Introduction to Spring Framework ***(Theory)***

1.What is Spring Framework?

1. Overview of the Spring Frame work and its purpose in Java development.

The **Spring Framework** is a comprehensive, open-source framework for building Java-based enterprise applications. It provides a robust programming and configuration model that is widely used for building scalable, flexible, and maintainable applications. It was developed to simplify Java development, making it easier to work with Java and addressing many of the challenges that developers face when building complex applications.

Spring is built around a lightweight, modular approach, and it can be used in various contexts, from simple applications to large-scale enterprise solutions. It provides a comprehensive infrastructure for Java applications, allowing developers to focus more on business logic rather than worrying about low-level infrastructure.

The **core purpose** of Spring is to:

- **Simplify Java development**: By providing an alternative to traditional Java EE development (Enterprise Edition), it offers simpler configuration and management.
- **Enhance modularity**: Spring's architecture promotes loose coupling and greater separation of concerns, leading to more maintainable code.
- **Increase productivity**: Through its various features and integrations, Spring makes development more efficient and less error-prone.

2. Key features of Spring:

- ***Inversion of Control (IoC)***
  - Inversion of Control (IoC) is a core principle of the Spring Framework, where the control over the creation and management of objects is handed over to the Spring container instead of being managed by the programmer. This is also known as the **Spring IoC Container**.
  - The **IoC Container** is responsible for managing the lifecycle of beans (objects) and their dependencies. This allows developers to focus on business logic while Spring takes care of the creation and configuration of objects.
  - In IoC, objects are typically created and managed via **Bean definitions**, which are configured in XML or Java annotations. The IoC container injects the required dependencies into the beans.

- ***Dependency Injection(DI)***

Dependency Injection (DI) is a specific type of Inversion of Control where an object's dependencies are provided (injected) by an external entity rather than the object creating them itself.

In the Spring Framework, DI can be achieved in various ways:

- **Constructor Injection**: Dependencies are passed to the class through its constructor.
- **Setter Injection**: Dependencies are injected through setter methods after the object is created.

DI reduces the coupling between components, allowing for easier testing, maintenance, and flexibility in the application.

```
public class MyService {
  private MyRepository repository;

  // Constructor Injection
  public MyService(MyRepository repository) {
    this.repository = repository;
  }

  public void performTask() {
    // Use repository
  }
}
```

- ***Aspect-Oriented Programming(AOP)***

- Aspect-Oriented Programming (AOP) is a programming paradigm that allows separation of cross-cutting concerns (e.g., logging, transaction management, security) from the main business logic. AOP complements object-oriented programming (OOP) by enabling the modularization of concerns that affect multiple classes.
- In Spring, AOP is used to create **aspects** that can be applied to specific methods or classes. Aspects define behavior that is executed before, after, or around method invocations.
- Spring provides support for AOP through proxies (using JDK dynamic proxies or CGLIB proxies) and offers a wide range of capabilities like declarative transaction management, logging, and security.
- **Example of a simple logging aspect in Spring:**

```
@Aspect public class LoggingAspect {
@Before("execution(* com.example.service.*.*(..))")
public void logBefore(JoinPoint joinPoint)
{ System.out.println("Logging before method: " + joinPoint.getSignature().getName()); }
}
```

- ***Transaction Management***

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Spring provides a robust and consistent way to manage transactions in Java applications. It supports both **programmatic** and **declarative** transaction management.

- **Programmatic transaction management**: The developer manually controls transaction boundaries using the TransactionTemplate or PlatformTransactionManager.
- **Declarative transaction management**: This is the preferred way in Spring, where developers annotate methods with @Transactional to automatically manage transaction boundaries, making it easier to maintain and less error-prone.

Spring handles different types of transactions, such as:

- Local transactions (using a single database).
- Global transactions (involving multiple resources, e.g., databases, message queues).

This abstraction allows developers to focus on business logic while Spring ensures that the transactions are consistent, roll-backed in case of errors, and follow the appropriate isolation levels.

- ## ***Spring's flexibility for creating both web and non-web applications.***

One of the most powerful aspects of the Spring Framework is its **flexibility**. It can be used for both **web** and **non-web** applications. This is made possible through the modular design of the framework.

