Activity Definitions

```
package tareweltworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tareweltworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tareweltworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

    private final ActivityOptions options = ActivityOptions.newBuilder()
            .setStartToCloseTimeout(Duration.ofSeconds(5))
            .build();

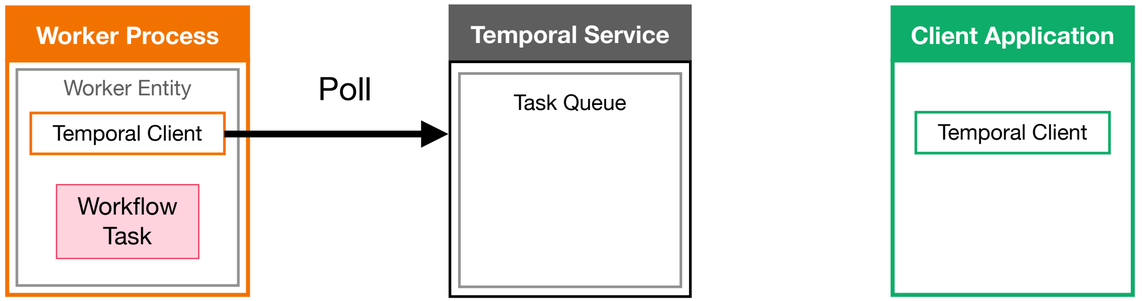
    private final GreetingActivities activities =
            Workflow.newActivityStub(GreetingActivities.class, options);

    @Override
    public String greetSomeone(String name) {
        String spanishGreeting = activities.greetInSpanish(name);
        String spanishFarewell = activities.farewellInSpanish(name);

        return "\n" + spanishGreeting + "\n" + spanishFarewell;
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)
WorkflowTaskScheduled	
WorkflowTaskStarted	



Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/%s?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

class GreetingWorkflowImpl implements GreetingWorkflow {

    private final ActivityOptions options = ActivityOptions.newBuilder()
            .setStartToCloseTimeout(Duration.ofSeconds(5))
            .build();

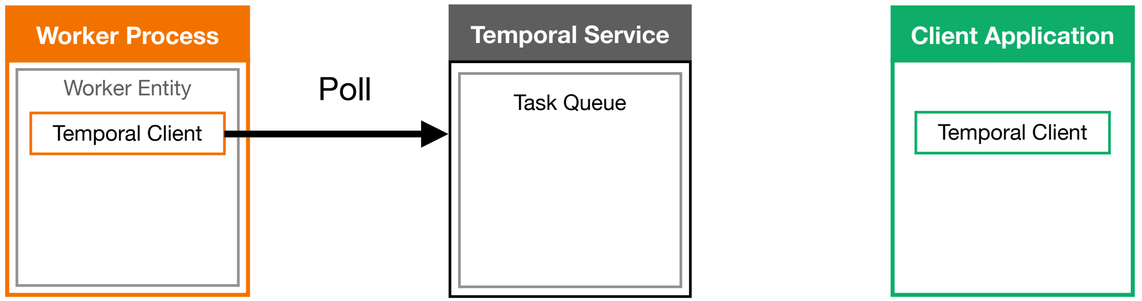
    private final GreetingActivities activities =
            Workflow.newActivityStub(GreetingActivities.class, options);

    @Override
    public String greetSomeone(String name) {
        String spanishGreeting = activities.greetInSpanish(name);
        String spanishFarewell = activities.farewellInSpanish(name);

        return "\n" + spanishGreeting + "\n" + spanishFarewell;
    }
}
```

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)
WorkflowTaskScheduled	
WorkflowTaskStarted	



Activity Definitions

```
package tareweltworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tareweltworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tareweltworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... code above has been omitted from this excerpt

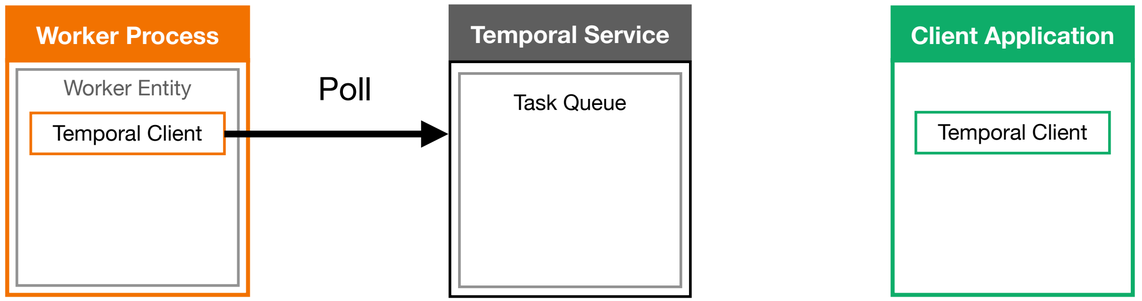
class GreetingWorkflowImpl implements GreetingWorkflow {

    private final ActivityOptions options = ActivityOptions.newBuilder()
            .setStartToCloseTimeout(Duration.ofSeconds(5))
            .build();

    private final GreetingActivities activities =
            Workflow.newActivityStub(GreetingActivities.class, options);

    @Override
    public String greetSomeone(String name) {
        String spanishGreeting = activities.greetInSpanish(name);
        String spanishFarewell = activities.farewellInSpanish(name);

        return "\n" + spanishGreeting + "\n" + spanishFarewell;
    }
}
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

Activity Definitions

```
package tarweliworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package tarweliworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarweliworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... this is code within your own application (for example a web or mobile app)

WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
WorkflowClient client = WorkflowClient.newInstance(service);

WorkflowOptions options = WorkflowOptions.newBuilder()
        .setWorkflowId("greeting-workflow")
        .setTaskQueue("greeting-tasks")
        .build();

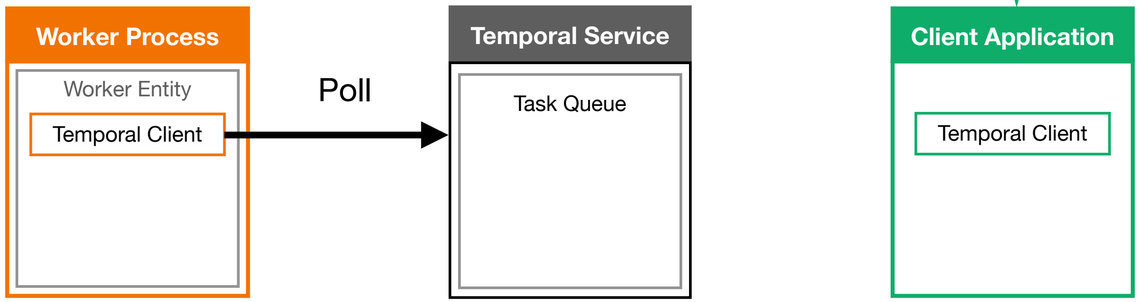
GreetingWorkflow workflow = client.newWorkflowStub(GreetingWorkflow.class, options);

String greeting = workflow.greetSomeone(args[0]);

String workflowId = WorkflowStub.fromTyped(workflow).getExecution().getWorkflowId();

System.out.println(workflowId + " " + greeting);

// ... other application-specific code might follow
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

Activity Definitions

```
package farewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
          throw Activity.wrap(e);
      }

      // code that uses this URL to call the service has been omitted here

  }
}
```

Workflow Definition

```
package farewellworkflow;

import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "hi" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... this is code within your own application (for example a web or mobile app)

WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
WorkflowClient client = WorkflowClient.newInstance(service);

WorkflowOptions options = WorkflowOptions.newBuilder()
        .setWorkflowId("greeting-workflow")
        .setTaskQueue("greeting-tasks")
        .build();

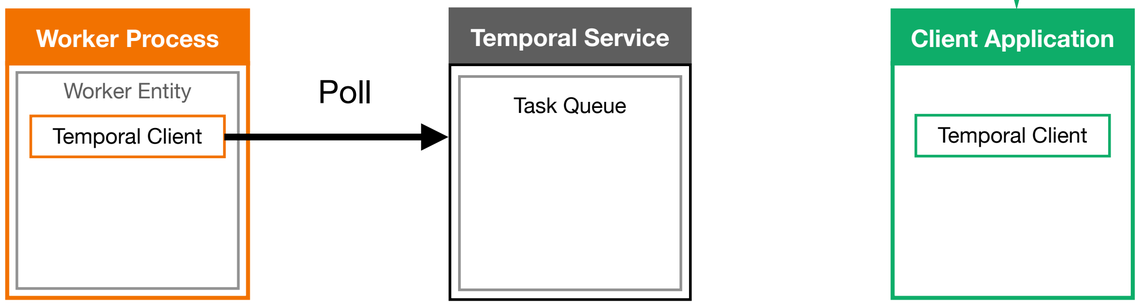
GreetingWorkflow workflow = client.newWorkflowStub(GreetingWorkflow.class, options);

String greeting = workflow.greetSomeone(args[0]);

String workflowId = WorkflowStub.fromTyped(workflow).getExecution().getWorkflowId();

System.out.println(workflowId + " " + greeting);

// ... other application-specific code might follow
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
WorkflowExecutionCompleted	

Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

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  public String farewellInSpanish(String name) {
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  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

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      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
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  }
}
```

Workflow Definition

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import io.temporal.activity.ActivityOptions;
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@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... this is code within your own application (for example a web or mobile app)

WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
WorkflowClient client = WorkflowClient.newInstance(service);

WorkflowOptions options = WorkflowOptions.newBuilder()
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        .setTaskQueue("greeting-tasks")
        .build();

GreetingWorkflow workflow = client.newWorkflowStub(GreetingWorkflow.class, options);

String greeting = workflow.greetSomeone(args[0]);

String workflowId = WorkflowStub.fromTyped(workflow).getExecution().getWorkflowId();

System.out.println(workflowId + " " + greeting);

// ... other application-specific code might follow
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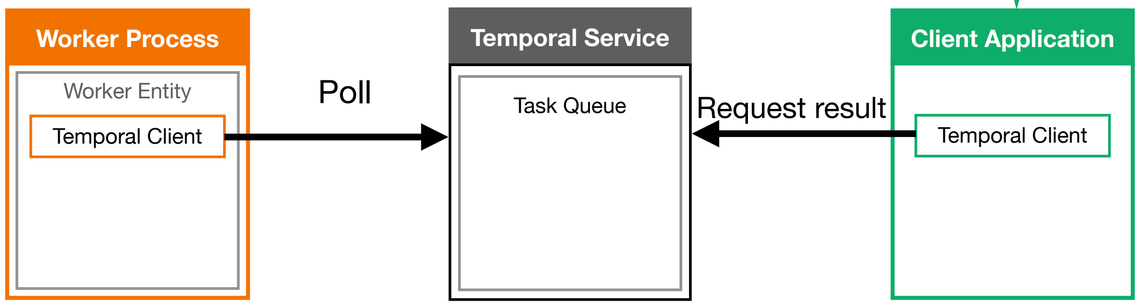

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ActivityTaskScheduled	(Greeting)
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WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Farewell)
ActivityTaskStarted	(Farewell)
ActivityTaskCompleted	(Farewell)
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
WorkflowExecutionCompleted	

The End

Activity Definitions

```
package tarewellworkflow;

// non-Temporal imports omitted here for brevity
import io.temporal.activity.ActivityInterface;
import io.temporal.activity.Activity;

@ActivityInterface
public interface GreetingActivities {
  String greetInSpanish(String name);

  String farewellInSpanish(String name);
}

class GreetingActivitiesImpl implements GreetingActivities {

  @Override
  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
  }

  @Override
  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
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  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/?name=%s";

      URL url = null;
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          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
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import io.temporal.activity.ActivityOptions;
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import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package tarewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

```
// ... this is code within your own application (for example a web or mobile app)

WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
WorkflowClient client = WorkflowClient.newInstance(service);

WorkflowOptions options = WorkflowOptions.newBuilder()
        .setWorkflowId("greeting-workflow")
        .setTaskQueue("greeting-tasks")
        .build();

GreetingWorkflow workflow = client.newWorkflowStub(GreetingWorkflow.class, options);

String greeting = workflow.greetSomeone(args[0]);

String workflowId = WorkflowStub.fromTyped(workflow).getExecution().getWorkflowId();

System.out.println(workflowId + " " + greeting);

// ... other application-specific code might follow
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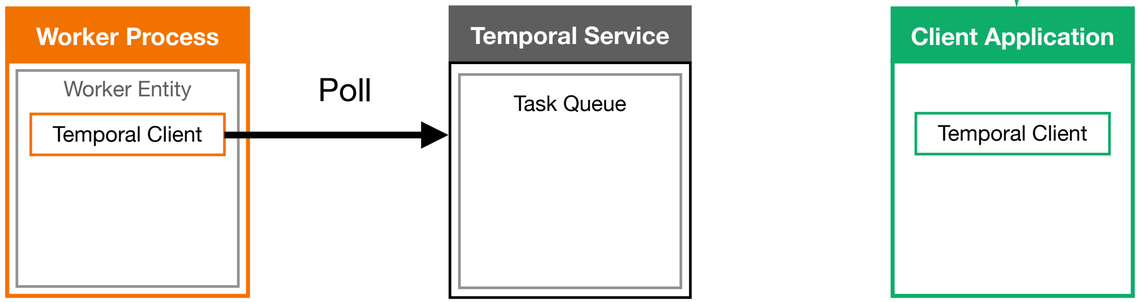

Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
ActivityTaskStarted	(Greeting)
ActivityTaskCompleted	(Greeting)
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class GreetingActivitiesImpl implements GreetingActivities {

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  public String greetInSpanish(String name) {
      return callService("get-spanish-greeting", name);
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  public String farewellInSpanish(String name) {
    return callService("get-spanish-farewell", name);
  }

  String callService(String stem, String name) {
      StringBuilder builder = new StringBuilder();

      String baseUrl = "http://localhost:9999/rs/";name=%s";

      URL url = null;
      try {
          url = new URL(String.format(baseUrl, stem, URLEncoder.encode(name, "UTF-8")));
      } catch (IOException e) {
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Workflow Definition

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import io.temporal.workflow.WorkflowInterface;
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import io.temporal.workflow.Workflow;

import java.time.Duration;

@WorkflowInterface
public interface GreetingWorkflow {

  @WorkflowMethod
  String greetSomeone(String name);
}

class GreetingWorkflowImpl implements GreetingWorkflow {

  private final ActivityOptions options = ActivityOptions.newBuilder()
          .setStartToCloseTimeout(Duration.ofSeconds(5))
          .build();

  private final GreetingActivities activities =
          Workflow.newActivityStub(GreetingActivities.class, options);

  @Override
  public String greetSomeone(String name) {
      String spanishGreeting = activities.greetInSpanish(name);
      String spanishFarewell = activities.farewellInSpanish(name);

      return "\n" + spanishGreeting + "\n" + spanishFarewell;
  }
}
```

Worker Initialization

```
package farewellworkflow;

import io.temporal.client.WorkflowClient;
import io.temporal.serviceclient.WorkflowServiceStubs;
import io.temporal.worker.Worker;
import io.temporal.worker.WorkerFactory;

public class GreetingWorker {

  public static void main(String[] args) {

      WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
      WorkflowClient client = WorkflowClient.newInstance(service);
      WorkerFactory factory = WorkerFactory.newInstance(client);

      Worker worker = factory.newWorker("greeting-tasks");

      worker.registerWorkflowImplementationTypes(GreetingWorkflowImpl.class);

      worker.registerActivitiesImplementations(new GreetingActivitiesImpl());

      factory.start();
  }
}
```

The End

```
// ... this is code within your own application (for example a web or mobile app)

WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();
WorkflowClient client = WorkflowClient.newInstance(service);

WorkflowOptions options = WorkflowOptions.newBuilder()
        .setWorkflowId("greeting-workflow")
        .setTaskQueue("greeting-tasks")
        .build();

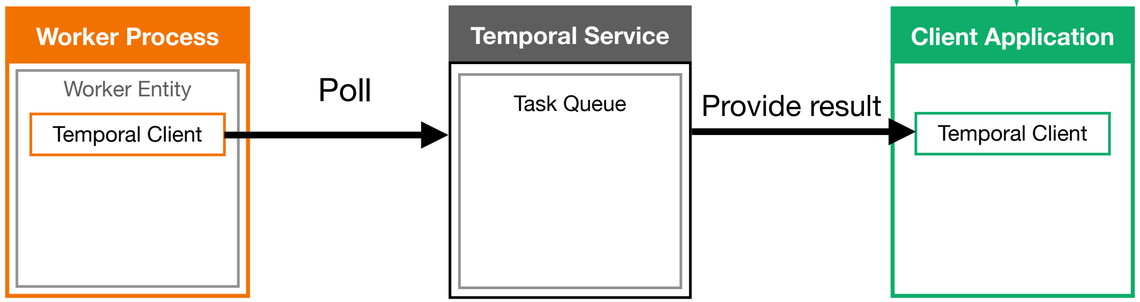
GreetingWorkflow workflow = client.newWorkflowStub(GreetingWorkflow.class, options);

String greeting = workflow.greetSomeone(args[0]);

String workflowId = WorkflowStub.fromTyped(workflow).getExecution().getWorkflowId();

System.out.println(workflowId + " " + greeting);

// ... other application-specific code might follow
```



Event History

WorkflowExecutionStarted	
WorkflowTaskScheduled	
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WorkflowTaskCompleted	
ActivityTaskScheduled	(Greeting)
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WorkflowTaskStarted	
WorkflowTaskCompleted	
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ActivityTaskCompleted	(Farewell)
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WorkflowTaskStarted	
WorkflowTaskCompleted	
WorkflowExecutionCompleted	

Beginner to Builder Bootcamp - Java

00. About this Workshop

01. The Basics of Temporal

02. Improving Your Temporal Application Code

03. Using Timers in a Workflow Definition

04. Understanding Event History

05. Understanding Workflow Determinism

06. Signals, Queries, and Workflow Updates

07. Timeouts and Retry Policies

08. Recovering from Failure

09. Conclusion

Changing your inputs can break running Workflows

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  - Define a class (e.g. `GreetingInput`) and pass that as the sole argument
  - Now you can add or rename fields freely without touching the method signature
- **Do the same for return values**
  - A dedicated output class gives you the same flexibility on the way out. You can evolve return values without breaking callers

Example: Using a class in an Activity (1)

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```
// This Activity returns a customized greeting in English, using the provided name
String createGreeting(String name){
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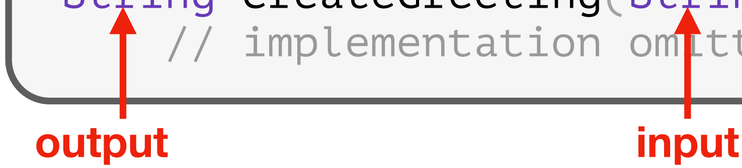

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- **You later need to update it to support other languages, such as Spanish**
  - Changing what is passed into or returned from the method changes its signature
  - Changes to the class composition don't affect the signature of the methods that use it

Example: Using a class in an Activity (2)

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- **The following code sample illustrates how you could support this**

```
// Define a class to encapsulate all data passed as input for this Activity
class GreetingInput {
    private String name;
    private String languageCode;

    // Constructors and Getters/Setters omitted for brevity
}

// Define a class to encapsulate all data returned by this Activity
class GreetingOutput {
    private String greeting;

    // Constructors and Getters/Setters omitted for brevity
}

// Specify these types for the input parameter and return type of the Activity
GreetingOutput createGreeting(GreetingInput input) {

    // An example to show how to access input parameters and create the return value
    if (input.getLanguageCode().equals("fr")) {
        String bonjour = "Bonjour, " + input.getName();
        return new GreetingOutput(bonjour)
    }
    // support for additional languages would follow...
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input

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Task Queues

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- **Plan to run *at least* two Worker Processes per Task Queue**

Workflow IDs

Workflow IDs

- **You specify a Workflow ID when starting a Workflow Execution**

```
// Example: An order processing Workflow might include order number in the Workflow ID
WorkflowOptions options = WorkflowOptions.newBuilder()
        .setWorkflowId("translation-workflow-" + input.getOrderNumber())
        .setTaskQueue("translation-tasks").build();

OrderProcessingWorkflow workflow = client.newWorkflowStub(OrderProcessingWorkflow.class, options);
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  - This is an important consideration for choosing a Workflow ID

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    - The default policy results in retrying until execution succeeds or is canceled

How to Raise Exceptions in Activity Code

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- **You can throw exceptions as necessary in Activities**
  - Wrapping an exception allows you to throw a checked exception without specifying it in the method signature. These failures will be retried:

```
try (BufferedReader in = new BufferedReader(new InputStreamReader(url.openStream()))) {
  String line;
  while ((line = in.readLine()) != null) {
    builder.append(line);
  }
} catch (IOException e) {
  throw Activity.wrap(e);
}
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```

  - If you don't want an Activity to retry, you can specify it as a Non-Retryable Failure

```
RetryOptions retryOptions = RetryOptions.newBuilder()
    .setInitialInterval(Duration.ofSeconds(15))
    .setBackoffCoefficient(2.0)
    .setMaximumInterval(Duration.ofSeconds(60))
    .setMaximumAttempts(100)
    .setDoNotRetry("IOException")
    .build();
```

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  - Raising an exception that extends TemporalFailure causes a Workflow Execution Failure
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How to Raise Exceptions in Workflow Code

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- **You can throw exceptions as necessary in Workflows**

```
if (isDelivery && (distance.getKilometers() > 25)) {
      logger.error("Customer lives outside the service area");
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          OutOfServiceAreaException.class.getName());
    }
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    - This is known as a WorkflowExecutionFailure
      - ApplicationFailure is a child of TemporalFailure

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- **The standard log levels are present, in increasing order of importance**
  - debug
  - info
  - warn
  - error

Using the WorkflowLogger

Using the WorkflowLogger

- **Accessing and using the Workflow logger using Workflow.getLogger**

```
import org.slf4j.Logger;
import io.temporal.workflow.Workflow;

// instance variable
public static final Logger logger = Workflow.getLogger(TranslationWorkflowImpl.class);

// code within a method
logger.debug("Preparing to execute an Activity")
logger.info("Calculated cost of order. Tax {}, Total {}", tax, total)
```

Logging in Activities

- **Activity logging needs no special Temporal Logger and can be done normally**

```
import org.slf4j.Logger;
import org.slf4j.LoggerFactory;

// instance variable
private static final Logger logger = LoggerFactory.getLogger(TranslationActivitiesImpl.class);

// code within a method
logger.info("getDistance invoked; determining distance to customer address");
logger.error("Database connection failed");
```

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  - Asynchronous calls do not block, so the result must be retrieved later
- **Workflows run until all Tasks yield and resume when new ones appear**
  - Example: If a Worker encounters a synchronous Activity call, it halts the current Workflow Task and requests Activity Execution. Once that completes, the Temporal Service adds a new Workflow Task to the queue.

Activity Execution

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- **Synchronous Execution**

```
private final GreetingActivities activities =
  Workflow.newActivityStub(GreetingActivities.class, options);

// Synchronous Activity Method call
String greeting = activities.createGreeting(bill);
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- **Asynchronous Execution**

```
private final GreetingActivities activities =
  Workflow.newActivityStub(GreetingActivities.class, options);

// Asynchronous Activity Method call
Promise<String> hello = Async.function(activities::createGreeting, name);

// Later in the program
String result = hello.get();
```

Workflow Execution

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- **Synchronous Execution**

```
// Use a client to request Workflow Execution.
GreetingWorkflow workflow = client.newWorkflowStub(GreetingWorkflow.class, options);
String greeting = workflow.greetSomeone(name);
```

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- **Asynchronous Execution**

```
import java.util.concurrent.CompletableFuture;
import io.temporal.client.WorkflowClient;

// Options defining code omitted for brevity
GreetingWorkflow workflow = client.newWorkflowStub(GreetingWorkflow.class, options);

// Workflow will be started at this point but the call doesn't block.
CompletableFuture<String> greeting = WorkflowClient.execute(workflow::greetSomeone, "World");

// This line will block, waiting on the result from the Workflow.
String result = greeting.get();
```

Deferring Access to Execution Results

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- **Deferring access to results *may* reduce overall execution time**

```
Promise<String> hello = Async.function(activities::greetInSpanish, name);
Promise<String> goodbye = Async.function(activities::farewellInSpanish, name);
Promise<String> thanks = Async.function(activities::thankInSpanish, name);

// The following lines block until their respective executions have finished

String hello_result = hello.get();
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// You could also collect them all at once
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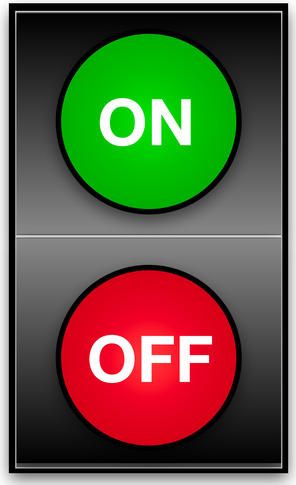

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  - You should balance the granularity of your Activities with the need to keep Event History small

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  - Worker finishes executing the Activity
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- **Activity will be retried since Event History does not indicate completion**
  - Therefore, idempotence is essential for preventing unwanted changes in application state

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  - In a Temporal Activity, you can compose one from a Workflow Run ID and Activity ID

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import io.temporal.activity.Activity;
import io.temporal.activity.ActivityExecutionContext;

ActivityExecutionContext context = Activity.getExecutionContext();
String idempotencyKey = context.getInfo().getRunId() + "-" context.getInfo().getActivityId();
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  - Guaranteed to be consistent across retry attempts, but unique among Workflow Executions

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Beginner to Builder Bootcamp - Java

00. About this Workshop
01. The Basics of Temporal
02. Improving Your Temporal Application Code
03. Using Timers in a Workflow Definition
04. Understanding Event History
05. Understanding Workflow Determinism
06. Signals, Queries, and Workflow Updates
07. Timeouts and Retry Policies
08. Recovering from Failure
09. Conclusion

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  - Code that awaits the Timer pauses execution for the specified duration
  - The duration is fixed and may range from seconds to years
  - Once the time has elapsed, the Timer fires, and execution continues
- **Workflow code must not use Java's built-in timers or sleep (non-deterministic)**

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- **Execute an Activity multiple times at dynamically-calculated intervals**
  - Delay calling the next Activity based on a value returned by a previous one
- **Allow time for offline steps to complete**
  - Wait five business days for a check to clear before proceeding

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  - There are synchronous and asynchronous versions
  - A Workflow-safe replacement for Thread.sleep and java.util.Timer are available
  - Workflow code must not use Java's methods for timers (non-deterministic)

Pausing Workflow Execution for a Specified Duration

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- **Use the Workflow.sleep method for this**

```
import java.time.Duration;
import io.temporal.workflow.Workflow;

// This will pause Workflow Execution for 10 seconds
Workflow.sleep(Duration.ofSeconds(10));
```

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Pausing Workflow Execution for a Specified Duration

- **Use the Workflow.sleep method for this**
  - This is an alternative to Java's Thread.sleep method
  - It blocks until the Timer is fired (or is canceled)

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Running Code a Specific Point in the Future

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- **Use the Workflow.newTimer method for this**

```
import java.time.Duration;
import io.temporal.workflow.Workflow;

// Workflow.newTimer is a Workflow-safe counterpart to java.util.Timer
Promise timerPromise = Workflow.newTimer(Duration.ofSeconds(30))
logger.info("The timer was set")

// Unlike Workflow.sleep, waiting for the timer is a separate operation
timerPromise.get()
logger.Info("The timer has fired")
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Running Code a Specific Point in the Future

- **Use the Workflow.newTimer method for this**
  - This is an alternative to Java's `java.util.NewTimer` method
  - This returns a Promise, which becomes ready when the Timer fires (or is canceled)

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  - If Worker is restarted 5 *minutes* later, the Timer will have already fired
    - In this case, the Worker will resume executing the Workflow code without delay

Exercise #2: Observing Durable Execution

https://t.mp/replay26-workshop-java

- **During this exercise, you will**
  - Create Workflow and Activity loggers
  - Add logging statements to the code
  - Add a Timer to the Workflow Definition
  - Launch two Workers, run the Workflow, and kill one of the Workers, observing that the remaining Worker completes the execution
- **Refer to this exercise's README.md file for details**
  - Don't forget to make your changes in the practice subdirectory

Beginner to Builder Bootcamp - Java

00. About this Workshop
01. The Basics of Temporal
02. Improving Your Temporal Application Code
03. Using Timers in a Workflow Definition
04. Understanding Event History
05. Understanding Workflow Determinism
06. Signals, Queries, and Workflow Updates
07. Timeouts and Retry Policies
08. Recovering from Failure
09. Conclusion

Workflow Definition

```java
import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;

@WorkflowInterface
public interface HelloWorkflow {

    @WorkflowMethod
    String greetSomeone(String name);
}

public class HelloWorkflowImpl implements HelloWorkflow {

    @Override
    public MyWorkflowOutput greetSomeone(MyWorkflowInput name) {
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Workflow Definition

combined with

Execution Request

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Workflow Execution

Running Workflow

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Workflow Execution States

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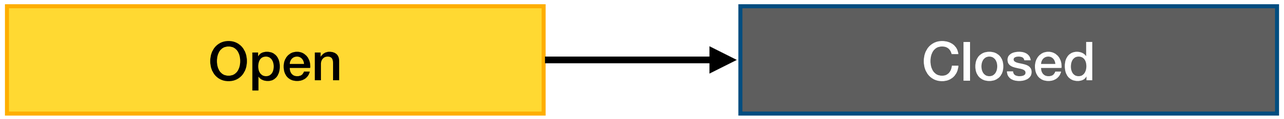
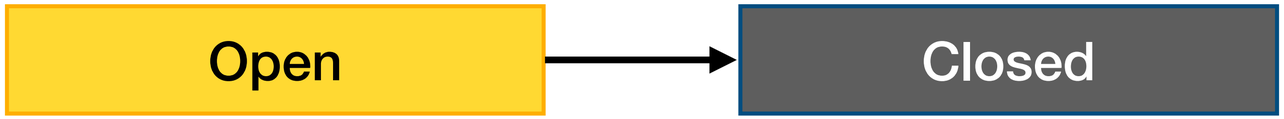
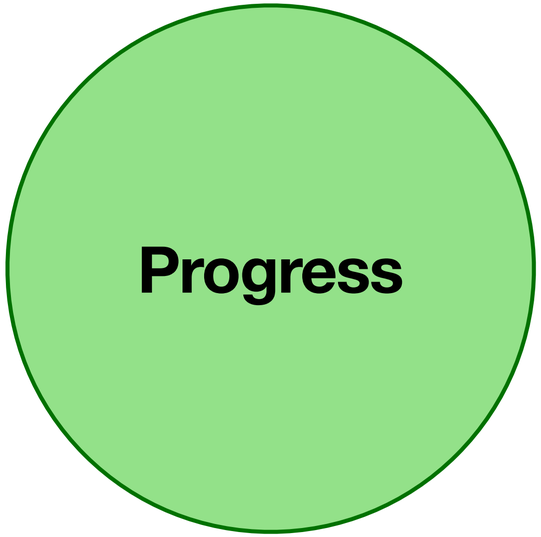


Workflow Execution States



This is a one-way transition

What Happens During Workflow Execution



This cycle continues throughout Workflow Execution

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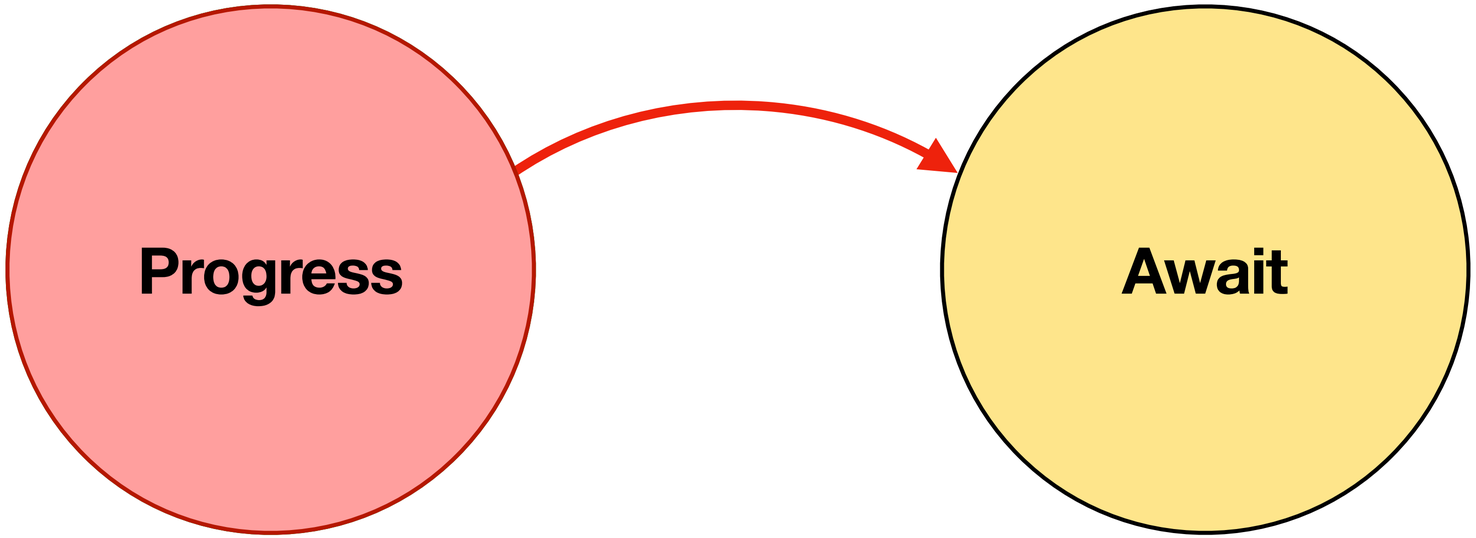

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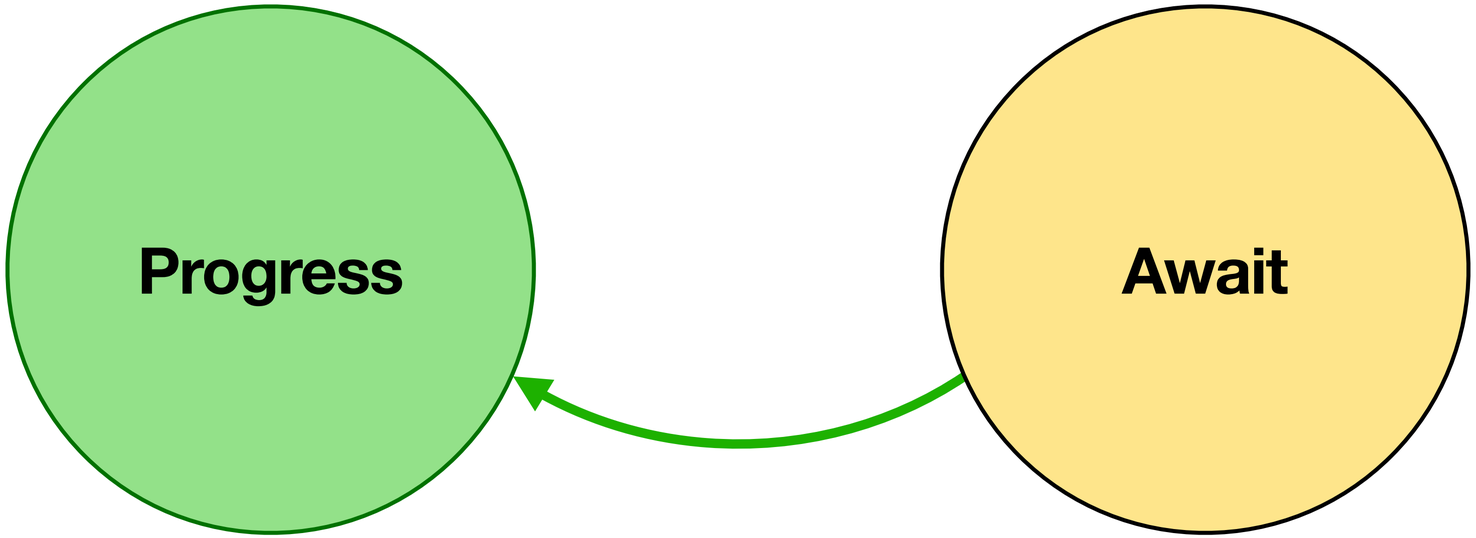

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Summary of Workflow Execution States

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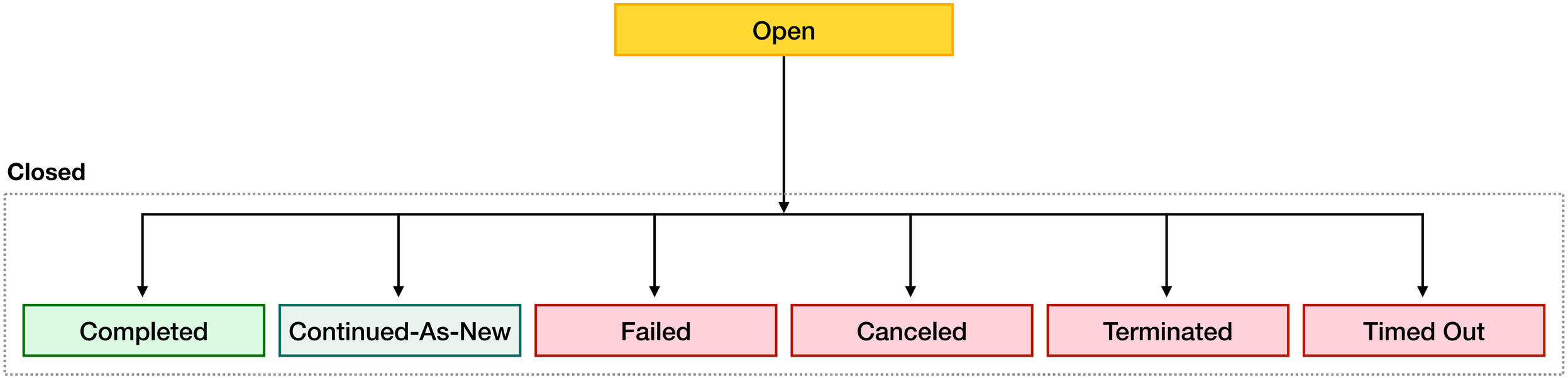
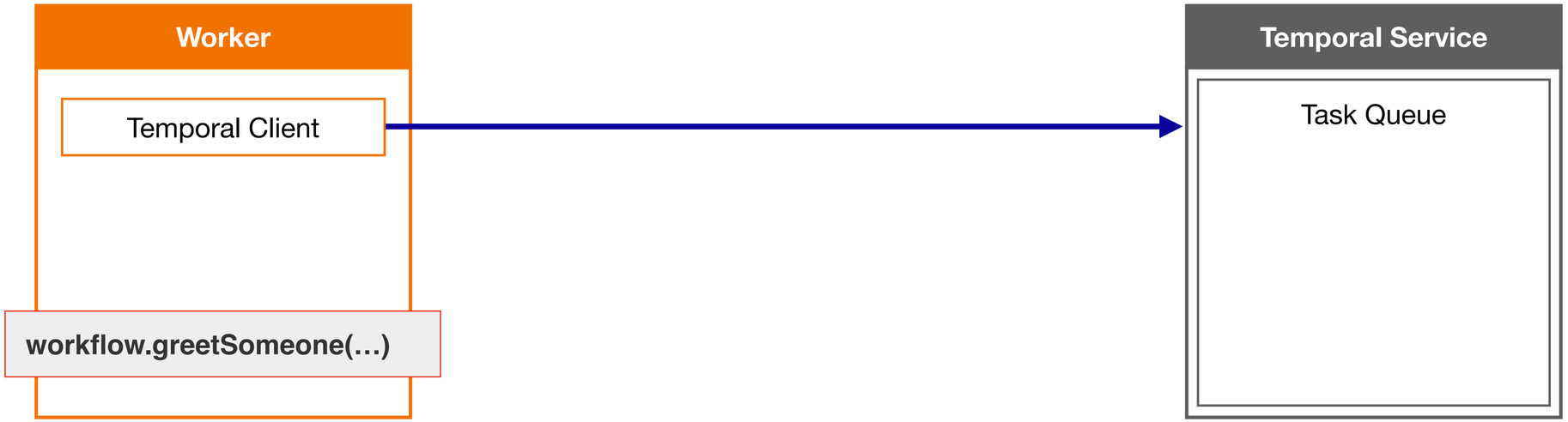
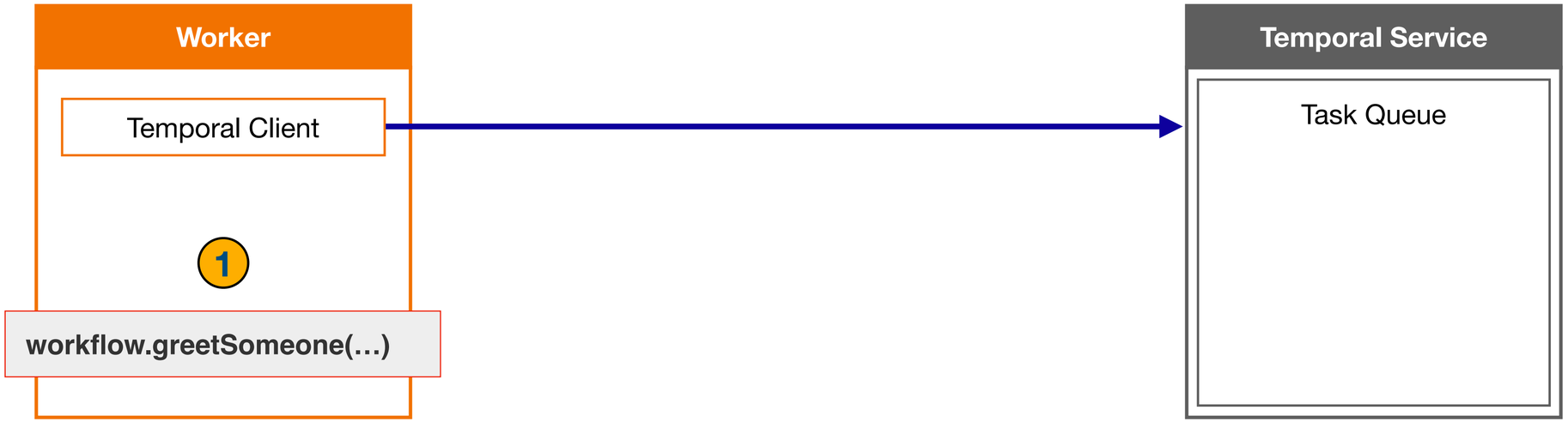


How Workflow Code Maps to Commands

Commands


Worker
Temporal Client
workflow.greetSomeone(…)
Temporal Service
Task Queue

Commands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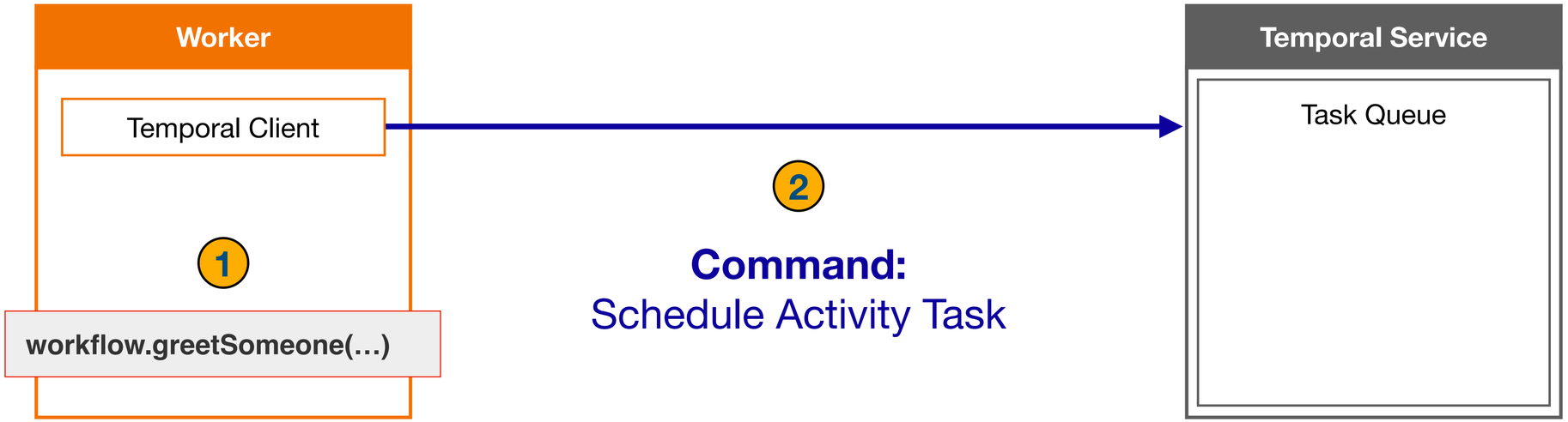

- Certain API calls result in the Worker issuing a Command to the Temporal Service

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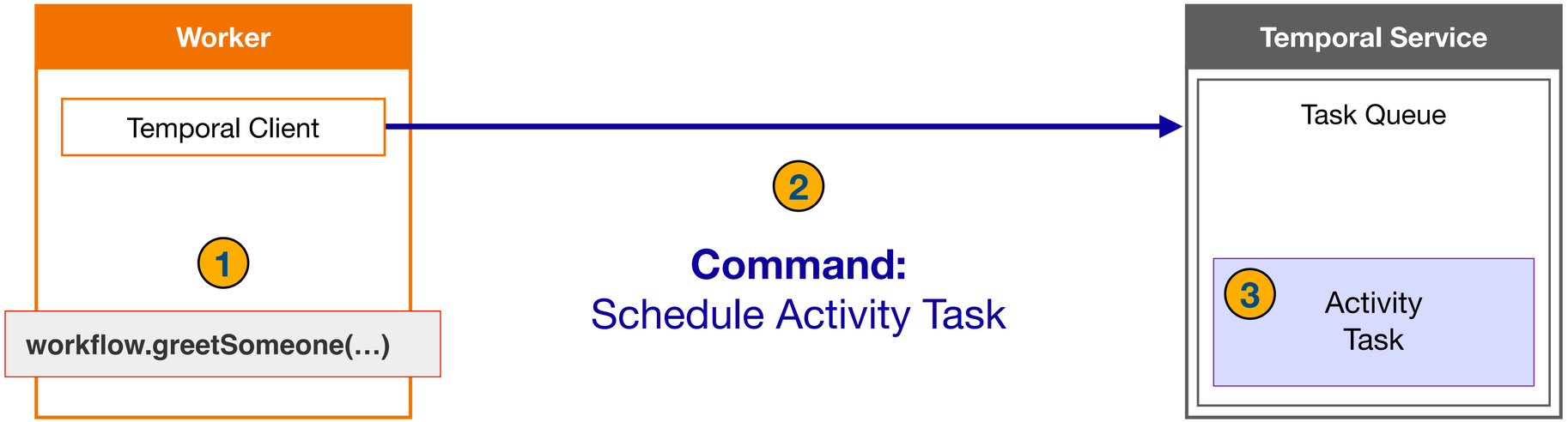

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- The Service acts on these commands, but also stores them

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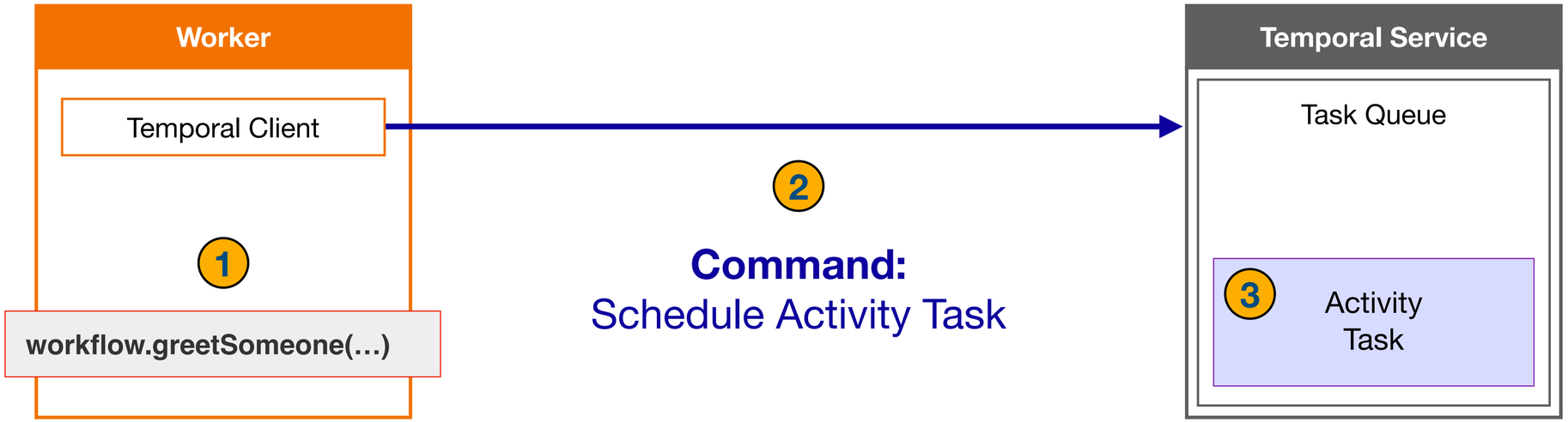

- Certain API calls result in the Worker issuing a Command to the Temporal Service
- The Service acts on these commands, but also stores them
- This allows the Worker to recreate the state of a Workflow Execution following a crash

Basic Temporal Workflow Definition

pseudocode

