Microservices with Quarkus

Day 2: Data Access & Security

Morning Session 1 (09:00 - 10:00)

Topic: Implementing Persistence

Activity: Hands-on Lab 3

Lab 3 Objectives

- Persist `TrainStop` data in a relational database.
- Implement a full CRUD REST API for `TrainStop` entities.
- Use a Test-Driven Development (TDD) approach for implementation.
- Leverage Quarkus Dev Services for a zero-config development database.

Morning Session 2 (10:45 - 11:45)

Topic: Relational Databases with Panache

Debrief: Lab 3 (Panache Entity)

- **Goal**: Simplify persistence with Hibernate ORM.
- **Key Features**:
  - No more `EntityManager` boilerplate.
  - Simplified queries: `Person.find("name", "Scott")`
  - Automatic generation of CRUD operations.
- **Guides**:
  - Hibernate ORM with Panache

Debrief: Lab 3 (Dev Services)

- **Dev Services for PostgreSQL**: Quarkus automatically started a PostgreSQL container for us!
- Dev Services for Datasources
- **Reactive Datasources**: `quarkus-reactive-oracle-client`
- **JDBC Data Sources**: `quarkus-jdbc-postgresql`

Debrief: Lab 3 (`@Transactional`)

- Manages the lifecycle of a database transaction.
  - **Start**: A transaction is automatically started when a method annotated with `@Transactional` is entered.
  - **Commit**: If the method completes successfully, the transaction is committed.
  - **Rollback**: If the method throws a runtime exception, the transaction is rolled back.
- **Why it's required**: All write operations in Panache (like `persist()`, `update()`, `delete()`) must be performed within a transaction.
- **Where to put it**: Typically on JAX-RS resource methods that modify data, or on methods in a service layer.
- **Guide**: Transactions in Quarkus

Debrief: Lab 3 (Active Record vs. Repository)

Feature	Active Record (`PanacheEntity`)	Repository (`PanacheRepository`)
Concept	Persistence logic is mixed with the business object.	Persistence logic is separated into a dedicated repository class.
Usage	`person.persist()`, `Person.findById(id)`	`personRepository.persist(person)`, `personRepository.findById(id)`
Pros	Simple, concise, great for small to medium applications.	Better separation of concerns, easier to test and mock.
Cons	Can violate Single Responsibility Principle, harder to mock.	More boilerplate code (entity + repository).
When to use?	When your data model is simple and closely maps to the DB.	For complex applications or when you need to abstract the data layer.

The Repository Pattern (Entity)

Separates the persistence logic from the entity.

1. The Entity (No Panache base class)

```java
@Entity
public class Person {
    @Id @GeneratedValue
    public Long id;
    public String name;
    public LocalDate birth;

    // Getters and Setters
}
```

The Repository Pattern (Repository)

2. The Repository

```java
@ApplicationScoped
public class PersonRepository implements PanacheRepository<Person> {

   // custom queries can be added here
   public Person findByName(String name){
     return find("name", name).firstResult();
   }
}
```

The Repository Pattern (Resource)

3. The Resource

```java
@Inject
PersonRepository personRepository;

@GET
@Path("/{id}")
public Person getById(Long id) {
    return personRepository.findById(id);
}

@GET
@Path("/search/{name}")
public Person search(String name) {
    return Person.findByName(name);
}
```

Paging and Sorting

```java
// Create a PanacheQuery object
PanacheQuery<Person> query = Person.find("status", Status.Alive);

// 1. Set the page size and index
query.page(Page.of(0, 10)); // 1st page, 10 results

// 2. Get the results for the current page
List<Person> firstPage = query.list();

// 3. Get the total number of pages
int pageCount = query.pageCount();

// 4. Get the total number of records
long recordCount = query.count();
```

