Beans and Dependency Injection

1. Components and beans
2. A closer look at components and beans
3. Dependency injection
4. A closer look at dependency injection

Demo project: **`demo-beans-dependencyinjection`**

1. Components and Beans

- Overview of components
- Defining a component
- Component scanning in Spring Boot
- Accessing a bean

Demo package: `demo.beans`

Overview of Components

- In Spring, a **component** is:
  - A class that Spring will automatically instantiate

- To define a component in Spring, annotate a class with any of the following annotations:
  - `@Component`
  - `@Service`
  - `@Repository`
  - `@Controller/@RestController`

Defining a Component

- Here's an example of how to define a component:

```
import org.springframework.stereotype.Component;

@Component
public class MyComponent {
    …
}
```

MyComponent.java

- Spring will automatically create an instance of this class
  - The instance is known as a "bean"

Component Scanning in Spring Boot

- When a Spring Boot app starts, it scans for component classes
  - It looks in the application class package, plus sub-packages

- You can tell Spring Boot to look elsewhere if necessary:

```
@SpringBootApplication( scanBasePackages={"mypackage1", "mypackage2"} )
public class Application {
    …
}
```

Accessing a Bean

- When a Spring Boot application starts up, it creates beans and stores them in the "application context"

- You can access beans in the application context as follows:

```
import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.context.ApplicationContext;

@SpringBootApplication
public class Application {

    public static void main(String[] args) {
        ApplicationContext ctx = SpringApplication.run(Application.class, args);
        MyComponent bean = ctx.getBean(MyComponent.class);
        System.out.println(bean);
    }
}
```

Application.java

2. A Closer Look at Components and Beans

- Specifying a name for a component
- Understanding singleton scope
- Getting a singleton-scope bean
- Lazily instantiating a singleton bean
- Defining a different scope
- Getting prototype-scope beans

Specifying a Name for a Component

- Every bean has a name
  - By default, it's the name of the component class (with the first letter in lowercase)

- You can specify a different name for the bean as follows
  - When Spring creates a bean, it will be named `myCoolBean`

```
import org.springframework.stereotype.Component;

@Component("myCoolBean")
public class SomeComponent {
    …
}
```

Understanding Singleton Scope

- By default, Spring creates a single bean instance
  - i.e., the default scope is `"singleton"`

- You can annotate with `@Scope("singleton")` if you want to be explicit:

```
@Component
public class MySingletonComponent { … }
```

Equivalent

```
@Component
@Scope("singleton")
public class MySingletonComponent { … }
```

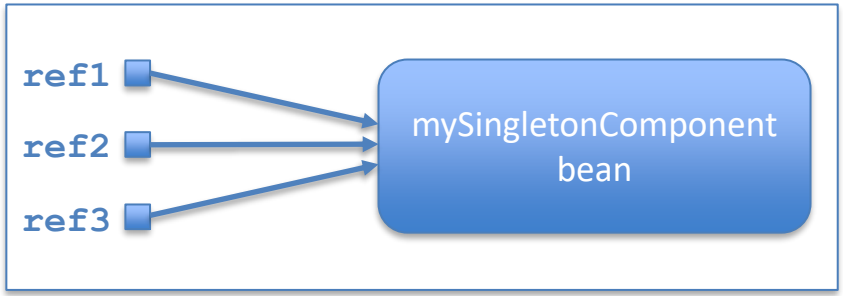
Getting a Singleton-Scope Bean

- Singleton beans are created at application start-up
  - For each call to `getBean()`, you get the same bean

```
ApplicationContext ctx = SpringApplication.run(Application.class, args);

MySingletonComponent ref1 = ctx.getBean(MySingletonComponent.class);
MySingletonComponent ref2 = ctx.getBean(MySingletonComponent.class);
MySingletonComponent ref3 = ctx.getBean(MySingletonComponent.class);
```

Application.java



Lazily Instantiating a Singleton Bean

- You can tell Spring to lazily instantiate a singleton bean
  - Annotate the component class with `@Lazy`

```
@Component
@Lazy
public class MySingletonComponent {
    …
}
```

- Avoids creating beans until needed
  - Speeds start-up time

Defining a Different Scope

- You can use `@Scope` to specify the scope for a bean:

```
@Component
@Scope("prototype")
public class MyPrototypeComponent { … }
```

MyPrototypeComponent.java

- There are several scopes available:
  - `"prototype"`
  - `"request"`
  - `"session"`
  - `"application"`

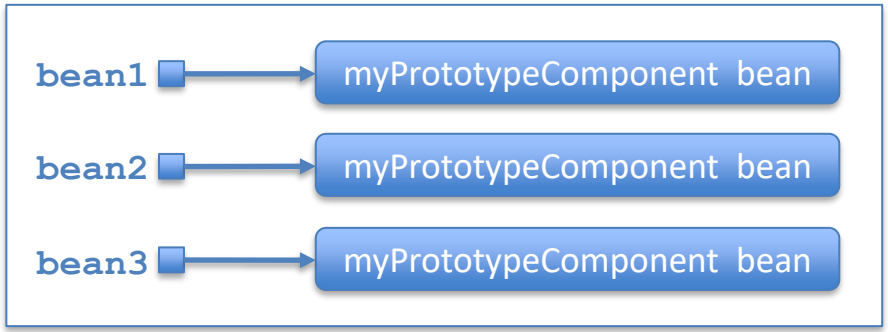
Getting Prototype-Scope Beans

- Consider this example of getting prototype beans
  - For each call to `getBean()`, Spring creates a new bean

```
ApplicationContext ctx = SpringApplication.run(Application.class, args);

MyPrototypeComponent bean1 = ctx.getBean(MyPrototypeComponent.class);
MyPrototypeComponent bean2 = ctx.getBean(MyPrototypeComponent.class);
MyPrototypeComponent bean3 = ctx.getBean(MyPrototypeComponent.class);
```

