Hawaii Framework Reference Documentation

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E kūlia i ka nu’u. Strive to reach the highest.

Chapter 1. Introduction to Hawaii

The Hawaii Framework is a Java framework for developing Spring based applications.

It provides production-ready features and integrations based best practices and experience to boost projects.

The Hawaii Framework is developed internally at QNH and is used in projects for medium and large enterprise customers.

1.1. Spring Boot

Combining Spring Boot and the Hawaii production-ready features and auto configuration brings even more power and simplicity to developers, without sacrificing flexibility.

The Hawaii Framework also provides various Spring Boot Starters to automatically include the needed dependencies and trigger the auto configuration of the Hawaii production-ready features.

But it is important to mention that most of the Hawaii features can also used without using Spring Boot. In that case the desired features need to be configured manually by defining the appropriate Spring beans inside the application's context.

Chapter 2. Getting Started with Hawaii

TODO.

Chapter 3. Hawaii Features

TODO.

3.1. Environments

TODO.

3.2. Configuration properties

TODO.

3.3. Logging

TODO.

3.4. Hawaii Time

`HawaiiTime` is not merely a convenient wrapper to instantiate new `java.time` date and time objects. It provides an application wide `java.time.Clock` reference which is particular useful for unit testing.

It is similar to Joda's `DateTimeUtils` which also allows setting a fixed current time. However it is important to note that Joda's `DateTimeUtils` uses a static variable to store the current time. `HawaiiTime` does not take this approach. Instead the `HawaiiTime` bean needs to be injected in any class that needs to instantiate new date and time objects. This approach is more flexible and e.g. has the benefit that unit tests can be run in parallel. See example usage below.

```java
public class MyClass {

    private HawaiiTime hawaiiTime;

    public MyClass(HawaiiTime hawaiiTime) { ①
        this.hawaiiTime = hawaiiTime;
    }

    public void doSomethingWithDate() {
        ZonedDateTime dateTime = this.hawaiiTime.zonedDateTime(); ②
        // ...
    }
}


public class MyClassTests {

    @Test
    public void testDoSomethingWithDate() {
        long millis = System.currentTimeMillis();
        HawaiiTime hawaiiTime = new HawaiiTime();
        hawaiiTime.useFixedClock(millis); ③
        MyClass myClass = new MyClass(hawaiiTime);
        myClass.doSomethingWithDate();
        // ...
    }
}
```

① Inject the `HawaiiTime` bean.

② Use the injected `HawaiiTime` bean to instantiate new date and time objects.

③ In unit tests a fixed clock can be used to manipulate and predict the exact current time.

Another benefit of using `HawaiiTime` is that a fixed time can be used in a running application to test how it behaves on a given date or time.

> Third-party libraries being used by the application do not use `HawaiiTime` and probably instantiate date and time objects based on the `System` time.

Hawaii uses `UTC` as default timezone but this can be changed by setting the `hawaii.time.timezone` configuration property. The provided value will be parsed by `java.time.ZoneId#of(String zoneId)` and supports different timezone formats like `UTC`, `Europe/Amsterdam` and `GMT+1`.

The creation of the `HawaiiTime` bean can also be disabled by setting `hawaii.time.enabled` to `false`.

3.5. Validation

Hawaii's validation mechanism can be used to validate any object. It basically validates values, collects validation errors and stores them in a validation result. These validation errors are simple field / error code combinations.

Hawaii's `Validator` is inspired on Spring's `org.springframework.validation.Validator` mechanism. However Hawaii's validator mechanism uses it's own `ValidationResult` instead of Spring's `org.springframework.validation.Errors`. The main difference is that Hawaii's `ValidationResult` does not bind directly the object being validated. This also gives the possibility to add errors for specific keys that are not direct properties of the object being validated.

Hawaii's validation mechanism also provides additional sugar like Hamcrest matcher support to write human readable validating code, the capability to validate and automatically throw a `ValidationException` in case of errors etc.

Like Spring's validation mechanism the Hawaii validation mechanism also supports the notion of nested error paths which also stimulates to re-use validators.

