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1. What is Dependency Injection (DI)?

Dependency Injection (DI) is a design pattern and a fundamental concept in software development and object-oriented programming. It is primarily used to achieve Inversion of Control (IoC), a principle that helps manage the flow of control and dependencies in a more flexible and modular manner. DI is commonly used in frameworks like Spring, Angular, and many others.

In Dependency Injection, the dependencies of a class or module are provided from the outside rather than being created or instantiated within the class itself. This is typically achieved through one of the following methods

1. Dependency: In software development, a dependency is an object or service that another object relies on to perform its function. Dependencies can include other classes, modules, or external services.

2. Injection: Injection, in the context of DI, refers to the process of providing the required dependencies to a class or component from an external source (usually a framework or container) rather than the class creating or managing its dependencies internally.

Constructor Injection: Dependencies are passed to a class through its constructor. This is the most common form of Dependency Injection.

class UserService { private UserRepository

userRepository; public UserService(UserRepository

userRepository) { this.userRepository =

userRepository;

}

}

Setter Injection: Dependencies are set using setter methods.

class UserService { private UserRepository userRepository;

```
public void setUserRepository(UserRepository userRepository) {

this.userRepository = userRepository;

}

}
```

Interface Injection: Dependencies are injected through interfaces that the class implements.

```
interface UserRepositoryProvider {

UserRepository getUserRepository();

}

class UserService implements UserRepositoryProvider { private

UserRepository userRepository;

@Override

public UserRepository getUserRepository() { return

userRepository;

} }
```

Dependency Injection frameworks and containers, such as Spring (Java), Angular (JavaScript/TypeScript), and .NET Core (C#), provide tools and mechanisms to manage the injection of dependencies automatically. These frameworks help maintain a clean separation of concerns and enable easier unit testing since you can mock or replace dependencies with test doubles during testing.

Advantages of Dependency Injection:

Decoupling: DI promotes loose coupling between components. When a class relies on external dependencies that are injected, it doesn't need to know how those dependencies are created or managed. This separation of concerns makes the codebase more maintainable and adaptable to changes.

2. Testability: By injecting dependencies, it becomes easier to substitute real dependencies with mock objects or stubs during unit testing. This allows for isolated testing of individual components without relying on the full system.

3. Reusability: Components with injected dependencies can be reused in different parts of the application or even in other applications, as they are not tightly coupled to specific implementations of their dependencies.

4. Flexibility: Changing or upgrading dependencies (e.g., switching a database library or a logging framework) can be done more easily by replacing the injected dependency without modifying the dependent classes.

5. Configuration: Dependency Injection allows for external configuration of the application's components. Dependencies can be configured and wired together in a configuration file or by using annotations, which provides flexibility and makes it easier to switch between different implementations.

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Dependency Injection is a powerful technique for improving the maintainability, flexibility, and testability of software systems by managing and injecting dependencies in a controlled manner.

2. What is the purpose of the @Autowired annotation in Spring Boot?

In Spring Boot and the wider Spring Framework, the @Autowired annotation is used for automatic dependency injection. Dependency injection is a design pattern that facilitates the management of dependencies between components in an application. The @Autowired annotation specifically serves the purpose of telling the Spring container to automatically inject a bean (a Spring-managed object) into a class where the annotation is used.

Here's a breakdown of the purpose and usage of @Autowired in Spring Boot:

Automatic Dependency Injection: When you annotate a field, constructor, or setter method with @Autowired, Spring Boot automatically resolves the corresponding dependency by searching for a bean of the same type in its ApplicationContext (the container of Spring-managed beans) and injects it into the annotated component.

Dependency Resolution: When you annotate a field, constructor, setter method, or even a configuration method with @Autowired, Spring will automatically search for a compatible bean (a class marked as a Spring component) to inject into that field or method parameter.

Type Matching: Spring looks for a bean that matches the type of the field or parameter being annotated. If it finds a unique match, it injects that bean. If multiple beans of the same type are available, you can further specify which one to inject using qualifiers or other annotations.

Here's an example of how @Autowired can be used:

```
@Service

public class MyService { private final

MyRepository myRepository;

@Autowired public MyService(MyRepository

myRepository) { this.myRepository =

myRepository;

}

}
```

In this example:

@Service marks the class as a Spring-managed bean.

The constructor of MyService is annotated with @Autowired, indicating that it expects an instance of MyRepository to be injected.