```
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  @Override
  public String pizzaWorkflow(Order order) {

    // Iterate over the items and calculate the cost of the order
    int totalPrice = 0;
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
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- Defines a Start-to-Close Timeout

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Basic Temporal Workflow Definition

- Defines a Start-to-Close Timeout
- Calculates total price of the pizzas

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- Calculates total price of the pizzas
- Determines distance to customer

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Basic Temporal Workflow Definition

- Defines a Start-to-Close Timeout
- Calculates total price of the pizzas
- Determines distance to customer
- Fails if customer is too far away for delivery

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    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```

Basic Temporal Workflow Definition

- Defines a Start-to-Close Timeout
- Calculates total price of the pizzas
- Determines distance to customer
- Fails if customer is too far away for delivery
- Sleeps for 30 minutes

pseudocode

```
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
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  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  @Override
  public String pizzaWorkflow(Order order) {

    // Iterate over the items and calculate the cost of the order
    int totalPrice = 0;
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
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Basic Temporal Workflow Definition

- Defines a Start-to-Close Timeout
- Calculates total price of the pizzas
- Determines distance to customer
- Fails if customer is too far away for delivery
- Sleeps for 30 minutes
- Populates a class with billing information

pseudocode

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Basic Temporal Workflow Definition

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- Calculates total price of the pizzas
- Determines distance to customer
- Fails if customer is too far away for delivery
- Sleeps for 30 minutes
- Populates a class with billing information
- Sends a bill to the customer

Basic Temporal Workflow Definition

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Basic Temporal Workflow Definition

- A Workflow is a sequence of steps

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Basic Temporal Workflow Definition

- A Workflow is a sequence of steps
- Some steps are *internal to the Workflow*

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Basic Temporal Workflow Definition

- A Workflow is a sequence of steps
- Some steps are *internal to the Workflow*
  - Do not involve interaction with the Temporal Service

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public class PizzaWorkflowImpl implements PizzaWorkflow {

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Basic Temporal Workflow Definition

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- Some steps are *internal to the Workflow*
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- Examples include
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Basic Temporal Workflow Definition

- A Workflow is a sequence of steps
- Some steps are *internal to the Workflow*
  - Do not involve interaction with the Temporal Service
- Examples include
  - Setting configuration parameters
  - Evaluating variables or expressions

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Basic Temporal Workflow Definition

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- Some steps are *internal to the Workflow*
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- Examples include
  - Setting configuration parameters
  - Evaluating variables or expressions
  - Performing calculations
  - Populating data structures

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public class PizzaWorkflowImpl implements PizzaWorkflow {

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Basic Temporal Workflow Definition

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- Some steps are *internal to the Workflow*
  - Do not involve interaction with the Temporal Service
- Examples include
  - Setting configuration parameters
  - Evaluating variables or expressions
  - Performing calculations
  - Populating data structures
- These internal steps are highlighted in white

Basic Temporal Workflow Definition

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Basic Temporal Workflow Definition

- Other steps *do* involve interaction with the cluster

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Basic Temporal Workflow Definition

- Other steps *do* involve interaction with the cluster
- Examples include

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Basic Temporal Workflow Definition

- Other steps *do* involve interaction with the cluster
- Examples include
  - Executing an Activity

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  private final PizzaActivities activities =
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Basic Temporal Workflow Definition

- Other steps *do* involve interaction with the cluster
- Examples include
  - Executing an Activity
  - Throwing an exception from the Workflow

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
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Basic Temporal Workflow Definition

- Other steps *do* involve interaction with the cluster
- Examples include
  - Executing an Activity
  - Throwing an exception from the Workflow
  - Setting a Timer

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
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    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```

Basic Temporal Workflow Definition

- Other steps *do* involve interaction with the cluster
- Examples include
  - Executing an Activity
  - Throwing an exception from the Workflow
  - Setting a Timer
  - Returning a value from the Workflow

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  ActivityOptions options = ActivityOptions.newBuilder()
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  private final PizzaActivities activities =
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Basic Temporal Workflow Definition

- Other steps *do* involve interaction with the cluster
- Examples include
  - Executing an Activity
  - Throwing an exception from the Workflow
  - Setting a Timer
  - Returning a value from the Workflow
- These external steps are highlighted in yellow

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ScheduleActivityTask

("pizza-tasks", GetDistance, { Line1: "123 Oak St.", Line2: "", ... })

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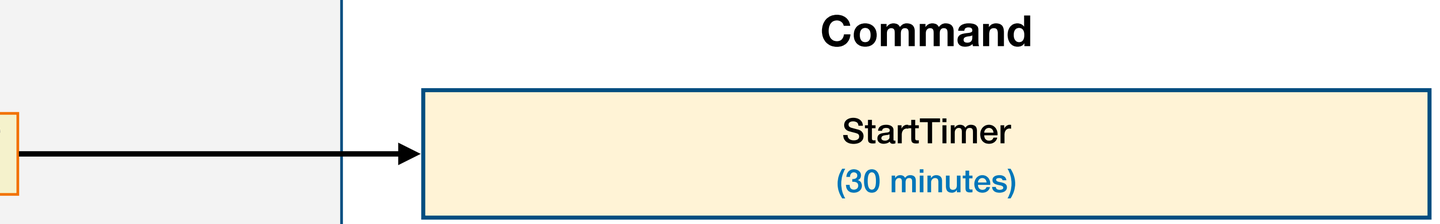

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ScheduleActivityTask

("pizza-tasks", SendBill, { Amount: 2750, Description: "Pizzas", ... }

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Command

CompleteWorkflowExecution

({ConfirmationNumber: "TPD-26074139"})

Workflow Execution Event History

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- **You can access them from code, command line, and Web UI**

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How Commands Map to Events

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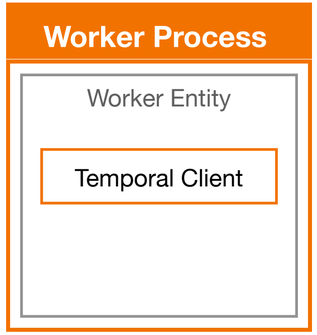

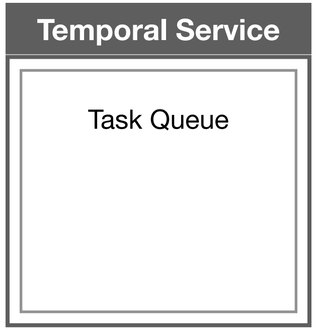

pseudocode

```
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
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  private final PizzaActivities activities =
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  public String pizzaWorkflow(Order order) {

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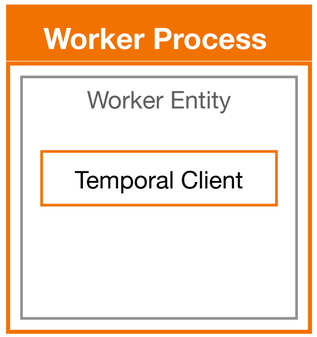

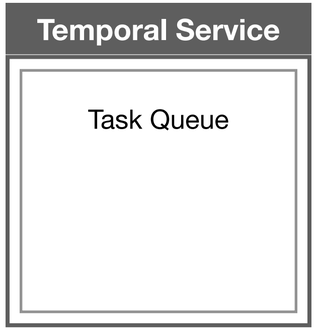

Commands

pseudocode

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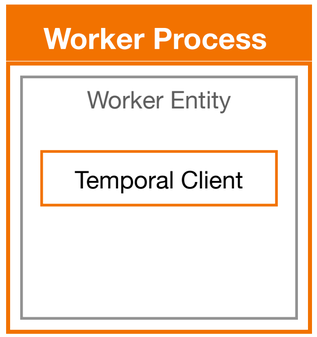

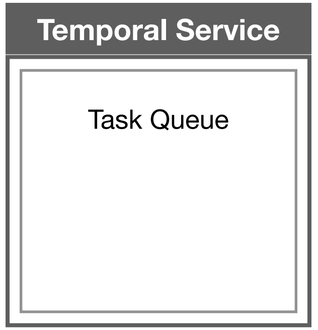

Commands

Events

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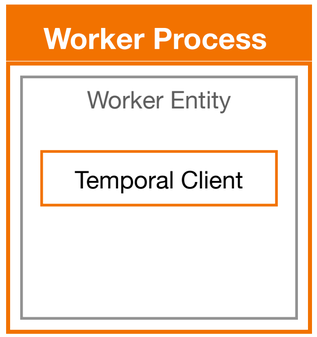

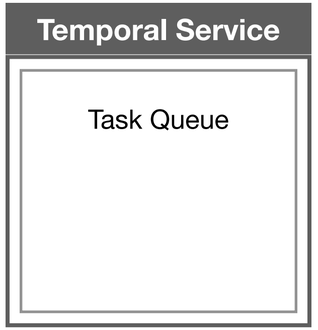

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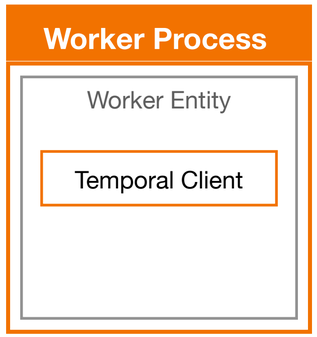

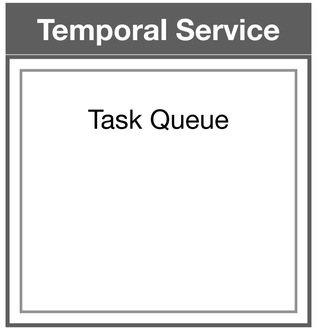

Commands

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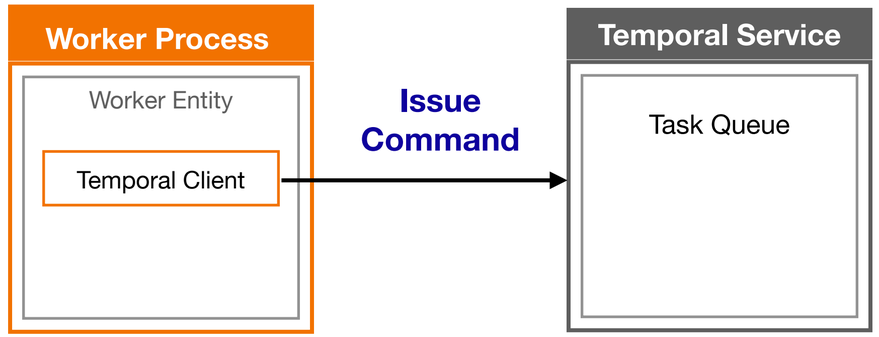

Commands

ScheduleActivityTask
(GetDistance)

Events

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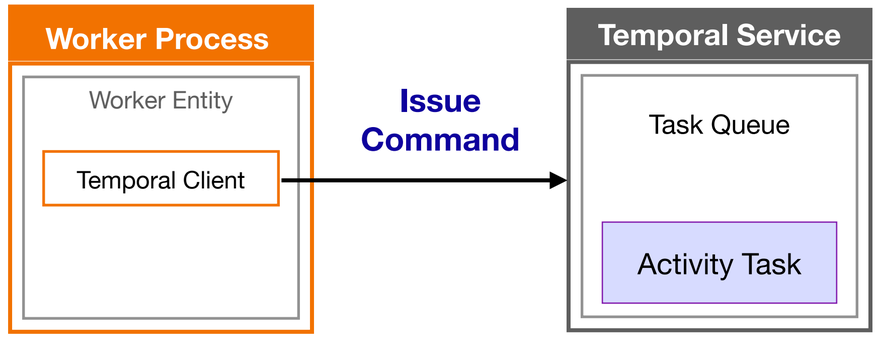

Commands

ScheduleActivityTask
(GetDistance)

Events

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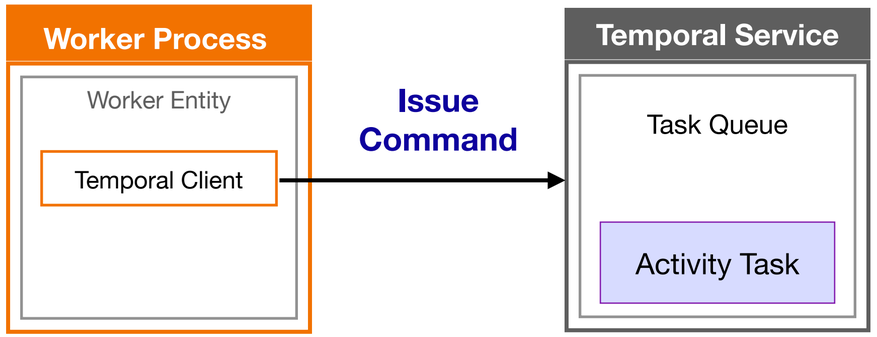

Commands

ScheduleActivityTask
(GetDistance)

Events

ActivityTaskScheduled

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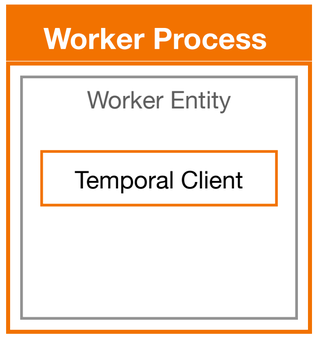

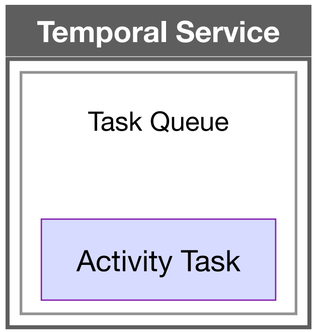

Commands

ScheduleActivityTask
(GetDistance)

Events

ActivityTaskScheduled

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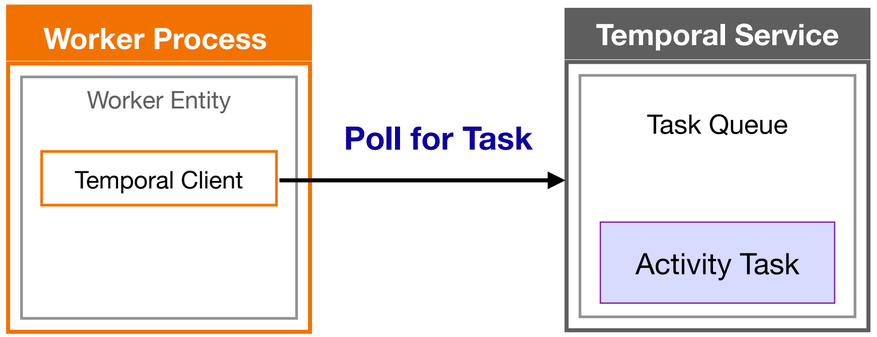

Commands

ScheduleActivityTask
(GetDistance)

Events

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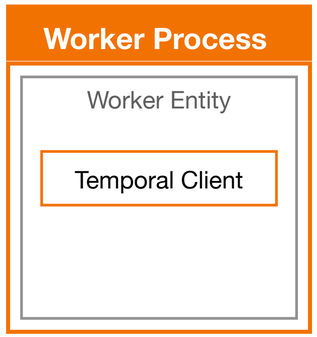

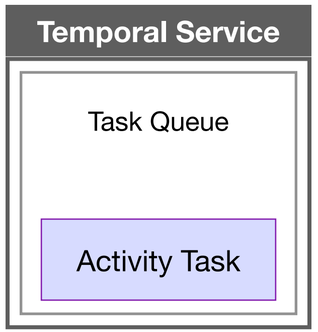

Commands

ScheduleActivityTask
(GetDistance)

Events

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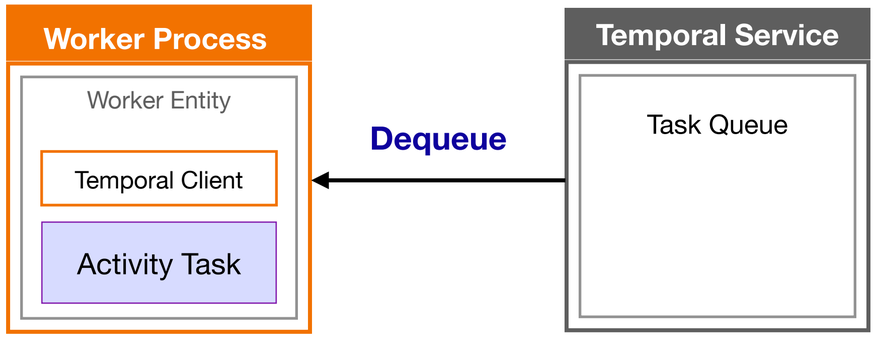

Commands

ScheduleActivityTask
(GetDistance)

Events

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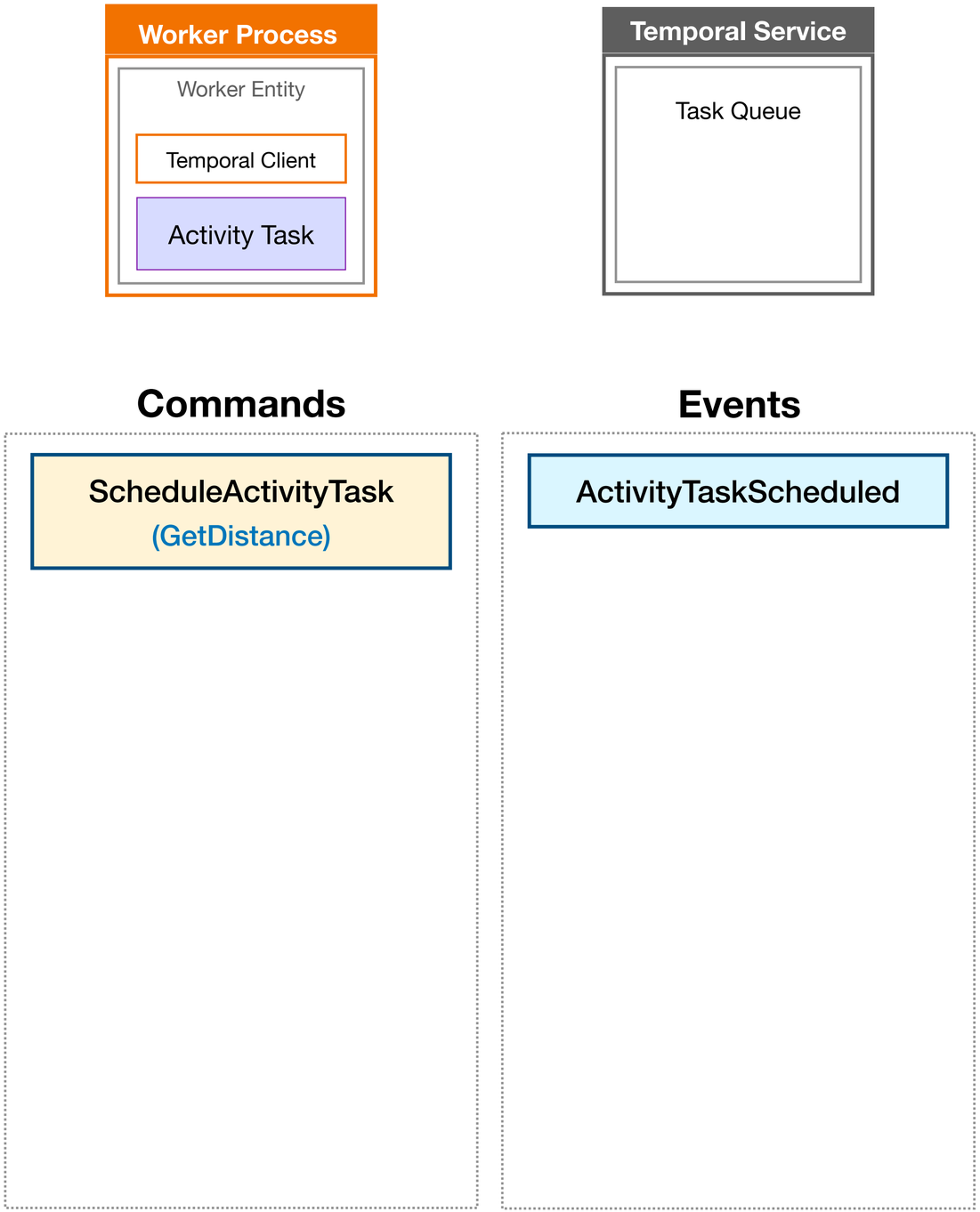

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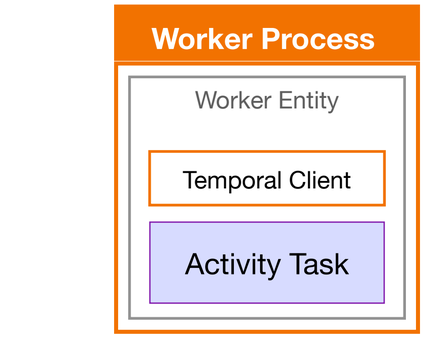

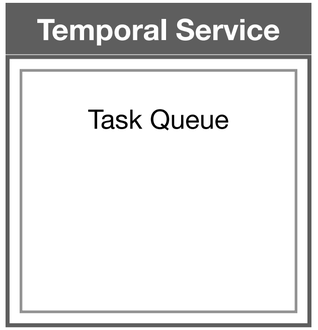

Commands

ScheduleActivityTask
(GetDistance)

Events

ActivityTaskScheduled

ActivityTaskStarted

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    Workflow.sleep(Duration.ofMinutes(30));

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    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
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    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

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}
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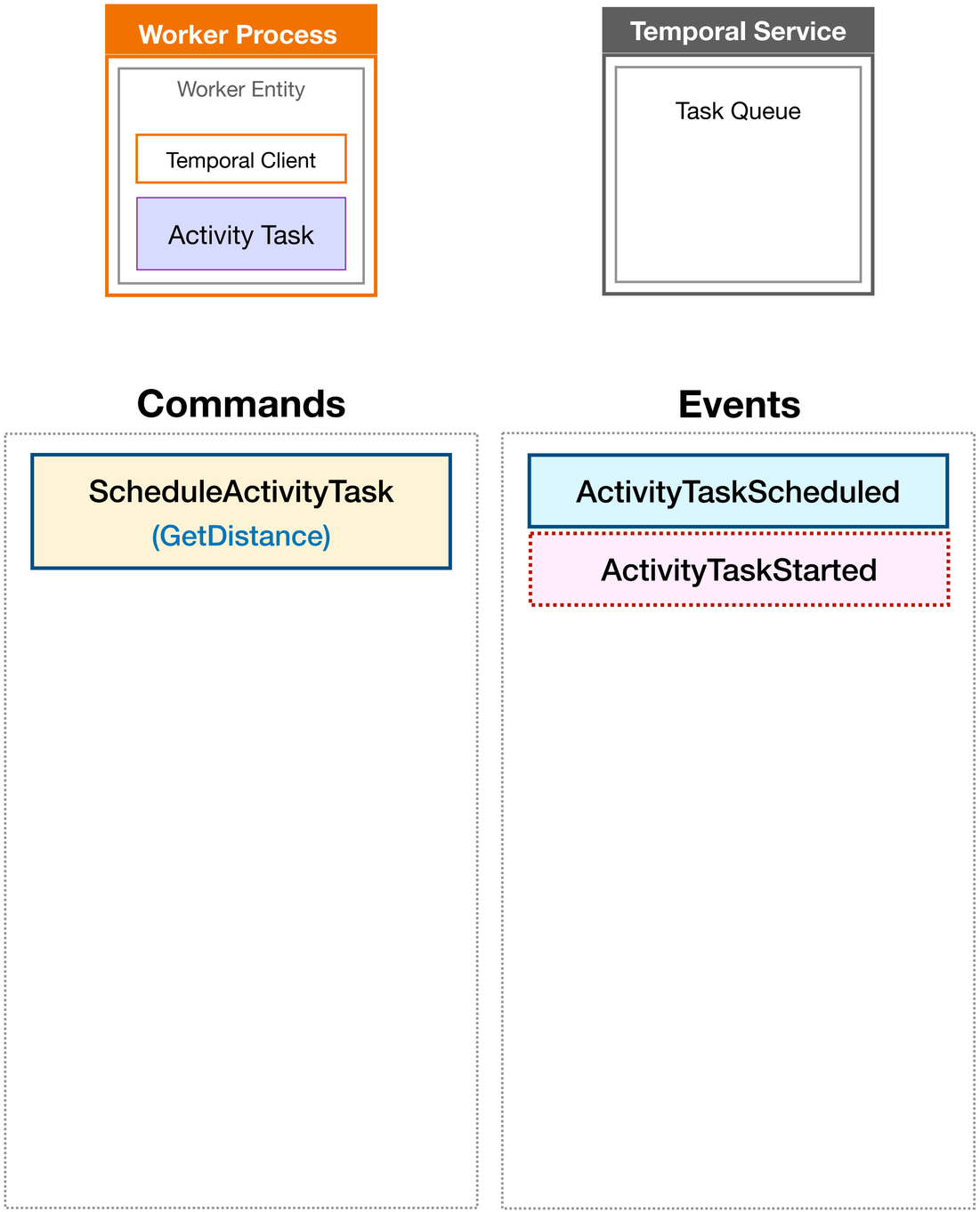

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public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
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  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  @Override
  public String pizzaWorkflow(Order order) {

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    int distance = activities.getDistance(order.getAddress());

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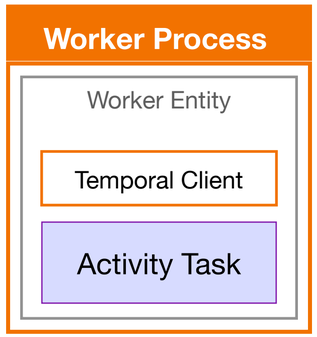

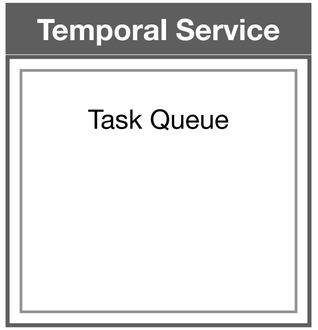

Commands

ScheduleActivityTask
(GetDistance)

Events

ActivityTaskScheduled

ActivityTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
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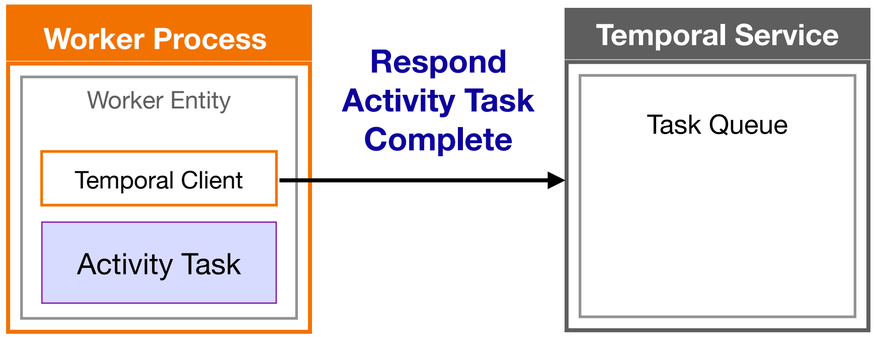

Commands

ScheduleActivityTask
(GetDistance)

Events

ActivityTaskScheduled

ActivityTaskStarted

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public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
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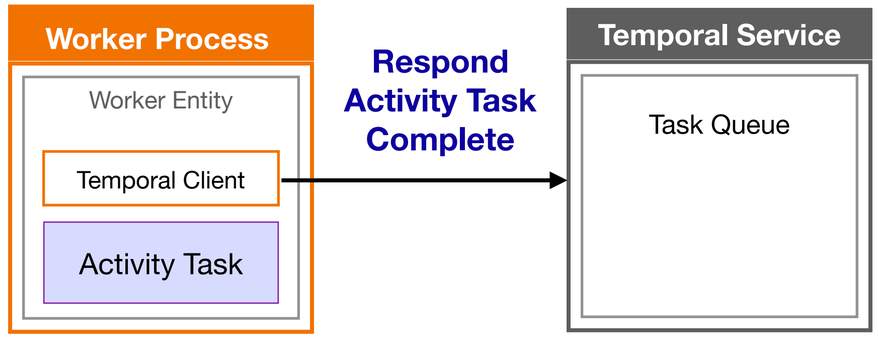

Commands

ScheduleActivityTask
(GetDistance)

Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

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public class PizzaWorkflowImpl implements PizzaWorkflow {

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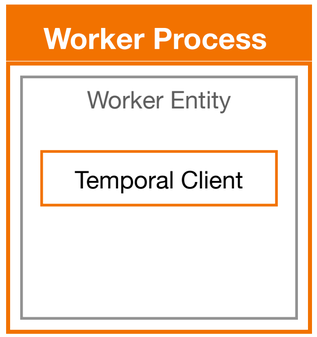

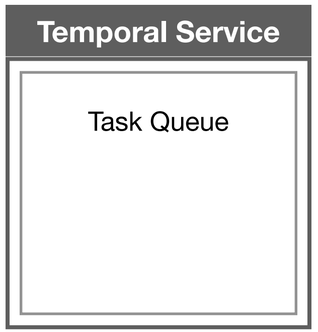

Commands

ScheduleActivityTask
(GetDistance)

Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

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public class PizzaWorkflowImpl implements PizzaWorkflow {

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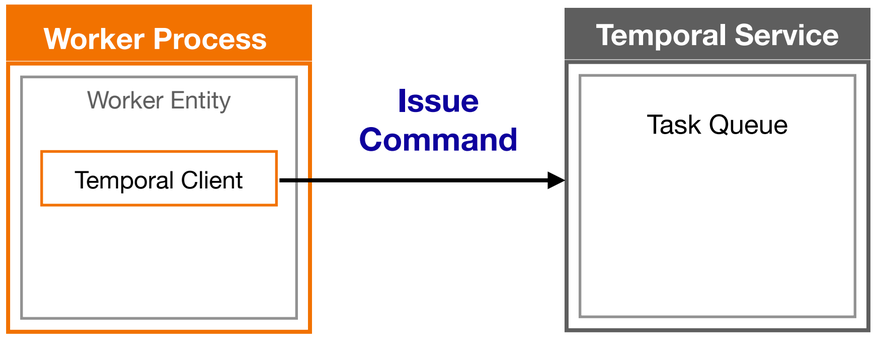

Commands

ScheduleActivityTask
(GetDistance)

Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

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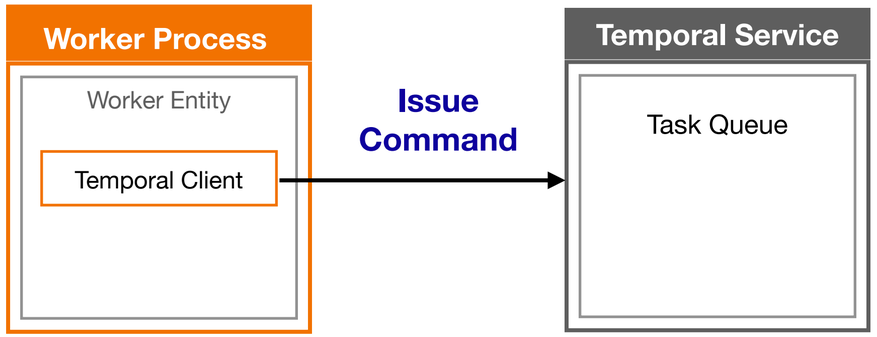

Commands

ScheduleActivityTask
(GetDistance)

StartTimer
(30 Minutes)

Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

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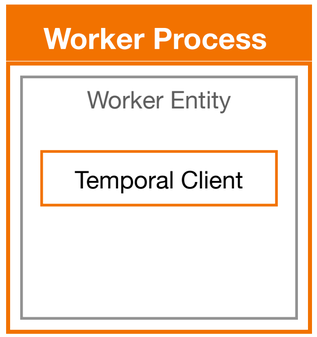

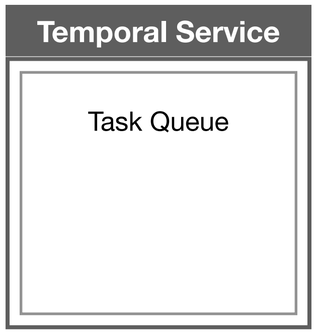

Commands

ScheduleActivityTask
(GetDistance)

StartTimer
(30 Minutes)

Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

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public class PizzaWorkflowImpl implements PizzaWorkflow {

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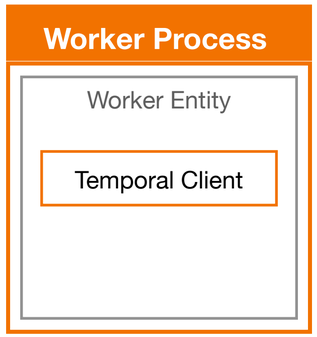

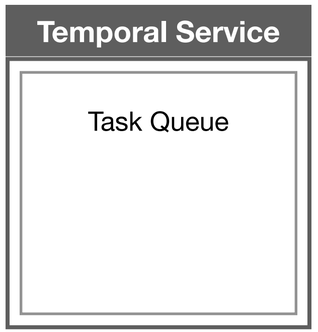

Commands

ScheduleActivityTask
(GetDistance)

StartTimer
(30 Minutes)

Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

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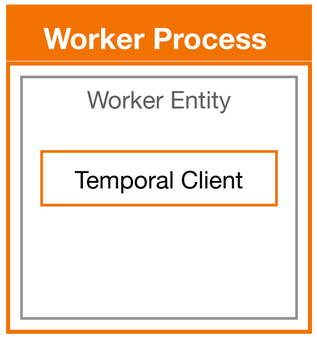

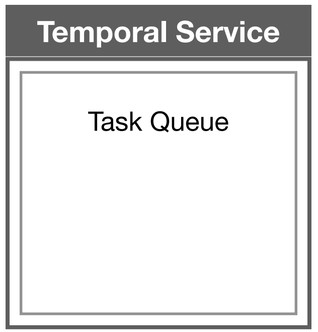

Commands

ScheduleActivityTask
(GetDistance)

StartTimer
(30 Minutes)

Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted

```java
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  ActivityOptions options = ActivityOptions.newBuilder()
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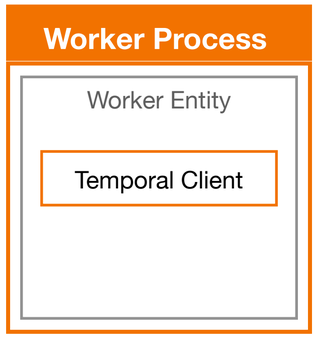

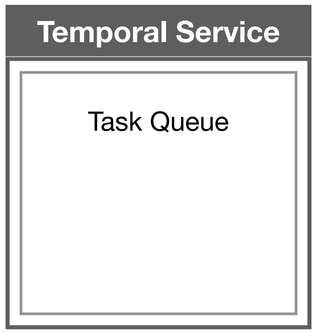

Commands

ScheduleActivityTask
(GetDistance)

StartTimer
(30 Minutes)

Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted

TimerFired

```java
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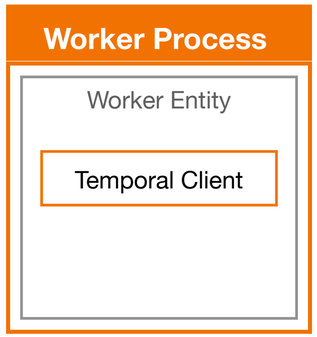

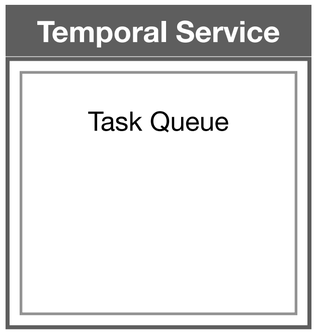

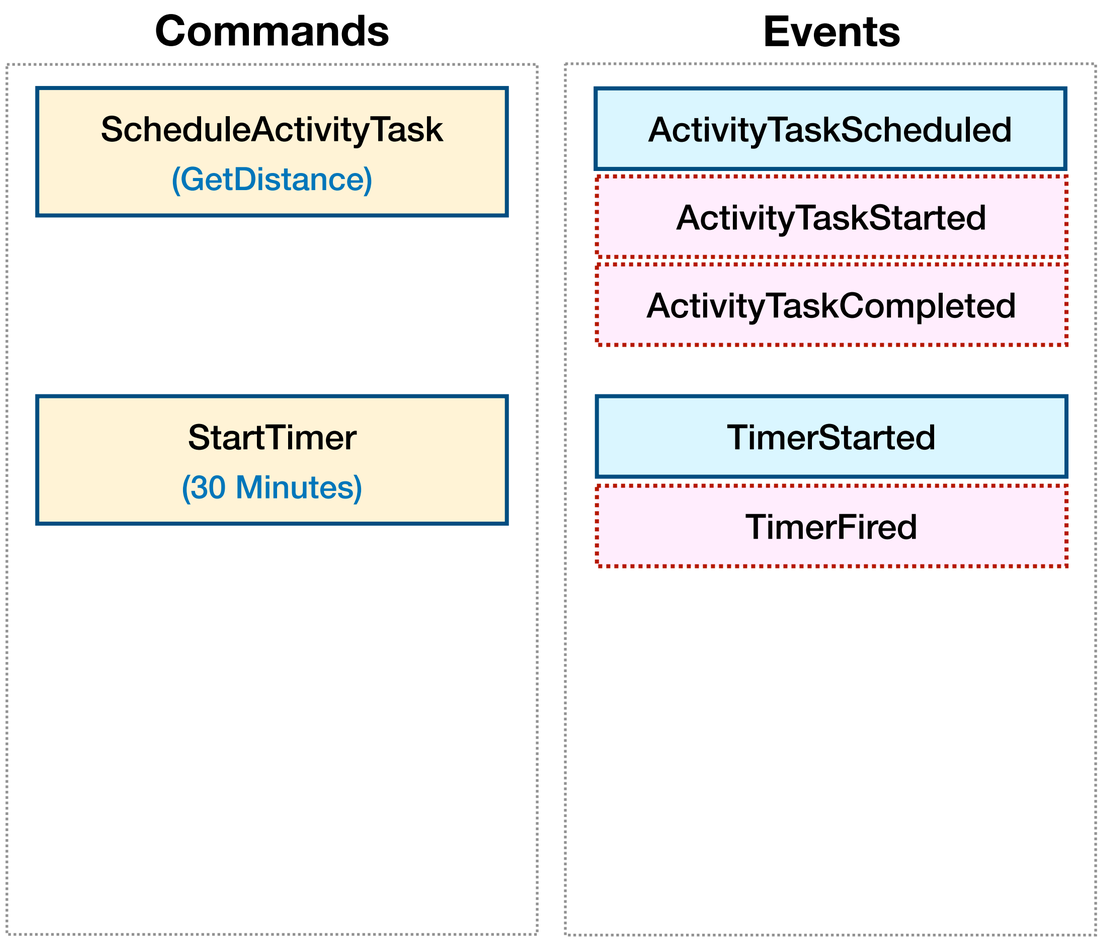

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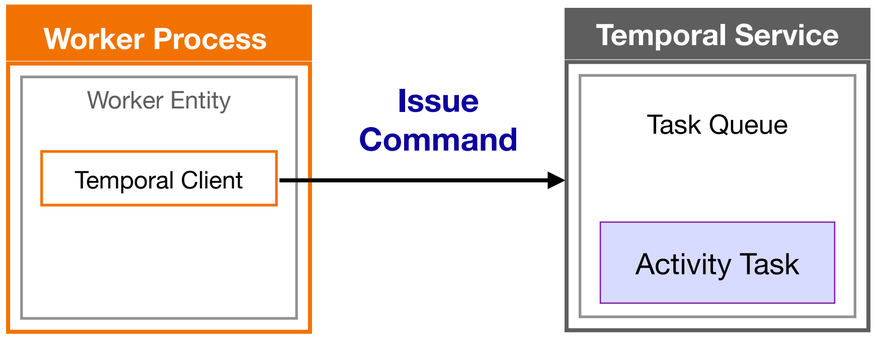