Let's take an example. Imagine a `Customer` object with common name, e-mail, and address fields. A validation result could for example contain the following field / error code combinations:

```
first_name = required ①
last_name = max_length_exceeded
email = invalid
addresses = primary_address_required ②
addresses[0].type = invalid ③
addresses[0].street_name = max_length_exceeded
addresses[0].postal_code = invalid
addresses[0].city = max_length_exceeded
addresses[0].country_code = required
```

① The field `first_name` has an `required` error code.

② The field `adresses` (an array in this case) has `primary_address_required` error code.

③ The field `type` of the first address in the `addresses` array has a `invalid` error code.

The example demonstrates simple field errors (like `first_name`) but also storing errors for arrays and nested paths (`addresses[0].type`). In theory a field could also have multiple error codes if needed.

Implementors should typically only implement the `org.hawaiiframework.sample.validator.Validator#validate(Object, ValidationResult)` method as the other methods in the interface are already implemented using the interface's default methods.

A generic `EmailValidator` would look like:

```
import org.hawaiiframework.validation.ValidationResult;
import org.hawaiiframework.validation.Validator;
import org.springframework.stereotype.Component;

import java.util.regex.Pattern;

@Component
public class EmailValidator implements Validator<String> { ①

    public static final String EMAIL_PATTERN = "^[_A-Za-z0-9-\\+]+(\\.[_A-Za-z0-9-
]+)*@[A-Za-z0-9-]+(\\.[A-Za-z0-9]+)*(\\.[A-Za-z]{2,})$";

    private Pattern pattern;

    public EmailValidator() {
        this.pattern = Pattern.compile(EMAIL_PATTERN);
    }

    @Override
    public void validate(String email, ValidationResult validationResult) { ②
        if (!pattern.matcher(email).matches()) {
            validationResult.rejectValue("invalid"); ③
        }
    }
}
```

① Implement the `Validator` (in this case a `String`).

② Override the `Validator#validate(Object, ValidationResult)` method.

③ In case the e-mail is invalid, reject the value with error code `invalid` and store it in the validation result.

The `CustomerValidator` would look like:

```
import org.apache.commons.lang3.StringUtils;
import org.hawaiiframework.sample.validator.EmailValidator;
import org.hawaiiframework.validation.ValidationResult;
import org.hawaiiframework.validation.Validator;
import org.springframework.stereotype.Component;

import java.util.List;

import static org.hamcrest.Matchers.greaterThan;

@Component
public class CustomerInputValidator implements Validator<CustomerInput> { ①

    private final EmailValidator emailValidator;
    private final AddressValidator addressValidator;
```

```
    public CustomerInputValidator(final EmailValidator emailValidator,
            final AddressValidator addressValidator) { ②
        this.emailValidator = emailValidator;
        this.addressValidator = addressValidator;
    }

    @Override
    public void validate(CustomerInput customer, ValidationResult validationResult) {
③

        // first name validation
        String firstName = customer.getFirstName();
        if (StringUtils.isBlank(firstName)) {
            validationResult.rejectValue("first_name", "required");
        } else {
            validationResult.rejectValueIf(firstName.length(), greaterThan(25),
"first_name",
                    "max_length_exceeded");
        }

        // last name validation
        String lastName = customer.getLastName();
        if (StringUtils.isBlank(lastName)) {
            validationResult.rejectValue("last_name", "required");
        } else {
            validationResult.rejectValueIf(lastName.length(), greaterThan(25),
"last_name",
                    "max_length_exceeded");
        }

        // e-mail validation
        String email = customer.getEmail();
        if (StringUtils.isBlank(email)) {
            validationResult.rejectValue("email", "required");
        } else if (email.length() > 100) {
            validationResult.rejectValue("email", "max_length_exceeded");
        } else {
            validationResult.pushNestedPath("email");
            emailValidator.validate(email, validationResult);
            validationResult.popNestedPath();
        }

        // adresses validation
        List<Address> addresses = customer.getAddresses();
        if (addresses == null || addresses.size() == 0) {
            validationResult.rejectValue("addresses", "required");
        } else {
            // addresses array validations
            long primaries = addresses.stream()
                    .filter(address -> address.getType() == AddressType.PRIMARY)
                    .count();
```

```
            if (primaries == 0) {
                validationResult.rejectValue("addresses", "primary_address_required");
            } else if (primaries > 1) {
                validationResult.rejectValue("addresses",
"only_1_primary_address_allowed");
            }
            if (addresses.size() > 3) {
                validationResult.rejectValue("addresses",
"max_array_length_exceeded");
            }
            // address validations
            for (int i = 0; i < addresses.size(); i++) {
                validationResult.pushNestedPath("addresses", i);
                addressValidator.validate(addresses.get(i), validationResult);
                validationResult.popNestedPath();
            }
        }
    }
}
```

