Spring

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Contents

Introduction

Seminar Topic

In this seminar we will learn to use Spring and its main features:

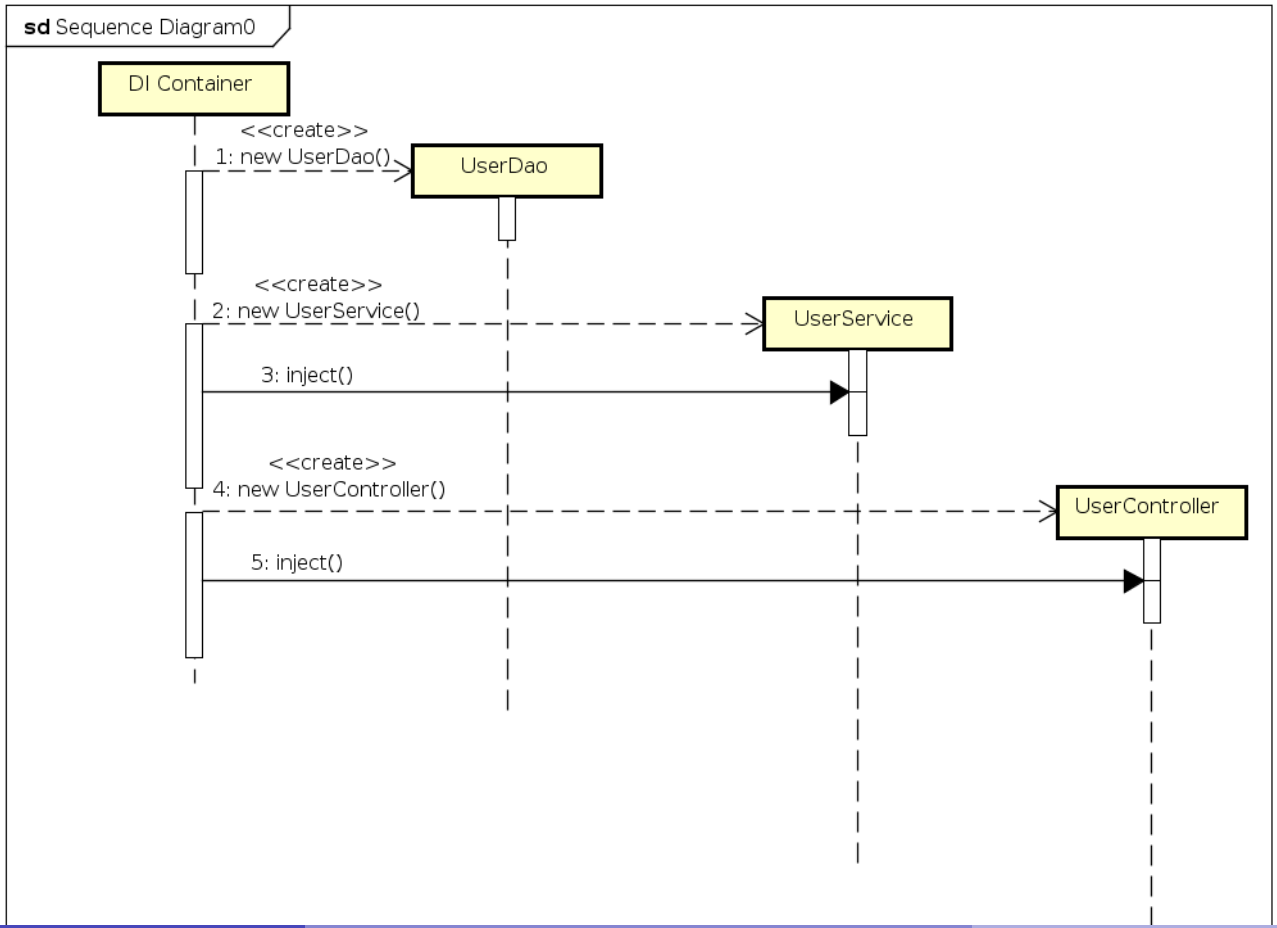
- Dependency Injection (DI)
- Transaction management

Dependency Injection - Revisited

Definition and Sequence Example

Dependency Injection

Component lifecycle is controlled by the *container* which is responsible for delivering correct implementation of the given dependency.