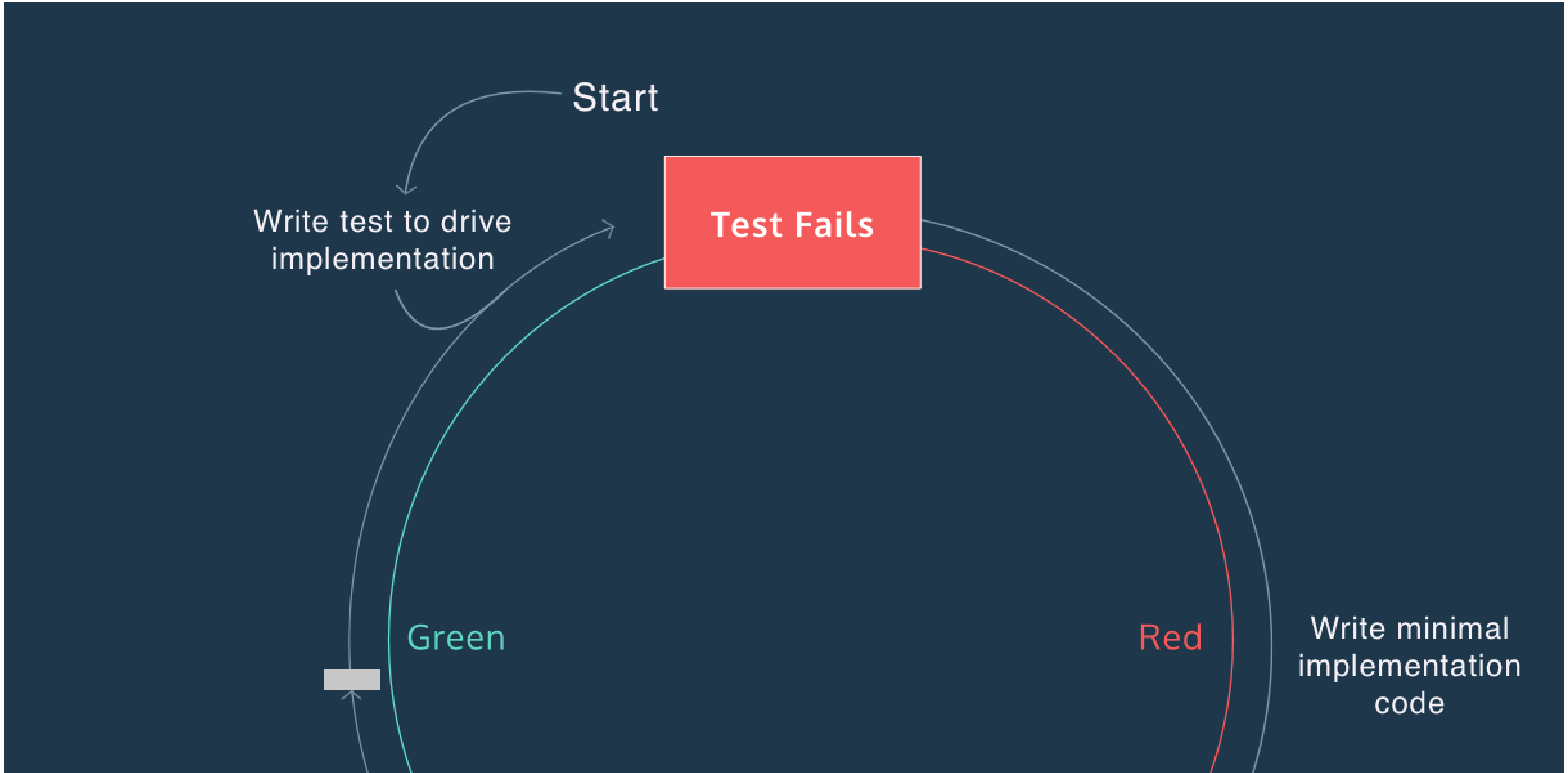
- Sorting is just as easy: `Person.find("status", Status.Alive).list()`
- **Guide**: Paging and Sorting

TDD with Quarkus Dev Mode (1)

Quarkus's dev mode (`./mvnw quarkus:dev`) provides an exceptional environment for Test-Driven Development.

- **Continuous Testing**: As soon as you save a file, Quarkus recompiles your code and re-runs the relevant tests.
- **Instant Feedback**: You get immediate feedback in your terminal, telling you whether your changes fixed a test or broke another one.
- **Guide**: Continuous Testing

TDD with Quarkus Dev Mode (2)


Start
Write test to drive implementation
Test Fails
Green
Red
Write minimal implementation code

Morning Session 3 (12:00 - 12:30)

Topic: Exposing and Documenting REST Endpoints

Jakarta RESTful Web Services

- The standard for creating RESTful web services in Java.
- **Core Annotations**:
  - `@Path` : Defines the base URI for the resource.
  - `@GET` , `@POST` , `@PUT` , `@DELETE` : Map to HTTP methods.
  - `@Produces` : Sets the response media type (e.g., `application/json`).
  - `@Consumes` : Sets the request media type.
  - `@PathParam` : Injects URI path parameters.
- **Returning a `Response`** : For more control, return a `Response` object. This allows you to set headers, status codes, and the response body.

```
@POST
@Transactional
public Response create(TrainStop stop) {
```

API Documentation with OpenAPI

- **Standard**: OpenAPI is the industry standard for defining REST APIs.
- **Automatic Generation**: Quarkus automatically generates an `openapi.yaml` file for your JAX-RS endpoints.
- **Swagger UI**: A user-friendly interface to explore and test your API.
    - Accessible at `/q/swagger-ui` in dev mode.
- **Guide**: OpenAPI and Swagger UI

Lunch Break (12:30 - 13:15)

Afternoon Session 1 (13:15 - 14:15)

Topic: Documenting Persisted Data

Activity: Hands-on Lab 4

Lab 4 Objectives

- Automatically generate API documentation from JAX-RS endpoints.
- Enrich the generated documentation with descriptive annotations.
- Implement an idempotent `create` endpoint for `TrainStopResource`.
- Explore and test the API using the integrated Swagger UI.

Afternoon Session 2 (14:30 - 15:00)

Topic: REST Clients & Security Concepts

MicroProfile REST Client

- **Goal**: Create a type-safe client to consume other RESTful services.
- **How it works**:
    i. Define a Java interface with JAX-RS annotations.
    ii. Annotate it with `@RegisterRestClient`.
    iii. Inject it with `@RestClient`.
- **Configuration**: Set the base URL in `application.properties`.
- **Guide**: REST Client Reactive

Introduction to Security

- **Core Concepts**:
  - **OAuth2**: An authorization framework for granting access to resources.
  - **OpenID Connect (OIDC)**: An identity layer built on top of OAuth2. It provides authentication and user information.
  - **JWT (JSON Web Token)**: A compact, URL-safe means of representing claims to be transferred between two parties.
- **Identity Provider**: A trusted provider that manages user identity and authentication (e.g., Keycloak, Auth0, Okta).
- **Guides**:
  - OpenID Connect (OIDC) Bearer Token Authentication
  - Using JWT RBAC

Afternoon Session 3 (15:00 - 16:00)

Topic: Securing and Consuming a Protected API

Activity: Hands-on Lab 5

Lab 5 Objectives

- Secure a REST endpoint using role-based access control (RBAC).
- Configure the microservice to authenticate with a Keycloak server.
- Consume a protected, external API using a type-safe REST client.
- Enrich service data with information from an external service.

End of Day 2

- Recap & Q&A
- Preview of Day 3: Reactive Messaging & Monitoring