① Implement the `Validator` (in this case a `Customer`).

② Inject other validators (`EmailValidator`, `AddressValidator`) to be re-used.

③ Override the `Validator#validate(Object, ValidationResult)` method.

3.6. Web

3.6.1. Global Exception Handler

TODO.

3.6.2. REST Representations

TODO.

Input Converter

TODO.

Resource Assembler

TODO.

Chapter 4. Hawaii Starters

TODO.

4.1. hawaii-starter

TODO.

4.2. hawaii-starter-rest

TODO.

4.3. hawaii-starter-test

TODO.

4.4. hawaii-starter-async

The asynchronous request execution in Hawaii is built on top of the scheduling in Spring Framework, see the Spring documentation for a baseline explanation.

There are two main additions:

- More flexibility in executor configuration
- Task timeout

4.4.1. Executor configuration

The Hawaii async configuration allows the definition of executors. An executor can be viewed as a thread pool. An executor configuration looks something like this:

```
executors:
-
    name: default
    corePoolSize: 10
    keepAliveTime: 60
    maxPendingRequests: 60
    maxPoolSize: 60
```

The lowest level of configuration is a task. Tasks are grouped into systems. A system could be some backend system against which requests are executed, or a database on which queries are executed. Each request or query represents a task in Hawaii async terminology. System and task configuration looks like this:

```
systems:
  -
      name: mySystem
      defaultExecutor: myExecutor
      defaultTimeout: 3
      tasks:
        -
            method: myTask
            executor: mySpecialExecutor
            timeout: 1
        -
            method: myOtherTask
```

As can be seen, an executor can be assigned on system level. This will be the default executor for all the tasks in the system, unless a specific executor is configured for a task, such as `myTask` in the example. The same mechanism applies to the timeout settings. It is therefore perfectly legal to configure a task without any properties. However, it remains necessary to define the task in the configuration, otherwise it can't be used, i.e. every task **must** be defined in the configuration.

Finally, there are some global properties:

```
defaultExecutor: default
defaultTimeout: 10
asyncTimeoutExecutorPoolSize: 10
```

These define the default executor and timeout. These defaults will be used if no executor or timeout is defined on either task or system.

The `asyncTimeoutExecutorPoolSize` property defines the number of threads that are used to run timeout tasks. See task timeout.

4.4.2. Task timeout

Another addition is automatically timing out tasks. For each task that is executed, the Hawaii async framework enqueues a cancellation task into a separate executor. If the timeout moment arrives, the timeout task is executed and will attempt to abort the actual task being executed. The actual task will remove the timeout task when it finishes, so if a task runs within its time limit, the timeout task will never be run.