Plain Java code vs DI

```
package cz.cvut.kbss.ear.spring_example;
import ...

public class SchoolInformationSystem {

  private CourseRepository repository
    = new InMemoryCourseRepository();

  public static void main(String[] args) {
    SchoolInformationSystem main = new SchoolInformationSystem();
    System.out.println(main.repository.getName());
  }
}
```

The client code (`SchoolInformationSystem`) itself decides which repository implementation to use

- change in **implementation** requires *client code* change.
- change in **configuration** requires *client code* change.

DI using Annotations

SchoolInformationSystem.java

```
package cz.cvut.kbss.ear.spring_example;
import ...

@Component
public class SchoolInformationSystem {
  @Autowired
  private CourseRepository repository;
}
```

CourseRepository.java

```
package cz.cvut.kbss.ear.spring_example;
public interface CourseRepository {
  public String getName() { return name; }
}
```

InMemoryCourseRepository.java

```
package cz.cvut.kbss.ear.spring_example;
import ...

@Component
public class InMemoryCourseRepository
  implements CourseRepository {
  public String getName() { return
    "In-memory course repository"; }
}
```

Spring Beans

Bean Declaration

Bean declaration tells Spring from which classes to create beans. We will learn about two ways of bean declaration:

- Bean creation through annotated classes
- Bean creation with a factory method

Spring needs to know where to look for bean declarations. With Spring Boot, it scans the package of the main application class and all its sub-packages.

Bean Declaration - Annotated Class

A bean can be declared using an annotation on a class. Annotations used for declaration of beans in this way are:

- `@Component`
- `@Configuration`
- `@Repository`
- `@Service`
- `@RestController` etc.

Code example:

```
package cz.cvut.kbss.ear.spring_example;
import ...

@Component
public class InMemoryCourseRepository implements CourseRepository {
  public String getName() { return "In-memory course repository"; }
}
```

Bean Declaration - Factory method

A bean factory method should be implemented in a configuration bean. The method should be annotated with the `@Bean` annotation and it should return the bean. The method's parameters will be injected if possible. Code example:

```
@Configuration // is this a bean? Yes it is.
public class RepositoryConfiguration{
  @Bean
  public InMemoryCourseRepository createInMemoryRepository() {
       return new InMemoryCourseRepository();
  }
}
```

Spring Bean Scopes

Scopes define the life cycle of a bean

- **singleton** a single bean instance per a Spring IoC container (the default scope)
- **prototype** a new bean instance every time when requested (e.g., injected during creation of another bean)
- **request** a single bean instance per an HTTP request
- **session** a single bean instance per an HTTP session
- **globalSession** a single bean instance per a global HTTP session (portlet apps)

Code example specifying the scope of a bean:

```
@Component
@Scope("singleton")
public class SchoolInformationSystem {
  @Autowired
  private CourseRepository repository;
}
```

Spring allows custom scope definition (e.g. JSF 2 Flash scope)

Bean Injection

During creation, declared dependencies (must be also beans) are injected into a bean. Injected fields/setters are annotated with:

- `@Autowired`

Code example:

```
package cz.cvut.kbss.ear.spring_example;
import ...

@Component
public class SchoolInformationSystem {
  @Autowired
  private CourseRepository repository;
}
```

Constructor bean Injection

Constructor injection in Spring Boot does not require `@Autowired`

```
package cz.cvut.kbss.ear.spring_example;
import ...

@Component
public class SchoolInformationSystem {

  private final CourseRepository repository;

  // CourseRepository will be injected
  public SchoolInformationSystem(CourseRepository repository) {
    this.repository = repository;
  }
}
```

Injecting Entity Manager

JPA entity manager is injected using the `@PersistenceContext` annotation (JPA, not Spring).
Code example:

```
@Repository
public class CartDao {
  @PersistenceContext
  private EntityManager em;
  ...
}
```

Spring Transaction Management

Transaction Management Annotations

Spring provides means to declaratively manage business transactions.
The following annotations work in conjunction with JPA.