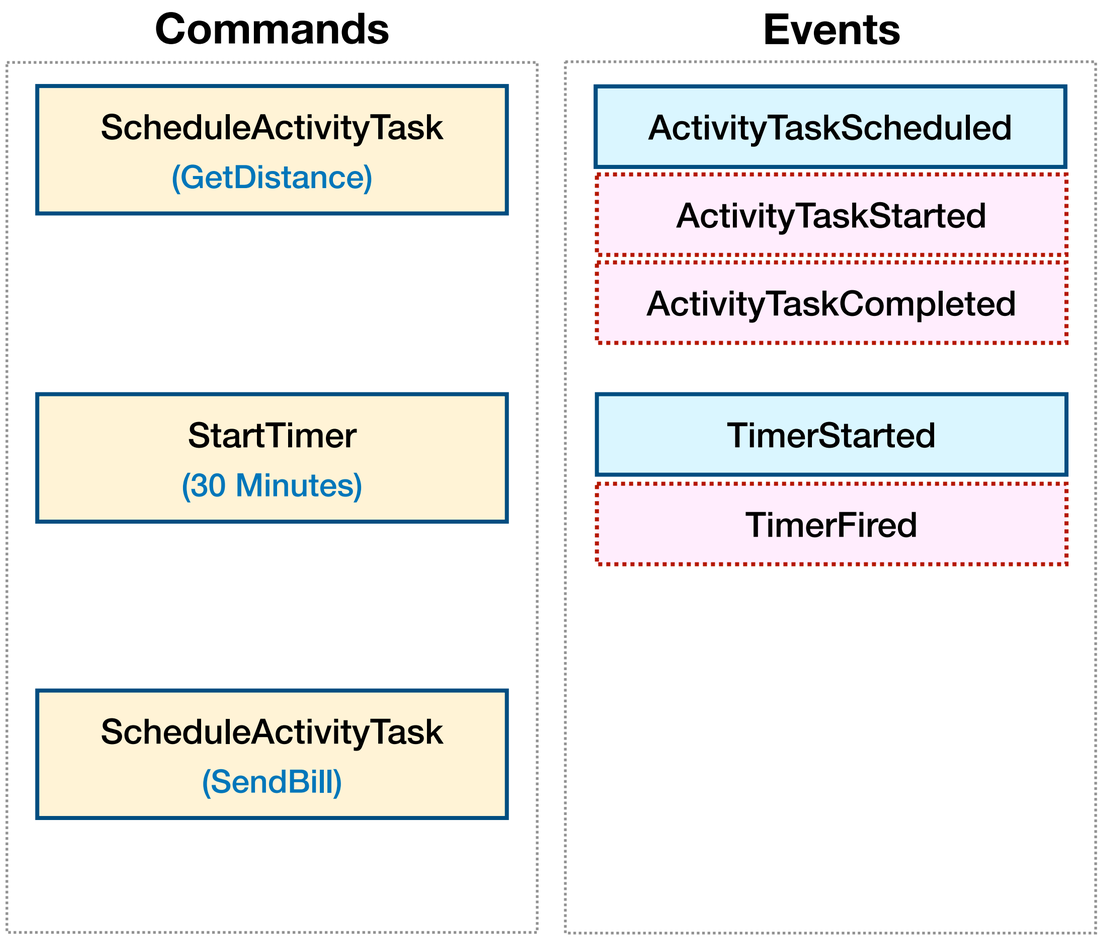

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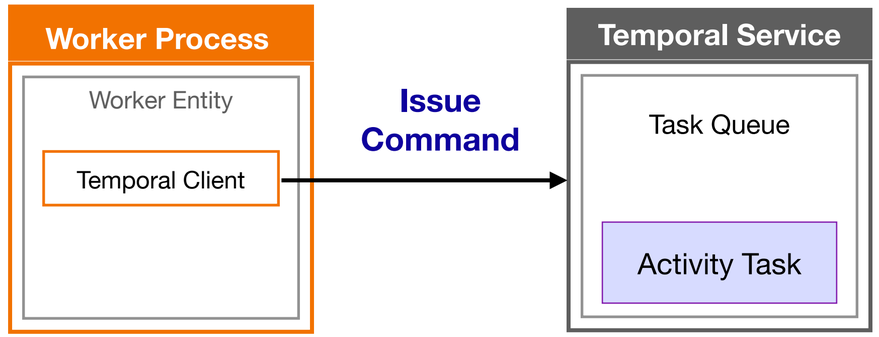

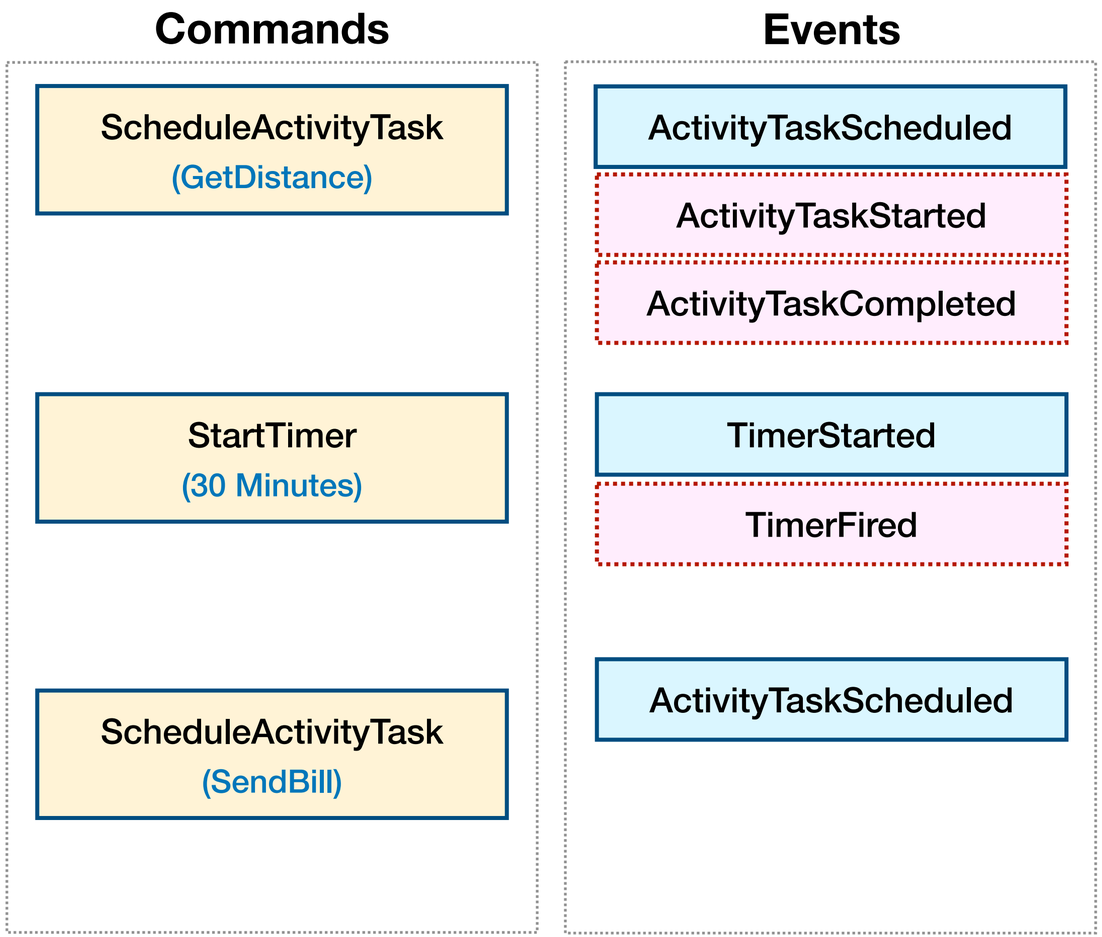

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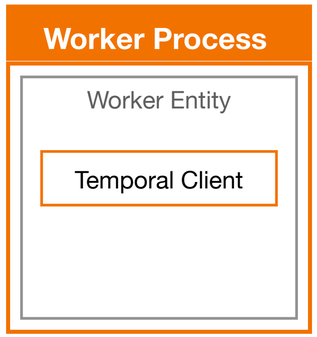

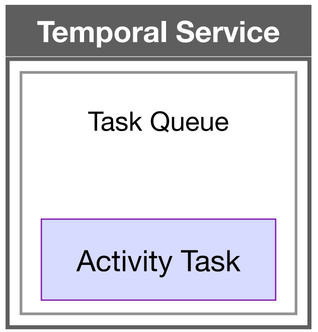

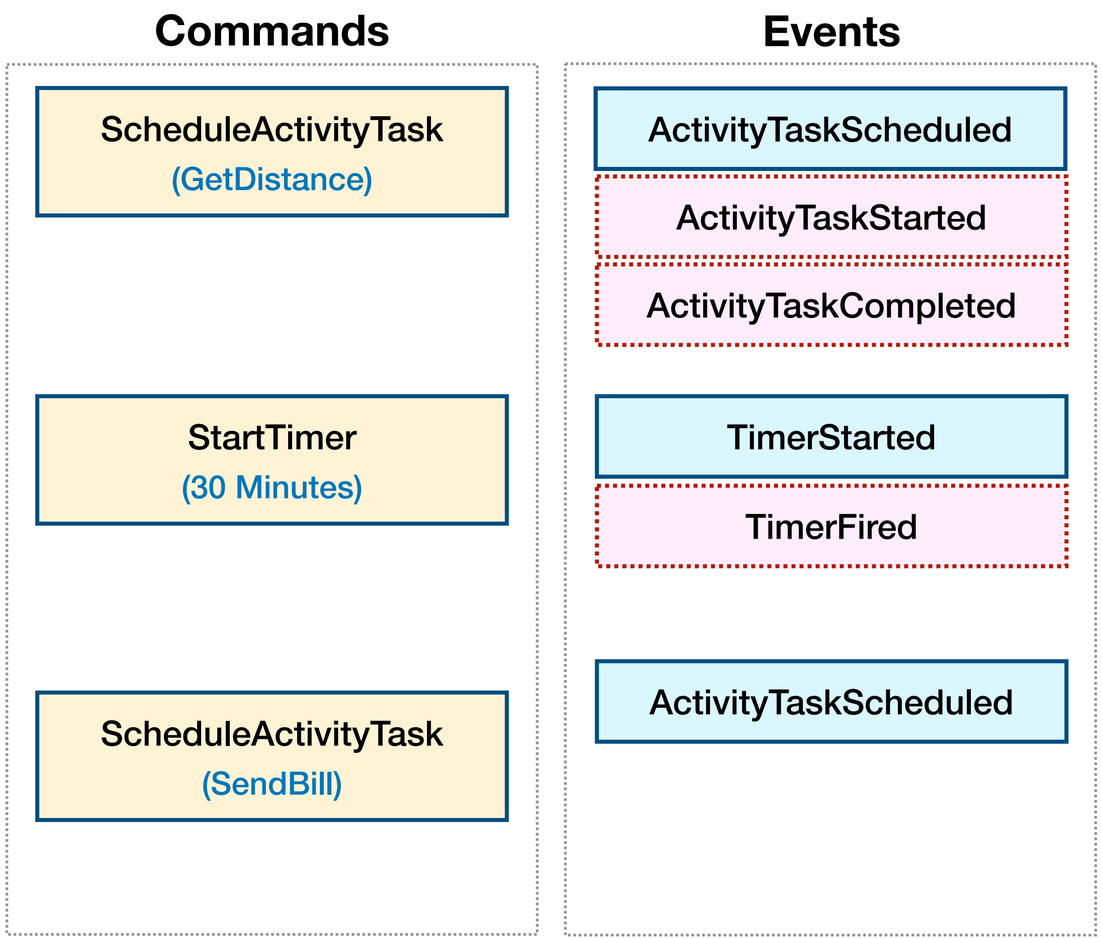

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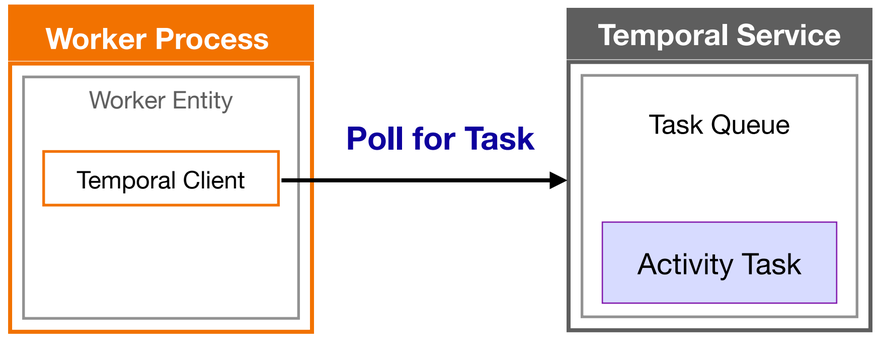

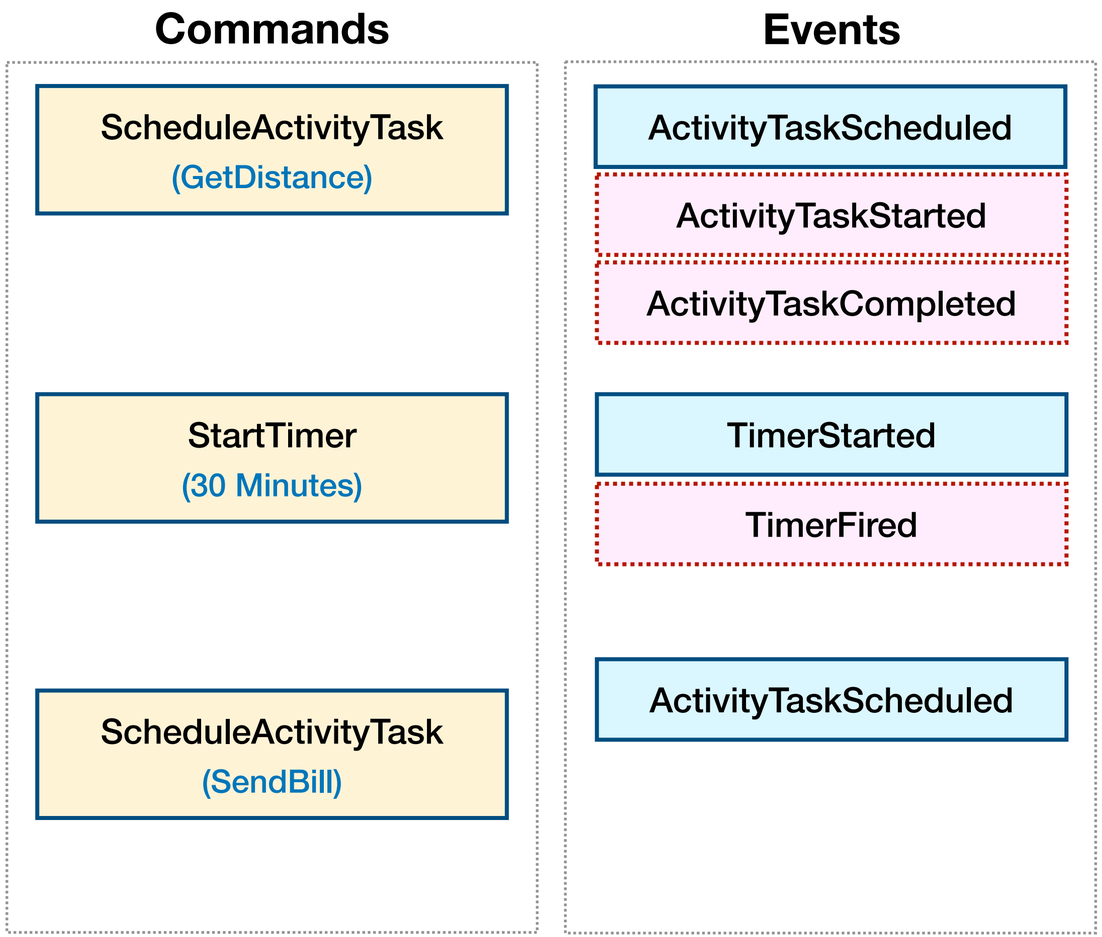

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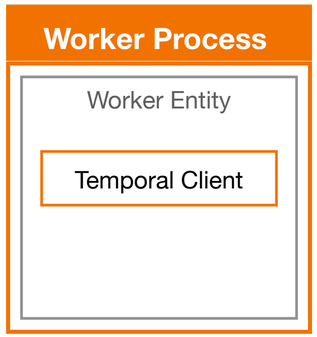

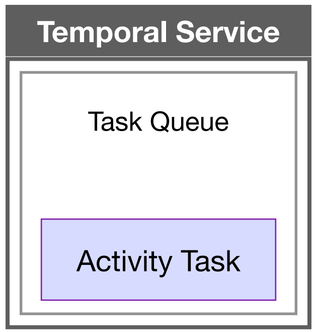

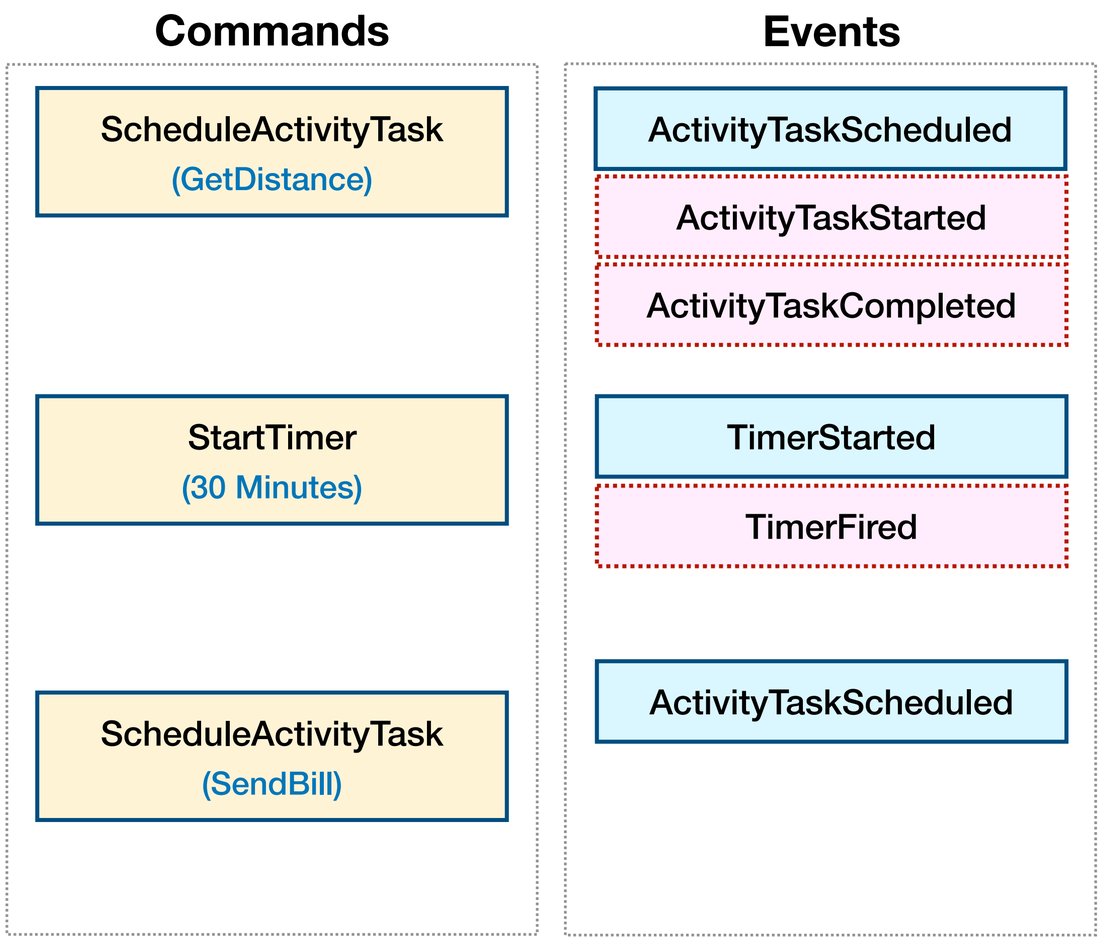

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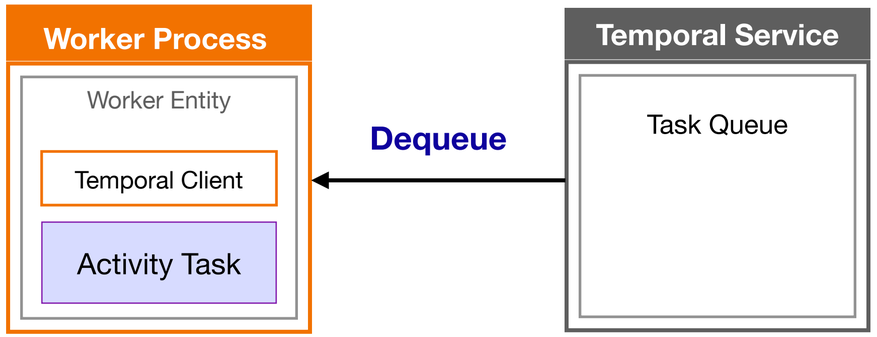

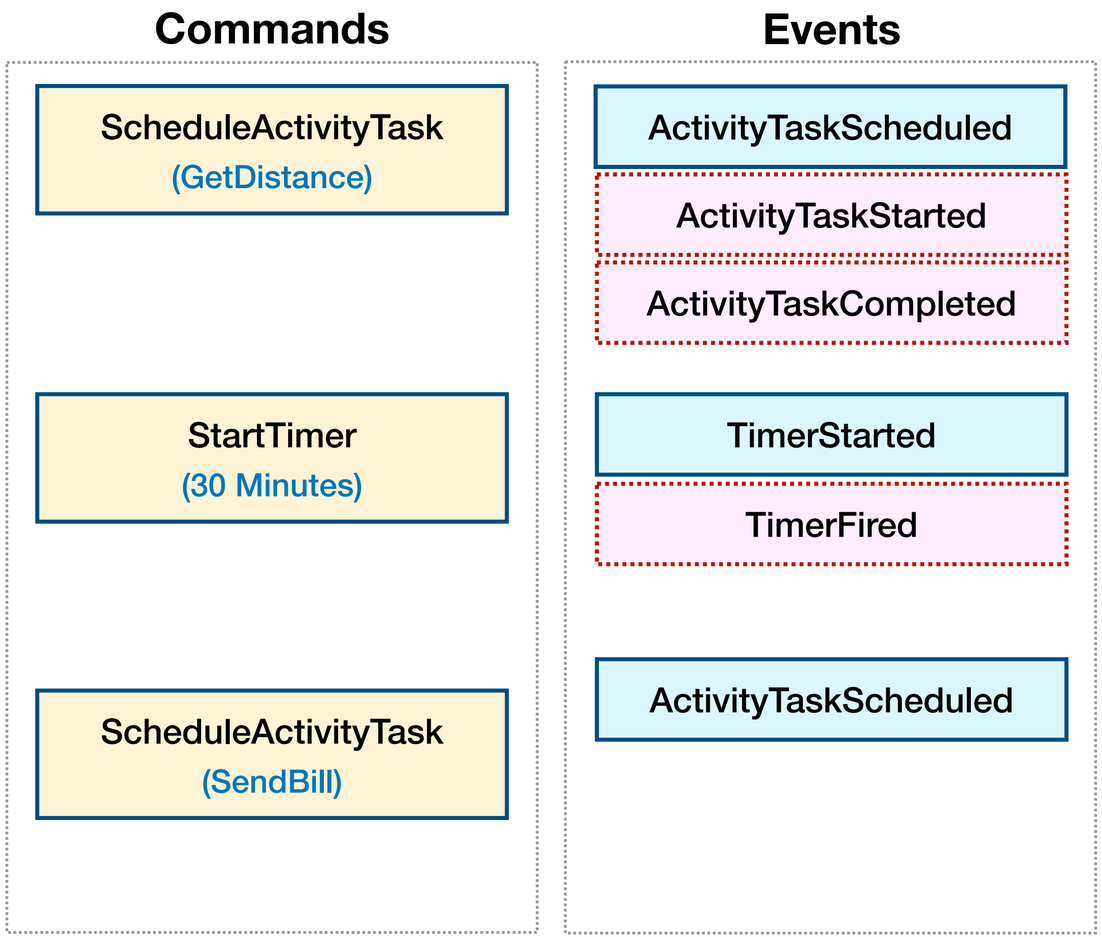

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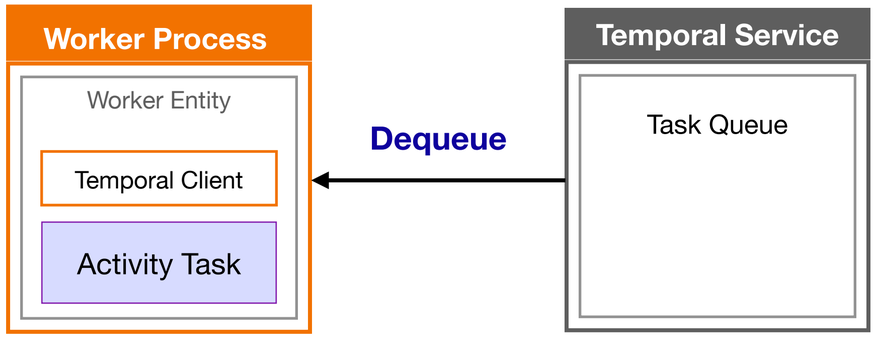

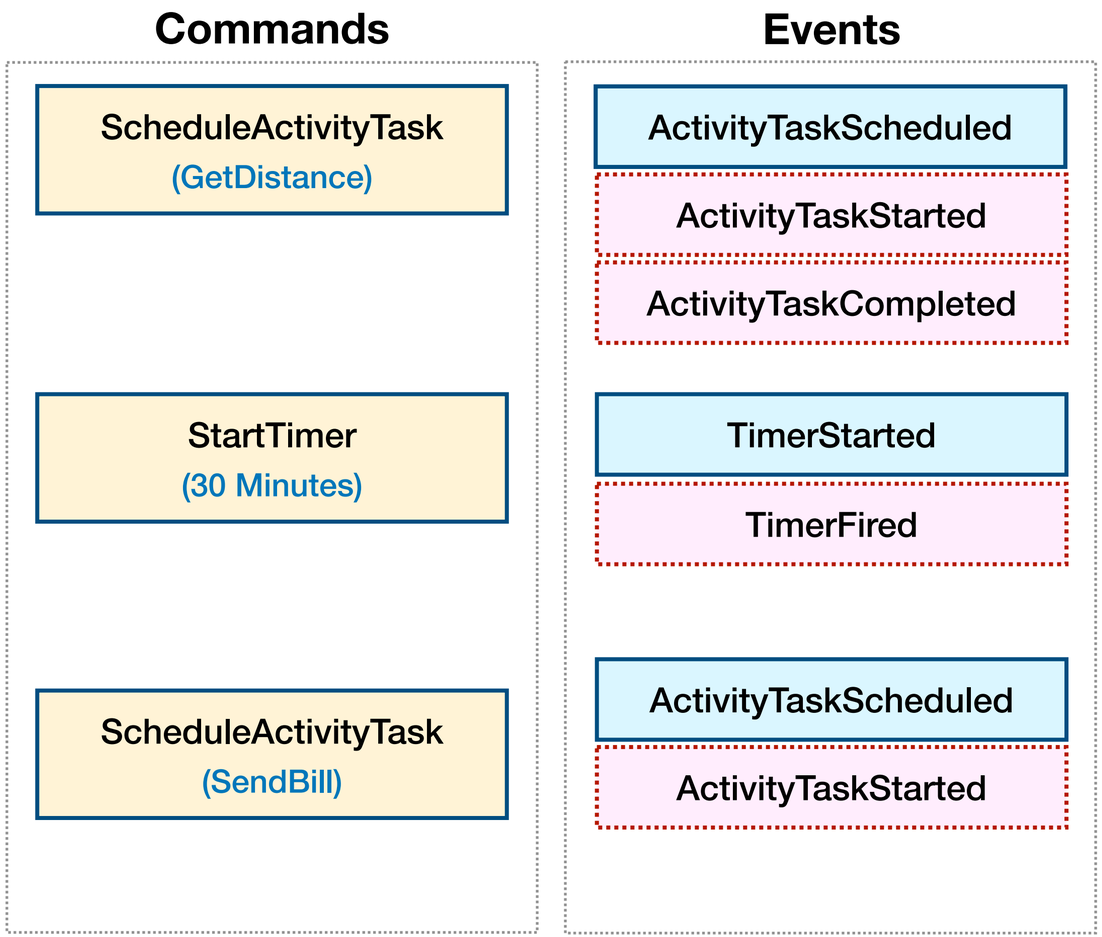

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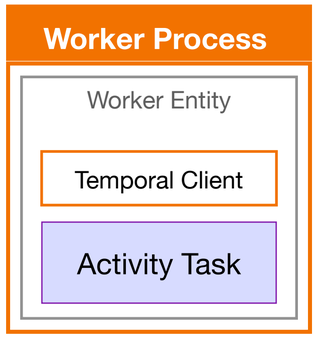

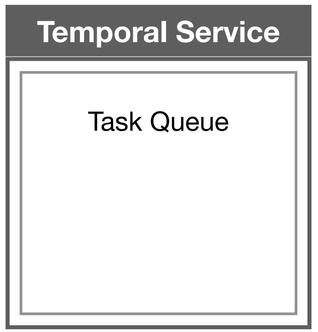

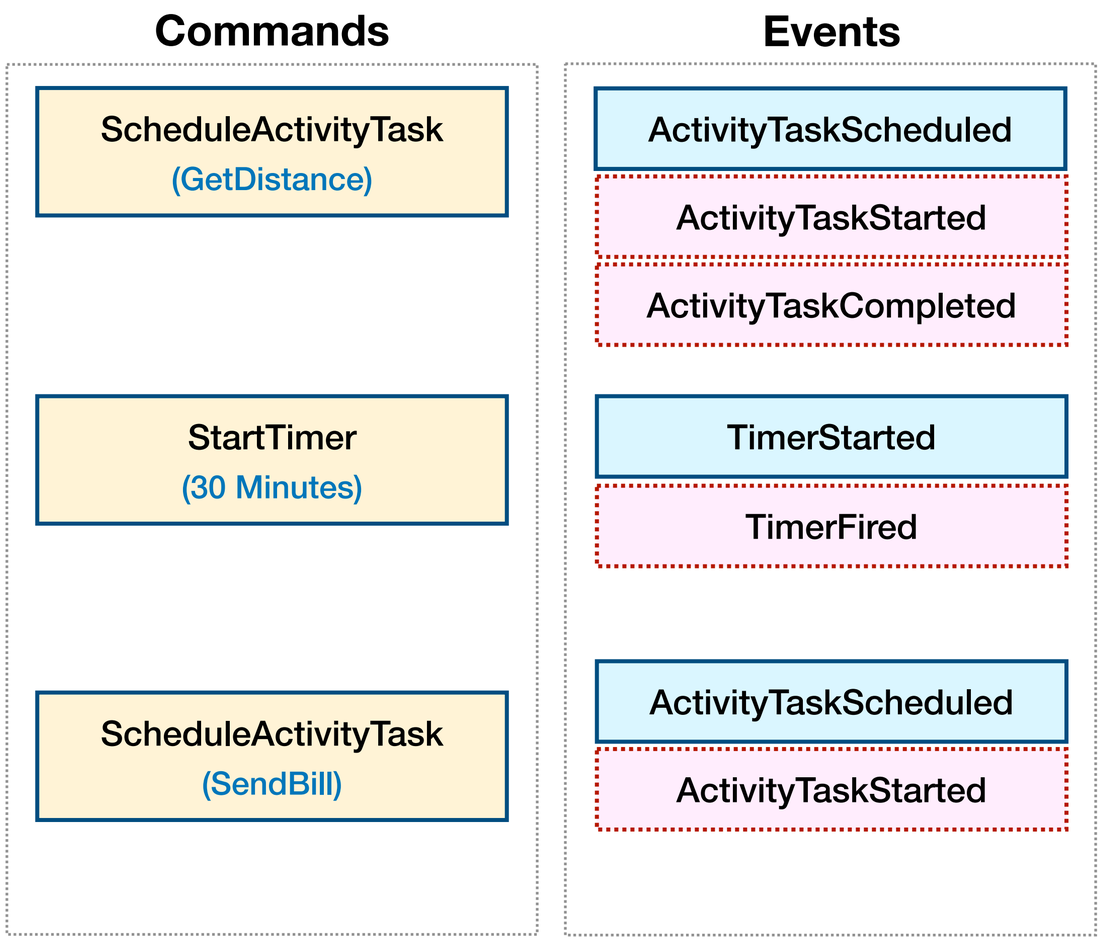

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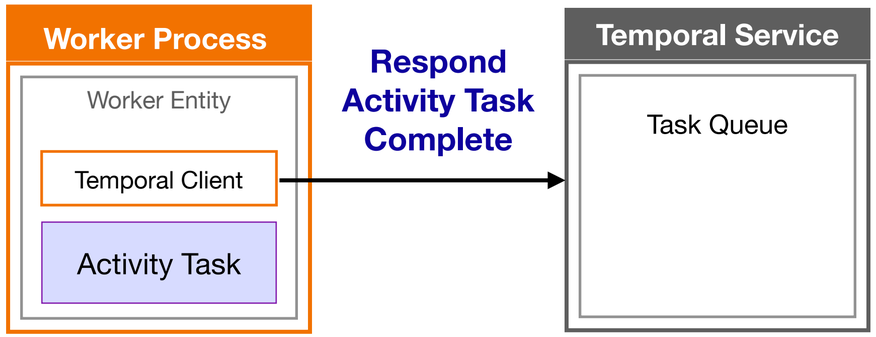

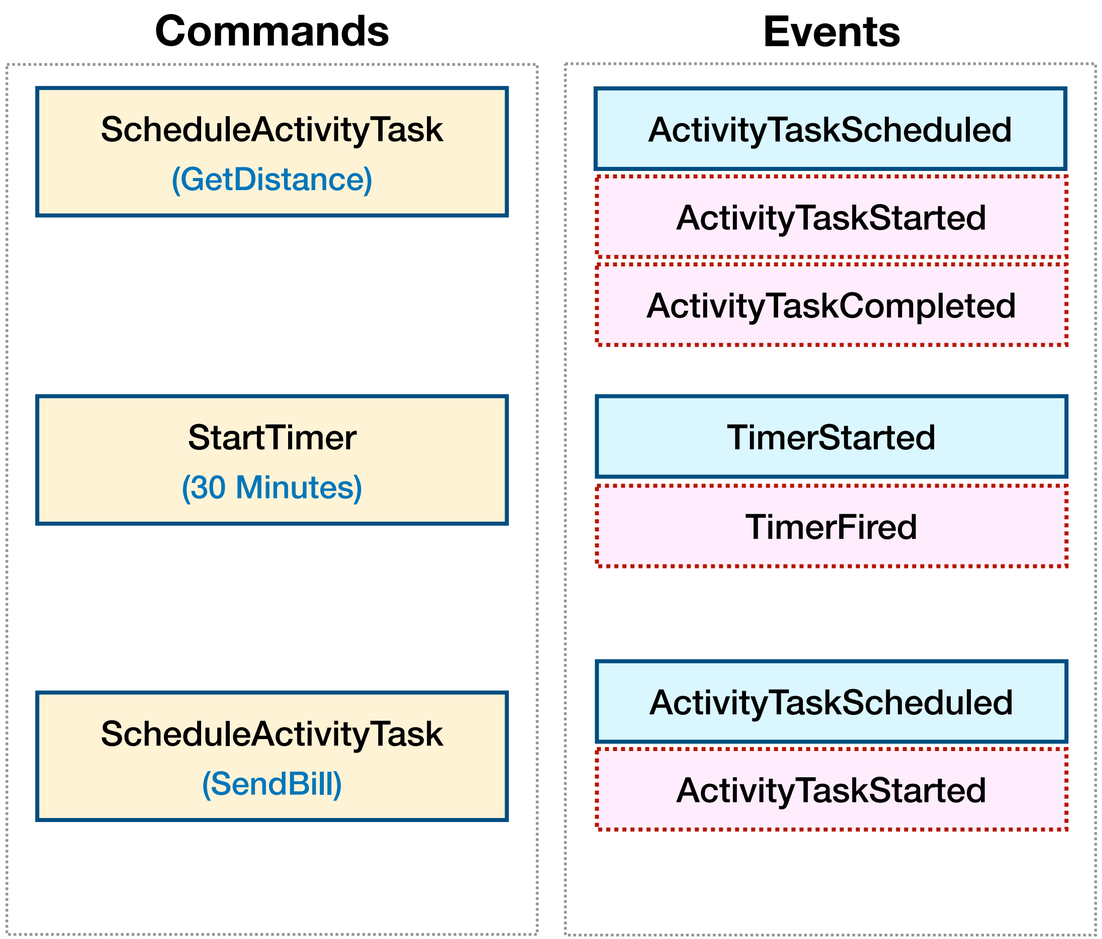

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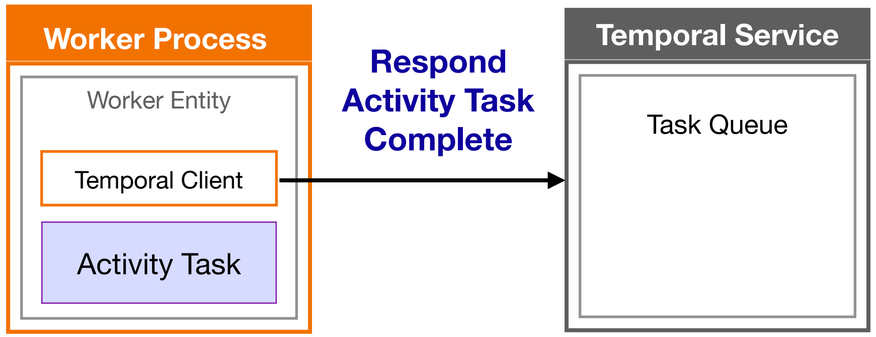

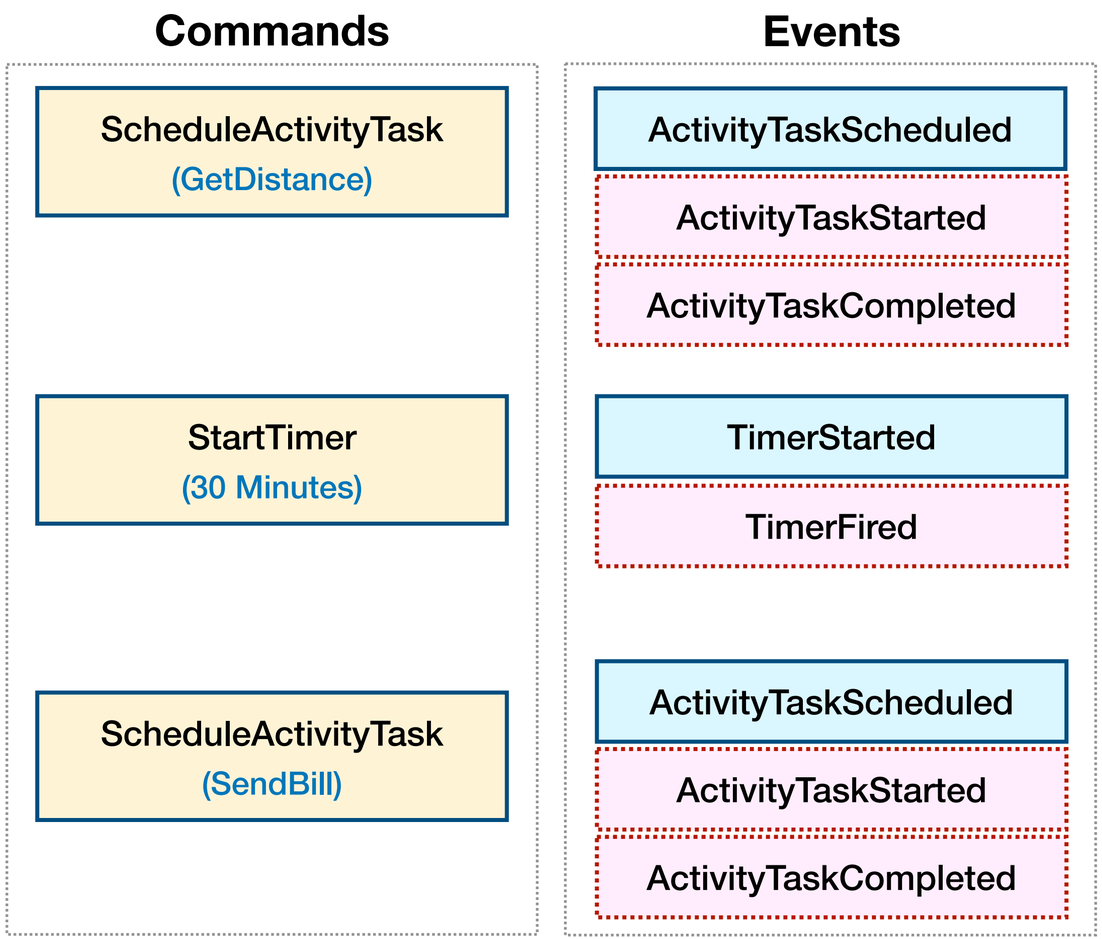

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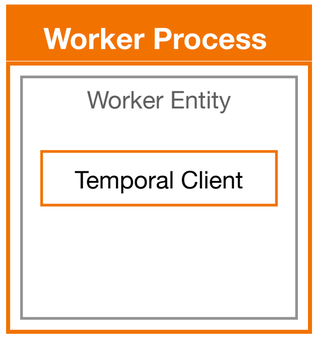
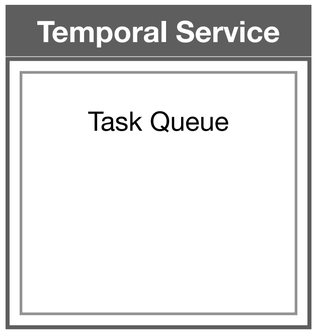
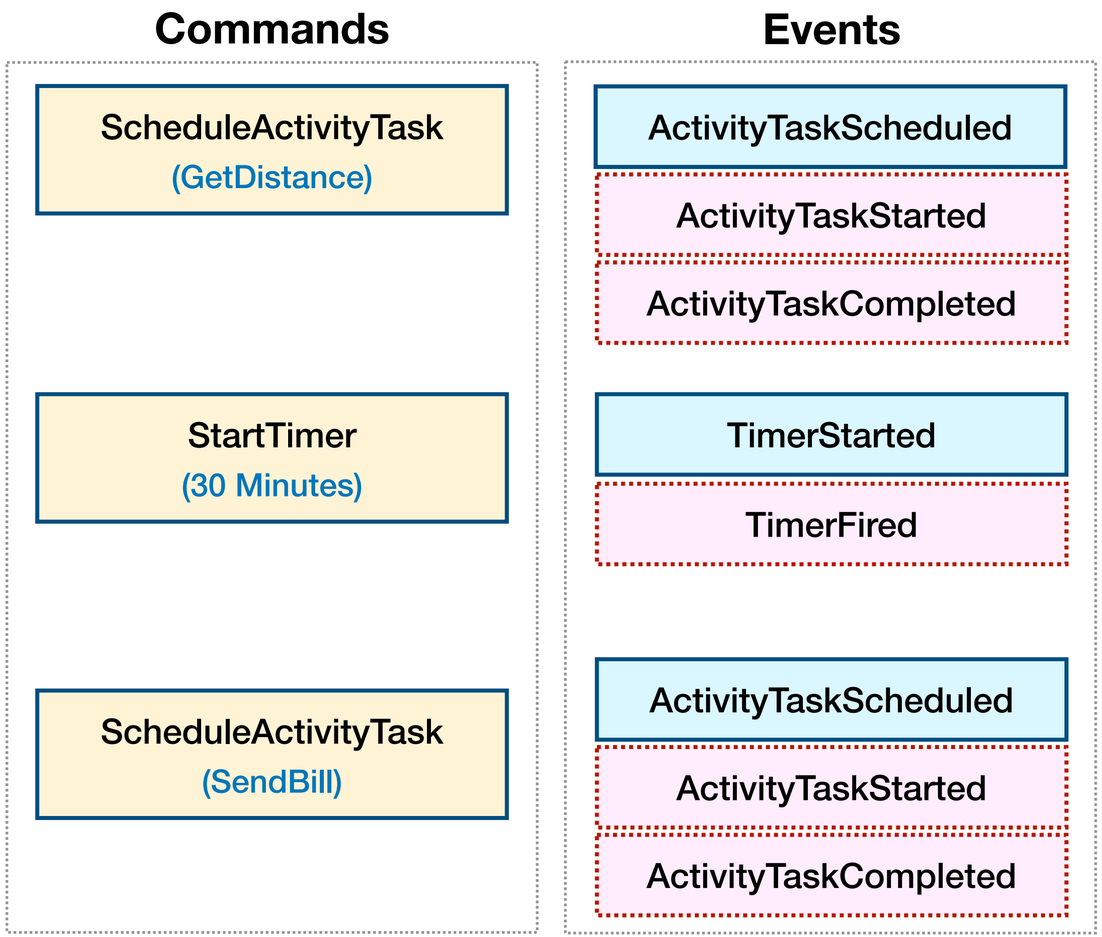
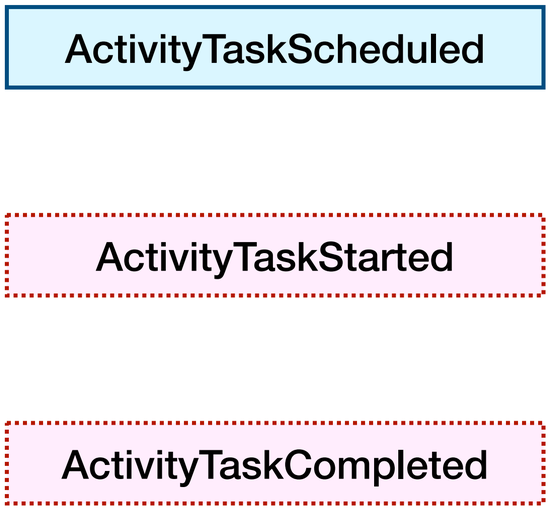




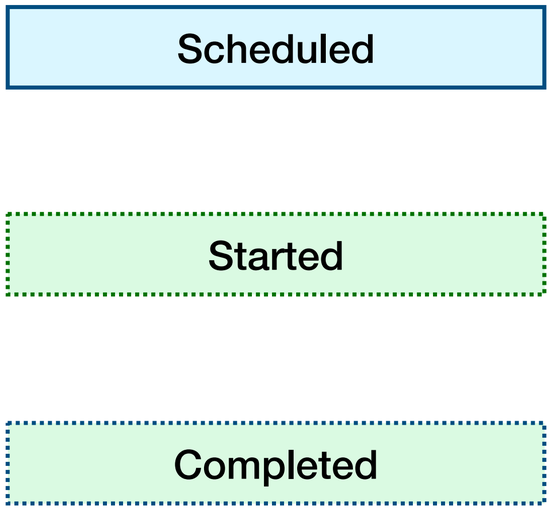


Workflow and Activity Task States

Activity Task Event Sequence



Activity States in that Sequence



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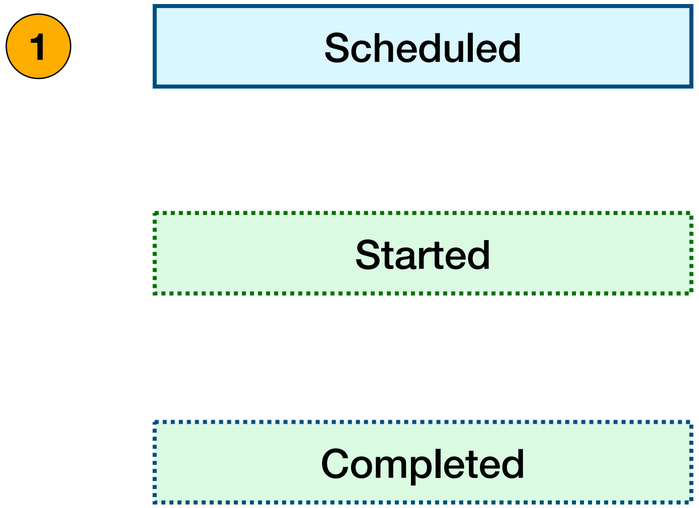