4.4.3. Usage

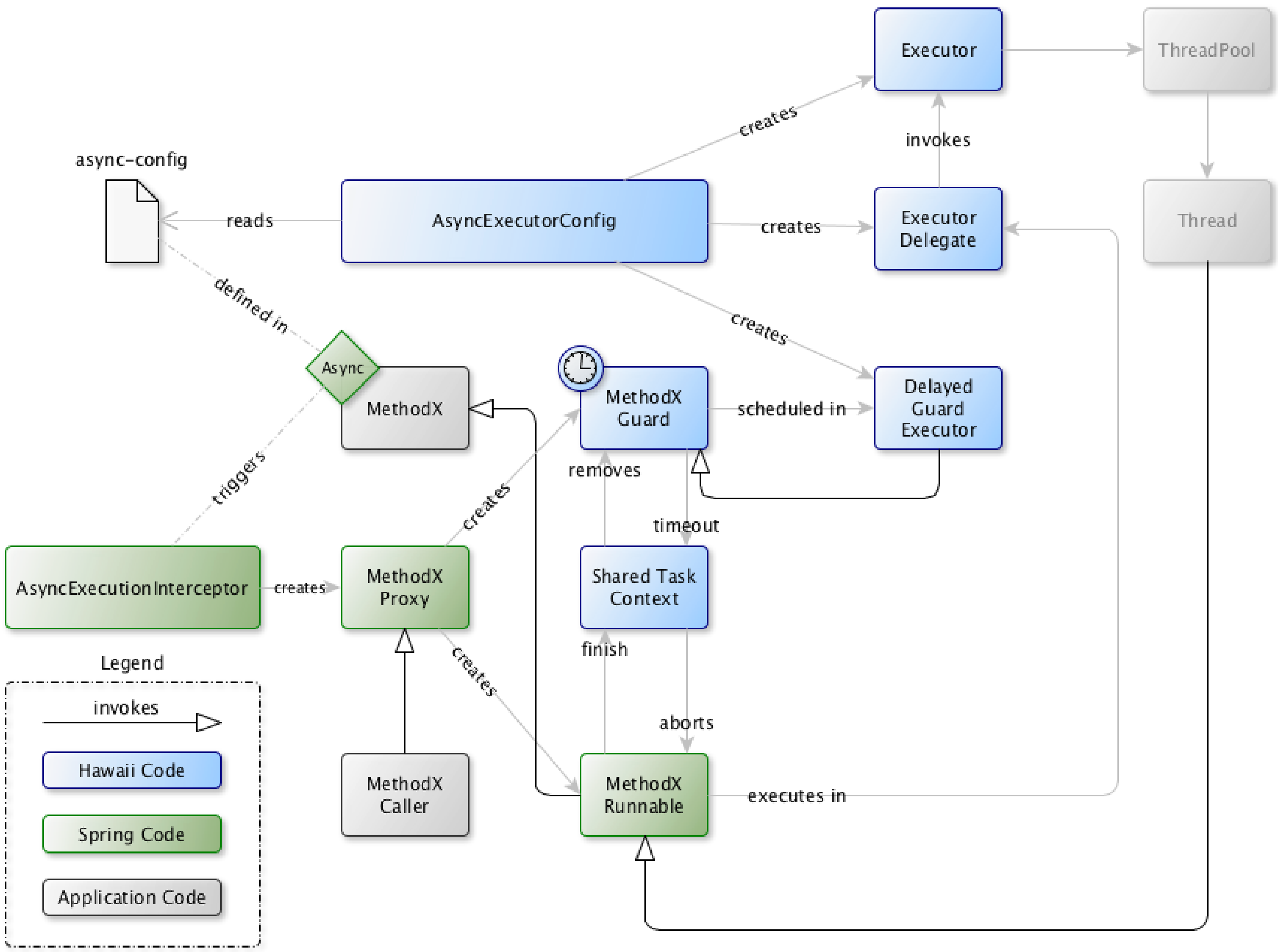
In practice, using the Hawaii asynchronous framework is not that different from using Spring's: asynchronous execution must be enabled with `@EnableAsync` and methods that are to be executed asynchronously must be annotated with the `@Async` annotation, and they must have a `Future` typed return value.

Additionally, an asynchronous configuration must be defined in the file identified by the `hawaii.async.configuration` property, which is set to `./config/async-config.yml` by default.

The essential difference in usage is that where Spring allows the specification of an executor by specifying the value of the `@Async` annotation, the Hawaii additions allow specifying the `Task` name instead of the executor. The Hawaii async configuration will take care of routing the execution to the correct `Executor`.