Spring Boot will automatically provide an instance of MyRepository (if it's a Spring bean) when creating a MyService object. This eliminates the need for manual instantiation or configuration.

The @Autowired annotation is a key part of Spring's Inversion of Control (IoC) and Dependency Injection features. It simplifies the configuration and wiring of components in your Spring Boot application, promoting loose coupling between different parts of your application and making it more maintainable and testable. It's important to note that since Spring Framework 4.3, @Autowired is not required for constructor injection if there is only one constructor in the class, as Spring will automatically detect it and inject dependencies. However, it can still be used for clarity and when you have multiple constructors.

3. Explain the concept of Qualifiers in Spring Boot.

In Spring Boot, qualifiers are used to disambiguate between multiple beans of the same type when performing dependency injection. When you have more than one bean of a particular type registered in the Spring context, and you need to specify which one to inject into a particular component, you can use qualifiers to indicate your choice.

Qualifiers are often used in conjunction with the @Autowired annotation to tell Spring which specific bean should be injected when there is more than one candidate bean of the same type.

Here's how qualifiers work:

Bean Registration: First, you register multiple beans of the same type in your Spring application context. For example, you might have multiple implementations of an interface or multiple beans with the same class type.

```
@Component

public class DataSourceA implements DataSource {

}

@Component

public class DataSourceB implements DataSource {

}
```

In this example, we have two beans of the DataSource type.

Qualify the Injection Point: When you need to inject one of these beans into another component, you can use the @Qualifier annotation to specify which bean

to inject. You provide the name of the bean you want to inject as a parameter to @Qualifier. @Service

public class MyService { private

final DataSource dataSource;

@Autowired

public MyService(@Qualifier("dataSourceA") DataSource dataSource) {

this.dataSource = dataSource;

}

}

In this example:

@Qualifier("dataSourceA") tells Spring to inject the bean named "dataSourceA" of type DataSource into the MyService class. If you want to inject "dataSourceB" instead, you would change the qualifier accordingly.

Matching Bean Name: The name specified in the @Qualifier annotation should match the name of the bean you want to inject. By default, the name of a bean in Spring is the name of the class with a lowercase first letter (e.g., "dataSourceA" for DataSourceA).

Qualifiers are essential when you have multiple beans of the same type, and Spring needs guidance to determine which one to inject. Without qualifiers, Spring may not know which bean to choose and may throw an exception due to ambiguity.

Qualifiers are a useful feature in Spring Boot to help manage complex dependency injection scenarios and ensure that the right beans are wired together in your application.

4. What are the different ways to perform Dependency Injection in Spring Boot?

In Spring Boot, there are several ways to perform dependency injection, and you can choose the one that best fits your application's needs and coding preferences. The primary ways to perform dependency injection in Spring Boot include:

Constructor Injection:

This is the most common and recommended way to perform dependency injection in Spring Boot. You declare dependencies as constructor parameters, and Spring automatically provides the required beans when creating instances of your class.

@Service

public class MyService { private final

MyRepository myRepository;

@Autowired

public MyService(MyRepository myRepository) { this.myRepository

= myRepository;

}

}

Setter Injection:

With setter injection, you provide setter methods for your dependencies, and Spring uses these methods to inject the required beans. This approach allows for optional dependencies or changing dependencies at runtime.

@Service

public class MyService { private

MyRepository myRepository;

@Autowired

public void setMyRepository(MyRepository myRepository) { this.myRepository

= myRepository;

} }

Field Injection:

Field injection involves directly annotating the fields that need to be injected with @Autowired. While this approach is concise, it's generally not recommended because it makes testing and mocking dependencies more challenging and can lead to issues with circular dependencies.

@Service

public class MyService { @Autowired

private MyRepository myRepository;

}

Method Injection:

You can also inject dependencies into methods using the @Autowired annotation on the method parameters. This is less common but can be useful in specific situations where you want to inject dependencies for a specific method rather than the entire class.

@Service

public class MyService {

public void doSomethingWithRepository(@Autowired MyRepository myRepository) {

}

}

Interface-Based Injection:

If you have multiple implementations of an interface and need to specify which one to inject, you can use qualifiers or the @Primary annotation to indicate the primary bean to inject. This approach is commonly used when you have multiple implementations, and you want to choose one as the default.