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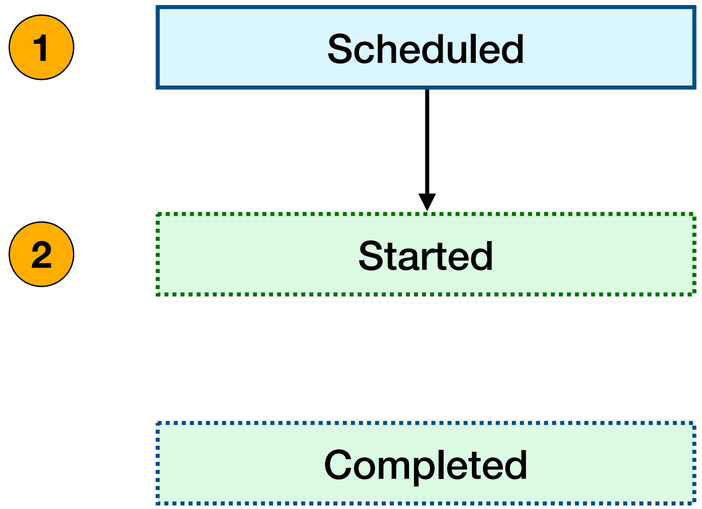

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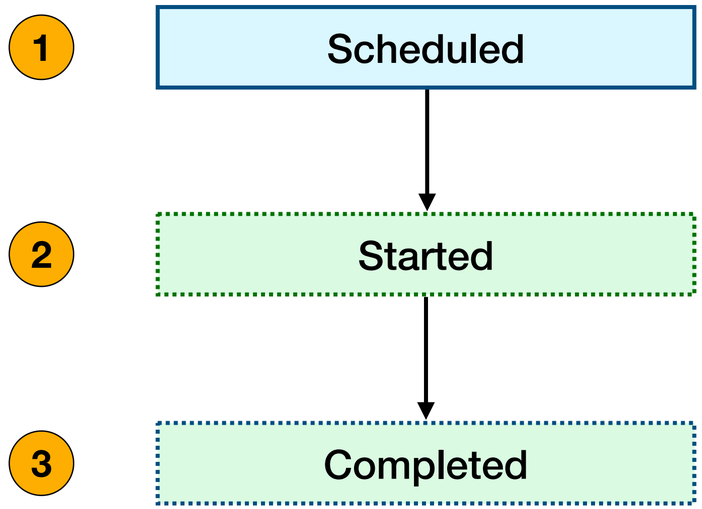

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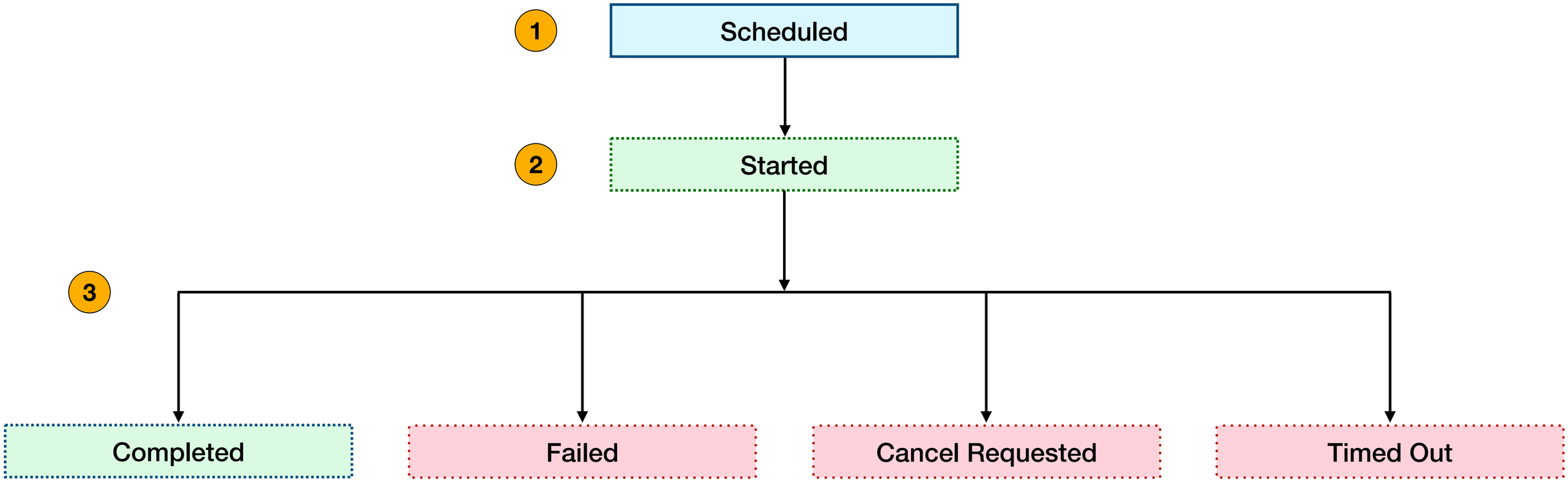
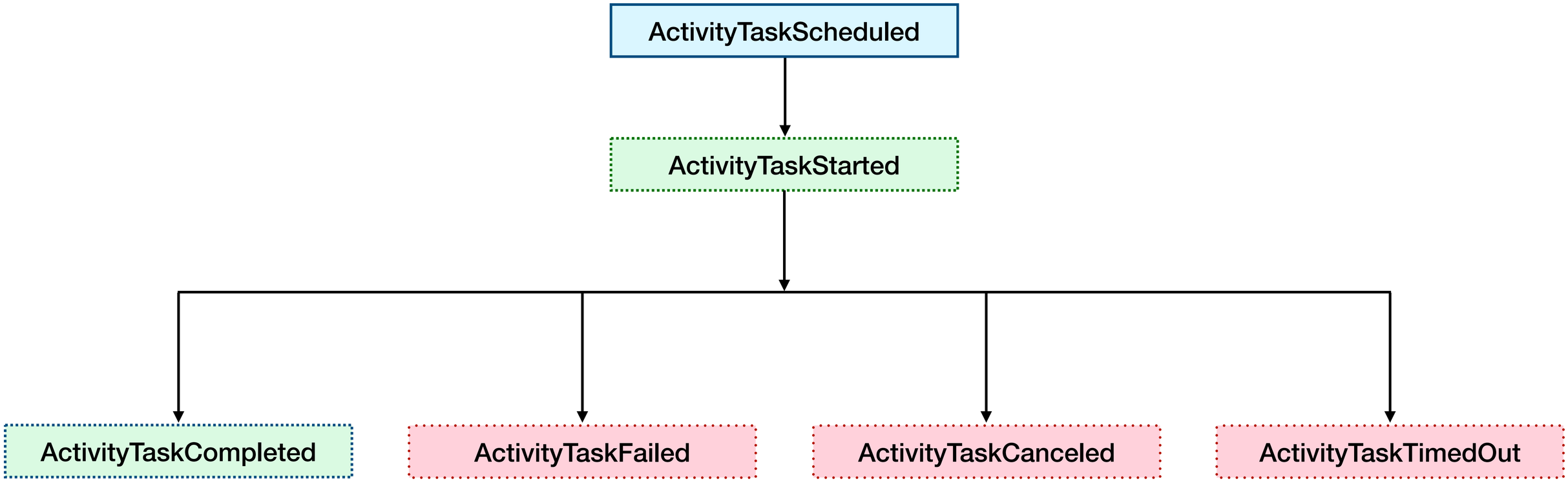


Activity Task Events



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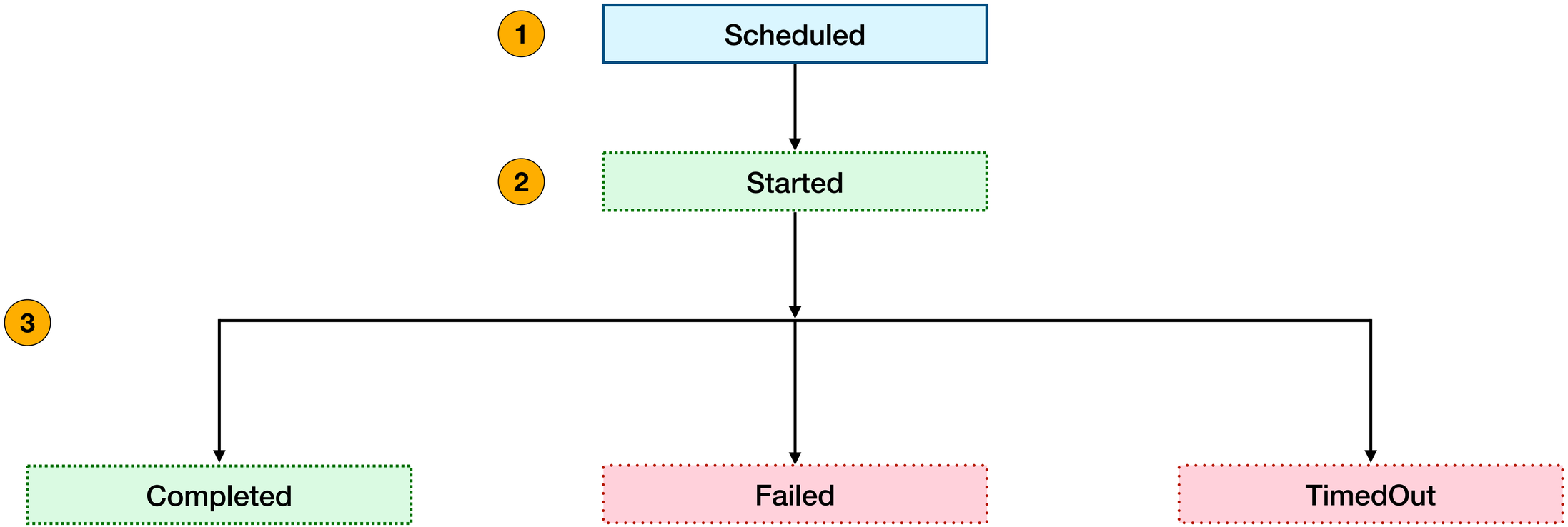

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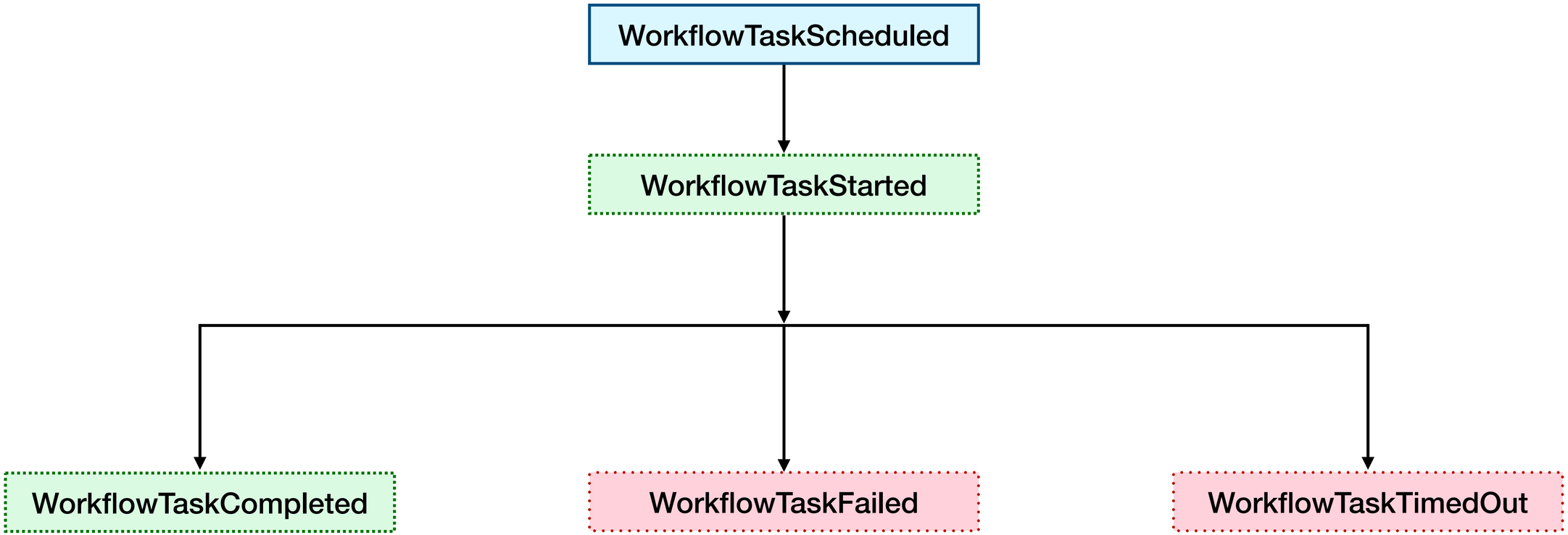

Sticky Execution

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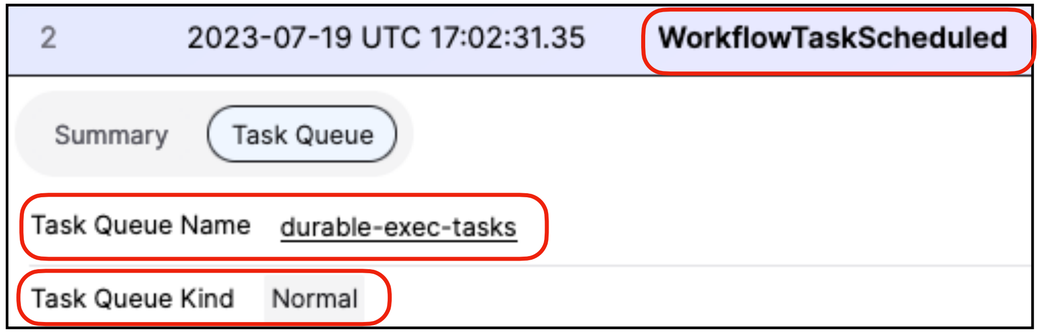

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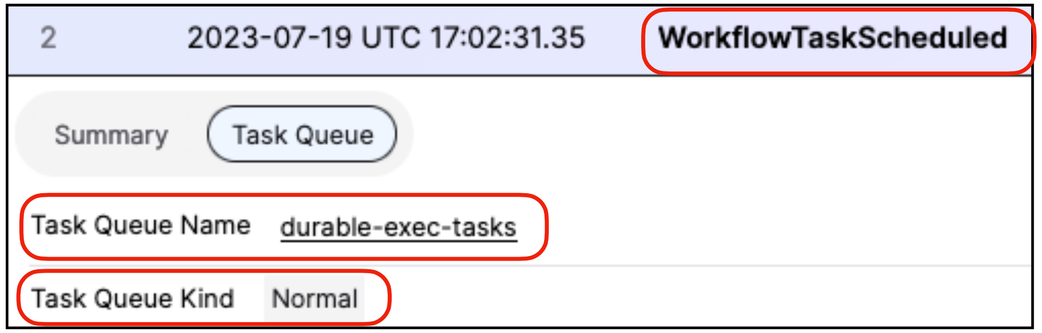
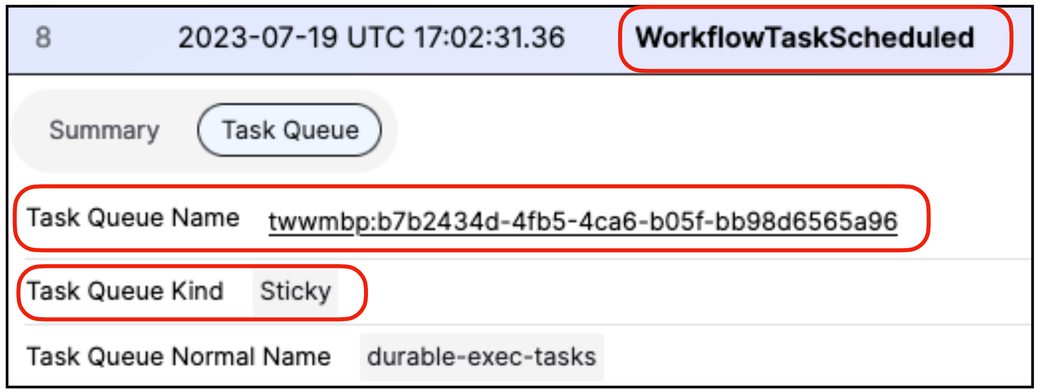


Later Workflow Task



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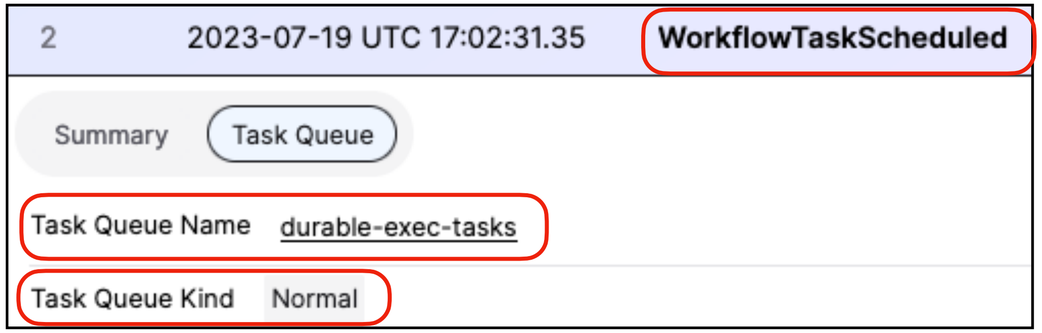

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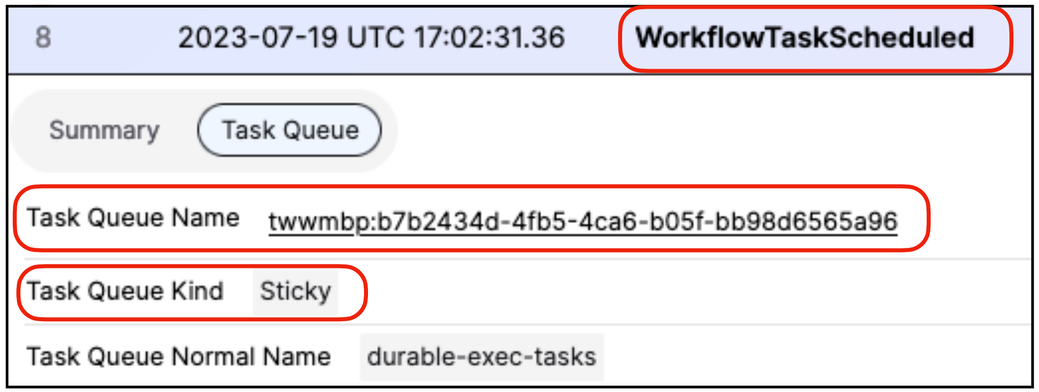

Beginner to Builder Bootcamp - Java

00. About this Workshop
01. The Basics of Temporal
02. Improving Your Temporal Application Code
03. Using Timers in a Workflow Definition
04. Understanding Event History
05. Understanding Workflow Determinism
06. Signals, Queries, and Workflow Updates
07. Timeouts and Retry Policies
08. Recovering from Failure
09. Conclusion

History Replay:

How Temporal Provides Durable Execution

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
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[
    {
      "orderNumber": "Z1238",
      "customer": {
        "customerID": 12983,
        "name": "María García",
        "email": "maria1985@example.com",
        "phone": "415-555-7418"
      },
      "items": [
        {
          "description": "Large, with pepperoni",
          "price": 1500
        },
        {
          "description": "Small, with mushrooms and onions",
          “price": 1000
        }
      ],
      "isDelivery": true,
      "address": {
        "line1": "701 Mission Street",
        "line2": "Apartment 9C",
        "city": "San Francisco",
        "state": "CA",
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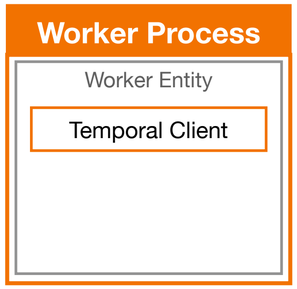

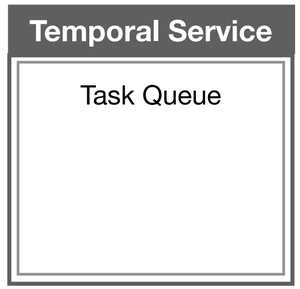

Commands

Events

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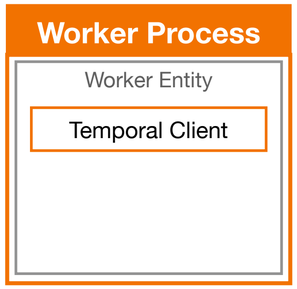

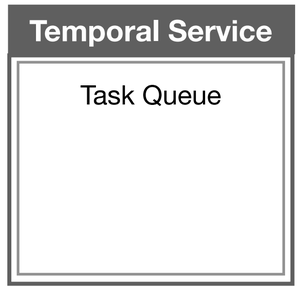

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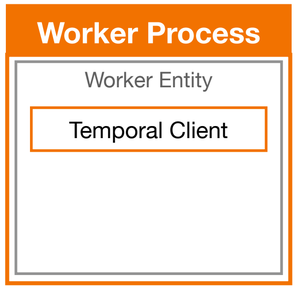

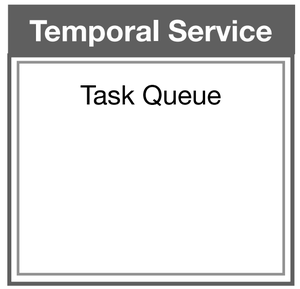

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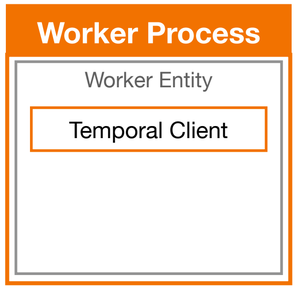

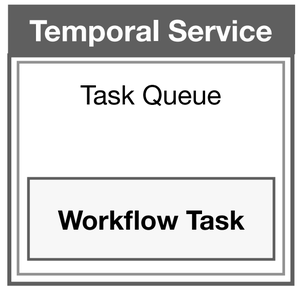

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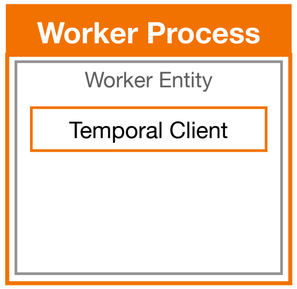

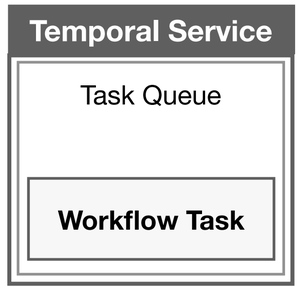

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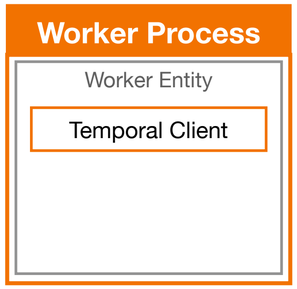

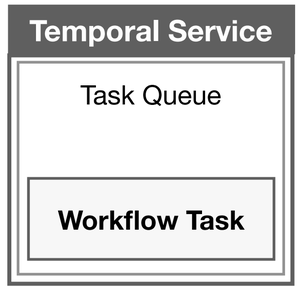

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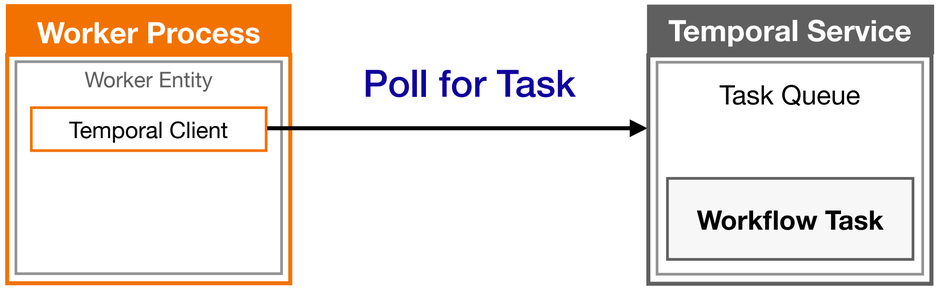

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    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```
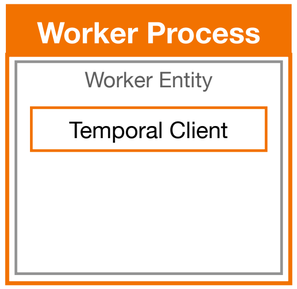
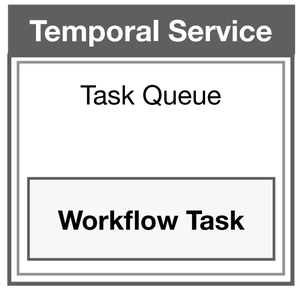



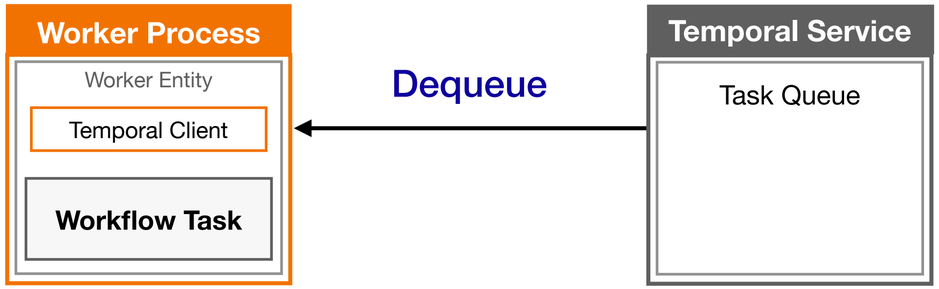


Commands

Events

WorkflowExecutionStarted
WorkflowTaskScheduled

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```



Commands

Events

WorkflowExecutionStarted
WorkflowTaskScheduled

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

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      Workflow.newActivityStub(PizzaActivities.class, options);

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    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
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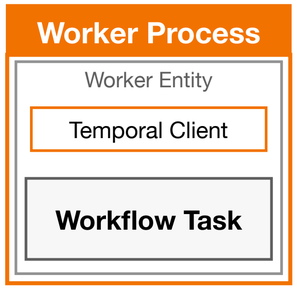

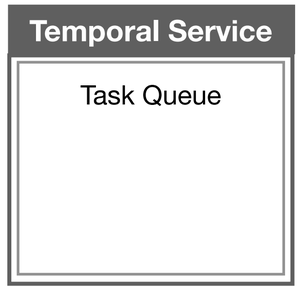

Commands

Events

WorkflowExecutionStarted
WorkflowTaskScheduled

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

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    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```

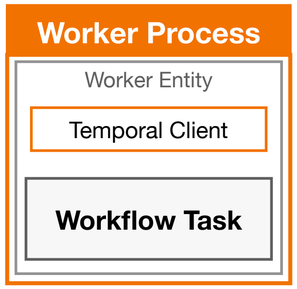

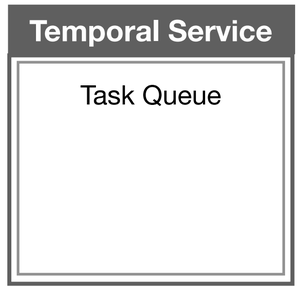

Commands

Events

WorkflowExecutionStarted

WorkflowTaskScheduled

WorkflowTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
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    // Wait for 30 minutes before billing the customer
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    Bill bill = new Bill();
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    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
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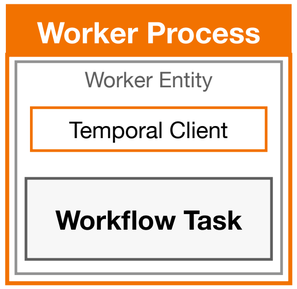

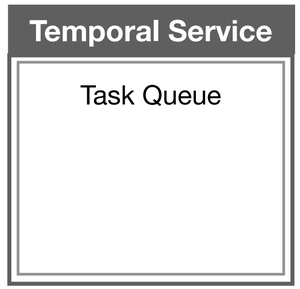

Commands

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
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    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```

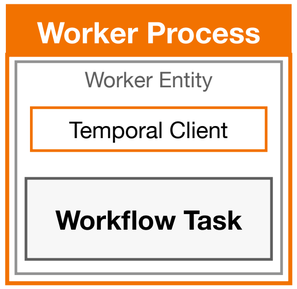

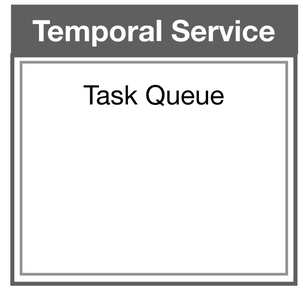

Commands

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

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      String message = "Customer lives outside the service area";
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    Bill bill = new Bill();
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    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
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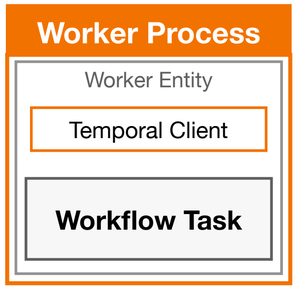

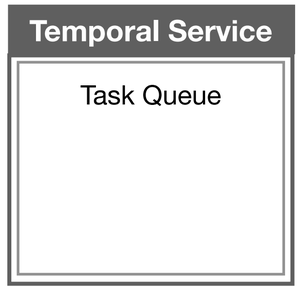

Commands

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
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  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
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    // Create a bill object
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    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
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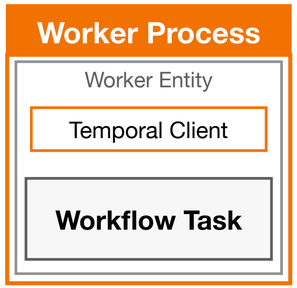

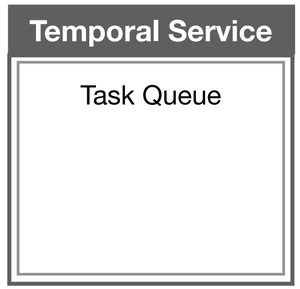

Commands

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
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  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

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    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

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    // Execute the getDistance activity
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    if (order.isDelivery() && distance > 25) {
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    }

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    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
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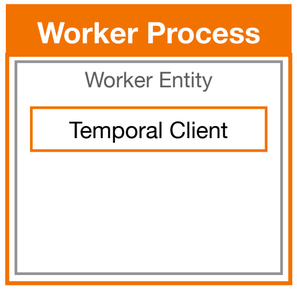

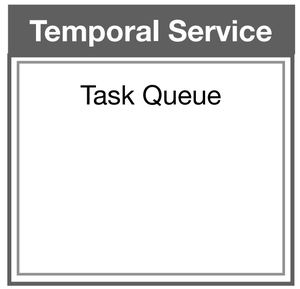

Commands

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
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  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
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    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

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    }

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    bill.setDescription(order.getOrderNumber());

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  }
}
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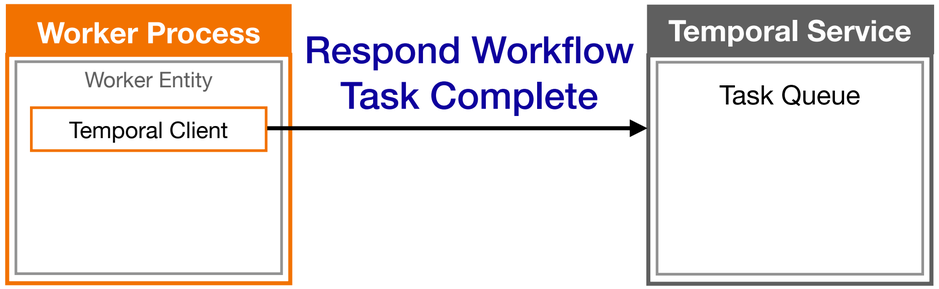

Commands

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
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    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
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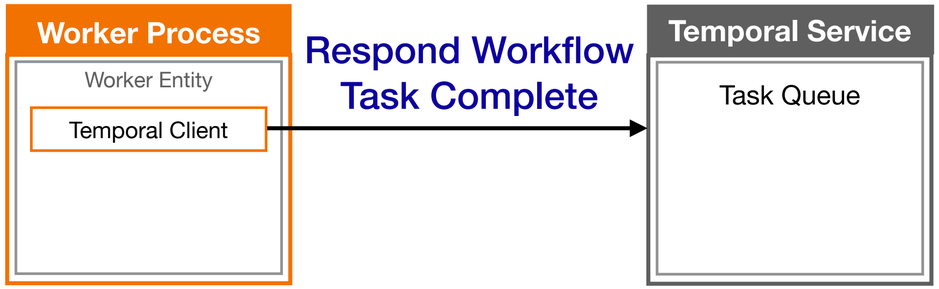

Commands

Events

- WorkflowExecutionStarted
- WorkflowTaskScheduled
- WorkflowTaskStarted
- **WorkflowTaskCompleted**

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
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  private final PizzaActivities activities =
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    int totalPrice = 0;

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    for (Pizza pizza : order.getItems()) {
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    if (order.isDelivery() && distance > 25) {
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    // Execute the SendBill activity
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}
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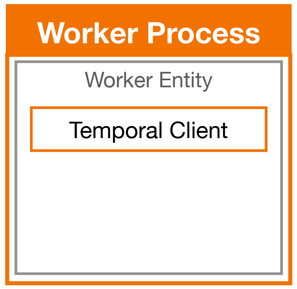

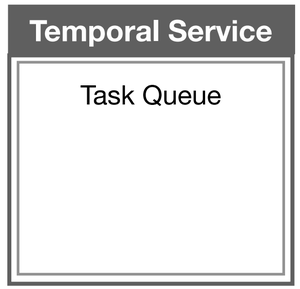

Commands

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
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  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

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    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```
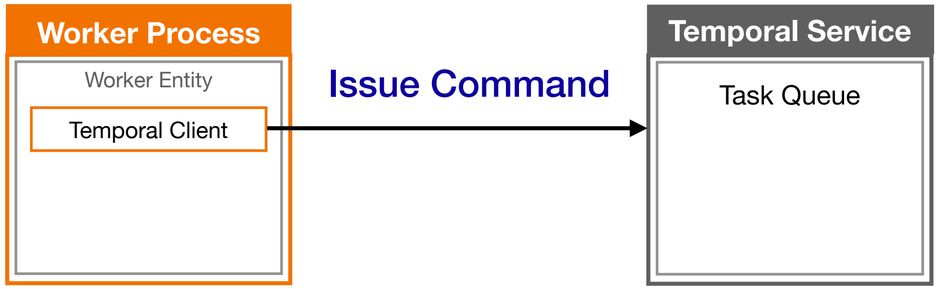
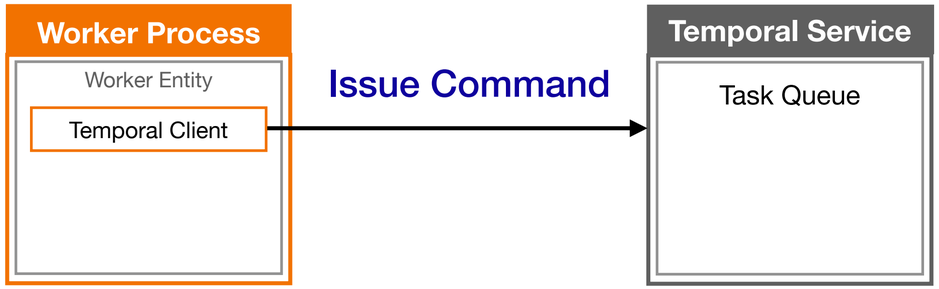



Commands

Events

- WorkflowExecutionStarted
- WorkflowTaskScheduled
- WorkflowTaskStarted
- WorkflowTaskCompleted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```



Commands

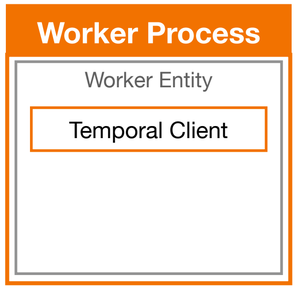
ScheduleActivityTask

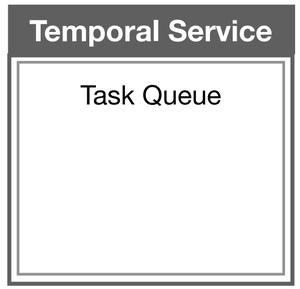
Queue: pizza-tasks
Type: get_distance
Input: “order_number": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```





Commands

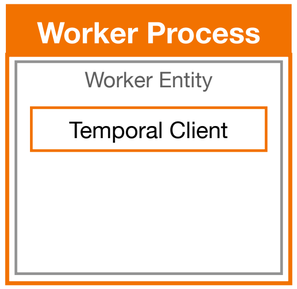
ScheduleActivityTask

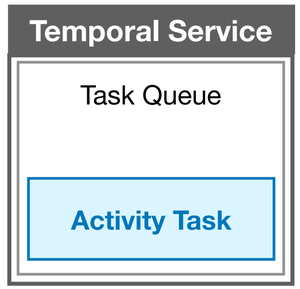
Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

- WorkflowExecutionStarted
- WorkflowTaskScheduled
- WorkflowTaskStarted
- WorkflowTaskCompleted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```





Commands

ScheduleActivityTask

Queue: pizza-tasks

Type: getDistance

Input: "orderNumber": "Z1238", ...

Events

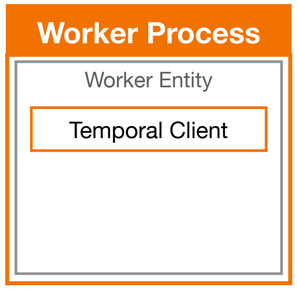
WorkflowExecutionStarted

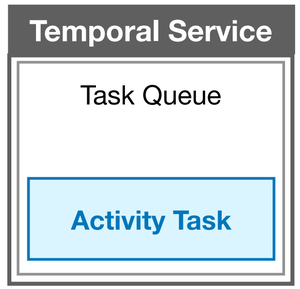
WorkflowTaskScheduled

WorkflowTaskStarted

WorkflowTaskCompleted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```





Commands

ScheduleActivityTask

Queue: pizza-tasks

Type: getDistance

Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted

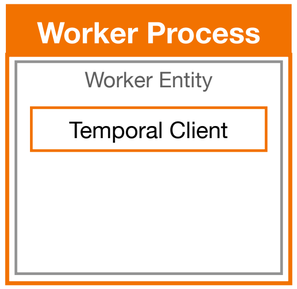
WorkflowTaskScheduled

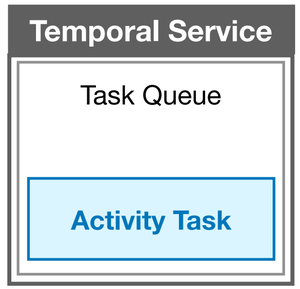
WorkflowTaskStarted

WorkflowTaskCompleted

ActivityTaskScheduled (get_distance)

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```





Commands

ScheduleActivityTask

Queue: pizza-tasks

Type: getDistance

Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted

WorkflowTaskScheduled

WorkflowTaskStarted

WorkflowTaskCompleted

ActivityTaskScheduled **(getDistance)**

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
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    // Create a bill object
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    bill.setDescription(order.getOrderNumber());

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}
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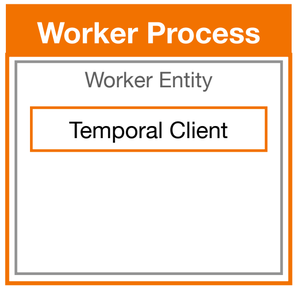

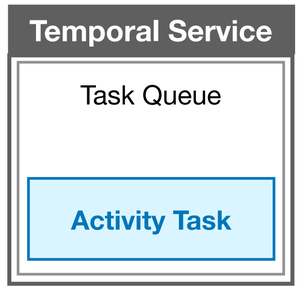

Commands

ScheduleActivityTask

Queue: pizza-tasks

Type: getDistance

Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted

WorkflowTaskScheduled

WorkflowTaskStarted

WorkflowTaskCompleted

ActivityTaskScheduled **(getDistance)**

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
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  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

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    // Execute the getDistance activity
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    if (order.isDelivery() && distance > 25) {
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          OutOfServiceAreaException.class.getName());
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    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```

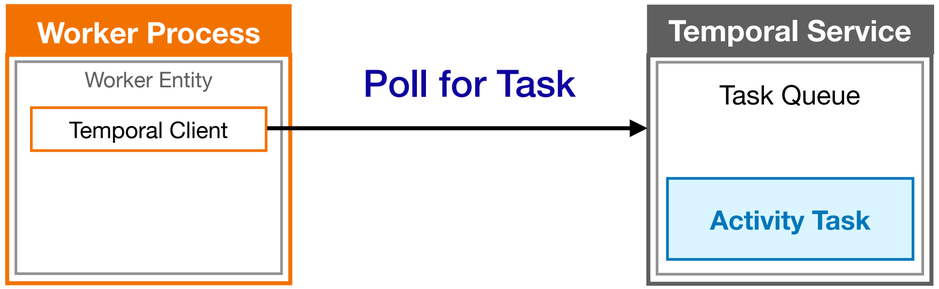

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled **(getDistance)**

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
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    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
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    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

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    // Wait for 30 minutes before billing the customer
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    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```

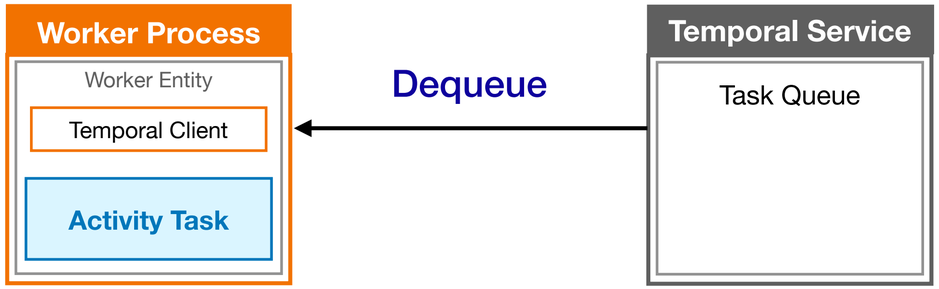

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled **(getDistance)**

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

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  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

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    bill.setAmount(totalPrice);
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    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

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  }
}
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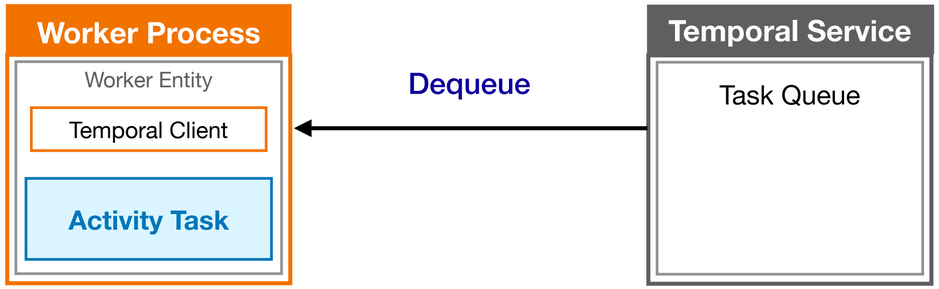

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled **(getDistance)**

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
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    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
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    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
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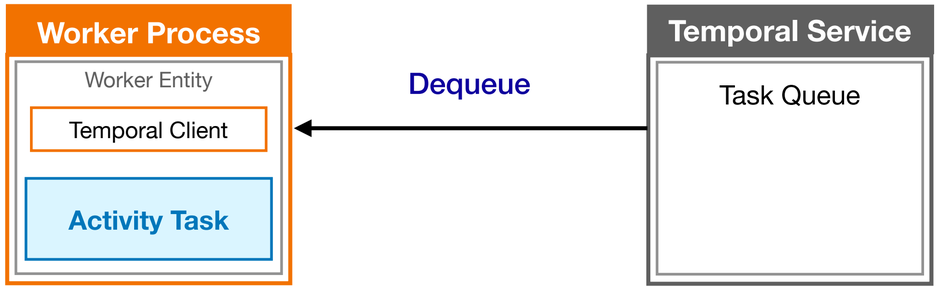

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled **(getDistance)**
ActivityTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

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    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

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    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
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    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
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    return confirmation;
  }
}
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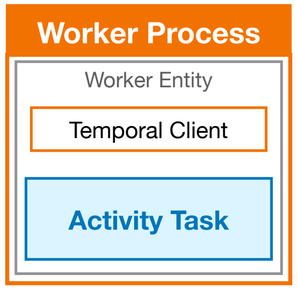
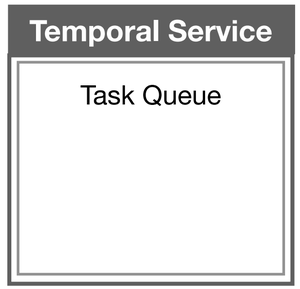




Commands

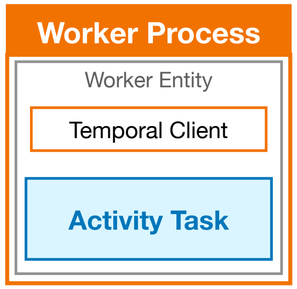
ScheduleActivityTask

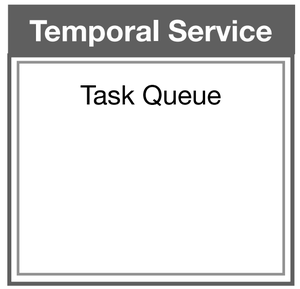
Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled **(getDistance)**
ActivityTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```





Commands

ScheduleActivityTask

Queue: pizza-tasks

Type: getDistance

Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled **(getDistance)**
ActivityTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
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    Bill bill = new Bill();
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    String confirmation = activities.sendBill(bill);

    return confirmation;
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}
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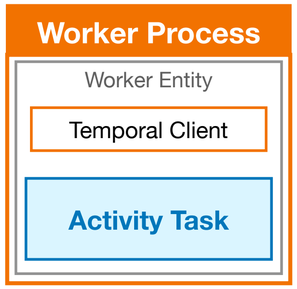

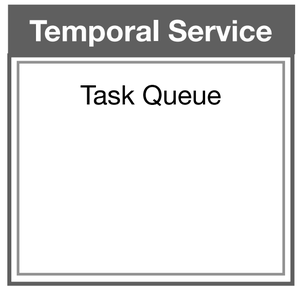

Commands

ScheduleActivityTask

Queue: pizza-tasks

Type: getDistance

Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled **(getDistance)**
ActivityTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
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      Workflow.newActivityStub(PizzaActivities.class, options);

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  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

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        totalPrice += pizza.getPrice();
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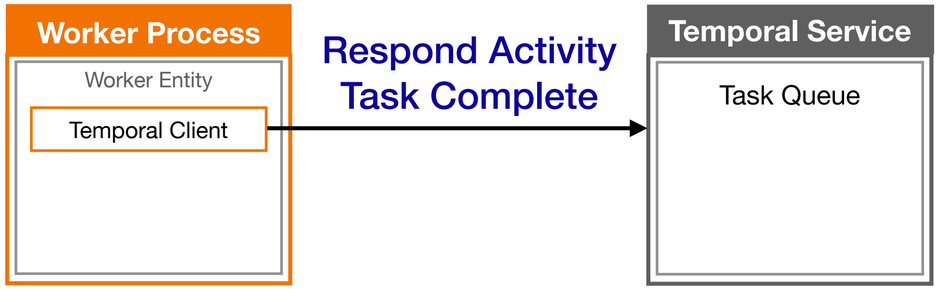

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled **(getDistance)**
ActivityTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
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  private final PizzaActivities activities =
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    int totalPrice = 0;

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        totalPrice += pizza.getPrice();
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    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
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    // Create a bill object
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    bill.setAmount(totalPrice);
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    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

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}
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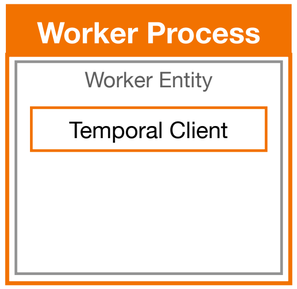

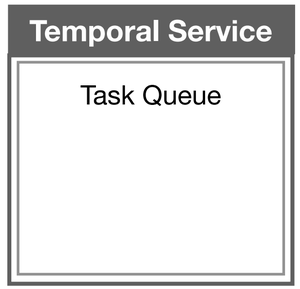

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled **(getDistance)**
ActivityTaskStarted **(distance=15)**

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

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  @Override
  public String pizzaWorkflow(Order order) {
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    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
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    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

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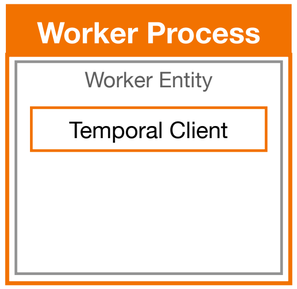

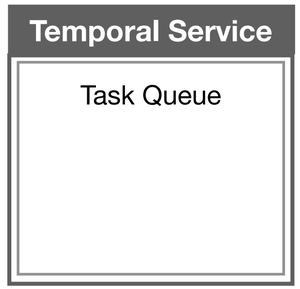

Commands

ScheduleActivityTask

Queue: pizza-tasks

Type: getDistance

Input: "orderNumber": "Z1238", ...