4.4.4. Components

The following diagram shows the various components in the Hawaii async solution:



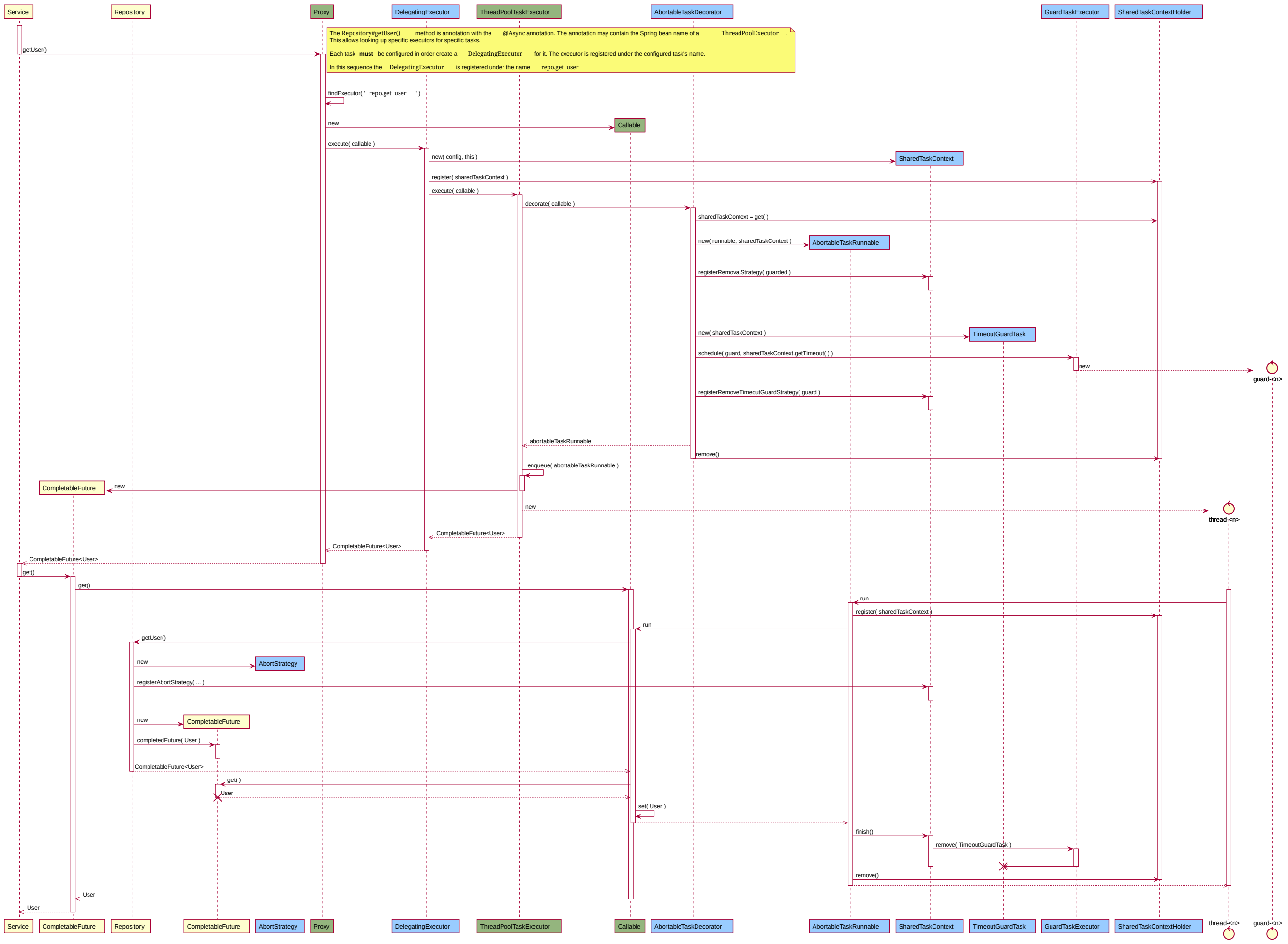
In the diagram, MethodX is the call that must be executed asynchronously, for example service or repository method. The `@Async` annotation causes Spring to create a proxy around this method. The proxy locates the executor, which in the Hawaii case is a `DelegatingExecutor` which will delegate to the real executor specified for the task. The executor takes the `MethodX Runnable` and executes it on an available thread.