Application.java



3. Dependency Injection

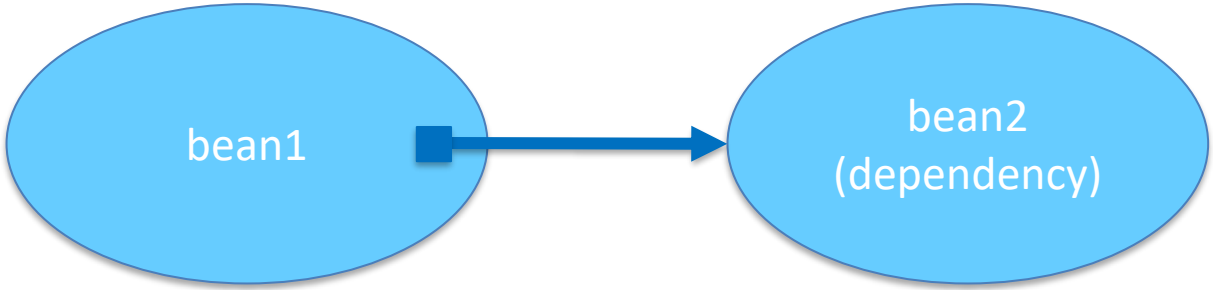
- Overview of dependency injection
- Injecting dependencies into fields
- Injecting dependencies into a constructor
- Fine-tuning autowiring

Demo package: `demo.di`

Overview of Dependency Injection

- Dependency Injection (DI) is a key Spring concept
  - Use configuration to describe dependencies between components

- Spring automatically injects dependencies into beans
  - This is known as "autowiring"



Injecting Dependencies into Fields

- If a bean has dependencies...
  - You can inject via `@Autowired`
- You can use `@Autowired` on a field
  - Spring injects a bean of the specified type into the field

```
@Service
public class BankServiceImpl implements BankService {

    @Autowired
    private BankRepository repository;
    …
}
```

BankServiceImpl.java

Injecting Dependencies into a Constructor

- You can also use `@Autowired` on a constructor
  - Spring will inject beans into all constructor parameters

```
@Service
public class BankServiceImpl implements BankService {

    private BankRepository repository;

    @Autowired
    public BankServiceImpl(BankRepository repository) {
        this.repository = repository;
    }
    …
}
```

BankServiceImpl.java

- Note: If a component only has one constructor, you can omit `@Autowired` (Spring autowires ctor params automatically)

Fine-Tuning Autowiring

- You can specify which bean instance to inject
  - Use `@Qualifier` to specify the bean name you want

```
@Autowired
@Qualifier("primaryRepository")
private BankRepository repository;
```

- You can mark an `@Autowired` member as optional
  - Set `required=false`

```
@Autowired(required=false)
private BankRepository repository;
```

4. A Closer Look at Dependency Injection

- Autowiring a collection
- Autowiring a map
- Injecting values into beans
- Specifying values in application properties
- Aside: Common application properties

Autowiring a Collection

- You can autowire a `Collection<T>`
  - Spring injects a collection of all the beans of type `T`

- Example
  - Autowire a collection of all beans that implement the `BankRepository` interface

```
@Service
public class BankServiceImpl implements BankService {

    @Autowired
    private Collection<BankRepository> repositories;
    …
}
```

Autowiring a Map

- You can also autowire a `Map<String,T>`
  - Spring injects a map indicating all beans of type `T`
  - Keys are bean names, values are bean instances

- Example
  - Autowire `BankRepository` names/beans

```
@Service
public class BankServiceImpl implements BankService {

    @Autowired
    private Map<String, BankRepository> repositoriesMap;
    …
}
```

Injecting Values into Beans

- You can inject values into beans, via `@Value`
  - Use `$` to inject an application property value
  - Use `#` to inject a general value via Spring Expression Language

```
import org.springframework.beans.factory.annotation.Value;
…

@Component
public class MyBeanWithValues {

    @Value("${name}")           // Inject value of "name" application property.
    private String name;

    @Value("#{ 5 * 7.5 }")      // Inject general Java value via SpEL.
    private double workingWeek;
    …
}
```

MyBeanWithValues.java

Specifying Values in Application Properties

- You can define values in the application properties file

```
name=John Smith
```

application.properties

- Here's how to access the bean in the main code

```
@SpringBootApplication
public class Application {

    public static void main(String[] args) {

        ApplicationContext ctx = SpringApplication.run(Application.class, args);
        …
        MyBeanWithValues beanWithValues = ctx.getBean(MyBeanWithValues.class);
        System.out.println(beanWithValues);
    }
}
```

Application.java

Aside: Common Application Properties

- Spring Boot defines lots of common application properties by default - you can see the full list here:
  - https://docs.spring.io/spring-boot/docs/current/reference/html/common-application-properties.html

- You can override any of these properties in your code
  - In `application.properties` or `application.yml`

Summary

- Components and beans
- A closer look at components and beans
- Dependency injection
- A closer look at dependency injection