Events

- WorkflowExecutionStarted
- WorkflowTaskScheduled
- WorkflowTaskStarted
- WorkflowTaskCompleted
- ActivityTaskScheduled **(getDistance)**
- ActivityTaskStarted
- **ActivityTaskCompleted** **(distance=15)**

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
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  private final PizzaActivities activities =
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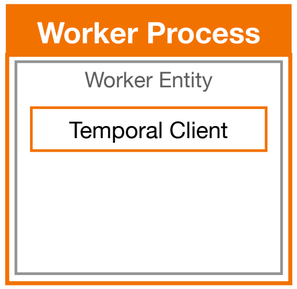

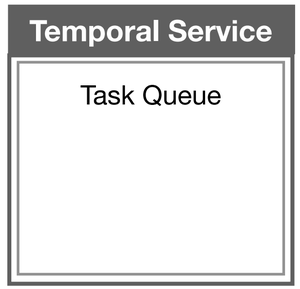

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

- WorkflowExecutionStarted
- WorkflowTaskScheduled
- WorkflowTaskStarted
- WorkflowTaskCompleted
- ActivityTaskScheduled **(getDistance)**
- ActivityTaskStarted
- **ActivityTaskCompleted** **(distance=15)**

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
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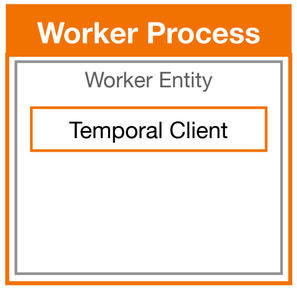

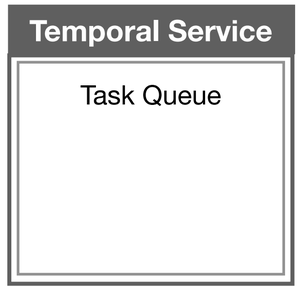

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
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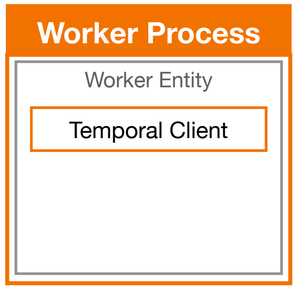

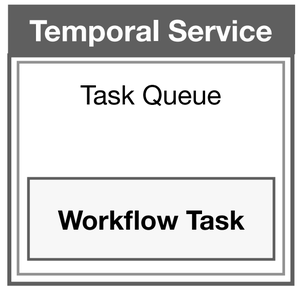

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
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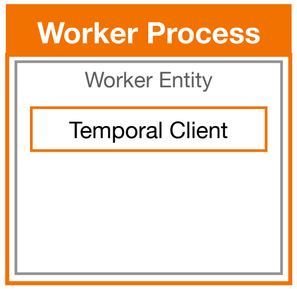

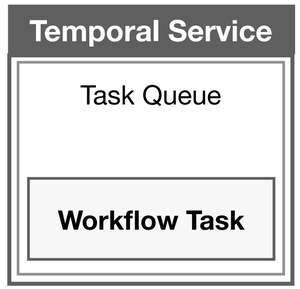

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	

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public class PizzaWorkflowImpl implements PizzaWorkflow {

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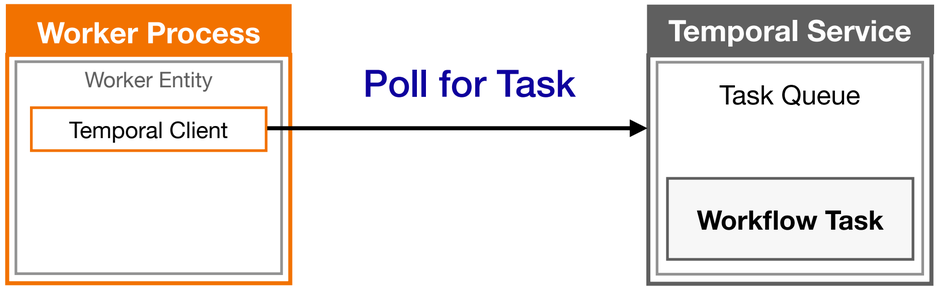

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

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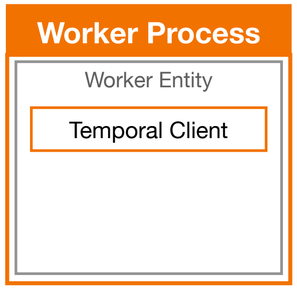
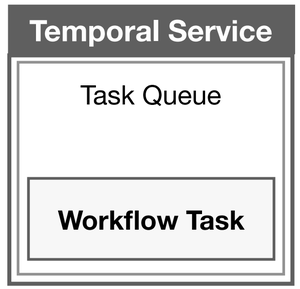




Commands

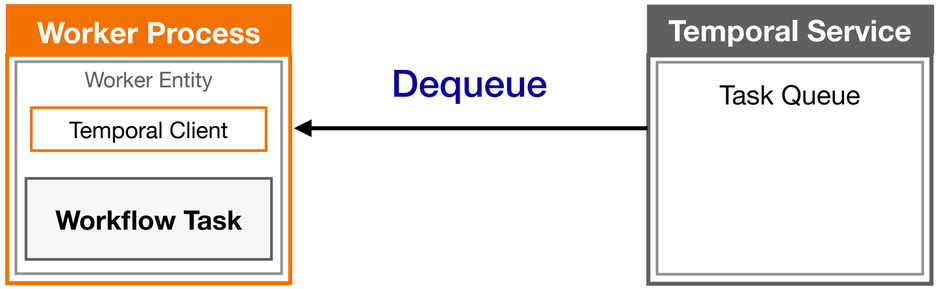
ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```



Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

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    // Execute the getDistance activity
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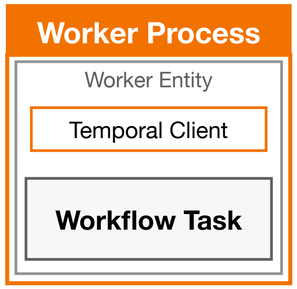

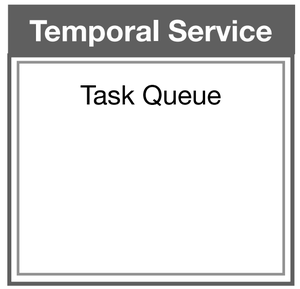

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	

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public class PizzaWorkflowImpl implements PizzaWorkflow {

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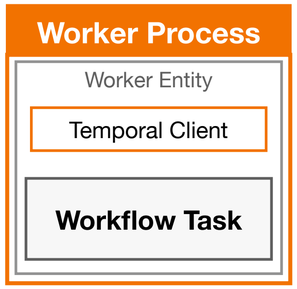

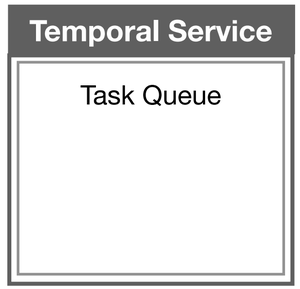

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled **(getDistance)**
ActivityTaskStarted
ActivityTaskCompleted **(distance=15)**
WorkflowTaskScheduled
WorkflowTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

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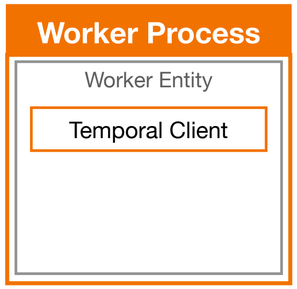

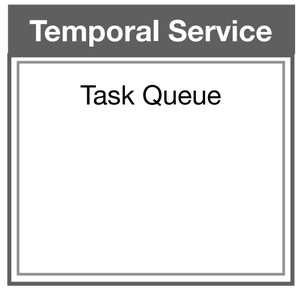

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	

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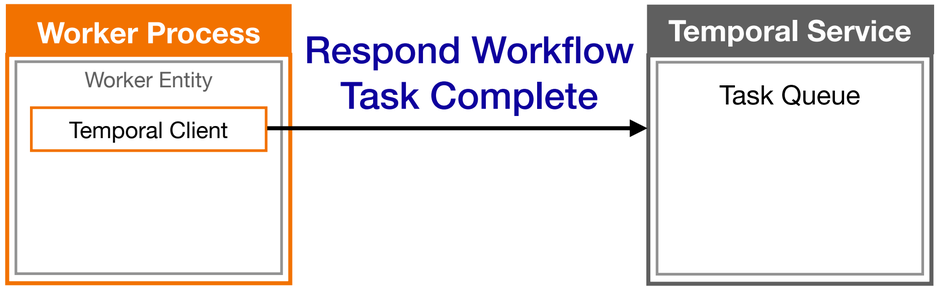

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

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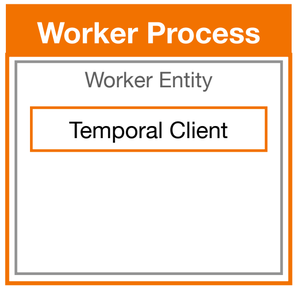

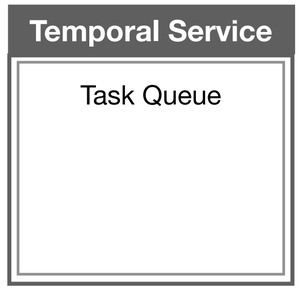

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

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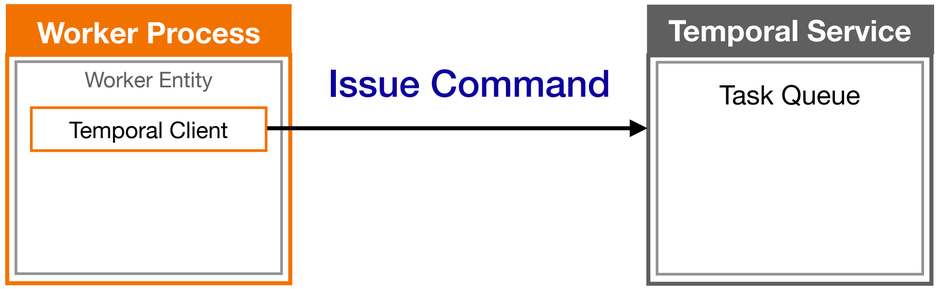

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

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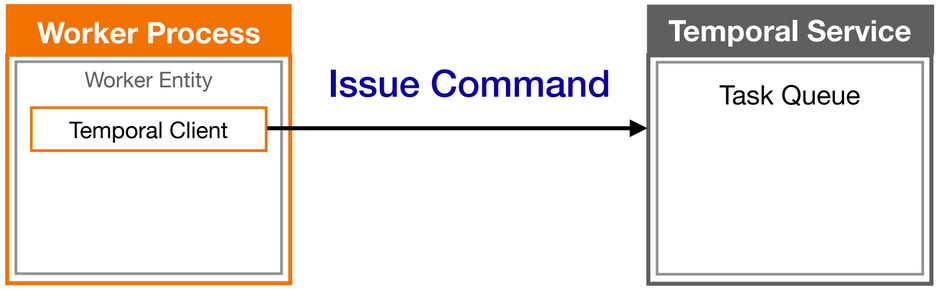

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

Duration: 30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

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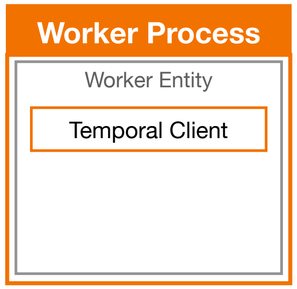

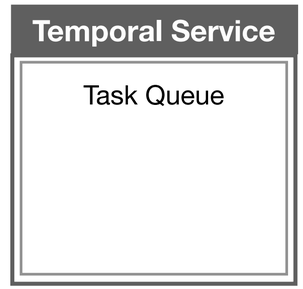

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

Duration: 30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

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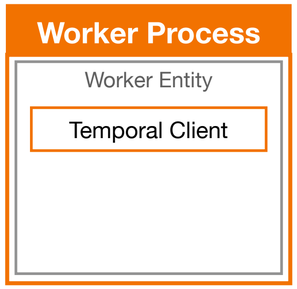

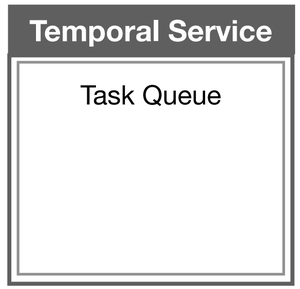

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

Duration: 30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**

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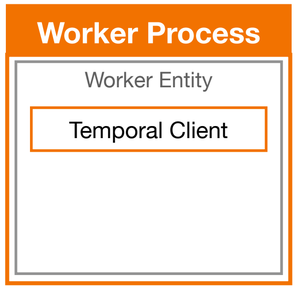

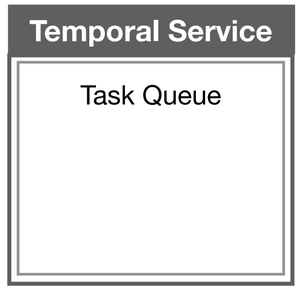

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

Duration: 30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
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WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**

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    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
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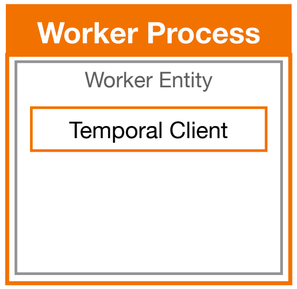

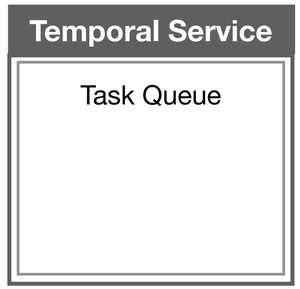

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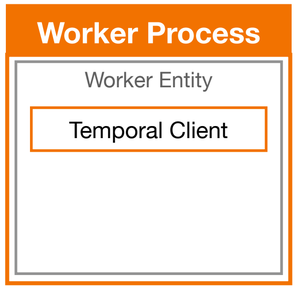

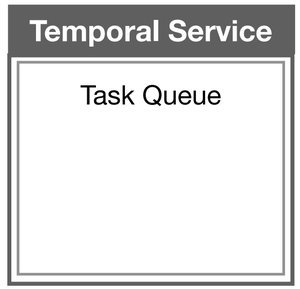

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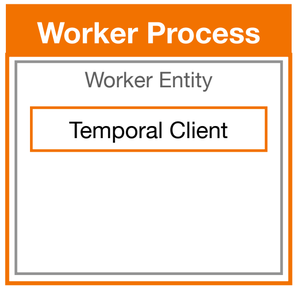

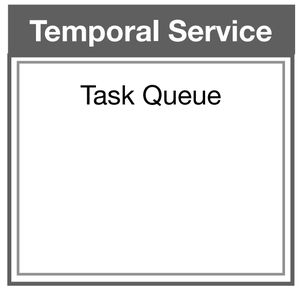

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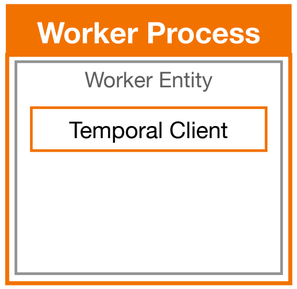

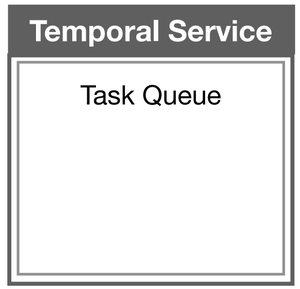

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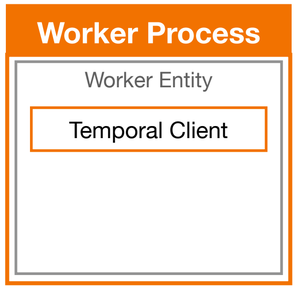

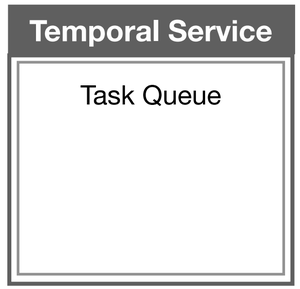

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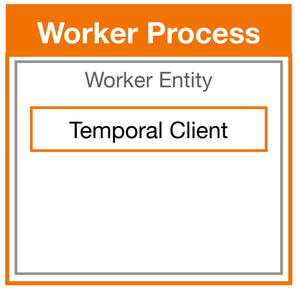

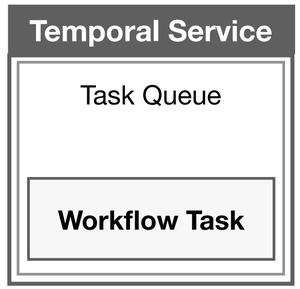

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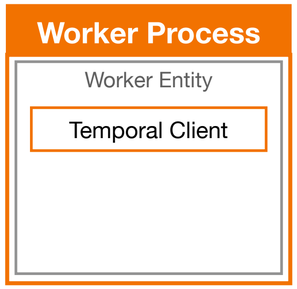

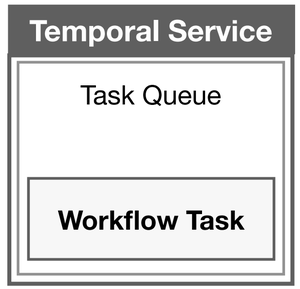

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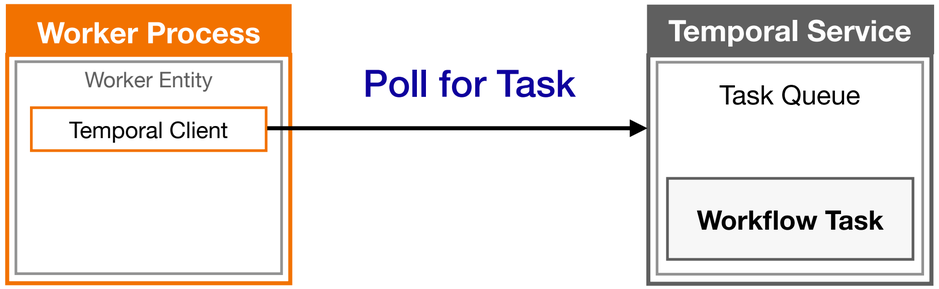

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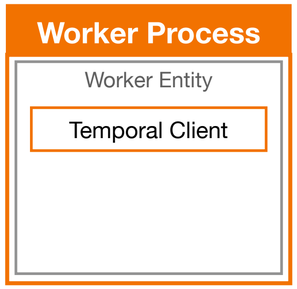

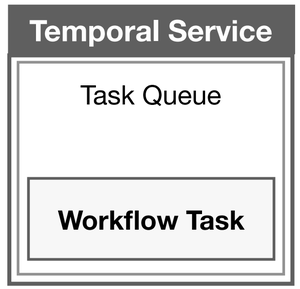

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    String confirmation = activities.sendBill(bill);

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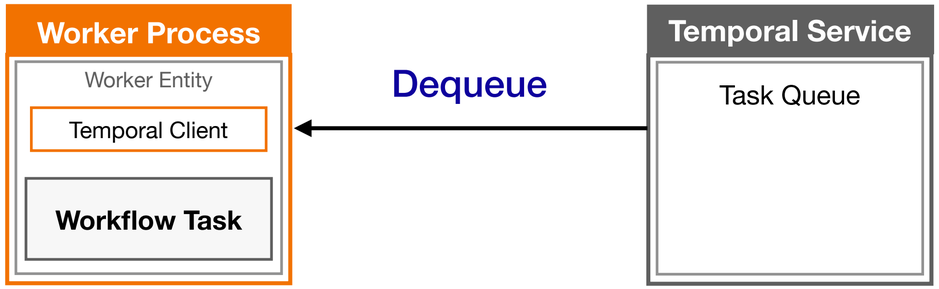

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

Duration: 30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	

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    // Execute the getDistance activity
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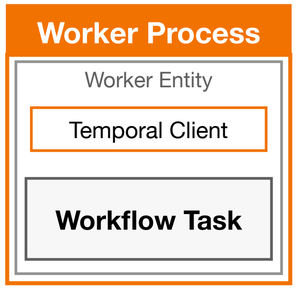

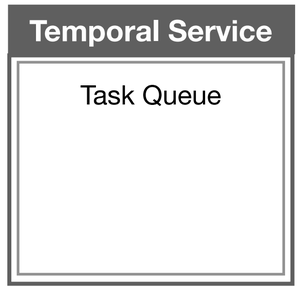

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Input: "orderNumber": "Z1238", ...

StartTimer

Duration: 30 minutes

Events

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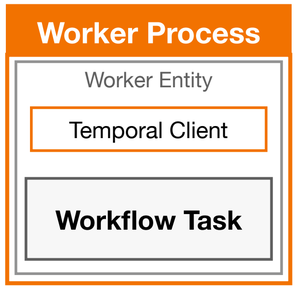

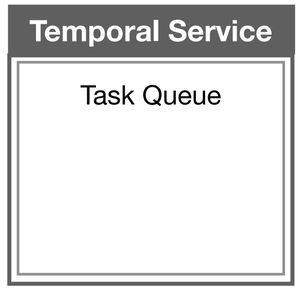

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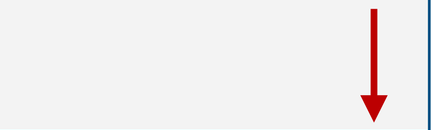
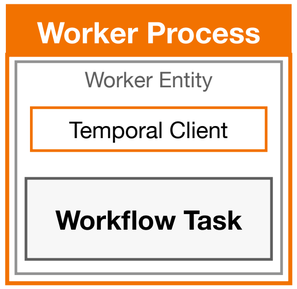
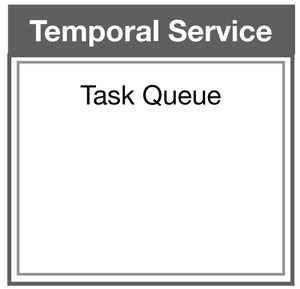
Worker crashes here







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ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

Duration: 30 minutes

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WorkflowTaskStarted	
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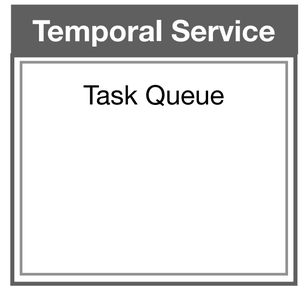

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

Duration: 30 minutes

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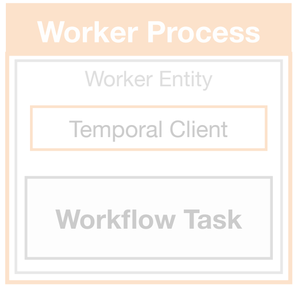

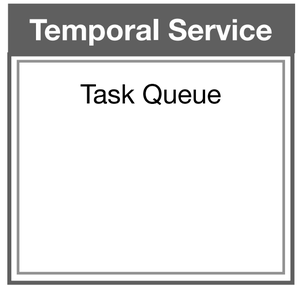

Commands

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
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Worker Process

Workflow Task Timeout Exceeded

Temporal Service

Task Queue

Commands

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
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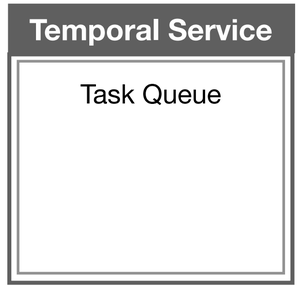

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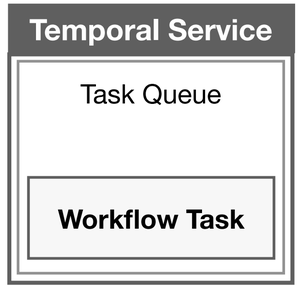

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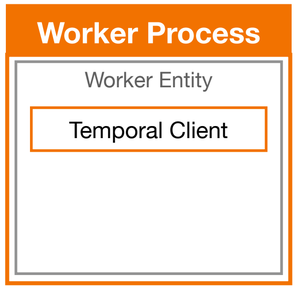

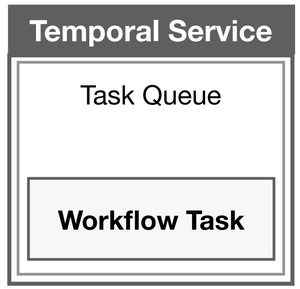

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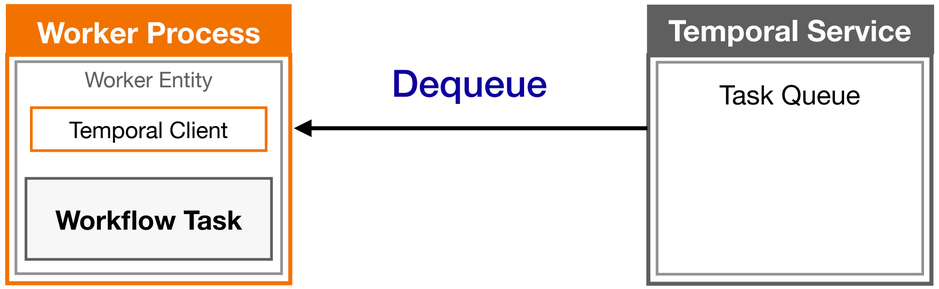

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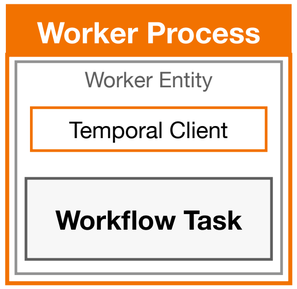

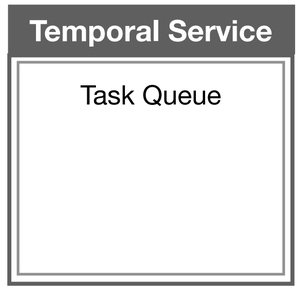

Commands

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WorkflowTaskStarted	
WorkflowTaskCompleted	
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ActivityTaskStarted	
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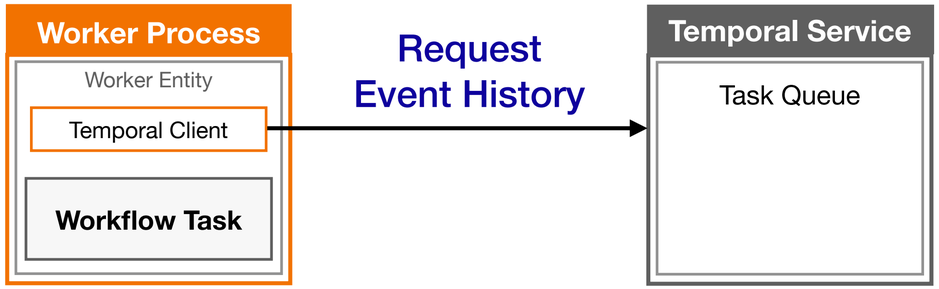

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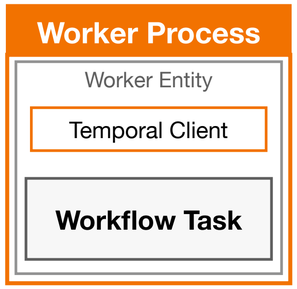

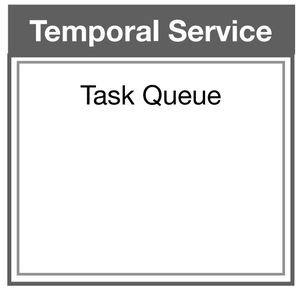

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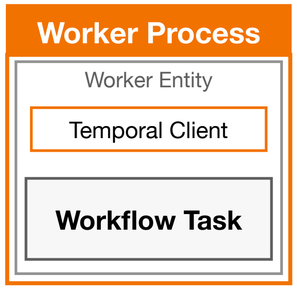

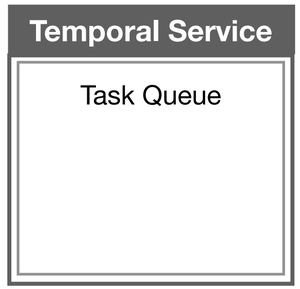

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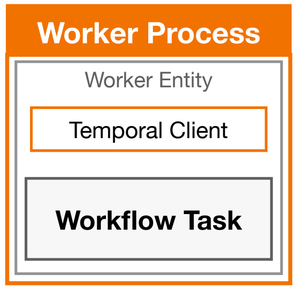

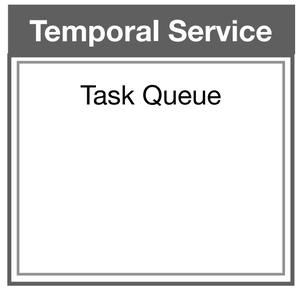

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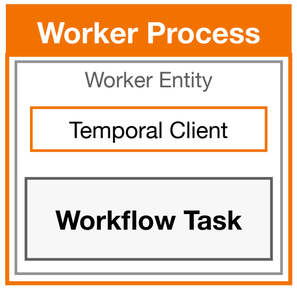

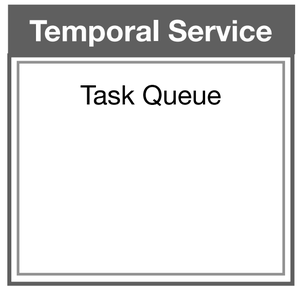

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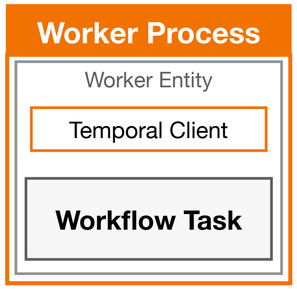

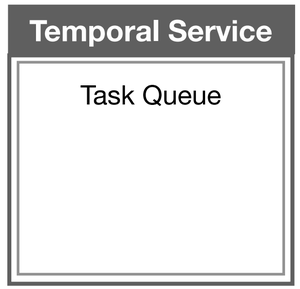

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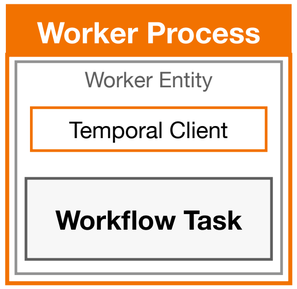

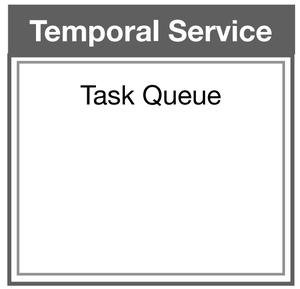

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

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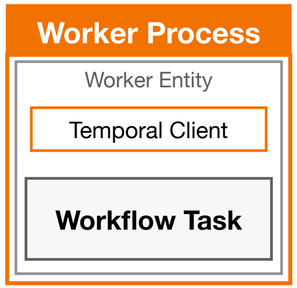

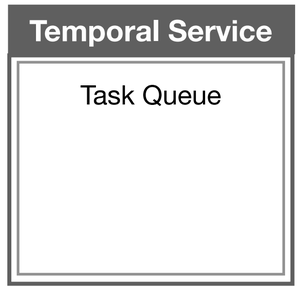

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
ActivityTaskScheduled **(getDistance)**
ActivityTaskStarted
ActivityTaskCompleted **(distance=15)**
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskCompleted
TimerStarted **(30 Minutes)**
TimerFired
WorkflowTaskScheduled
WorkflowTaskStarted
WorkflowTaskTimedOut
WorkflowTaskScheduled
WorkflowTaskStarted

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

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  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
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    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
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    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
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    String confirmation = activities.sendBill(bill);

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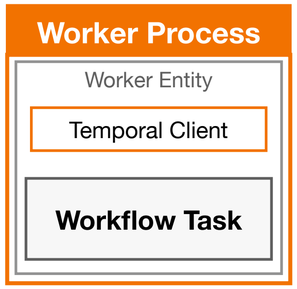

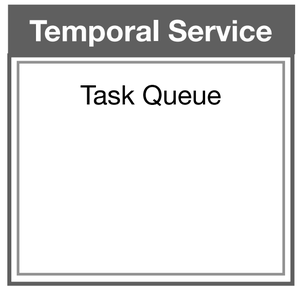

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Input: "orderNumber": "Z1238", ...

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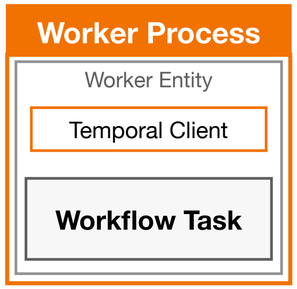

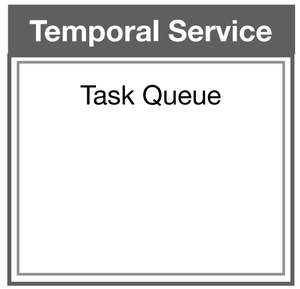

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Type: getDistance
Input: "orderNumber": "Z1238", ...

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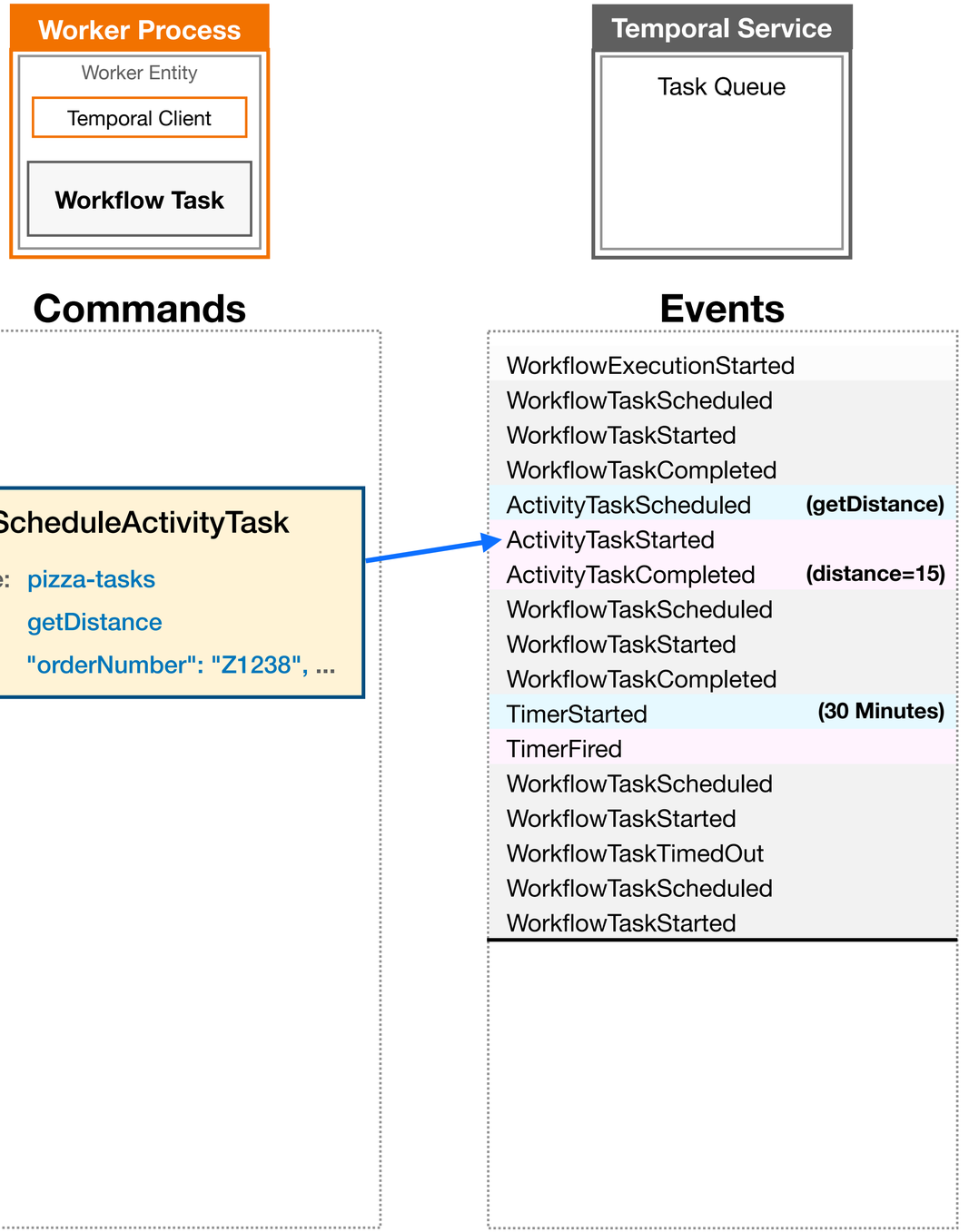

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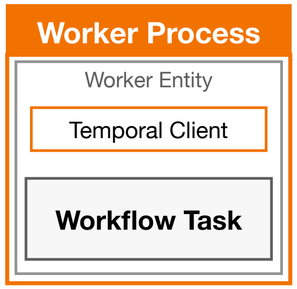

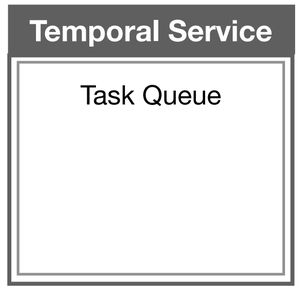

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
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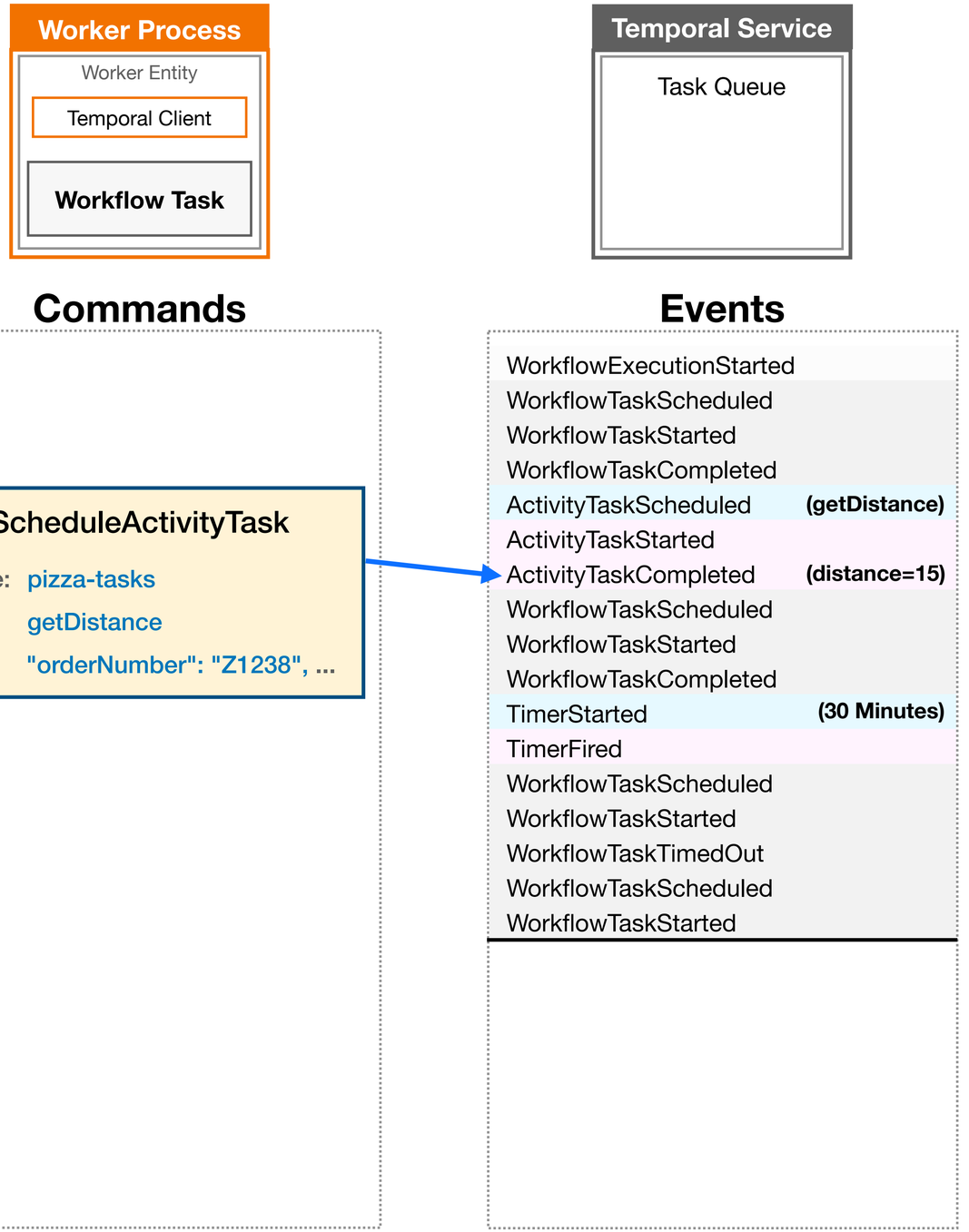