Additionally, a delayed (by the configured timeout) task, the `MethodX Guard` is created and passed to the `Delayed Guard Executor`.

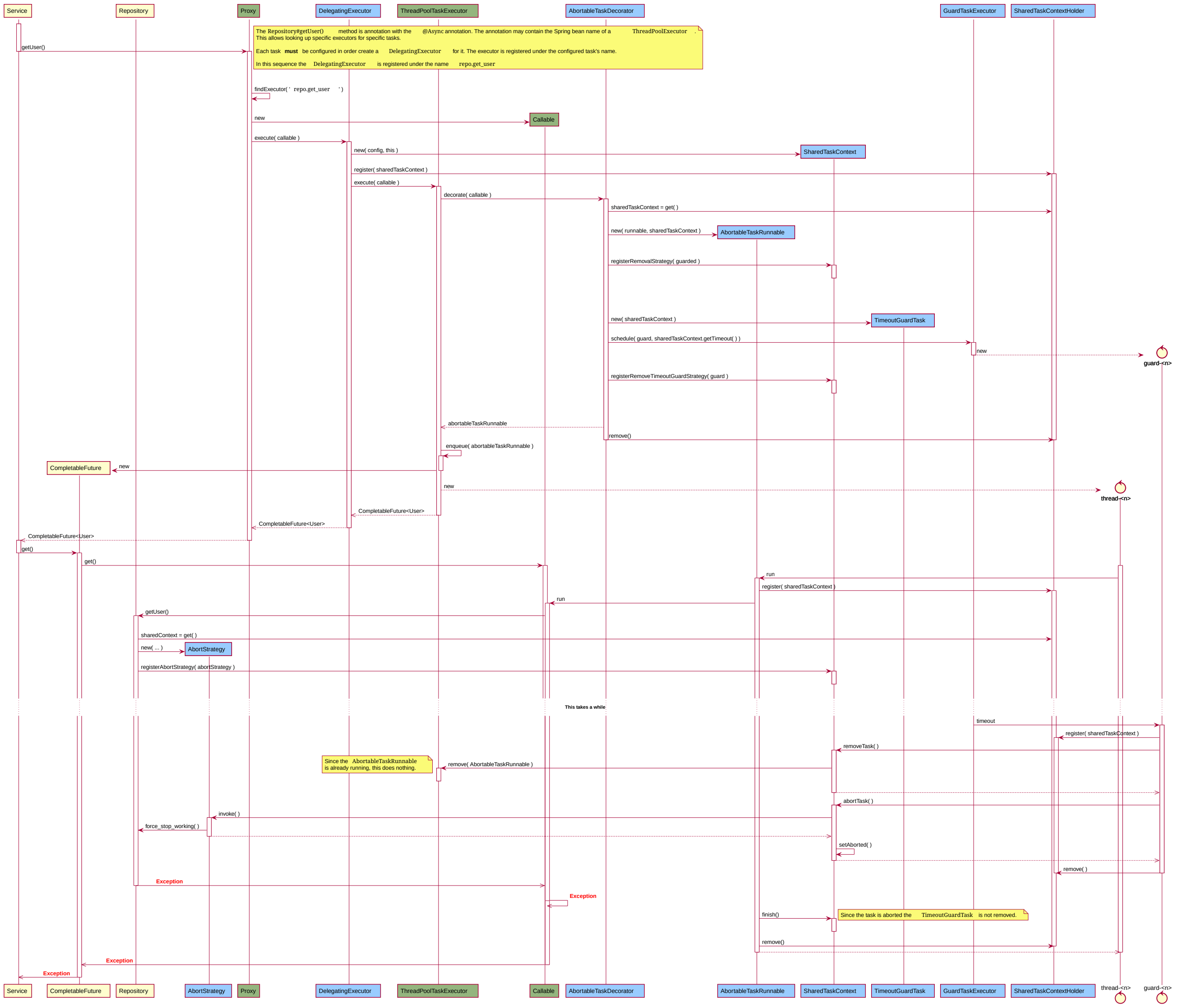
Both tasks share the `Shared Task Context` which allows them to share logging context, and which also provides access for the guarded task to remove the guard task upon completion, and for the guard task to abort the guarded task upon activation.