@Service

public class MyService { private

final DataSource dataSource;

@Autowired

```
public MyService(DataSource dataSource) { this.dataSource

= dataSource;

}

}
```

Constructor-Based Injection with Lombok:

If you're using Project Lombok in your Spring Boot project, you can use the @RequiredArgsConstructor annotation to automatically generate constructors with the required dependencies.

```
@Service

@RequiredArgsConstructor public class

MyService { private final MyRepository

myRepository;

}
```

Choose the dependency injection method that best suits your project's requirements and maintainability goals. Constructor injection is generally recommended because it results in cleaner and more testable code while helping to avoid issues with circular dependencies. However, the choice may also depend on the specific use case and design considerations for your Spring Boot application.

5. Create a SpringBoot application with MVC using Thymeleaf.

(create a form to read a number and check the given number is even or not)

ThymeleafenabledspringbootwebApplication.java package

```
com.demo.example;
import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
@SpringBootApplication
public class ThymeleafenabledspringbootwebApplication { public
static void main(String[] args) {
SpringApplication.run(ThymeleafenabledspringbootwebApplication.class, args);
}
}
```

MainController.java package

```
com.demo.example;
import org.springframework.stereotype.Controller; import
org.springframework.ui.Model;
import org.springframework.web.bind.annotation.GetMapping; import
org.springframework.web.bind.annotation.RequestParam; import
org.springframework.web.bind.annotation.ResponseBody;
@Controller
public class MainController {
/* http://localhost:8080/evenForm */
@GetMapping("/evenForm")
public String evenForm() { return
"eventest";
}
```

```
/*http://localhost:8080/processEven */ @GetMapping("/processEven")

public String processEven(@RequestParam("number") int number, Model model) {

model.addAttribute("number", number); if

(number % 2 == 0) {

model.addAttribute("result", "Even");

}else {

model.addAttribute("result", "Not Even");

}

return "eventresult";

}

}
```

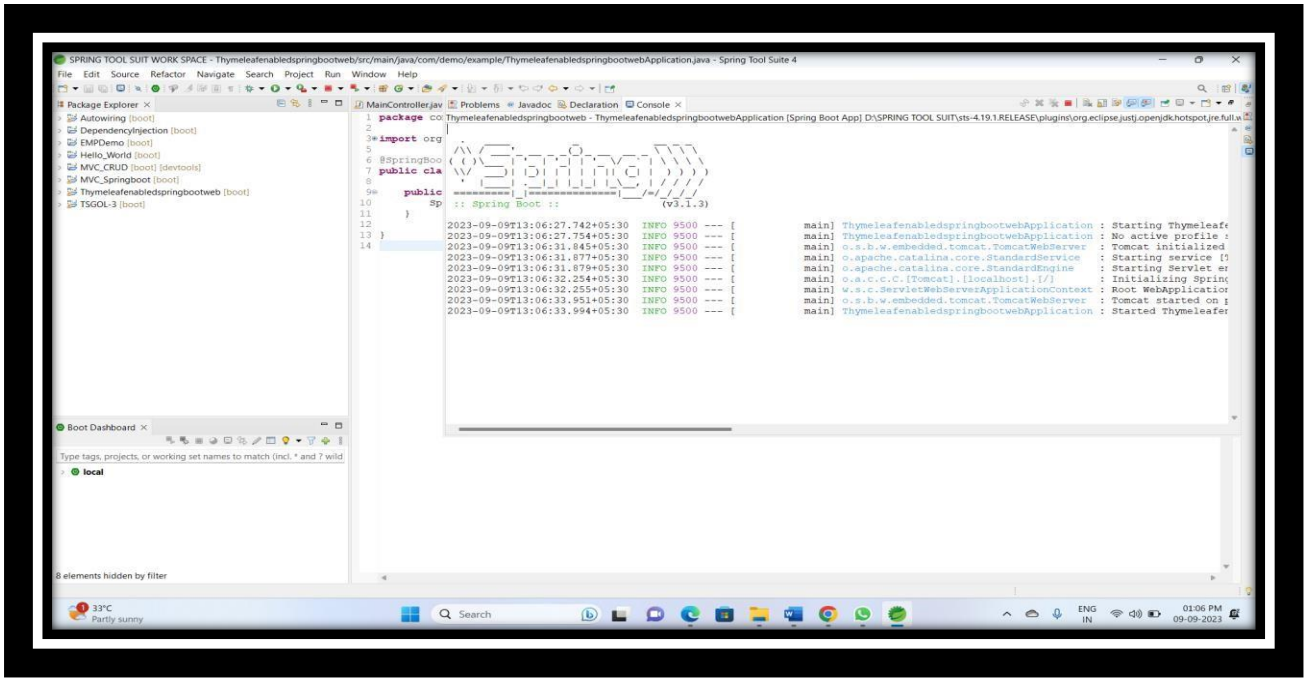
Eventest.html

```
<!DOCTYPE html>
<html xmlns:th="http://www.thymeleaf.org">
<head>
<meta charset="UTF-8"/>
<title>Finding Even Number</title>
</head>
<body>
<form method="get" action="processEven">
<label>Enter the Value</label>
<input type="text" name="number">
<br/>
<button type="submit">Is Even</button>
</form>
</body>
</html>
```