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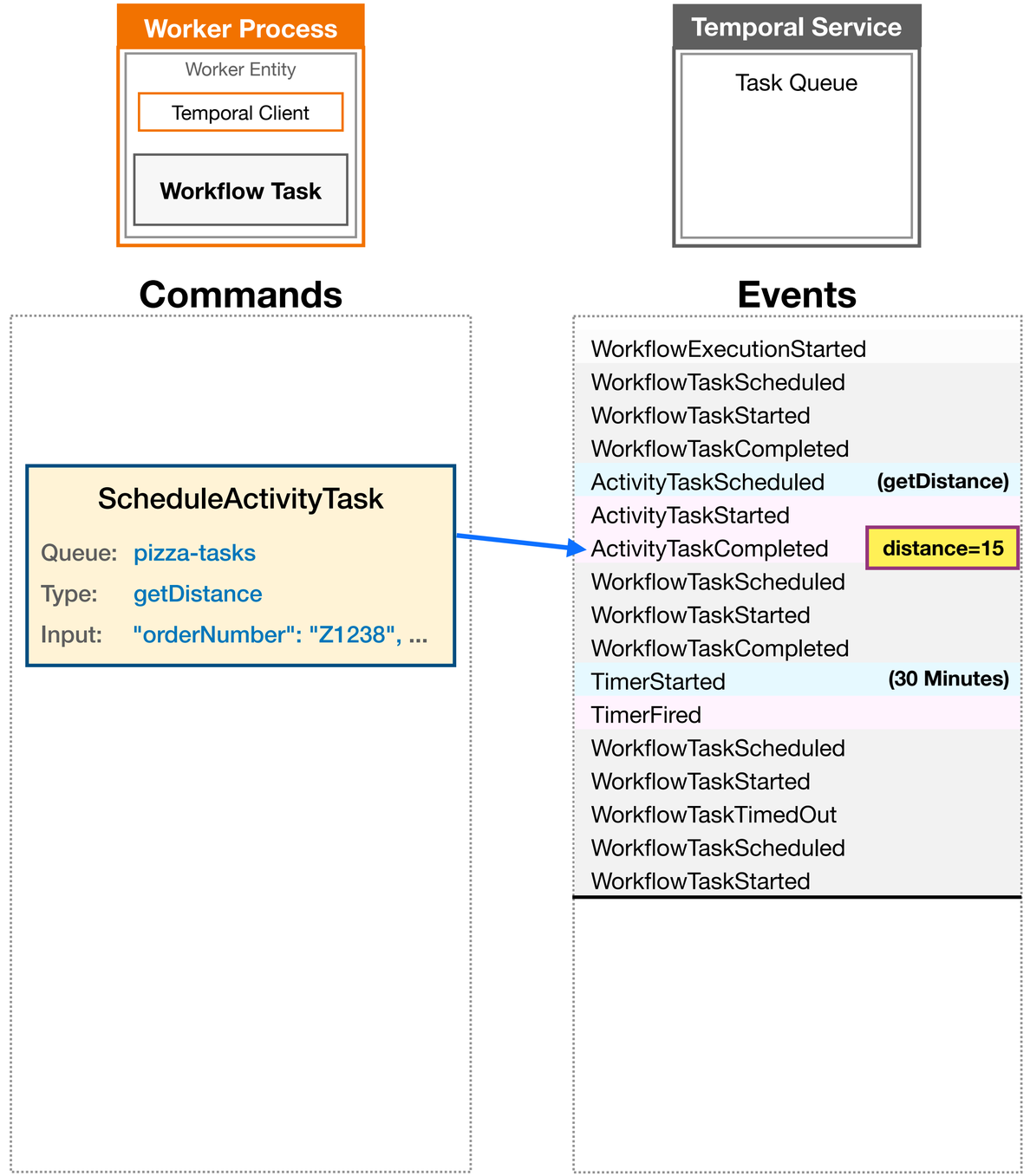

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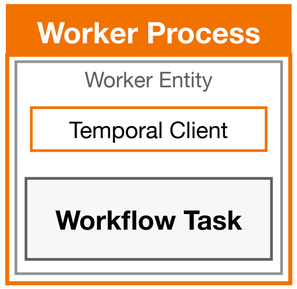

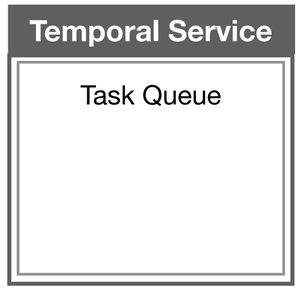

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
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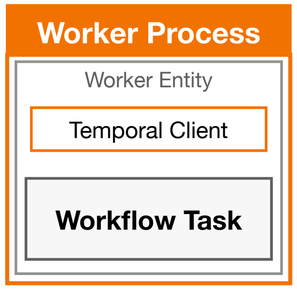
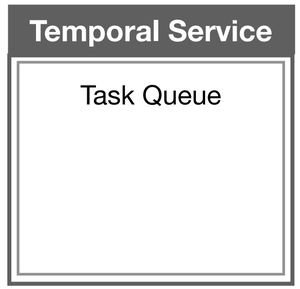
Worker assigns 15 to this variable





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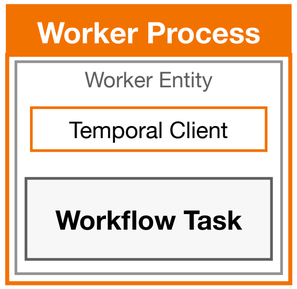

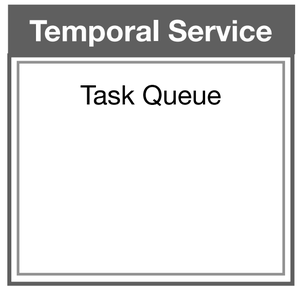

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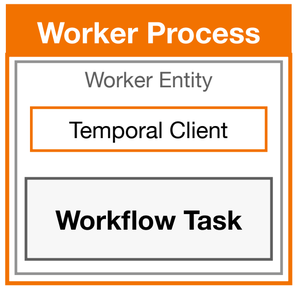

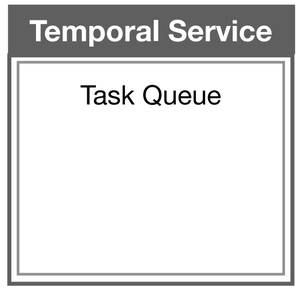

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
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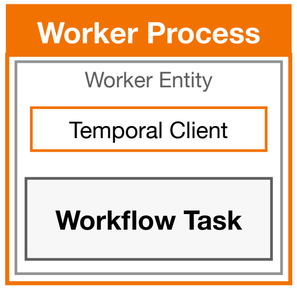

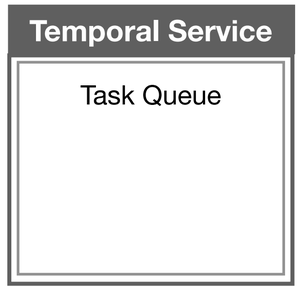

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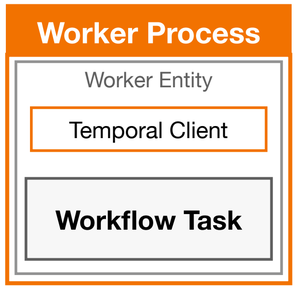

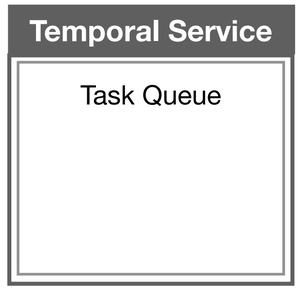

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

Duration: 30 minutes

Events

WorkflowExecutionStarted	
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WorkflowTaskStarted	
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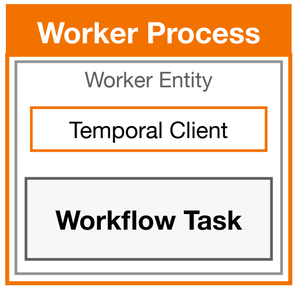

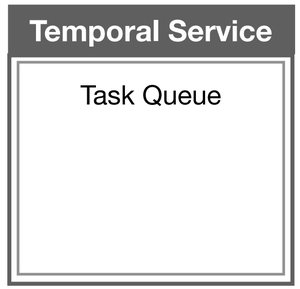

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Queue: pizza-tasks
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Input: "orderNumber": "Z1238", ...

StartTimer

Duration: 30 minutes

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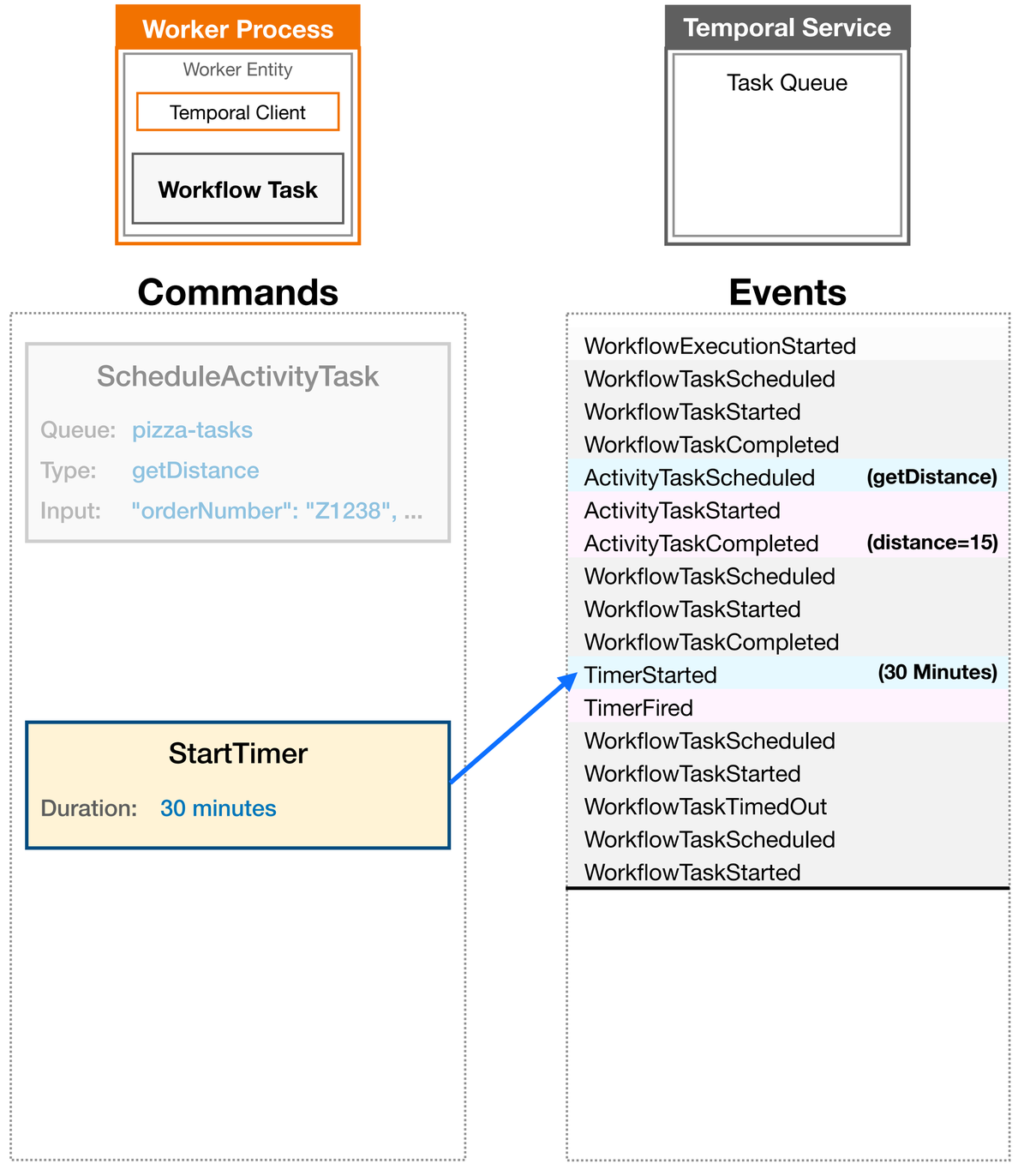

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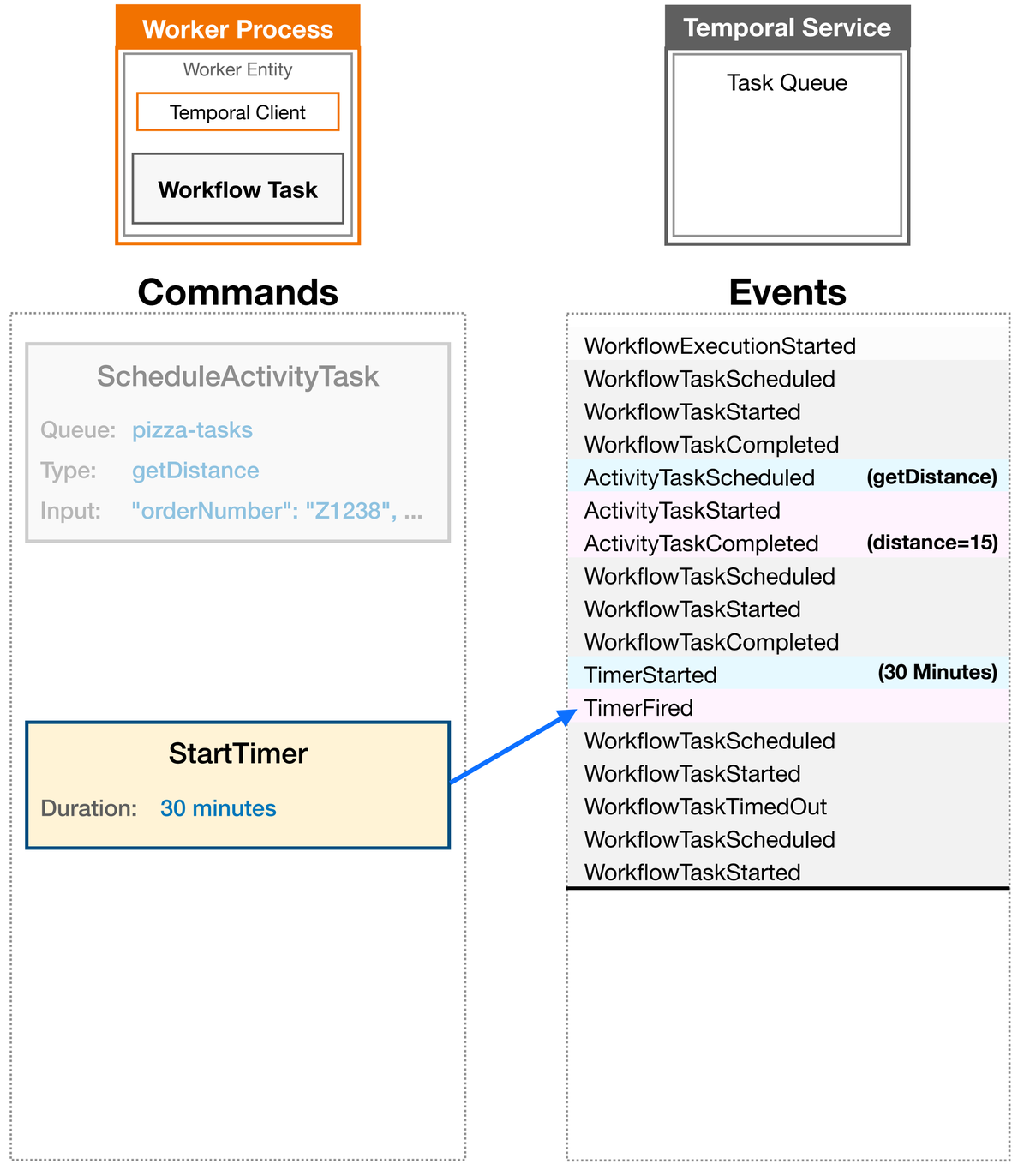

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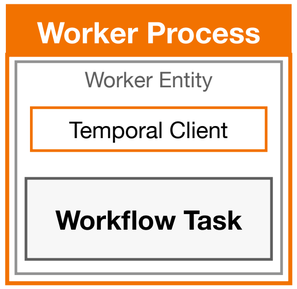

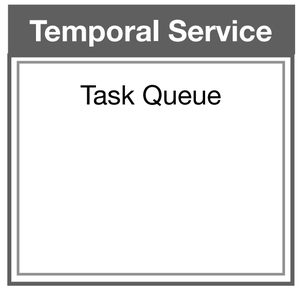

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
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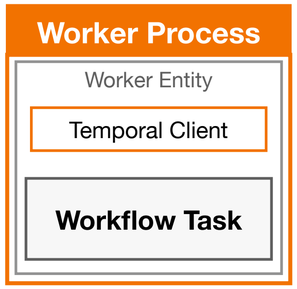

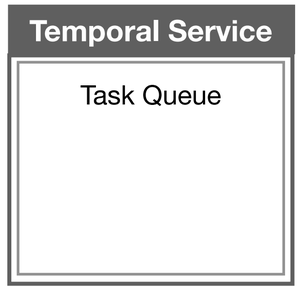

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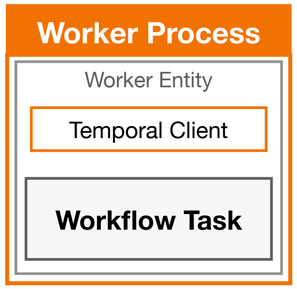

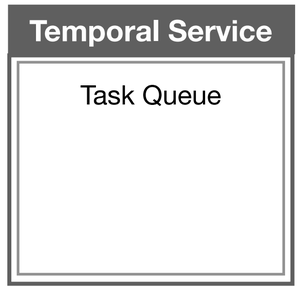

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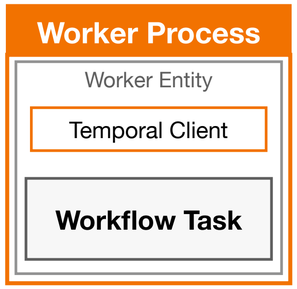

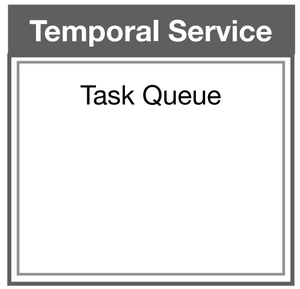

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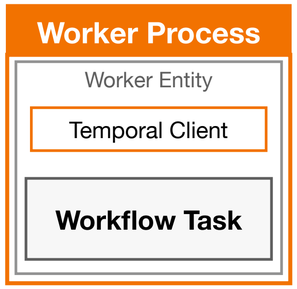
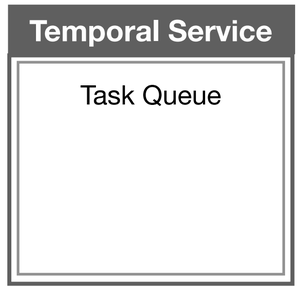




Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

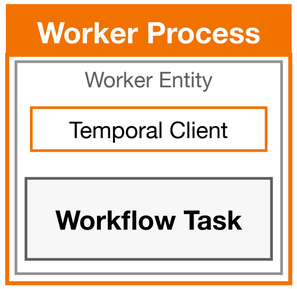
StartTimer

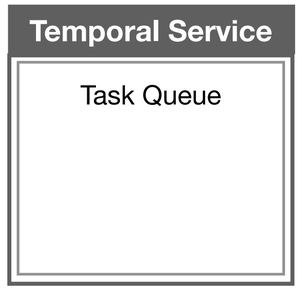
30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```





Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	

```java
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  ActivityOptions options = ActivityOptions.newBuilder()
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      Workflow.newActivityStub(PizzaActivities.class, options);

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  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```

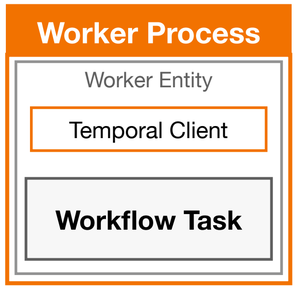

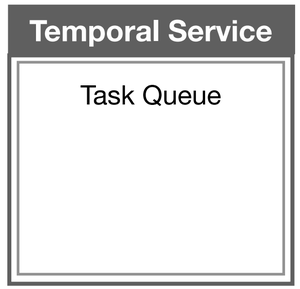

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
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TimerStarted	**(30 Minutes)**
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WorkflowTaskScheduled	
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WorkflowTaskTimedOut	
WorkflowTaskScheduled	
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    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

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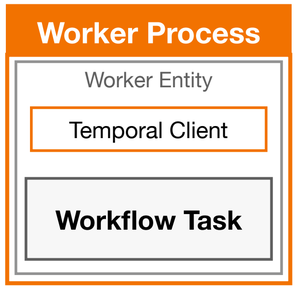

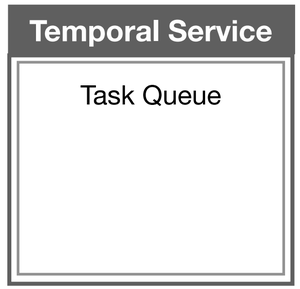

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
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WorkflowTaskScheduled	
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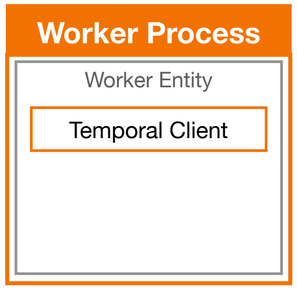

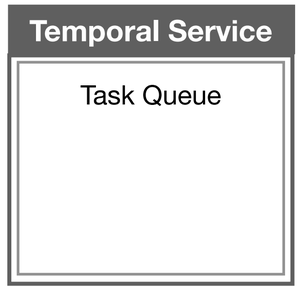

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
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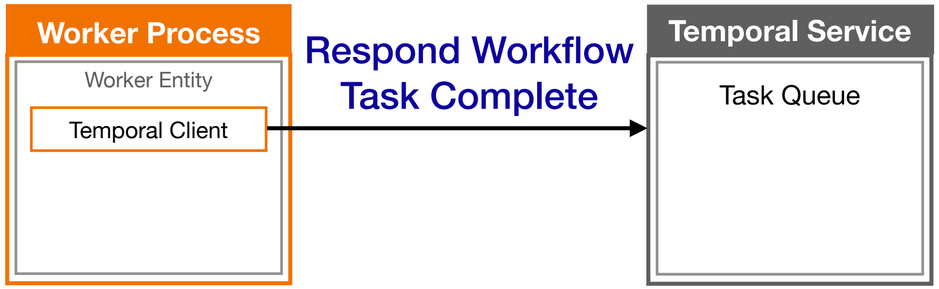

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
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    // Execute the SendBill activity
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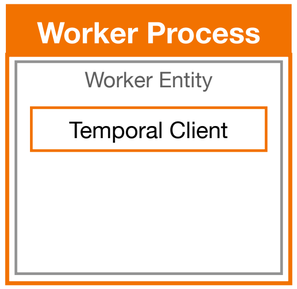

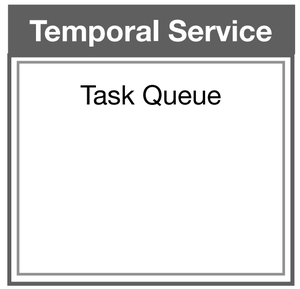

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

30 minutes

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
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WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

```java
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        totalPrice += pizza.getPrice();
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    String confirmation = activities.sendBill(bill);

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  }
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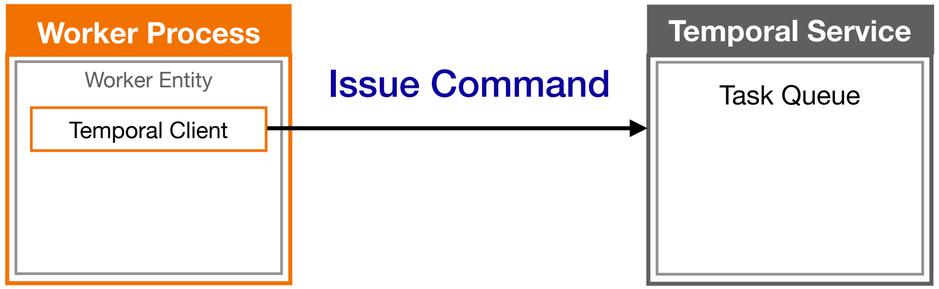

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "orderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
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  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

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    int distance = activities.getDistance(order.getAddress());

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      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
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  }
}
```

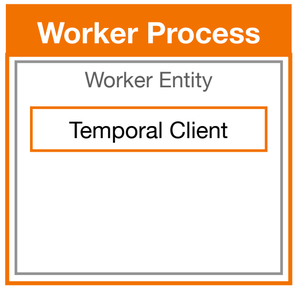

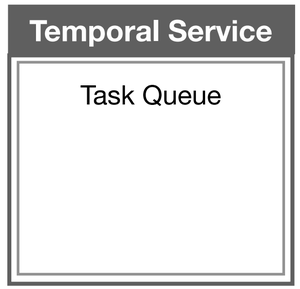

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
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  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

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    // Iterate over the items and calculate the cost of the order
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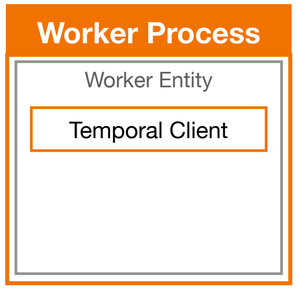

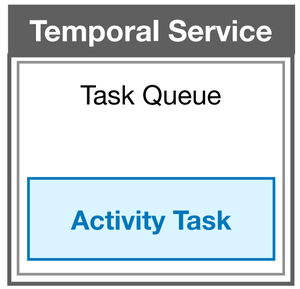

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
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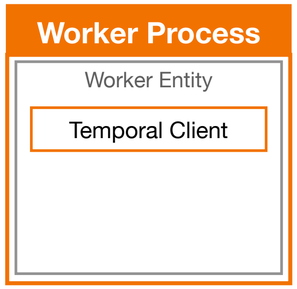
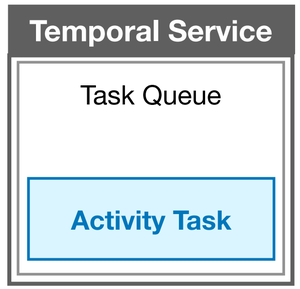
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(send_bill)**

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```





Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(sendBill)**

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    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
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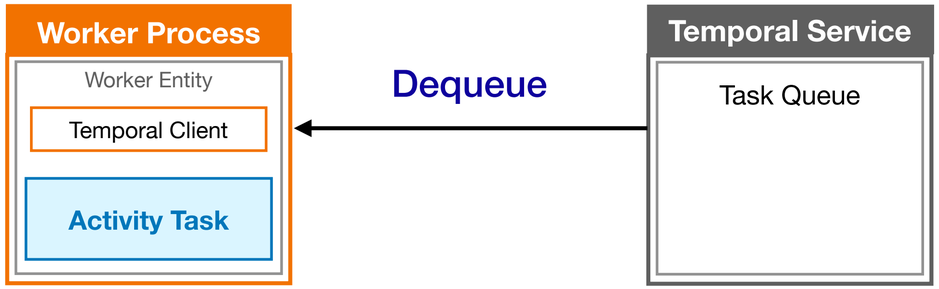

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	

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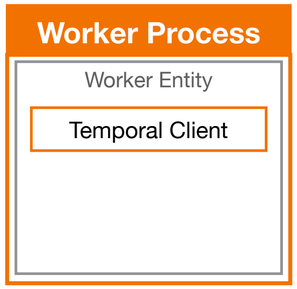

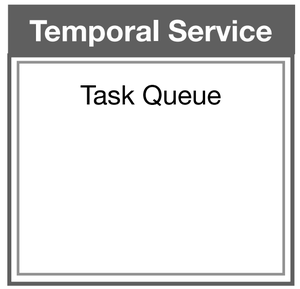

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
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WorkflowTaskCompleted	
ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	

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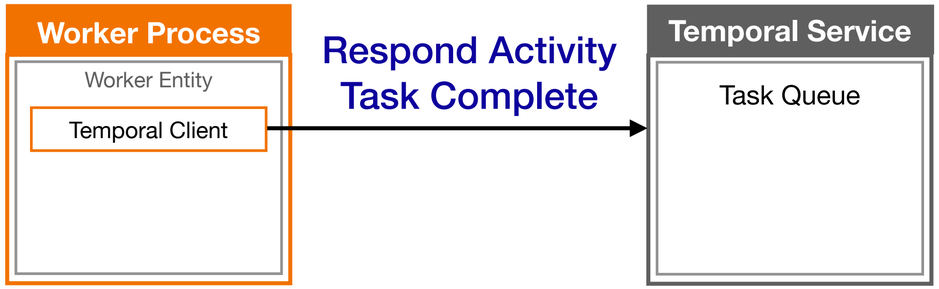

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
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WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	

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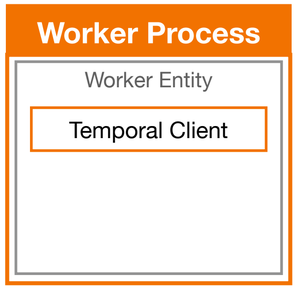

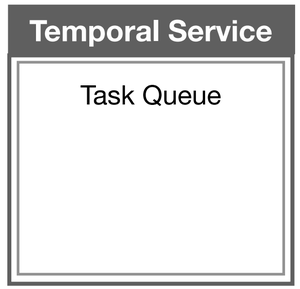

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
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ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	

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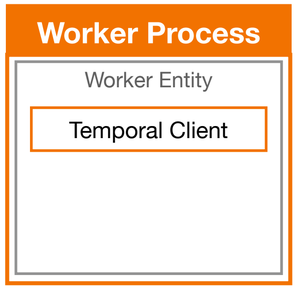

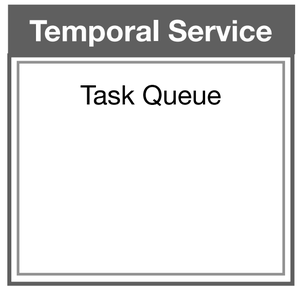

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
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ActivityTaskScheduled	**(getDistance)**
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ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	
ActivityTaskCompleted	**(confirmation=...)**

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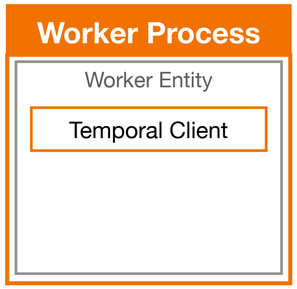

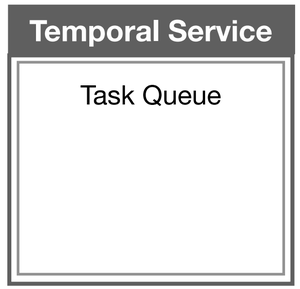

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
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WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	
ActivityTaskCompleted	**(confirmation=...)**

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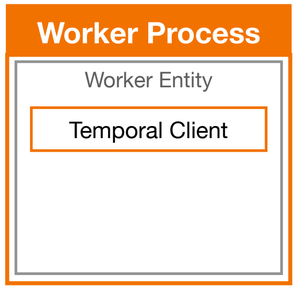

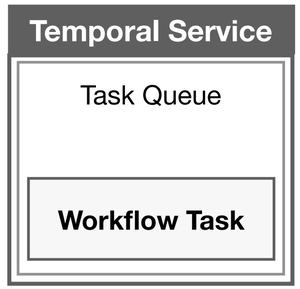

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

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WorkflowExecutionStarted	
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ActivityTaskCompleted	**(confirmation=...)**
WorkflowTaskScheduled	

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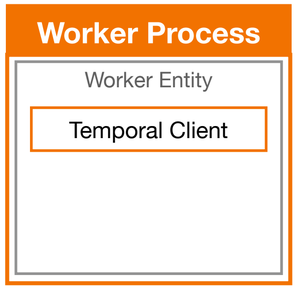

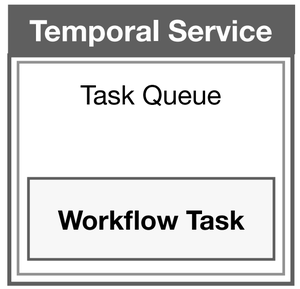

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

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WorkflowExecutionStarted	
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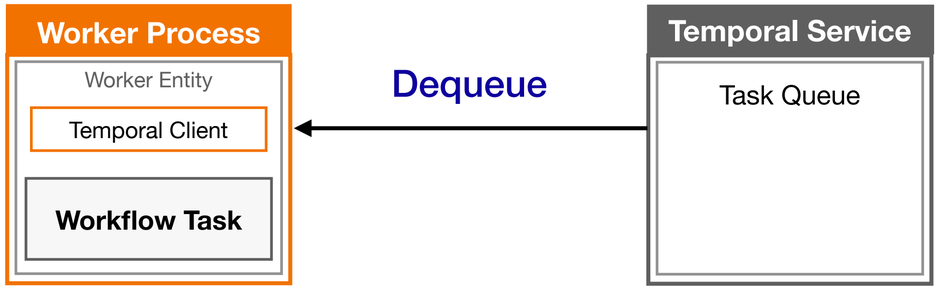
ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	
ActivityTaskCompleted	**(confirmation=...)**
WorkflowTaskScheduled	

```java
public class PizzaWorkflowImpl implements PizzaWorkflow {

  ActivityOptions options = ActivityOptions.newBuilder()
      .setStartToCloseTimeout(Duration.ofSeconds(5))
      .build();

  private final PizzaActivities activities =
      Workflow.newActivityStub(PizzaActivities.class, options);

  public static final Logger logger = Workflow.getLogger(PizzaWorkflowImpl.class);

  @Override
  public String pizzaWorkflow(Order order) {
    int totalPrice = 0;

    // Iterate over the items and calculate the cost of the order
    for (Pizza pizza : order.getItems()) {
        totalPrice += pizza.getPrice();
    }

    logger.info("Calculated cost of order: " + totalPrice);

    // Execute the getDistance activity
    int distance = activities.getDistance(order.getAddress());

    if (order.isDelivery() && distance > 25) {
      String message = "Customer lives outside the service area";
      throw ApplicationFailure.newFailure(message,
          OutOfServiceAreaException.class.getName());
    }

    // Wait for 30 minutes before billing the customer
    Workflow.sleep(Duration.ofMinutes(30));

    // Create a bill object
    Bill bill = new Bill();
    bill.setCustomerId(order.getCustomer().getCustomerId());
    bill.setAmount(totalPrice);
    bill.setDescription(order.getOrderNumber());

    // Execute the SendBill activity
    String confirmation = activities.sendBill(bill);

    return confirmation;
  }
}
```



Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	
ActivityTaskCompleted	**(confirmation=...)**
WorkflowTaskScheduled	
WorkflowTaskStarted	

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public class PizzaWorkflowImpl implements PizzaWorkflow {

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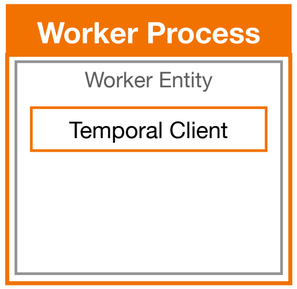

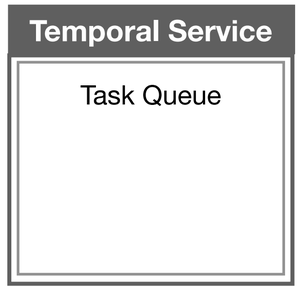

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	
ActivityTaskCompleted	**(confirmation=...)**
WorkflowTaskScheduled	
WorkflowTaskStarted	

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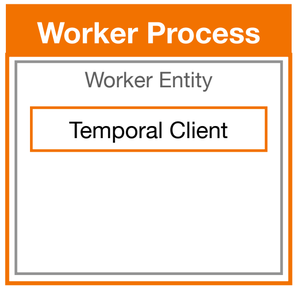

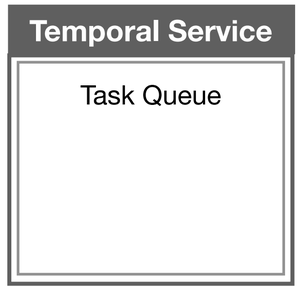

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	
ActivityTaskCompleted	**(confirmation=...)**
WorkflowTaskScheduled	
WorkflowTaskStarted	

```java
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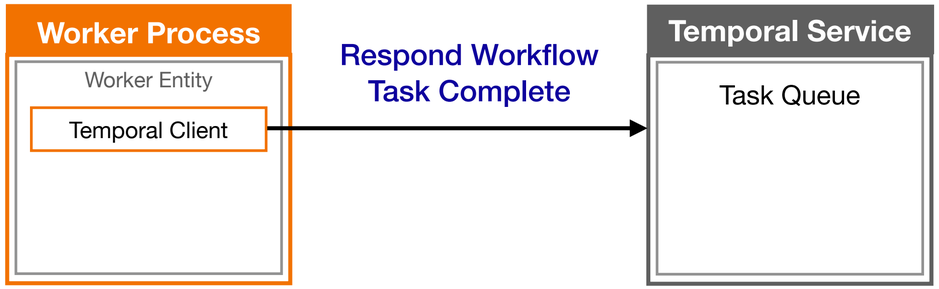

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
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WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	
ActivityTaskCompleted	**(confirmation=...)**
WorkflowTaskScheduled	
WorkflowTaskStarted	

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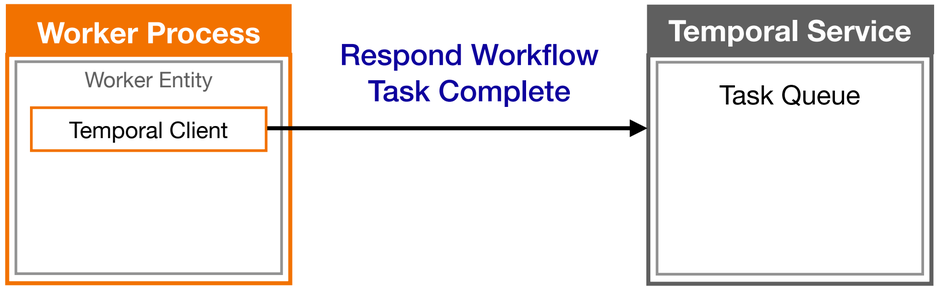

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
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WorkflowTaskStarted	
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ActivityTaskStarted	
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WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

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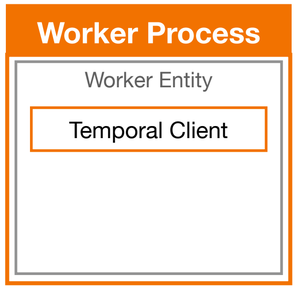

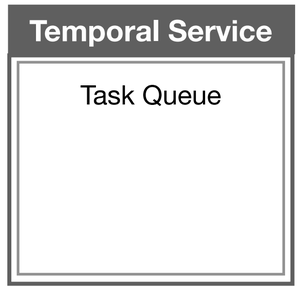

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
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WorkflowTaskStarted	
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WorkflowTaskStarted	
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ActivityTaskStarted	
ActivityTaskCompleted	**(confirmation=...)**
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WorkflowTaskStarted	
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  public String pizzaWorkflow(Order order) {
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        totalPrice += pizza.getPrice();
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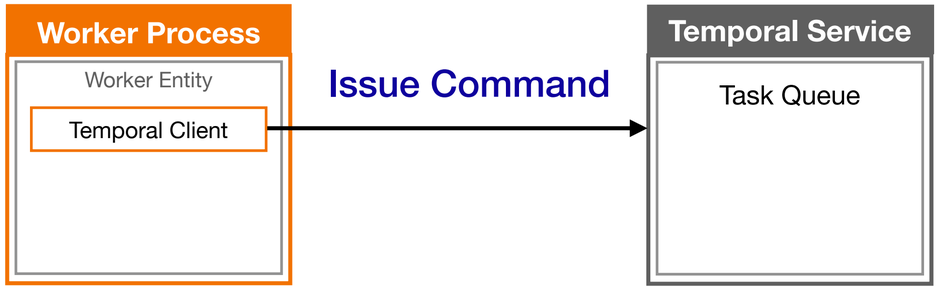

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "customerID": 12983, ...

CompleteWorkflowExecution

Result: "confirmationNumber": "TPD-26074139"

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskTimedOut	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	
ActivityTaskCompleted	**(confirmation=...)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	

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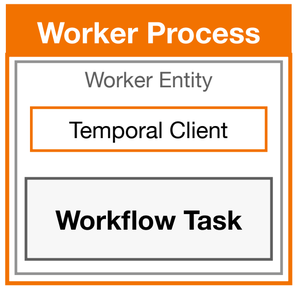

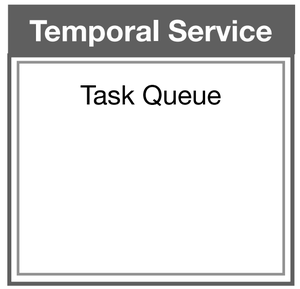

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "CustomerID": 12983, ...

CompleteWorkflowExecution

Result: "ConfirmationNumber": "TPD-26074139"

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
WorkflowTaskStarted	
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WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	
ActivityTaskCompleted	**(confirmation=...)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
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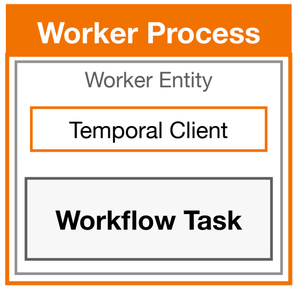

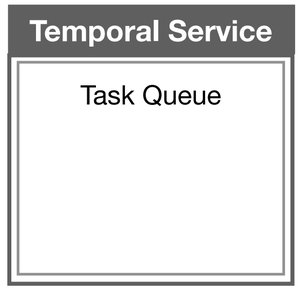

Commands

ScheduleActivityTask

Queue: pizza-tasks
Type: getDistance
Input: "OrderNumber": "Z1238", ...

StartTimer

30 minutes

ScheduleActivityTask

Queue: pizza-tasks
Type: sendBill
Input: "CustomerID": 12983, ...