4.4.5. Processing

The sequence below shows the components working together to execute a task.



The sequence below shows the flow when a task times out.


Service
Repository
Proxy
DelegatingExecutor
ThreadPoolTaskExecutor
AbortableTaskDecorator
GuardTaskExecutor
SharedTaskContextHolder
The Repository#getUser() method is annotation with the @Async annotation. The annotation may contain the Spring bean name of a ThreadPoolExecutor.
This allows looking up specific executors for specific tasks.
Each task must be configured in order create a DelegatingExecutor for it. The executor is registered under the configured task's name.
In this sequence the DelegatingExecutor is registered under the name repo.get_user
getUser()
findExecutor(' repo.get_user ')
new
Callable
execute(callable)
new(config, this)
SharedTaskContext
register(sharedTaskContext)
execute(callable)
decorate(callable)
sharedTaskContext = get( )
new(runnable, sharedTaskContext)
AbortableTaskRunnable
registerRemovalStrategy(guarded)
new(sharedTaskContext)
TimeoutGuardTask
schedule(guard, sharedTaskContext.getTimeout( ))
new
guard-<n>
registerRemoveTimeoutGuardStrategy(guard)
abortableTaskRunnable
remove()
enqueue(abortableTaskRunnable)
CompletableFuture
new
new
thread-<n>
CompletableFuture<User>
CompletableFuture<User>
CompletableFuture<User>
get()
get()
run
register(sharedTaskContext)
run
getUser()
sharedContext = get( )
new(...)
AbortStrategy
registerAbortStrategy(abortStrategy)
This takes a while
timeout
register(sharedTaskContext)
removeTask( )
Since the AbortableTaskRunnable is already running, this does nothing.
remove(AbortableTaskRunnable)
abortTask( )
invoke( )
force_stop_working( )
setAborted( )
remove( )
Exception
Exception
finish()
Since the task is aborted the TimeoutGuardTask is not removed.
remove()
Exception
Exception
Service
CompletableFuture
Repository
AbortStrategy
Proxy
DelegatingExecutor
ThreadPoolTaskExecutor
Callable
AbortableTaskDecorator
AbortableTaskRunnable
SharedTaskContext
TimeoutGuardTask
GuardTaskExecutor
SharedTaskContextHolder
thread-<n>
guard-<n>

Chapter 5. Deployment

TODO.

Appendices

Appendix A: Hawaii application properties

Various properties can be specified inside your `application.properties/application.yml` file or as command line switches. This section provides a list of available Hawaii application properties.

```
# ===================================================================
# HAWAII PROPERTIES
#
# This sample file is provided as a guideline. Do NOT copy it in its
# entirety to your own application.               ^^^
# ===================================================================

# HAWAII SPRING BOOT DEFAULTS
spring:
  jackson:
    date-format: com.fasterxml.jackson.databind.util.ISO8601DateFormat
    property-naming-strategy: CAMEL_CASE_TO_LOWER_CASE_WITH_UNDERSCORES
    serialization:
      indent-output: false
      write-dates-as-timestamps: false
      write-date-timestamps-as-nanoseconds: false
logging:
  file: log/hawaii.log
  level:
      org.hawaiiframework: INFO
      org.springframework: INFO


# HAWAII TIME
hawaii:
  time:
    enabled: true # Enable creation of the `HawaiiTime` bean.
    timezone: UTC # The timezone to use like `UTC`, `Europe/Amsterdam` or `GMT+1`.
     async:
       configuration: ./config/async-config.yml # location of the Hawaii async
configuration file

---

spring:
  profiles: dev
  jackson:
    serialization.indent-output: true
logging:
  level:
    org.hawaiiframework: DEBUG
```

```
---

spring:
  profiles: test

---

spring:
  profiles: prod
```