- `@Transactional` - on methods and classes, wraps a method in a transaction
- `@EnableTransactionManagement` - enabling declarative transaction support, enabled by default in Spring Boot

Code example:

```
@Service
public class CartService {
  @Transactional
  public void addItem(Cart cart, CartItem toAdd) {
    ...
  }
}
```

Proxy Design Pattern

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Proxy Design Pattern

Spring implements transaction management using the Proxy Design Pattern on beans. The `CartService` is sub-classed in the background to enable wrapping transactional method calls with code managing the transactions.

Proxy Design Pattern - Java Code Example

Calculator.java

```
public class Calculator{
  public int add(int a, int b){
    return a + b;
  }

  public int subtract(int a, int b){
    return a - b;
  }
}
```

CalculatorLoggerProxy.java

```
public class CalculatorLoggerProxy extends
  Calculator{
  private static final Logger LOG ...
  @Override
  public int add(int a, int b){
    int ret = super.add(a,b);
    LOG.debug("{} + {} = {}", a, b, ret);
    return ret;
  }

  @Override
  public int subtract(int a, int b){
    int ret = super.subtract(a,b);
    LOG.debug("{} - {} = {}", a, b, ret);
    return ret;
  }
}
```

Some observations:

- `CalculatorLoggerProxy` is also a `Calculator`
- Extends execution by adding pre- and post-processing code

Other Commonly Used Spring Features

Annotation based Spring Configuration

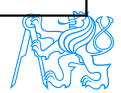
- `@ComponentScan` searching for Spring beans among classes in a given package
  - `@ComponentScan` without argument scans the current package and all its sub-packages
- `@Import` composing Spring configuration

Searching for beans:

```
@Configuration
@ComponentScan(basePackages = "cz.cvut.kbss.ear.eshop.dao")
public class PersistenceConfig {
...
}
```

Importing configuration:

```
@Configuration
@Import( {PersistenceConfig.class})
public class AppConfig {
...
}
```



Spring Configuration in E-shop

The E-Shop application is implemented using Spring Boot, which has many benefits over plain Spring:

- Provides a single Maven dependency which includes profiles of different Spring packages commonly used together
- *Starter* projects provide fixed versions of related external libraries (such as Hibernate, JDBC drivers etc.)
- Provides a simpler Maven build configuration
  - A Maven plugin which builds the application into a JAR with an embedded application server for rapid deployment
- Requires minimal application configuration compared to Spring
  - Contains a lot of sensible defaults that *just work* in most cases

Tasks

Syncing Your Fork

1. Ensure you have no uncommitted changes in the working tree
   - `git status` → your branch is up to date, nothing to commit
2. Fetch branches and commits from the upstream repository (EAR/B251-eshop)
   - `git fetch upstream`
3. Check out the task branch from **upstream** (one line!)
   - `git checkout -b b251-seminar-05-task upstream/b251-seminar-05-task`
4. Do the task
5. Commit and push the solution to **your** fork
   - `git push -u origin b251-seminar-05-task`

Task 1 – Configuration of Persistence Layer (1 point)

1. Declare missing bean declarations and injections.
   - Some of the classes in the `dao` package should be declared as beans but they are not. Declare them properly.
   - In the `dao` package, there is also one dependency injection which is not declared properly. Fix it.
   - **Hint:** `@Repository`, `@PersistenceContext`
2. Create a prototype bean of type `java.time.LocalDate`.
   - **Hint:** `@Configuration`, `@Bean`

- **Hint:** Use tests to help you debug the issues.
- **Acceptance criteria:** All enabled tests are passing.

Task 2 – Implementation of a Service (1 point)

1. Remove the `@Disabled` annotation from `CartServiceTest` and verify that tests are now failing
2. Implement `CartService` that allows to
   - Add specific items to a cart
   - Remove specific items from a cart
   - Amount of products available in stock is correctly adjusted after every add/remove operation
   - `CartService` class must be declared as a Spring bean
   - Inject beans necessary to implement the service methods (DAO)
3. Make sure that service methods are transactional
4. **Hint:** @Service
5. **Acceptance criteria:** Transactional processing is configured properly and all tests are passing.

The End

The End

Thank You

Resources

- https://docs.spring.io/spring-boot/