CompleteWorkflowExecution

Result: "ConfirmationNumber": "TPD-26074139"

Events

WorkflowExecutionStarted	
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
ActivityTaskScheduled	**(getDistance)**
ActivityTaskStarted	
ActivityTaskCompleted	**(distance=15)**
WorkflowTaskScheduled	
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TimerStarted	**(30 Minutes)**
TimerFired	
WorkflowTaskScheduled	
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WorkflowTaskTimedOut	
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ActivityTaskScheduled	**(sendBill)**
ActivityTaskStarted	
ActivityTaskCompleted	**(confirmation=...)**
WorkflowTaskScheduled	
WorkflowTaskStarted	
WorkflowTaskCompleted	
WorkflowExecutionCompleted	

Why Temporal Requires Determinism for Workflows

Workflow Definition

```
import io.temporal.activity.ActivityOptions;
import io.temporal.workflow.Workflow;

public class DeterministicWorkflowImpl implements DeterministicWorkflow {

    ActivityOptions options = ActivityOptions.newBuilder()
            .setStartToCloseTimeout(Duration.ofMinutes(45))
            .build();

    private final DeterministicActivities activities =
      Workflow.newActivityStub(DeterministicActivities.class, options);

    @Override
    public void deterministicWorkflow() {

      String salesData = activities.importSalesData();

      // Sleep for 4 hours
      Workflow.sleep(Duration.ofHours(4));

      String report = activities.runDailyReport(salesData);

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import io.temporal.activity.ActivityOptions;
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Commands

Events

Workflow Definition

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    }
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Commands

ScheduleActivityTask

Type: importSalesData

ScheduleActivityTask

Type: runDailyReport

Events

Workflow Definition

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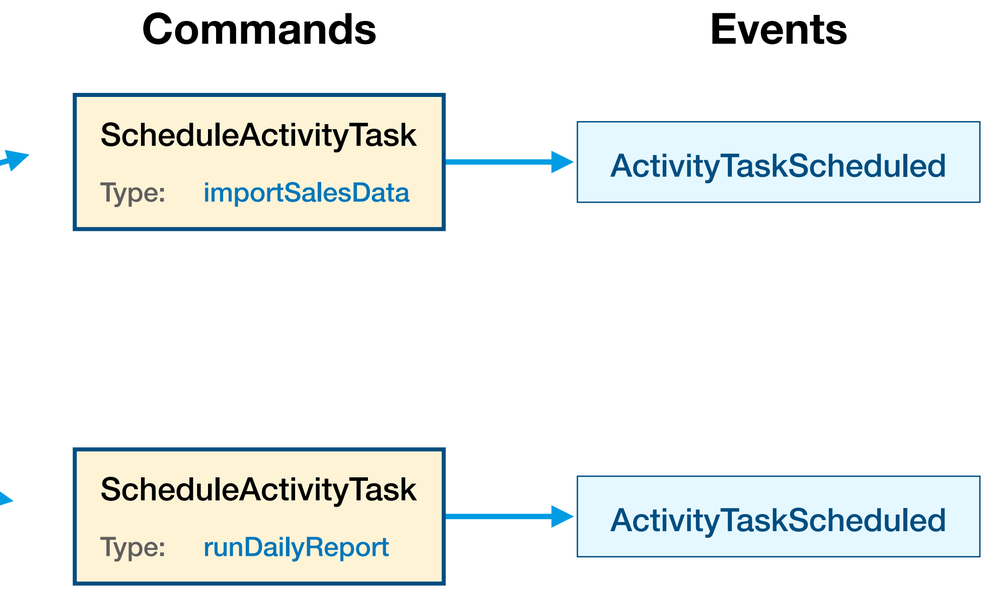

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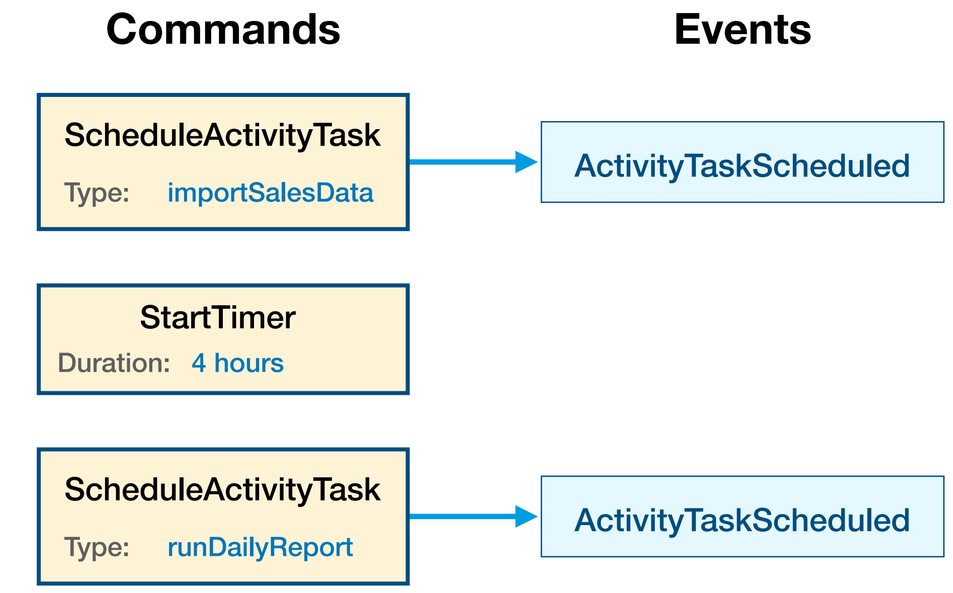

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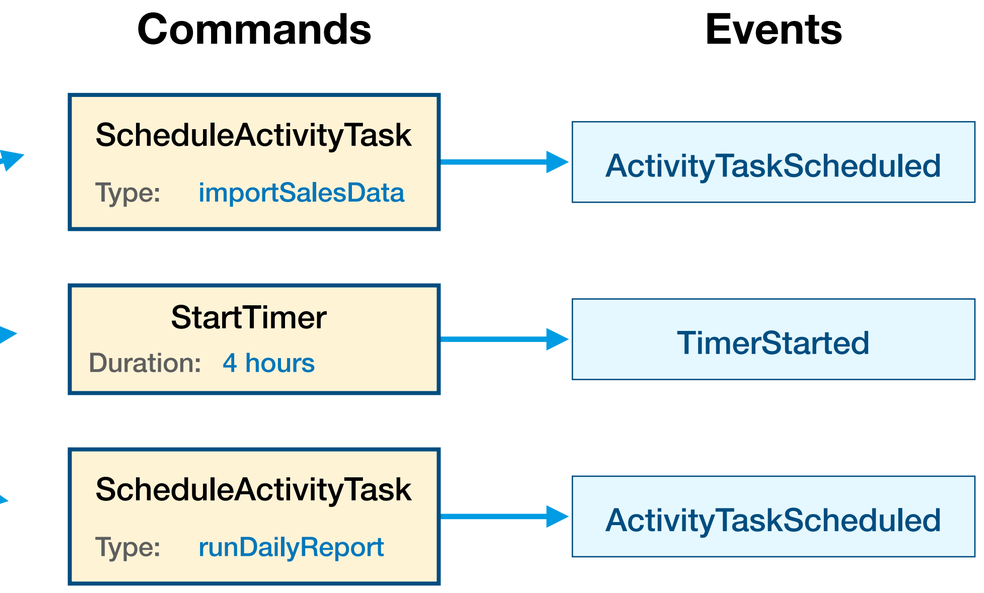


Commands

ScheduleActivityTask

Commands

ScheduleActivityTask

Events

ActivityTaskScheduled

Commands

ScheduleActivityTask

Events

ActivityTaskScheduled

ActivityTaskStarted

Commands

ScheduleActivityTask

Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

Commands

ScheduleActivityTask

Events

ActivityTaskScheduled

ActivityTaskStarted

ActivityTaskCompleted

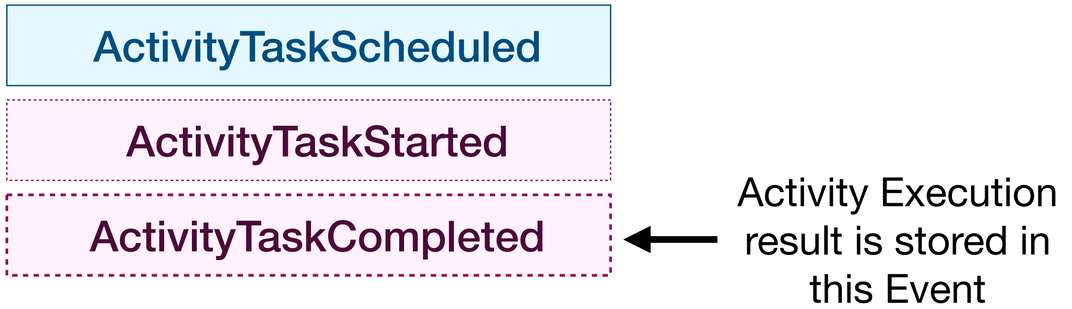
Activity Execution result is stored in this Event

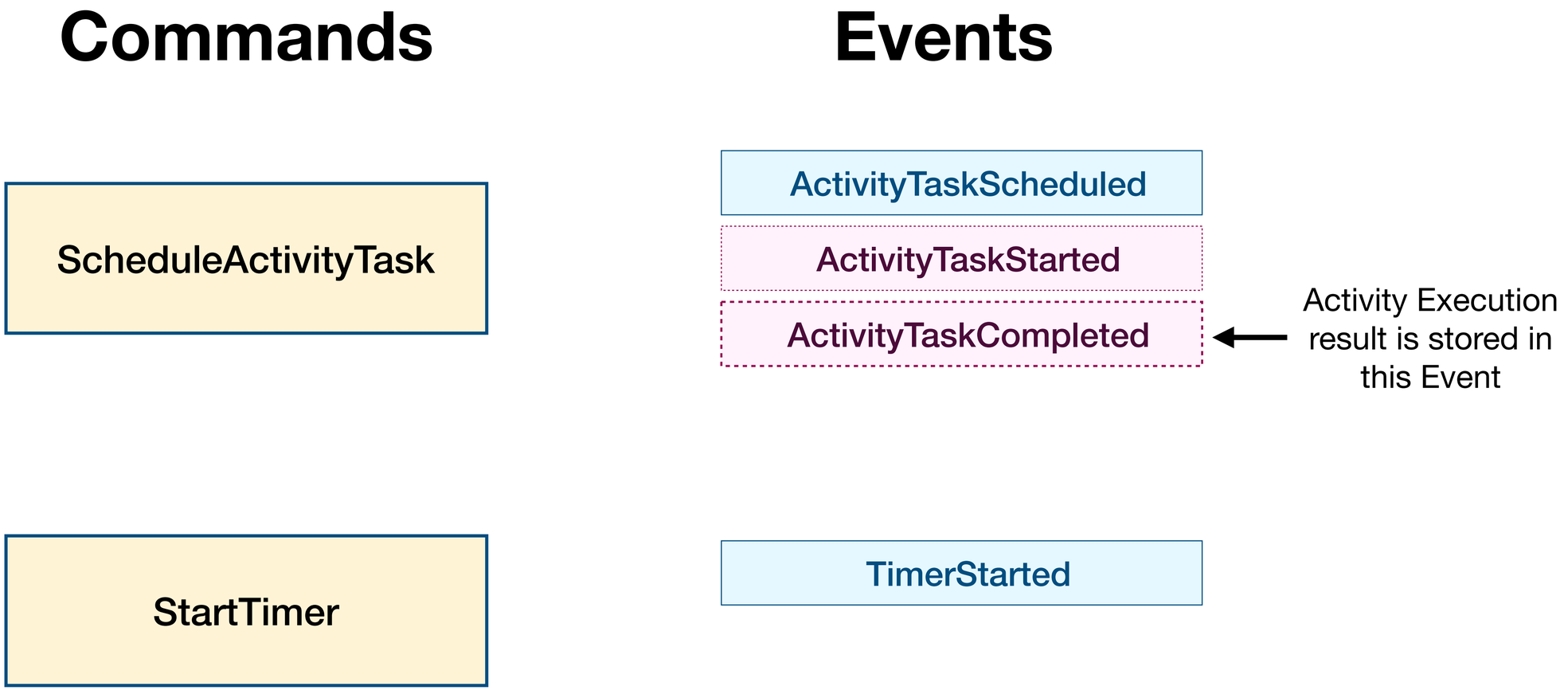
Commands

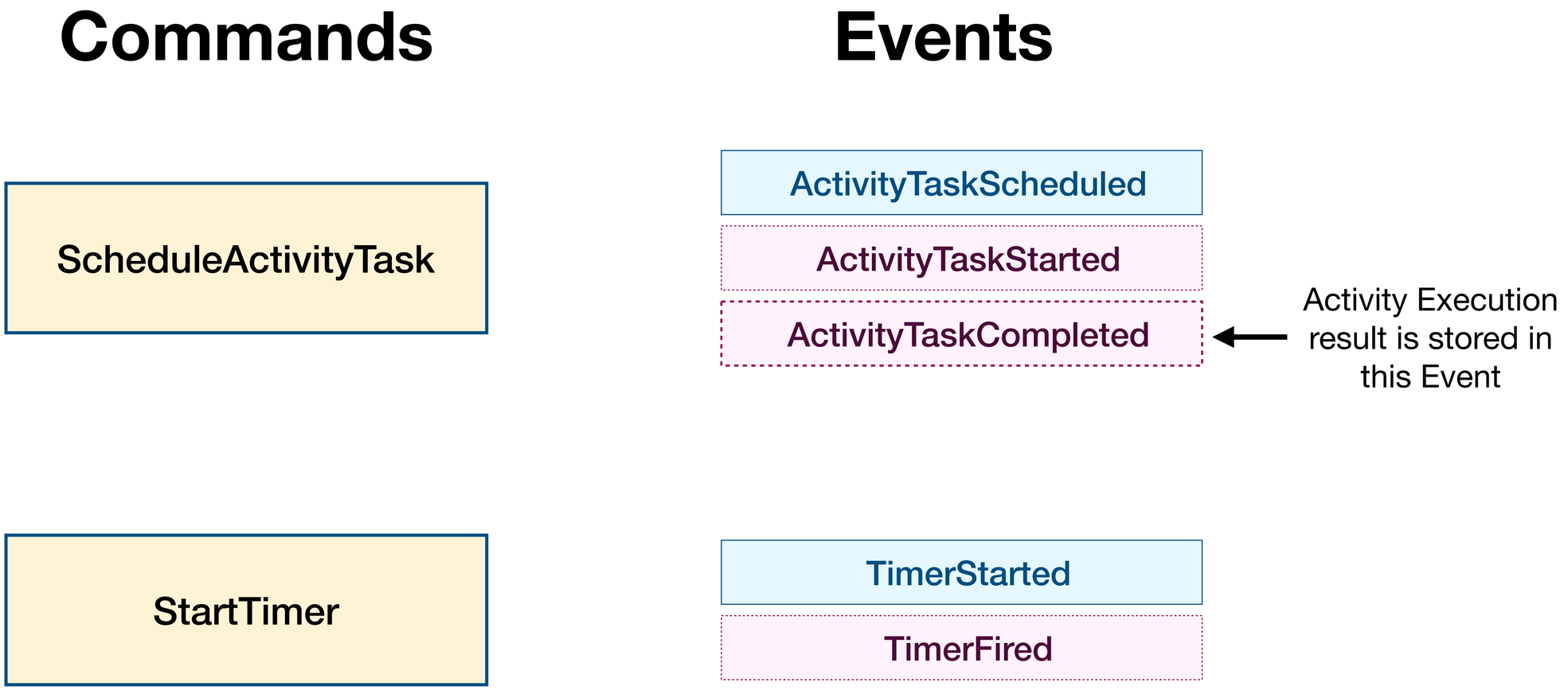
ScheduleActivityTask

StartTimer

Events




Commands
Events
ScheduleActivityTask
ActivityTaskScheduled
ActivityTaskStarted
ActivityTaskCompleted
Activity Execution result is stored in this Event
StartTimer
TimerStarted


Commands
Events
ScheduleActivityTask
ActivityTaskScheduled
ActivityTaskStarted
ActivityTaskCompleted
Activity Execution result is stored in this Event
StartTimer
TimerStarted
TimerFired

Deterministic Workflows:

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- **A Workflow is deterministic if every execution of its Workflow Definition:**
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  - **given the same input**

Temporal's ability to guarantee durable execution of your Workflow depends on deterministic Workflows.

Workflow Definition

```
import io.temporal.activity.ActivityOptions;
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public class DeterministicWorkflowImpl implements DeterministicWorkflow {

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      String salesData = activities.importSalesData();

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Commands

Events

Workflow Definition

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    }
}
```

Commands

ScheduleActivityTask

Type: importSalesData

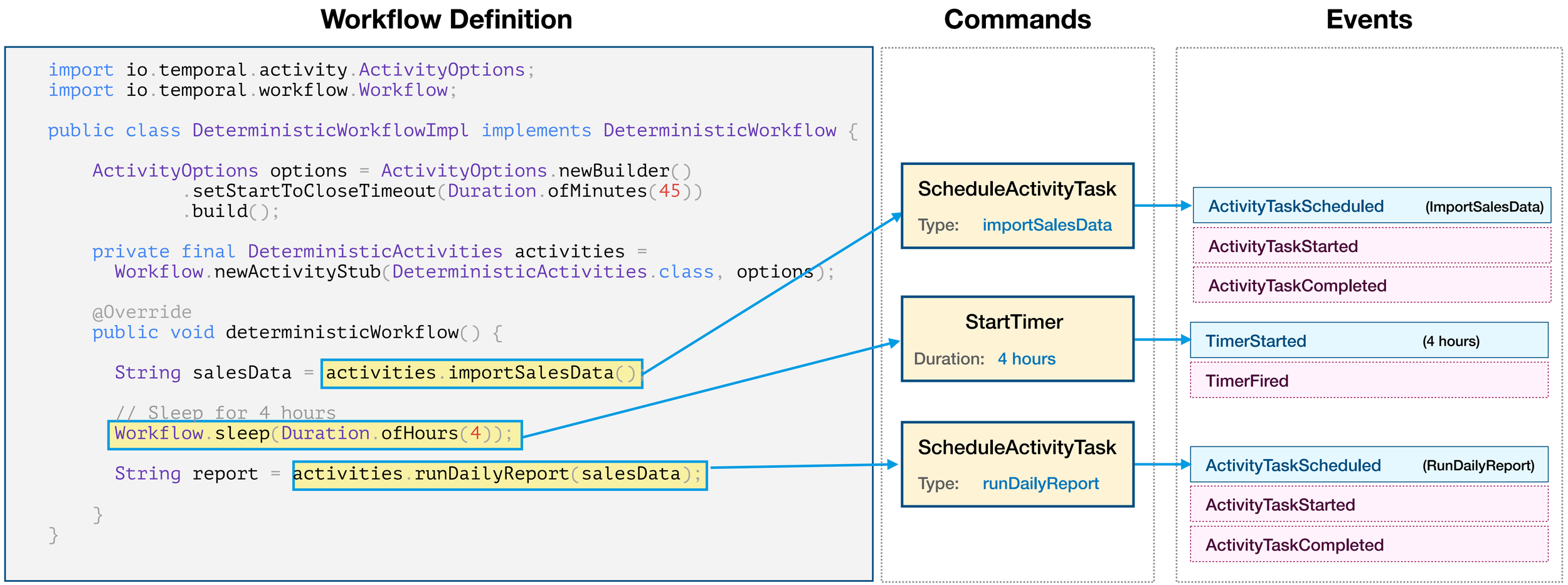
StartTimer

Duration: 4 hours

ScheduleActivityTask

Type: runDailyReport

Events


Workflow Definition
Commands
Events
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ActivityOptions options = ActivityOptions.newBuilder()
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private final DeterministicActivities activities =
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@Override
public void deterministicWorkflow() {
String salesData = activities.importSalesData()
// Sleep for 4 hours
Workflow.sleep(Duration.ofHours(4));
String report = activities.runDailyReport(salesData);
}
}
ScheduleActivityTask
Type: importSalesData
StartTimer
Duration: 4 hours
ScheduleActivityTask
Type: runDailyReport
ActivityTaskScheduled (ImportSalesData)
ActivityTaskStarted
ActivityTaskCompleted
TimerStarted (4 hours)
TimerFired
ActivityTaskScheduled (RunDailyReport)
ActivityTaskStarted
ActivityTaskCompleted

Commands Generated

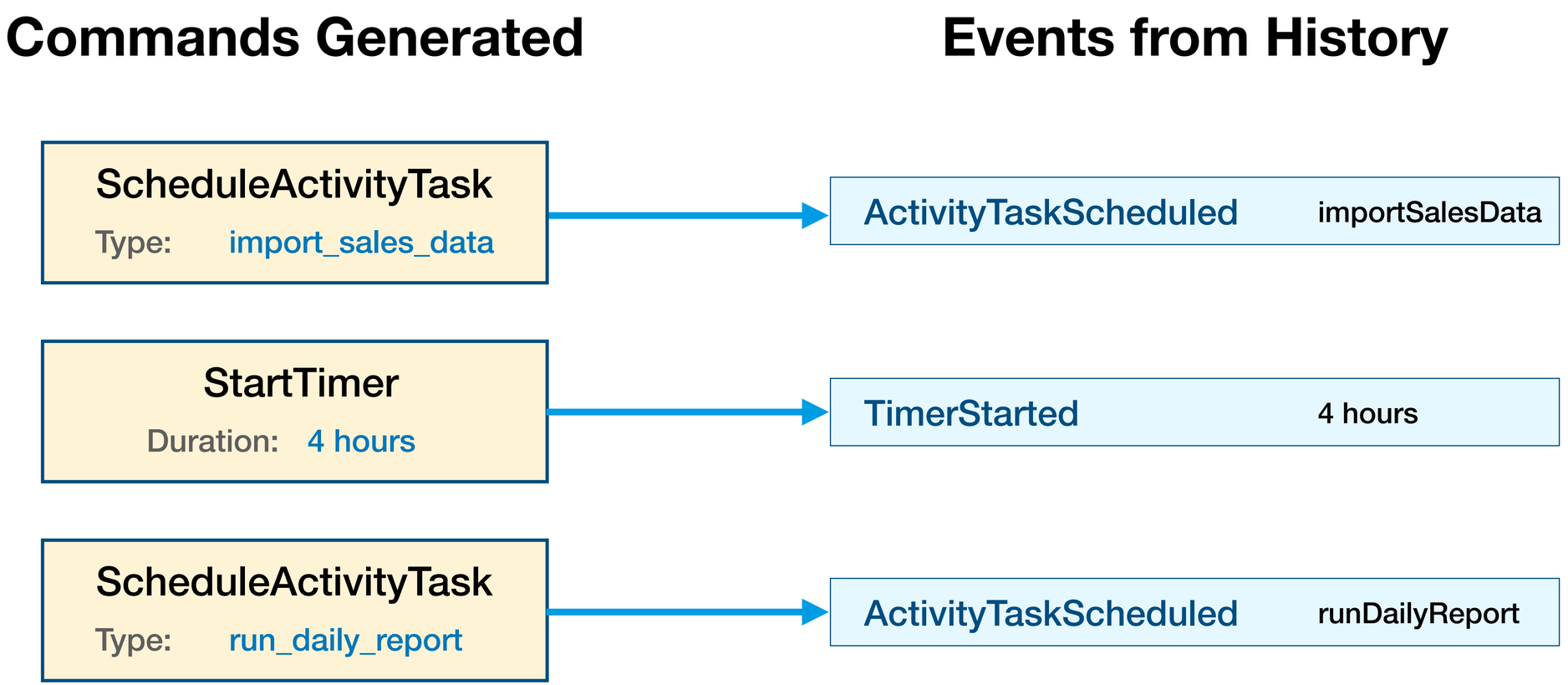
ScheduleActivityTask
Type: import_sales_data

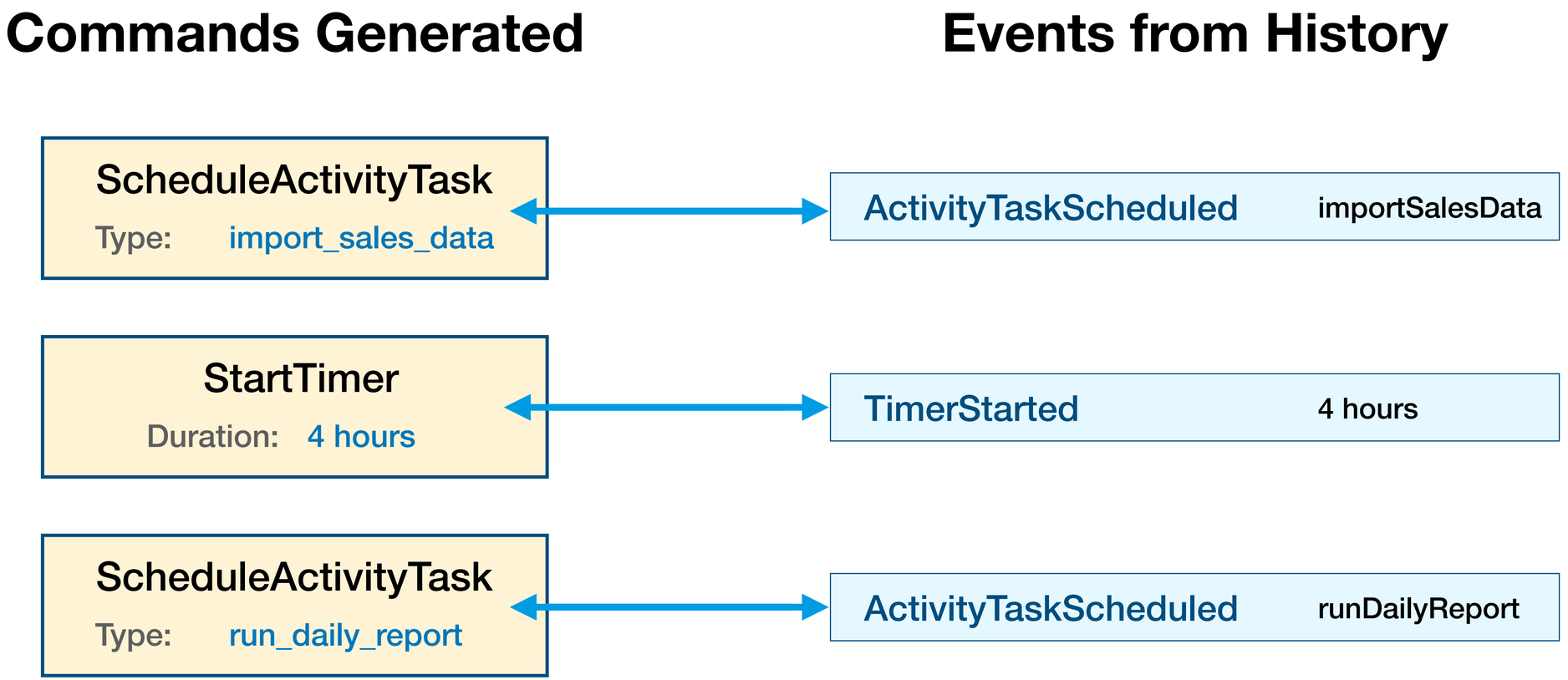
StartTimer
Duration: 4 hours

ScheduleActivityTask
Type: run_daily_report

Events from History

ActivityTaskScheduled	importSalesData
TimerStarted	4 hours
ActivityTaskScheduled	runDailyReport


Commands Generated
Events from History
ScheduleActivityTask
Type: import_sales_data
ActivityTaskScheduled
importSalesData
StartTimer
Duration: 4 hours
TimerStarted
4 hours
ScheduleActivityTask
Type: run_daily_report
ActivityTaskScheduled
runDailyReport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Events from History
ScheduleActivityTask
Type: import_sales_data
ActivityTaskScheduled
importSalesData
StartTimer
Duration: 4 hours
TimerStarted
4 hours
ScheduleActivityTask
Type: run_daily_report
ActivityTaskScheduled
runDailyReport

Example of a Non-Deterministic Workflow

A Non-Deterministic Workflow Definition

```
import io.temporal.activity.ActivityOptions;
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    @Override
    public void deterministicWorkflow() {

      String salesData = activities.importSalesData();

      Random random = new Random();
      if(random.nextInt(101) >= 50) {
        // Sleep for 4 hours
        Workflow.sleep(Duration.ofHours(4));
      }

      DailyReport report = new DailyReport();

      report = activities.runDailyReport(salesData);

      // remaining code omitted

    }
}
```

Commands Created

Relevant Events Logged

A Non-Deterministic Workflow Definition

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import io.temporal.activity.ActivityOptions;
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        Workflow.sleep(Duration.ofHours(4));
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      DailyReport report = new DailyReport();

      report = activities.runDailyReport(salesData);

      // remaining code omitted

    }
}
```

Commands Created

Relevant Events Logged

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}
```

Commands Created

ScheduleActivityTask

Type: importSalesData

Relevant Events Logged

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        Workflow.sleep(Duration.ofHours(4));
      }

      DailyReport report = new DailyReport();

      report = activities.runDailyReport(salesData);

      // remaining code omitted

    }
}
```

Commands Created

ScheduleActivityTask

Type: importSalesData

Relevant Events Logged

- ActivityTaskScheduled (importSalesData)
- ActivityTaskStarted
- ActivityTaskCompleted

A Non-Deterministic Workflow Definition

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Commands Created

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      DailyReport report = new DailyReport();

      report = activities.runDailyReport(salesData);

      // remaining code omitted

    }
}
```

Happens to return `84` during this execution

Commands Created

ScheduleActivityTask

Type: importSalesData

Relevant Events Logged

- ActivityTaskScheduled (importSalesData)
- ActivityTaskStarted
- ActivityTaskCompleted

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ScheduleActivityTask

Type: importSalesData

Relevant Events Logged

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- ActivityTaskStarted
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Commands Created

ScheduleActivityTask

Type: importSalesData

Relevant Events Logged

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      report = activities.runDailyReport(salesData);

      // remaining code omitted

    }
}
```

Commands Created

ScheduleActivityTask

Type: importSalesData

StartTimer

Duration: 4 hours

Relevant Events Logged

ActivityTaskScheduled (importSalesData)

ActivityTaskStarted

ActivityTaskCompleted

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Commands Created

ScheduleActivityTask

Type: importSalesData

StartTimer

Duration: 4 hours

Relevant Events Logged

ActivityTaskScheduled (importSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

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Commands Created

ScheduleActivityTask

Type: importSalesData

StartTimer

Duration: 4 hours

Relevant Events Logged

- ActivityTaskScheduled (importSalesData)
- ActivityTaskStarted
- ActivityTaskCompleted

- TimerStarted (4 hours)
- TimerFired

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      report = activities.runDailyReport(salesData);

      // remaining code omitted

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}
```

Worker crashes here

Commands Created

ScheduleActivityTask

Type: importSalesData

StartTimer

Duration: 4 hours

Relevant Events Logged

ActivityTaskScheduled (importSalesData)

ActivityTaskStarted

ActivityTaskCompleted

TimerStarted (4 hours)

TimerFired

A Non-Deterministic Workflow Definition

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}
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Commands Created

Relevant History Events

- ActivityTaskScheduled (importSalesData)
- ActivityTaskStarted
- ActivityTaskCompleted
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Commands Expected (Based on History)

ScheduleActivityTask

Type: ImportSalesData

StartTimer

4 hours

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Happens to return 14 during this execution

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Using random numbers in a Workflow Definition has resulted in Non-Deterministic Error

Each time a particular Workflow Definition is executed with a given input, it must yield exactly the same commands in exactly the same order.

Common Sources of Non-Determinism

Things to Avoid in a Workflow Definition

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How Workflow Changes Can Lead to Non-Deterministic Errors

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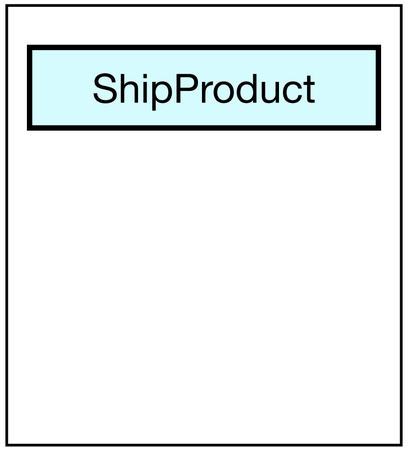

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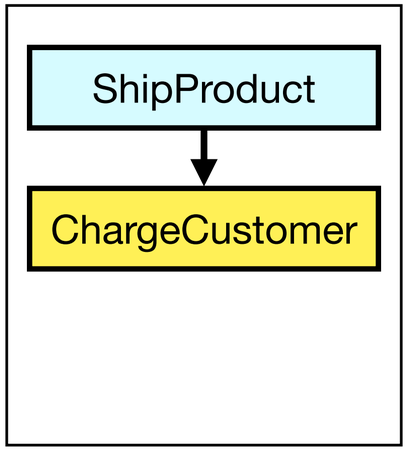

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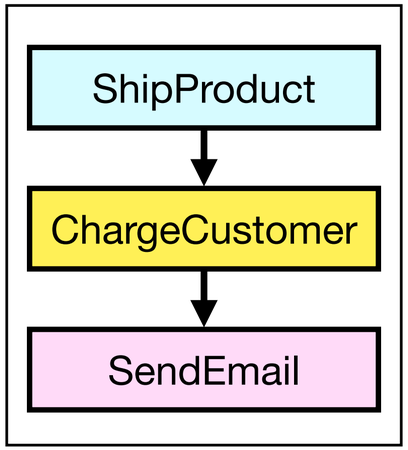

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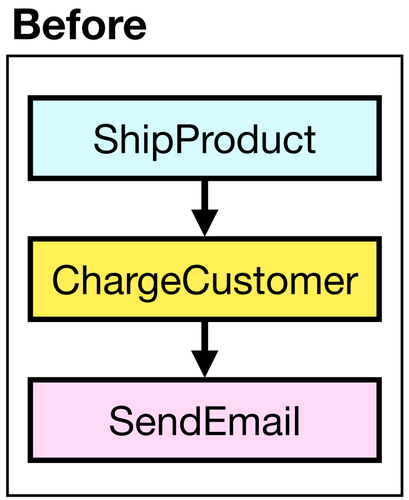

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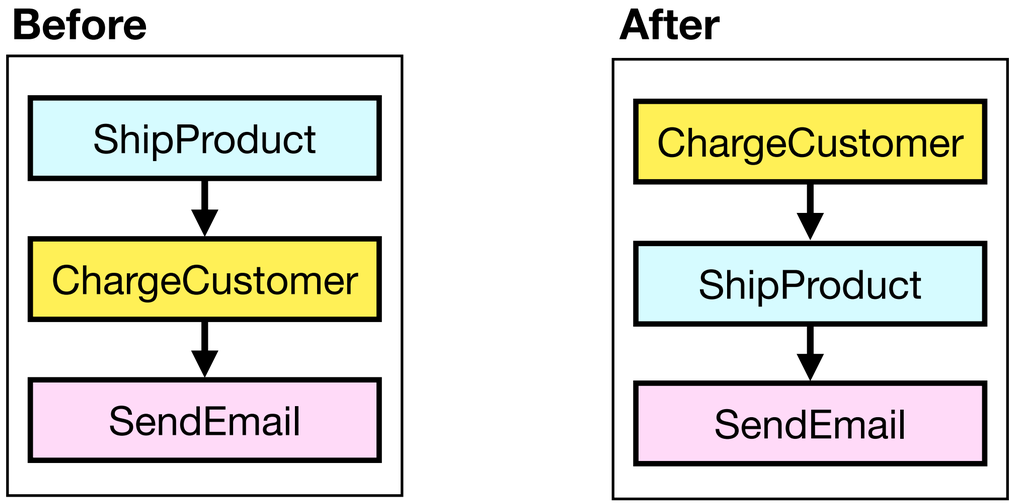

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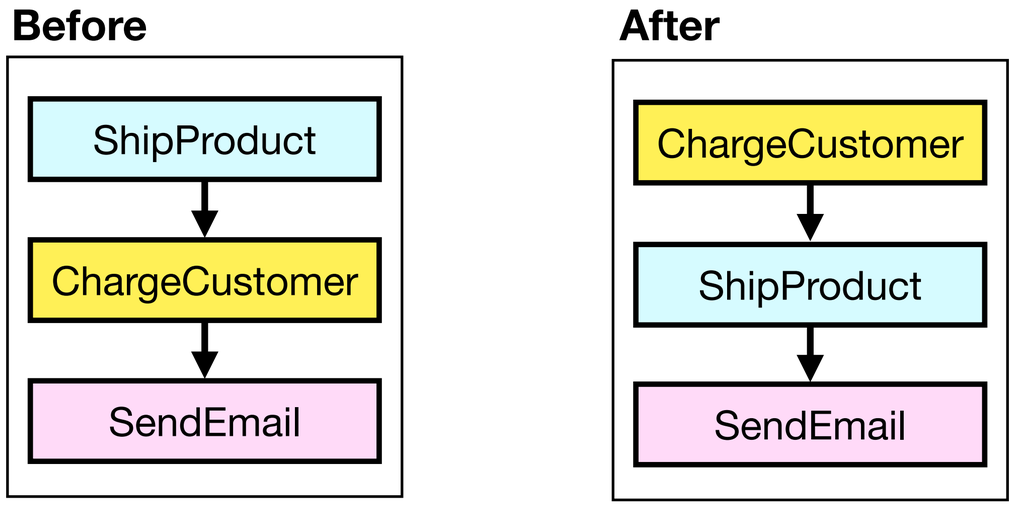

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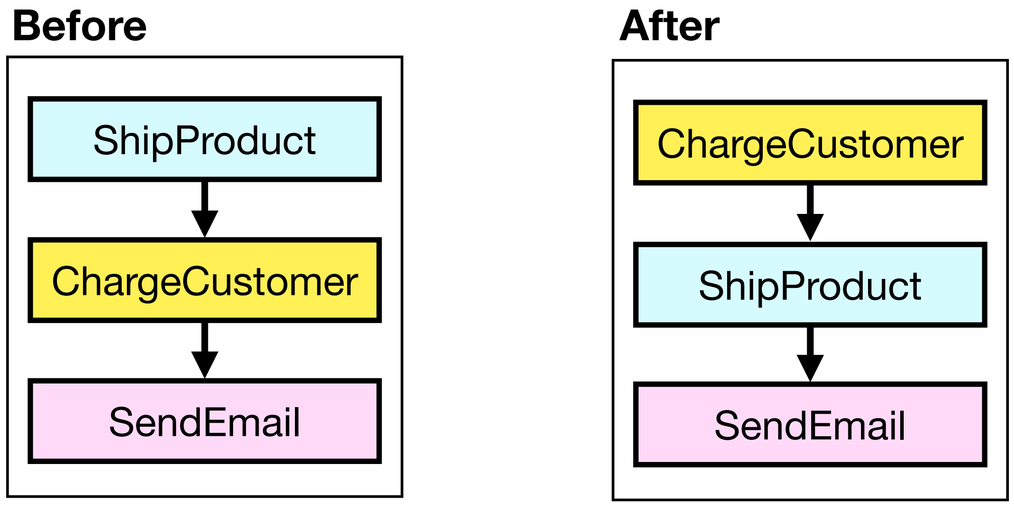

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  - Use Workflow Reset to restart execution to a point before the change was introduced
  - Not always desirable, as any progress made in Activities after the reset point will be lost and reexecuted

Beginner to Builder Bootcamp - Java

00. About this Workshop
01. The Basics of Temporal
02. Improving Your Temporal Application Code
03. Using Timers in a Workflow Definition
04. Understanding Event History
05. Understanding Workflow Determinism
06. Signals, Queries, and Workflow Updates
07. Timeouts and Retry Policies
08. Recovering from Failure
09. Conclusion

Signaling Your Workflows

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- **Each Signal is uniquely identified by a Signal type**
  - Case-sensitive string value specified by the Client when sending the Signal
  - The Signal Type is the name of the Signal Method

```
@WorkflowInterface
public interface MyWorkflow {

  @WorkflowMethod
  String workflow(String input);

  @SignalMethod
  void mySignal(String data);

}
```

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- **Each Signal is uniquely identified by a Signal type**
  - Case-sensitive string value specified by the Client when sending the Signal
  - The Signal Type is the name of the Signal Method
  - Signals can include a list of arguments (these must be Serializable)

```
@WorkflowInterface
public interface MyWorkflow {

  @WorkflowMethod
  String workflow(String input);

  @SignalMethod
  void mySignal(String data);

}
```

Defining Signals

```
public class UserInfo {
  private String userId;
  private String groupId;
}


@WorkflowInterface
public interface MyWorkflow {

  @WorkflowMethod
  String workflow(String input);

  @SignalMethod
  void joinSignal(UserInfo user);
}
```

Handling Signals

```
public class MyWorkflowImpl implements MyWorkflow {
  private String signalData;

  @Override
  public void joinSignal(String data) {
    this.signalData = data;
  }
}
```

Handling Signals

- We need to let the Workflow know what to do when it receives a Signal of that type

```
public class MyWorkflowImpl implements MyWorkflow {
  private String signalData;

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Handling Signals

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- Signal handlers are methods defined in the Workflow that listen for incoming Signals of a given type

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public class MyWorkflowImpl implements MyWorkflow {
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Handling Signals

- We need to let the Workflow know what to do when it receives a Signal of that type
- Signal handlers are methods defined in the Workflow that listen for incoming Signals of a given type
- Define your handler by implementing the Signal Method as defined in the Interface

```
public class MyWorkflowImpl implements MyWorkflow {
  private String signalData;

  @Override
  public void joinSignal(String data) {
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  }
}
```

Awaiting within a Workflow

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  - Once it does resolve to true, execution continues with the next statement
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  - `Workflow.await(Duration.ofDays(30, this.subCancelled)`
    - It allows you to limit the wait time by passing a maximum duration as a parameter

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- **You can implement this by using Workflow.await()**
  - This pauses execution until the expression supplied to this function resolves to true
  - Once it does resolve to true, execution continues with the next statement
  - `Workflow.await(Duration.ofDays(30, this.subCancelled)`
    - It allows you to limit the wait time by passing a maximum duration as a parameter
    - If this duration is exceeded, the method unblocks and returns false

Waiting for Signals

```
import io.temporal.workflow.Workflow;

boolean continue = Workflow.await(Duration.ofDays(30), this.subCancelled);

if (!continue){
  activities.sendCancelEmail();
}
```

How to Send Signals

- The WorkflowStub is used to obtain a reference, or a "handle", to a specific Workflow Execution

How to Send Signals from Client

```
public class SignalClient {
  public static void main(String[] args) throws Exception {

    WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();

    WorkflowClient client = WorkflowClient.newInstance(service);

    SignalWorkflow handle = client.newWorkflowStub(SignalWorkflow.class, "workflow-id-123");

    handle.joinSignal("user-1", "group-1");

    System.exit(0);
  }
}
```

How to Send Signals from Client

```
public class SignalClient {
  public static void main(String[] args) throws Exception {

    WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();

    WorkflowClient client = WorkflowClient.newInstance(service);

    SignalWorkflow handle = client.newWorkflowStub(SignalWorkflow.class, "workflow-id-123");

    handle.joinSignal("user-1", "group-1");

    System.exit(0);
  }
}
```

Exercise #3: Sending Signals from the Client

- **During this exercise, you will**
  - Define and handle a Signal
  - Retrieve a handle on the Workflow to Signal
  - Send a Signal from the Client
- **Refer to the README.md file in the exercise environment for details**
  - The code is below the **exercises/sending-signals-client**
    - Make your changes to the code in the **practice** subdirectory (look for TODO comments)
    - If you need a hint or want to verify your changes, look at the complete version in the **solution** subdirectory

How to Send Signals from Within a Workflow

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- A signal sent from one Workflow to another is called an *External Signal*
- Use newExternalWorkflowStub to send an External Signal

```
public String signalingWorkflow() {

  MyWorkflow workflow =
      Workflow.newExternalWorkflowStub(MyWorkflow.class, "workflow-id-123");

  workflow.joinSignal("user-1", "group-1");
  return "Success";
}
```

How to Send Signals from Within a Workflow

- A signal sent from one Workflow to another is called an *External Signal*
- Use newExternalWorkflowStub to send an External Signal

```
public String signalingWorkflow() {

  MyWorkflow workflow =
      Workflow.newExternalWorkflowStub(MyWorkflow.class, "workflow-id-123");

  workflow.joinSignal("user-1", "group-1");
  return "Success";
}
```

- This method ensures that the Workflow remains deterministic

Signal-With-Start

Signal-With-Start

- **Signals a Workflow Execution by Workflow ID, starting it if necessary**

```
import io.temporal.client.BatchRequest;

...

public static void signalWithStart() {

  // boilerplate creating Client omitted for brevity

  MyWorkflow workflow = client.newWorkflowStub(MyWorkflow.class, options);

  BatchRequest request = client.newSignalWithStartRequest();
  request.add(workflow::joinSignal, "user-1", "group-1");
```

Signal-With-Start

- **Signals a Workflow Execution by Workflow ID, starting it if necessary**
  - If there is currently an open Workflow Execution with this Workflow ID, it will be signaled

```
import io.temporal.client.BatchRequest;

...

public static void signalWithStart() {

  // boilerplate creating Client omitted for brevity

  MyWorkflow workflow = client.newWorkflowStub(MyWorkflow.class, options);

  BatchRequest request = client.newSignalWithStartRequest();
  request.add(workflow::joinSignal, "user-1", "group-1");
```

Signal-With-Start

- **Signals a Workflow Execution by Workflow ID, starting it if necessary**
  - If there is currently an open Workflow Execution with this Workflow ID, it will be signaled
  - If not, one is started and the Signal immediately delivered to it

```
import io.temporal.client.BatchRequest;

...

public static void signalWithStart() {

  // boilerplate creating Client omitted for brevity

  MyWorkflow workflow = client.newWorkflowStub(MyWorkflow.class, options);

  BatchRequest request = client.newSignalWithStartRequest();
  request.add(workflow::joinSignal, "user-1", "group-1");
```

Signal Limits

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- **There is a limit of 2,000 pending Signals sent per Workflow Execution**
  - Sending Signals in batches smaller than 2,000 can help you to stay within this limit
  - The Continue-As-New feature may also be helpful here
- **The Temporal Service also limits the total number of Signals *received***
  - Each Workflow Execution is limited to receiving 10,000 Signals during its entire lifespan

Unhandled Command

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  - Acceptable to ignore in Java SDK

Unhandled Command

- **This error may occur when a Workflow receives a high volume of Signals in a short period of time**
  - It may be unable to process them all before attempting to complete or transition to another state.
  - Acceptable to ignore in Java SDK
  - Potentially performance degradation

Optional Exercise #4: Sending an External Signal

- **This is an optional exercise**
  - We will do this together if time allows; otherwise, you may do it on your own later
- **During this exercise, you will**
  - Define and handle a Signal
  - Retrieve a handle on the Workflow to Signal
  - Send an External Signal
  - Use a Temporal Client to submit execution requests for both Workflows
- **Refer to the README.md file in the exercise environment for details**
  - The code is below the **exercises/sending-signals-external**
    - Make your changes to the code in the **practice** subdirectory (look for TODO comments)
    - If you need a hint or want to verify your changes, look at the complete version in the **solution** subdirectory

Querying Your Workflows

What are Queries?

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- **Used to retrieve the state during or even after a Workflow Execution**

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  - Monitoring progress of long-running Workflows

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- **Used to retrieve the state during or even after a Workflow Execution**
- **Examples of when you would use Queries** :
  - Monitoring progress of long-running Workflows
  - Retrieving results

Query Attributes

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Query Attributes

- Do not mutate state of Workflow Execution
- Do not execute any Workflow command
- Queries are read-only and must complete synchronously
- Possible to send to a closed Workflow Execution
- Queries will return the most recent state
- A single Workflow can support multiple Queries

Developing Queries pt. 1

1. Defining the Query Type (name)

```
import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.WorkflowMethod;
import io.temporal.workflow.QueryMethod;

@WorkflowInterface
public interface MyWorkflow {

  @WorkflowMethod
  String workflow(String input);

  @QueryMethod
  String queryStatus();
}
```

Developing Queries pt. 2

2. Handling the Query

```
public class MyWorkflowImpl implements MyWorkflow {

  private String status;

  // Workflow code omitted for brevity

  public String queryStatus() {
    return this.status;
  }

}
```

Defining a Query

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- Query Type: A unique name used to identify the query

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- Arguments must be serializable

Defining a Query

- Query Type: A unique name used to identify the query
- Arguments must be serializable
- Use the @QueryMethod annotation

```
import io.temporal.workflow.WorkflowInterface;
import io.temporal.workflow.QueryMethod;

@WorkflowInterface
public interface MyWorkflow {

  // Workflow Definition omitted for brevity

  @QueryMethod
  String queryStatus();
}
```

Handling a Query

Handling a Query

- Query handlers: specify what Workflow should do upon receiving a Query

Handling a Query

- Query handlers: specify what Workflow should do upon receiving a Query
- Define the Query Method to handle Queries in a Workflow

```
public class MyWorkflowImpl implements MyWorkflow {

  private String status;

  // Workflow code omitted for brevity

  @Override
  public String queryStatus() {
    return this.status;
  }
}
```

Sending a Query with the SDK

- Use Workflow Stub to invoke the Workflow's Query method
  - You can do this to query both open and closed Workflow Executions

```
public class QueryClient {
  public static void main(String[] args) throws Exception {

    WorkflowServiceStubs service = WorkflowServiceStubs.newLocalServiceStubs();

    WorkflowClient client = WorkflowClient.newInstance(service);

    MyWorkflow workflow = client.newWorkflowStub(MyWorkflow.class, "state-id-0");

    System.out.println(workflow.queryStatus());

    System.exit(0);
  }
```

Sending a Query with the CLI

```
$ temporal workflow query \
    --workflow-id="state-id-0" \
    --type="getValueQuery" \
    --input=\"meaning-of-life\"
```

Exercise #5: Querying Workflows

- **During this exercise, you will**
  - Define and handle a Query
  - Create a handle on a Workflow to be queried
  - Call the Query from the Client
  - Send a Query from the Command Line
- **Refer to the README.md file in the exercise environment for details**
  - The code is below the **exercises/querying-workflows**
    - Make your changes to the code in the **practice** subdirectory (look for TODO comments)
    - If you need a hint or want to verify your changes, look at the complete version in the **solution** subdirectory

Workflow Updates

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- **Unlike Signals, sender *must* wait until Worker processes the Update**
  - The sender *may* wait further to receive a returned value

What are Updates?

- **An update is a trackable, synchronous request to a Workflow Execution**
  - Comparable to sending a Signal and a Query at the same time
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  - The sender *may* wait further to receive a returned value
  - If you need an asynchronous response, use a Signal instead

What are Updates?