Eventresult.html

```
<!DOCTYPE html>
<html xmlns:th="http://www.thymeleaf.org">
<head>
<meta charset="UTF-8">
<title>Finding Even Number - Result Page</title>
</head>
<body>
<div style="background-color: rgb(128, 255, 255); color: rgb(0, 0, 0)">
<h3>The <span th:text="${number}"></span> is <span
th:text="${result}"></span> </h3>
<h1>Test</h1>
</div>
</body>
</html>
```

OUTPUT:



RESULT: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Spring , Spring Boo...
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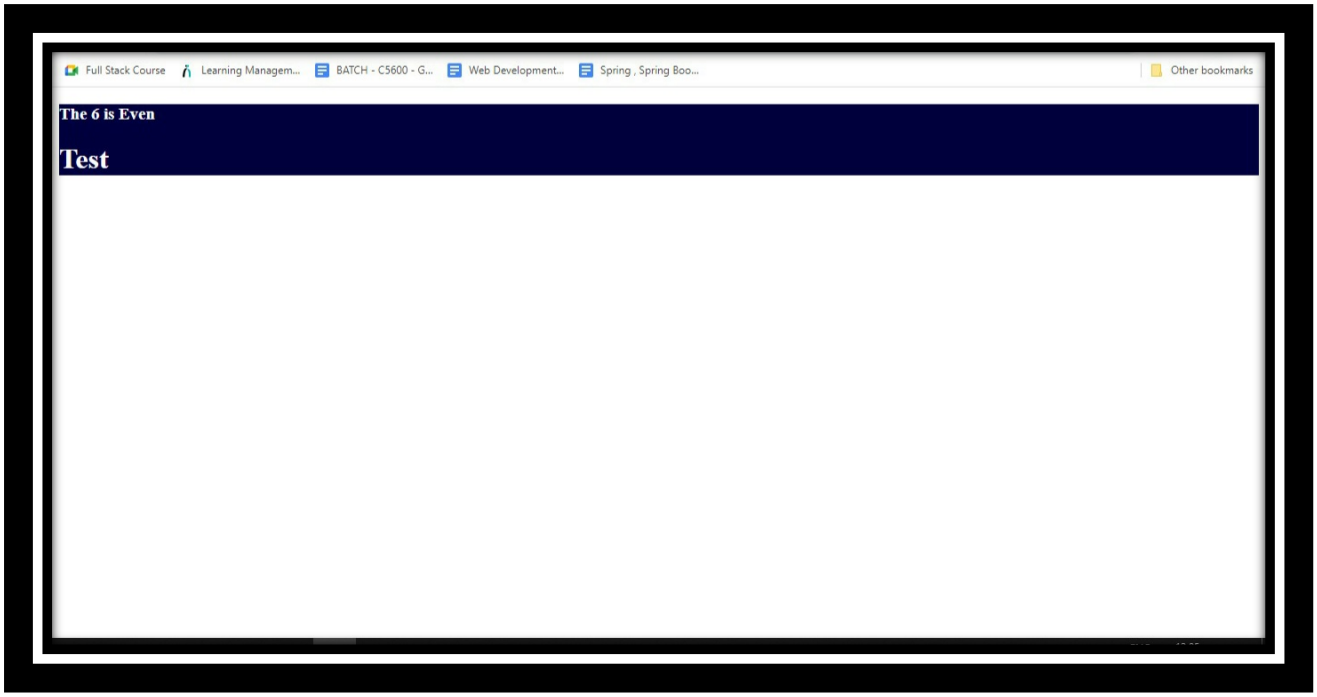
Enter the Value 6
Is Even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