- **An update is a trackable, synchronous request to a Workflow Execution**
  - Comparable to sending a Signal and a Query at the same time
- **Unlike Signals, sender *must* wait until Worker processes the Update**
  - The sender *may* wait further to receive a returned value
  - If you need an asynchronous response, use a Signal instead
- **A Workflow cannot send an Update to another Workflow**

Update Handlers

- **Defining an Update Handlers is similar to a Signal and Query Handler**

```
public class GreetingWorkflowImpl implements GreetingWorkflow {

    private Language language = Language.ENGLISH;

    @Override
    public String greet() {
        // ... workflow logic
    }

    @Override
    public Language setLanguage(Language newLanguage) {
        Language previousLanguage = this.language;
        this.language = newLanguage;
        return previousLanguage;
    }
}
```

Sending Updates via the Java API

- **Use the Temporal Client's UpdateWorkflow method to send an update**
  - This returns a handle, which you can use to retrieve the Update's result

```
WorkflowStub workflowStub = client.newUntypedWorkflowStub(
    we.getWorkflowId(),
    Optional.of(we.getFirstExecutionRunId()),
    Optional.empty()
);

UpdateOptions<Language> updateOptions = UpdateOptions.<Language>newBuilder(Language.class)
    .setUpdateName(GreetingWorkflow.SET_LANGUAGE_UPDATE)
    .setWaitForStage(WorkflowUpdateStage.ACCEPTED)
    .build();

WorkflowUpdateHandle<Language> updateHandle = workflowStub.startUpdate(
    updateOptions,
    Language.CHINESE
);

Language previousLang = updateHandle.getResultAsync().get(15, TimeUnit.SECONDS);
```

Update Validators

Update Validators

- **Validators can be used to reject an Update before it is written to history**

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  - To reject an Update, return an error in the Validator

Update Validators

- **Validators can be used to reject an Update before it is written to history**
  - To reject an Update, return an error in the Validator
- **If there is no Validator, each Update will be accepted**

Adding Validators to Update Handlers

```
@WorkflowInterface
public interface GreetingWorkflow {

    @WorkflowMethod
    String greet();

    @UpdateMethod(name = "set-language")
    Language setLanguage(Language newLanguage);

    @UpdateValidatorMethod(updateName = "set-language")
    void validateSetLanguage(Language newLanguage);
}
```

Adding Validators to Update Handlers

```
public class GreetingWorkflowImpl implements GreetingWorkflow {

    private Language language = Language.ENGLISH;

    @Override
    public String greet() {
        // ... workflow logic
    }

    @Override
    public Language setLanguage(Language newLanguage) {
        Language previousLanguage = this.language;
        this.language = newLanguage;
        return previousLanguage;
    }

    @Override
    public void validateSetLanguage(Language newLanguage) {
        if (!greetings.containsKey(newLanguage)) {
            throw new IllegalArgumentException(newLanguage + " is an unsupported language");
        }
    }
}
```

Update-with-Start and Dynamic Updates

Update-with-Start and Dynamic Updates

- **Update-With-Start checks if there is currently a running Workflow Execution with the given Workflow ID**

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- **Update-With-Start checks if there is currently a running Workflow Execution with the given Workflow ID**
  - Just as Signal-With-Start does
- **If one exists, it will be sent the Update**
  - If it does not, one will be started and then immediately sent the Update

Update-with-Start and Dynamic Updates

- **Update-With-Start checks if there is currently a running Workflow Execution with the given Workflow ID**
  - Just as Signal-With-Start does
- **If one exists, it will be sent the Update**
  - If it does not, one will be started and then immediately sent the Update
- **Dynamic Update Handlers work the same as Dynamic Signal Handlers**

Beginner to Builder Bootcamp - Java

00. About this Workshop
01. The Basics of Temporal
02. Improving Your Temporal Application Code
03. Using Timers in a Workflow Definition
04. Understanding Event History
05. Understanding Workflow Determinism
06. Signals, Queries, and Workflow Updates
▶ **07. Timeouts and Retry Policies**
08. Recovering from Failure
09. Conclusion

Timeouts

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What are Timeouts?

- **A predefined duration provided for an operation to complete**
- **Temporal uses timeouts for two primary reasons:**
  - Detect failure
  - Establish a maximum time duration for your business logic

Activity Timeouts

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- **Controls the maximum duration of an aspect of an Activity Execution**

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Activity Timeouts

- **Controls the maximum duration of an aspect of an Activity Execution**
- **A measure of the time it takes to transition between one state to another**
- **Specified as an argument in the ActivityOptions class**
- **As with an Activity that fails, an Activity that times out will be retried**
  - Based on details specified in the Retry Policy

Review of Activity Task States

Order	Event Type	Event Description

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1	ActivityTaskScheduled	

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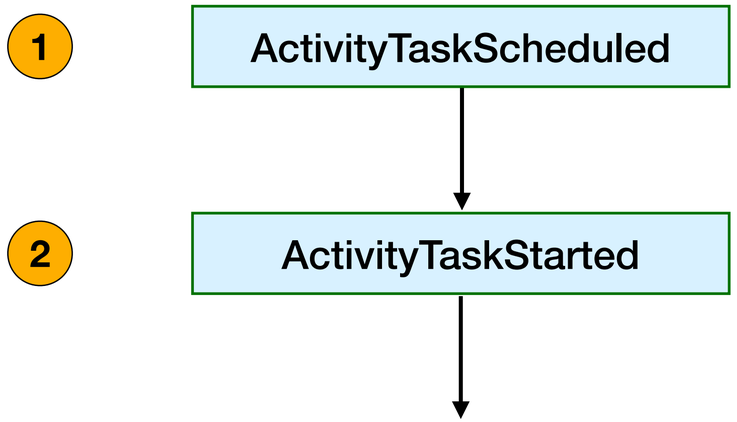


Review of Activity Task States

Order	Event Type	Event Description
1	ActivityTaskScheduled	Temporal Service adds the Activity Task to the Task Queue
2	ActivityTaskStarted	Worker accepts the Activity Task; it's removed from the Task Queue)
3	ActivityTaskCompleted	

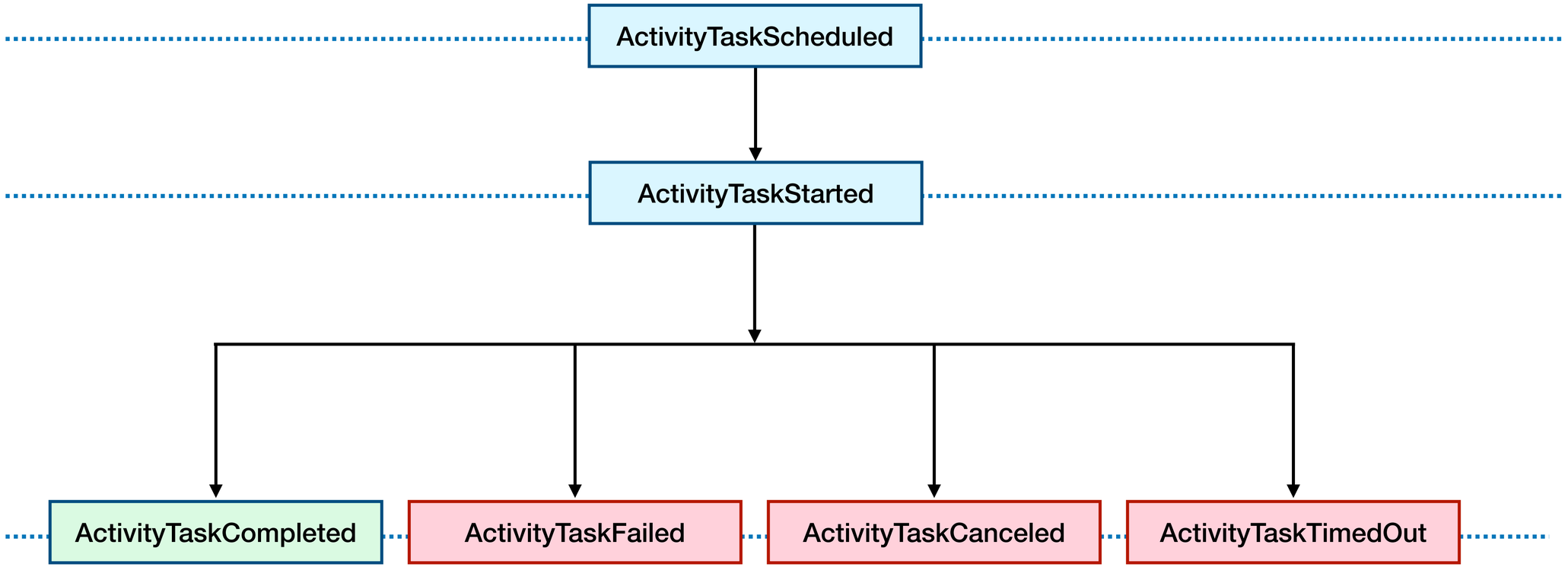
(One of many closed states)

Review of Activity Task States

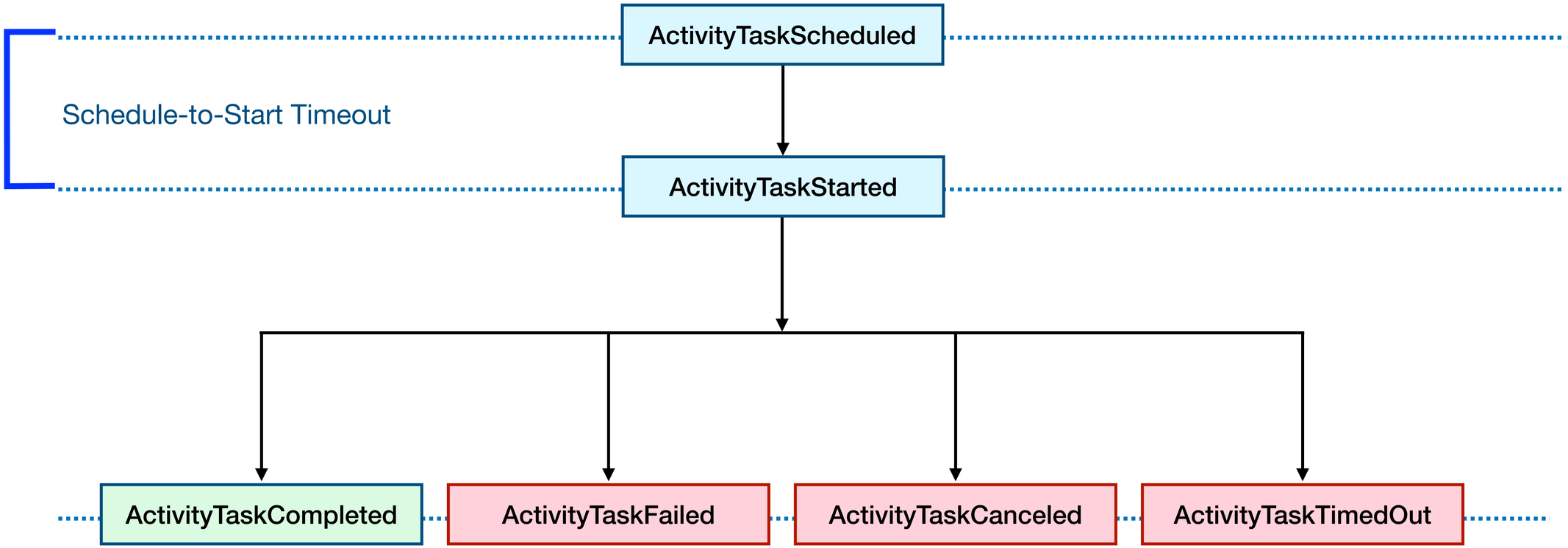
Order	Event Type	Event Description
1	ActivityTaskScheduled	Temporal Service adds the Activity Task to the Task Queue
2	ActivityTaskStarted	Worker accepts the Activity Task; it's removed from the Task Queue)
3	ActivityTaskCompleted	Worker reports result of Activity Execution to the Temporal Service

(One of many closed states)

Understanding Activity Timeout Names



Understanding Activity Timeout Names



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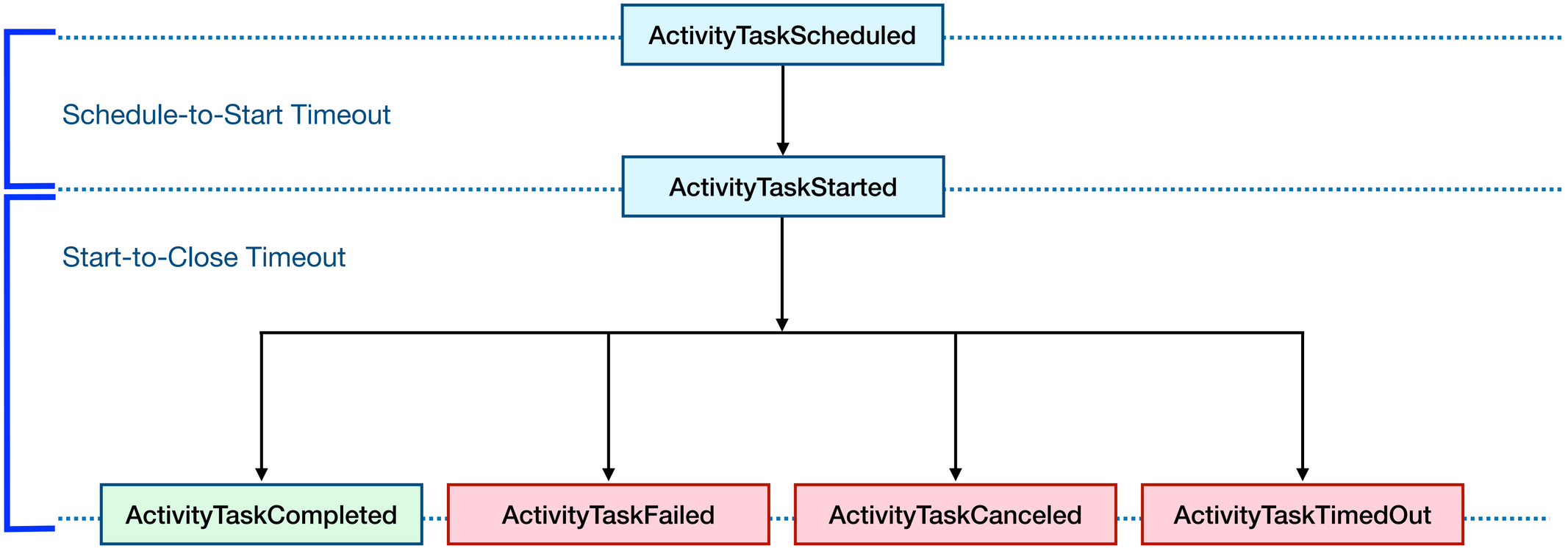
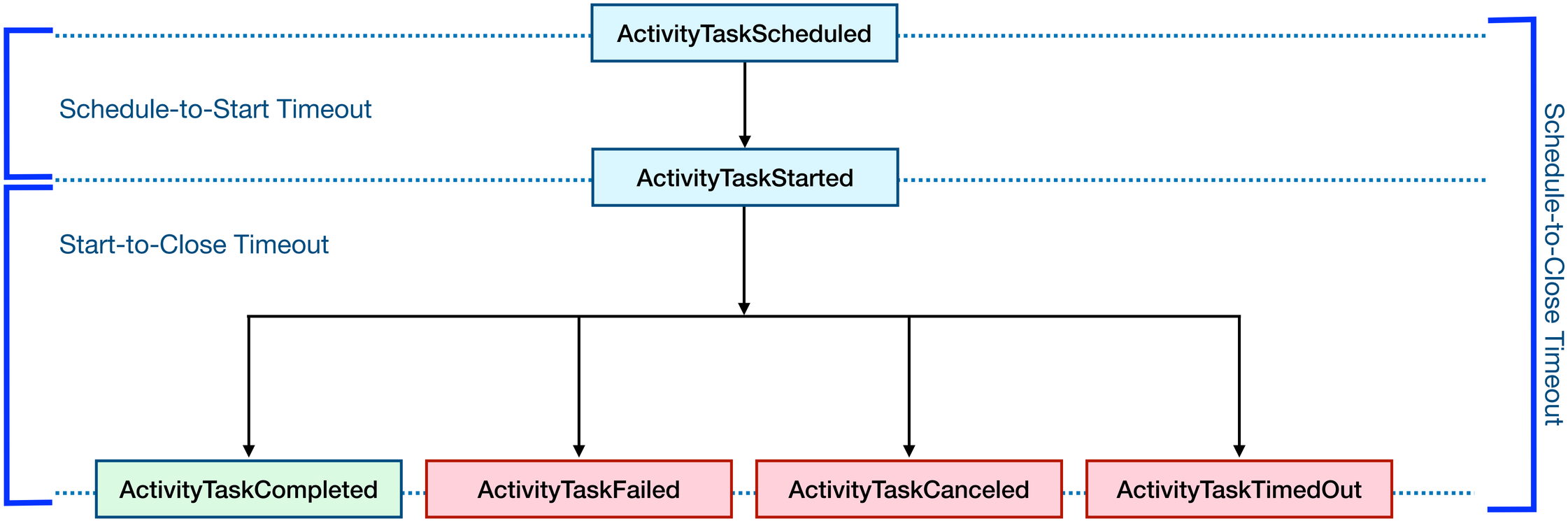
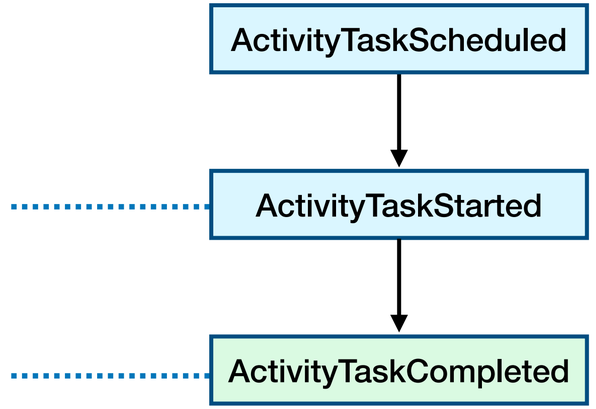


Understanding Activity Timeout Names



Start-to-Close Timeout



Start-to-Close Timeout

- **Limits maximum time allowed for a single Activity *Task* Execution**

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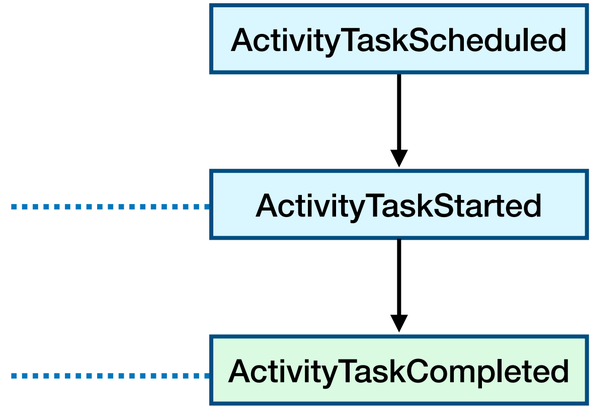
ActivityOptions options = ActivityOptions.newBuilder()
    .setStartToCloseTimeout(Duration.ofSeconds(5))
    .build();
```



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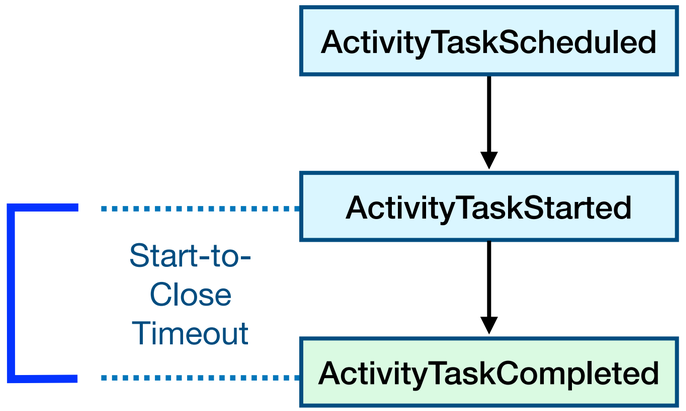

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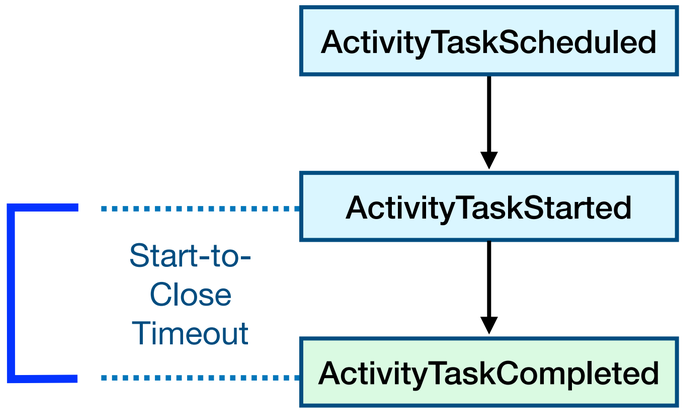

Start-to-Close Timeout

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  - Recommended: Set duration slightly longer than *maximum* time you expect the Activity will take

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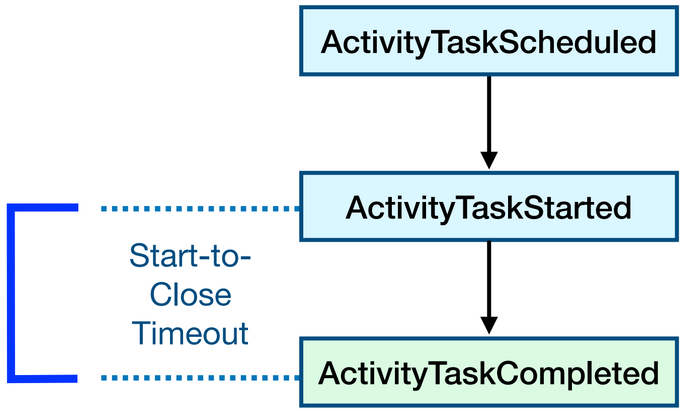
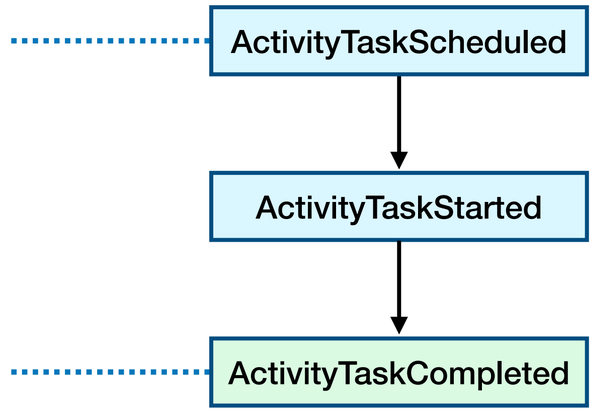


Schedule-to-Close Timeout



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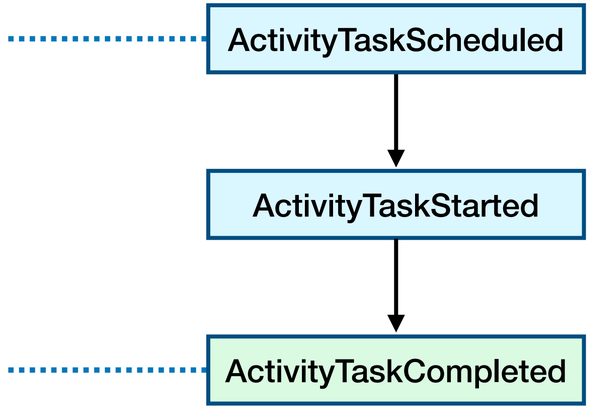

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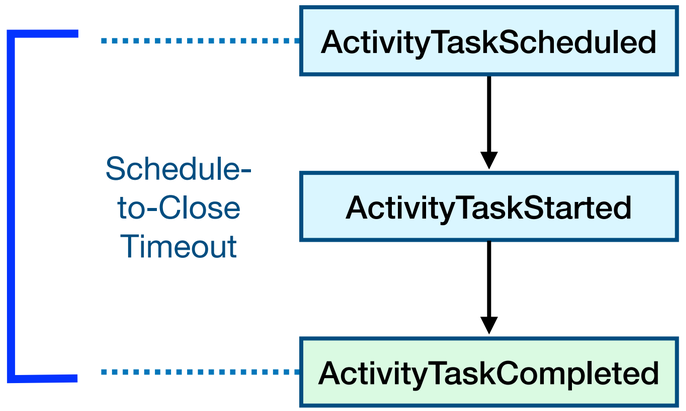

Schedule-to-Close Timeout

- **Limits maximum time allowed for entire Activity Execution**
  - Because it includes all retries, it is typically less predictable than a Start-to-Close Timeout

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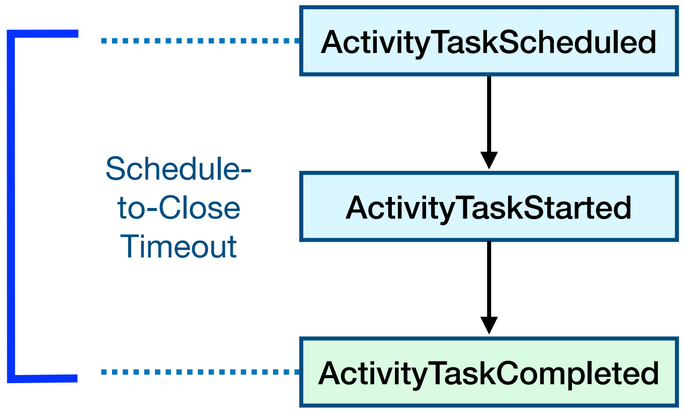
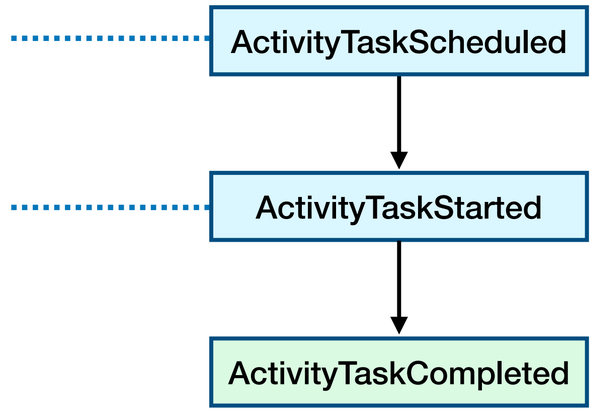
    .build();
```



Schedule-to-Start Timeout



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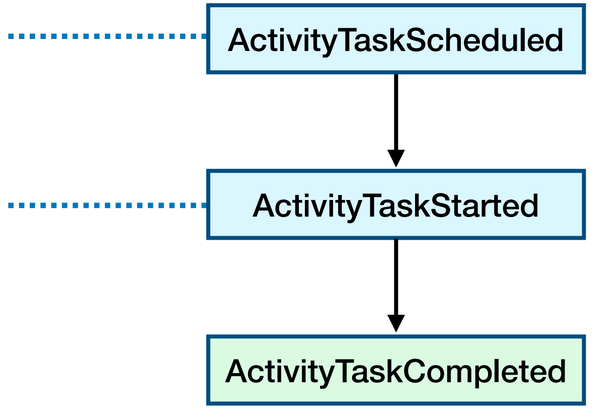

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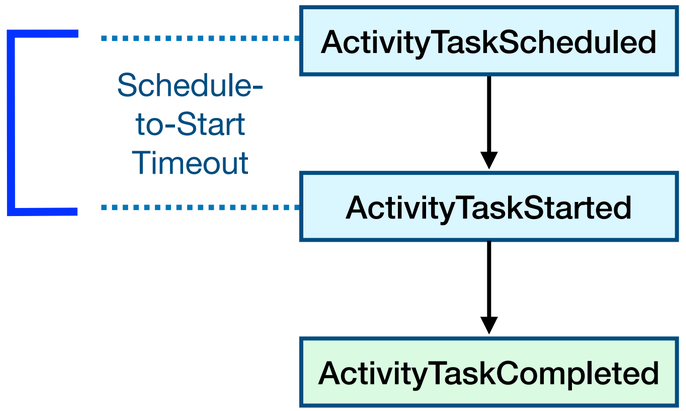

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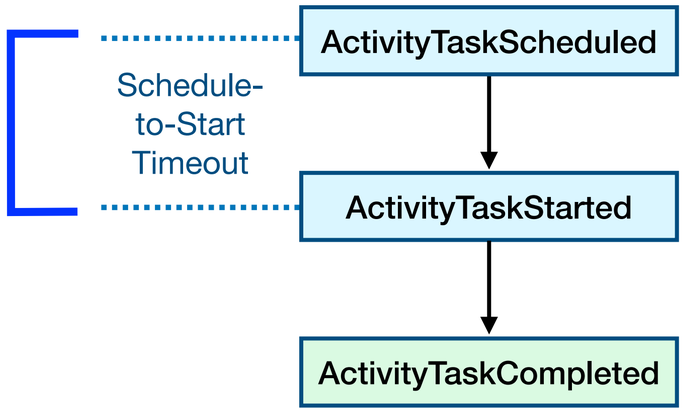

Schedule-to-Start Timeout

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  - Ensures the Activity is started within a specified time frame, though it's seldom recommended
  - If set, it is done *in addition to* a Start-to-Close or Schedule-to-Close Timeout

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    .setStartToCloseTimeout(Duration.ofSeconds(10))
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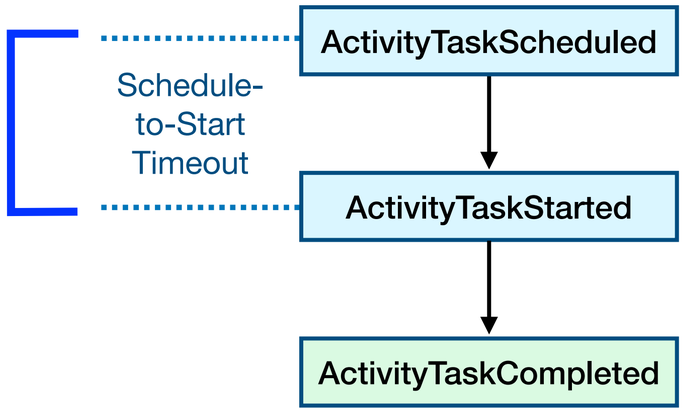
```



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- **Retry Policies allow you to specify a maximum number of retry attempts**
  - However, using Timeouts to limit the duration is typically more useful
  - Business logic tends to be concerned with how long something takes (for example, SLAs)

Workflow Timeouts

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Workflow Execution Timeout

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- **The maximum amount of time that a single Workflow Execution can be executed**

```
WorkflowOptions options = WorkflowOptions.newBuilder()
    .setWorkflowId(workflowID)
    .setTaskQueue(Constants.TASK_QUEUE_NAME)
    .setWorkflowExecutionTimeout(Duration.ofSeconds(10))
    .build();
```

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Workflow Execution Timeout

- **The maximum amount of time that a single Workflow Execution can be executed**
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- **Default is infinite**

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```
WorkflowOptions options = WorkflowOptions.newBuilder()
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    .setWorkflowRunTimeout(Duration.ofSeconds(10))
    .build();
```

Workflow Run Timeout

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  - Restricts the maximum duration of a single Workflow Run

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- **Restricts the maximum amount of time that a Worker can execute a Workflow Task**

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WorkflowOptions options = WorkflowOptions.newBuilder()
    .setWorkflowId(workflowID)
    .setTaskQueue(Constants.TASK_QUEUE_NAME)
    .setWorkflowTaskTimeout(Duration.ofSeconds(20))
    .build();
```

Workflow Task Timeout

- **Restricts the maximum amount of time that a Worker can execute a Workflow Task**
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- **Default value of is ten seconds**

```
WorkflowOptions options = WorkflowOptions.newBuilder()
    .setWorkflowId(workflowID)
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  - No, really, we REALLY don't recommend it.
- **If you need to perform an action inside your Workflow after a specific period time, we recommend using a Timer**

Activity Heartbeats

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  - Progress indication
  - Cancellation Detection
  - Worker Health Check

How to Send a Heartbeat Message

```
for(int x = 0; x < 10; x++){
  Activity.getExecutionContext().heartbeat(x);
  try {
    Thread.sleep(Duration.ofSeconds(1));
  } catch (InterruptedException e) {
    continue;
  }
}
```

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  - When an Activity sends a Heartbeat, the Temporal Service checks if there has been a cancellation request.
  - If a cancellation request exists, it is included in the response to the Heartbeat.
  - This allows the Activity to respond promptly to cancellation requests.
- **If you need to cancel a long-running Activity Execution, make sure it is configured to send Heartbeats periodically**

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```
ActivityOptions options = ActivityOptions.newBuilder()
    .setStartToCloseTimeout(Duration.ofMinutes(5))
    .setHeartbeatTimeout(Duration.ofSeconds(3))
    .build();
```

Heartbeat Timeout

- **The maximum time allowed between Activity Heartbeats**
- **The Heartbeat Timeout must be set in order for Temporal to track the Heartbeats sent by the Activity**
  - If this Timeout is not set, any Heartbeats sent by the Activity will be ignored.

```
ActivityOptions options = ActivityOptions.newBuilder()
    .setStartToCloseTimeout(Duration.ofMinutes(5))
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```

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- **Must send Heartbeats at intervals shorter than the Heartbeat Timeout**

Heartbeat Throttling

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- **Does not apply to the final Heartbeat in the case of Activity Failure**

Heartbeat Throttling

Activity ID	Details	
4	**Activity Type**	**pollDeliveryDriver**
	Attempt	1
	Maximum Attempts	5
	Last Heartbeat	
	State	PENDING_ACTIVITY_STATE_STARTED
	Last Started Time	2024-08-08 UTC 01:28:12.76
	Last Worker Identity	45943@Angelas-MBP

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  - Workflow Tasks retry automatically and indefinitely

Retry Policy for Activities

Method	Specifies	Default Value

Retry Policy for Activities

- Customize RetryPolicy by calling methods on RetryOptions.Builder

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setBackoffCoefficient	Multiplier used for subsequent retries	2.0
setMaximumInterval	Maximum duration between retries, in seconds	100 * InitialInterval
setMaximumAttempts	Maximum number of retry attempts before giving up	0 (unlimited)

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setInitialInterval	Duration before the first retry	1 second
setBackoffCoefficient	Multiplier used for subsequent retries	2.0
setMaximumInterval	Maximum duration between retries, in seconds	100 * InitialInterval
setMaximumAttempts	Maximum number of retry attempts before giving up	0 (unlimited)
setDoNotRetry	List of application failure types that won’t be retried	[] (empty array)

Retry Policy for Activities

- Customize RetryPolicy by calling methods on RetryOptions.Builder

Method	Specifies	Default Value
setInitialInterval	Duration before the first retry	1 second
setBackoffCoefficient	Multiplier used for subsequent retries	2.0
setMaximumInterval	Maximum duration between retries, in seconds	100 * InitialInterval
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setDoNotRetry	List of application failure types that won't be retried	[] (empty array)

```
RetryOptions retryOptions = RetryOptions.newBuilder()
    .setInitialInterval(Duration.ofSeconds(20))
    .setBackoffCoefficient(3.0)
    .setMaximumInterval(Duration.ofSeconds(360))
    .setDoNotRetry(CreditCardProcException.class.getName(), "ExpiredCardError")
    .build();
```

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- **Define a Retry Policy for failures you anticpate**

Custom Retry Policy for Activity Execution

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import io.temporal.common.RetryOptions;

public class GreetingWorkflowImpl implements GreetingWorkflow {

    RetryOptions retryOptions = RetryOptions.newBuilder()
        .setInitialInterval(Duration.ofSeconds(15))
        .setBackoffCoefficient(2.0)
        .setMaximumInterval(Duration.ofSeconds(60))
        .setMaximumAttempts(100)
        .build();

    ActivityOptions options = ActivityOptions.newBuilder()
            .setStartToCloseTimeout(Duration.ofSeconds(5))
            .setRetryOptions(retryOptions)
            .build();

    private final GreetingActivities activities =
            Workflow.newActivityStub(GreetingActivities.class, options);

    @Override
    public String greetSomeone(String name) {
        // .. remainder of Workflow code would follow
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  - One of the few instances where setting Maximum Attempts is appropriate

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- **Avoid retry policies for Workflow Executions**

Customizing a Retry Policy for a Specific Activity

```
// Create Activity Stub with Retry Policy One
RetryOptions retryOptionsOne = RetryOptions.newBuilder()
    .setInitialInterval(Duration.ofSeconds(5))
    .setBackoffCoefficient(3.0)
    .build();

ActivityOptions optionsOne = ActivityOptions.newBuilder()
    .setStartToCloseTimeout(Duration.ofMinutes(5))
    .setRetryOptions(retryOptionsOne)
    .setHeartbeatTimeout(Duration.ofSeconds(3))
    .build();

private final MyActivities activitiesOne =
    Workflow.newActivityStub(MyActivities.class, optionsOne);

// Create Activity Stub with Retry Policy Two
RetryOptions retryOptionsTwo = RetryOptions.newBuilder()
    .setInitialInterval(Duration.ofSeconds(10))
    .setBackoffCoefficient(1.25)
    .build();

ActivityOptions optionsTwo = ActivityOptions.newBuilder()
    .setStartToCloseTimeout(Duration.ofMinutes(5))
    .setRetryOptions(retryOptionsTwo)
    .setHeartbeatTimeout(Duration.ofSeconds(3))
    .build();

private final MyActivities activitiesTwo =
    Workflow.newActivityStub(MyActivities.class, optionsTwo);
```

```
public String myWorkflow(String name){

    // Calling the greet Activity useing Retry Policy One
    String resultOne = activitiesOne.greet(name);

    // Calling the greet Activity useing Retry Policy Two
    String resultTwo = activitiesTwo.greet(name);

    return resultOne + " " + resultTwo;
}
```

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  - Workflow failures typically indicate a permanent failure
- **We do not recommend associating a Retry Policy with your Workflow Execution**

Exercise #6: Non-Retryable Error Types

- **During this exercise, you will**
  - Configure non-retry able error types for Activities
  - Implement customized retry policies for Activities
  - Add Heartbeats and Heartbeat timeouts to help users monitor the health of Activities
- **Refer to the README.md file in the exercise environment for details**
  - The code is below the **exercises/non-retryable-error-types**
    - Make your changes to the code in the **practice** subdirectory (look for TODO comments)
    - If you need a hint or want to verify your changes, look at the complete version in the **solution** subdirectory

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  - Resets the Workflow Execution state to a previous point in the Event History

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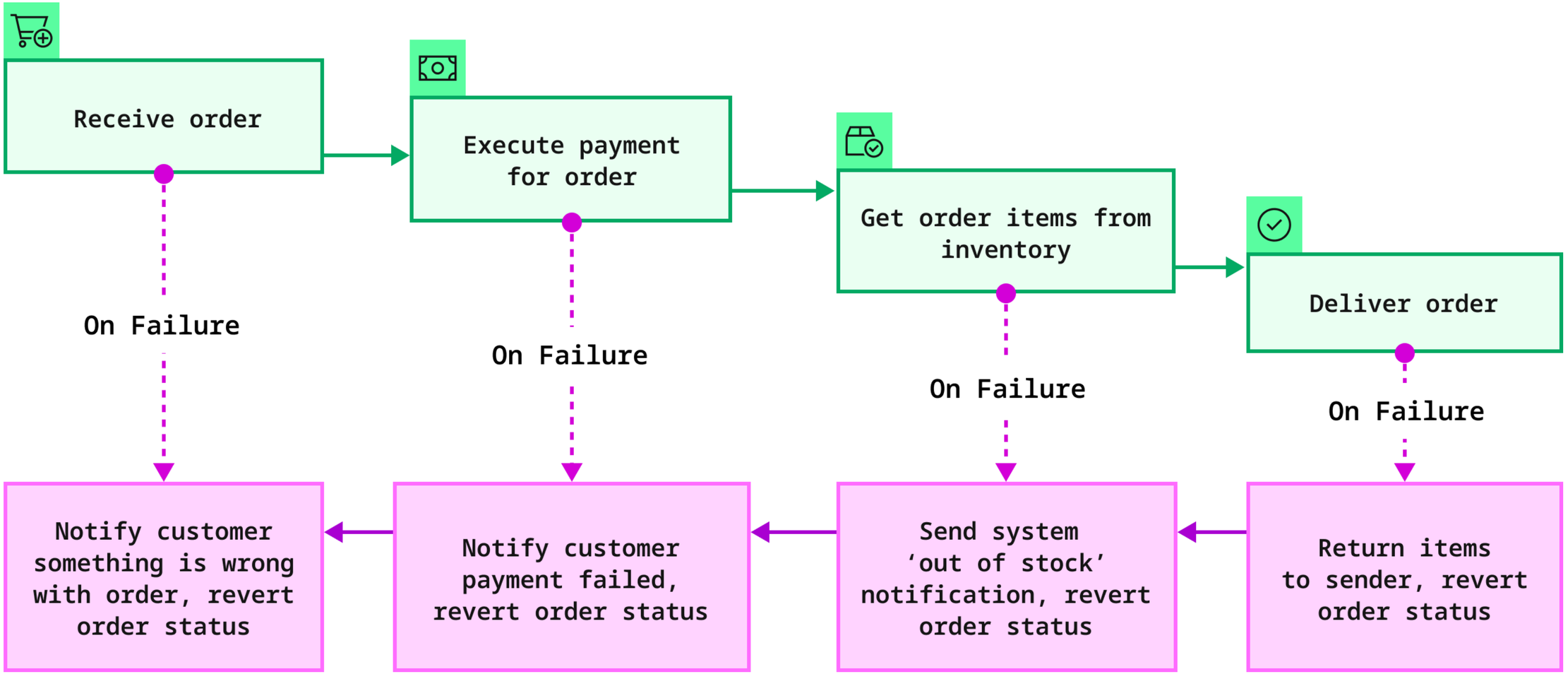
  - Distributed Data Updates

Rollback Actions and the Saga Pattern



Rollback Actions and the Saga Pattern

```
import io.temporal.workflow.Saga;

// within Workflow method

Saga saga = new Saga(new Saga.Options.Builder().build());
try {
  saga.addCompensation(activities::refundHotel, billingInfo);
  activities.bookHotel(billingInfo);
} catch (ActivityFailure e) {
  // Compensating action for booking failure
  saga.compensate();
}
```

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try {
  saga.addCompensation(activities::revertInventory, order.getItems());
  String inventoryResult = activities.updateInventory(order.getItems());


  saga.addCompensation(activities::refundBill, bill);
  String creditCardConfirmation = activities.sendBill(bill);
} catch (ActivityFailure e) {
  saga.compensate();
  throw e;
}
```

Optional Exercise #7
Implementing a Rollback Action with the Saga Pattern

- **This is an optional exercise**
  - We will do this together if time allows; otherwise, you may do it on your own later
- **During this exercise, you will**
  - Orchestrate Activities using a Saga pattern to implement compensating transactions
  - Handle failures with rollback logic
- **Refer to the README.md file in the exercise environment for details**
  - The code is below the **exercises/rollback-with-saga**
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  - You can change this behavior with a custom Retry Policy

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- **Temporal uses History Replay to achieve Durable Execution**
  - Essentially, the Worker selectively re-runs code based on what is in the Event History

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- **Signals are a way of passing data to a running Workflow Execution**

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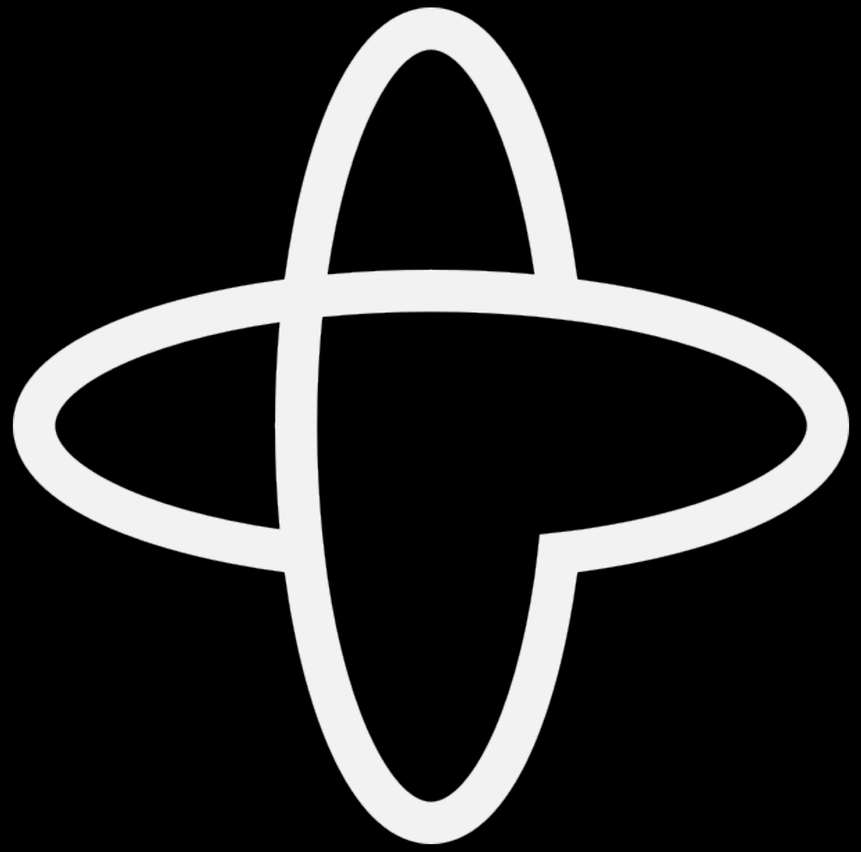

Thank You