- **For web applications**: Spring provides several tools and features to develop robust web applications, such as:
  - **Spring MVC**: A powerful, flexible web framework for building web applications following the Model-View-Controller pattern.
  - **Spring WebFlux**: A reactive programming framework for handling asynchronous, non-blocking web requests (introduced in Spring 5).
  - **Spring Security**: A comprehensive framework for securing web applications with authentication, authorization, and protection against common web vulnerabilities.
- **For non-web applications**: Spring can be used in various domains like batch processing, messaging, integration with databases, and more. Some of the key modules include:
  - **Spring Batch**: For processing large volumes of data in batch jobs.
  - **Spring Integration**: For integrating with external systems and implementing Enterprise Integration Patterns.
  - **Spring Data**: To simplify database interactions by providing repositories, templates, and automatic query generation.

2. SpringArchitecture:

1. Overview of the core components of the Spring Framework:

The **Spring Framework** consists of several core components that provide essential functionality for building enterprise-grade Java applications. Below is an overview of some key components:

- ***Core Container: IoC and DI***

  The **Core Container** is the foundation of the Spring Framework, and it consists of several modules that work together to provide essential functionality, such as **Inversion of Control (IoC)** and **Dependency Injection (DI)**.

  - **IoC (Inversion of Control)**: This is the fundamental principle that governs the Spring Framework. With IoC, the control over the creation and management of objects is given to the Spring container. Instead of manually instantiating and managing objects, you delegate this responsibility to the container.
  - **DI (Dependency Injection)**: DI is a specific form of IoC where Spring manages the dependencies between objects. It injects dependencies (objects or resources) into beans (objects managed by the Spring container), allowing developers to focus on business logic without worrying about the relationships between components.

The core container includes the following sub-modules:

- **Core Module**: Provides fundamental functionality like IoC, BeanFactory, and ApplicationContext.
- **Beans Module**: Deals with bean definitions, configuration, and management.
- **Context Module**: Extends the core functionality by providing a framework for accessing beans in a more general, application-specific context (using ApplicationContext).
- **SpEL (Spring Expression Language)**: Supports powerful querying and manipulation of beans using expressions.

- ***Spring AOP: Aspect-Oriented Programming***

Aspect-Oriented Programming (AOP) is a programming paradigm that allows you to separate cross-cutting concerns (such as logging, transaction management, security) from business logic.

It allows you to modularize aspects of your application that are not part of the core business logic but are needed in multiple places across the application.

Spring AOP provides the following key concepts:

- **Aspect**: A module that encapsulates a cross-cutting concern (e.g., logging or transaction management).
- **Join Point**: A point in the application where an aspect can be applied (e.g., method execution).
- **Advice**: The code that runs at a specific join point (e.g., before, after, or around method execution).
- **Pointcut**: An expression that matches join points where an aspect should be applied.
- **Weaving**: The process of applying aspects to the target objects (could be at compile-time, load-time, or runtime).

```
@Aspect

public class LoggingAspect {

   @Before("execution(* com.example.service.*.*(..))")

   public void logBefore(JoinPoint joinPoint) {

      System.out.println("Logging before method: " +
joinPoint.getSignature().getName());

   }

}
```

- ***Spring ORM: Integrating Spring with ORM frameworks(e.g., Hibernate ,JPA)***

Spring ORM provides integration with popular ORM (Object-Relational Mapping) frameworks like **Hibernate**, **JPA (Java Persistence API)**, **JDO (Java Data Objects)**, and **MyBatis**. ORM frameworks simplify database interactions by mapping Java objects to database tables.

Spring ORM helps to reduce the complexity of working with databases by providing:

- **Declarative transaction management** with **@Transactional**.
- Integration with **Hibernate** and **JPA** for efficient object-relational mapping.
- Support for **lazy loading**, **caching**, and **custom queries** in ORM frameworks.

Spring's ORM module promotes the use of Spring's dependency injection and transaction management in combination with ORM frameworks to build a more maintainable and scalable application.

Example:

```
@Service
@Transactional
public class UserService {
   @Autowired
   private UserRepository userRepository;

   public void saveUser(User user) {
      userRepository.save(user);
   }
}
```

- ***Spring Web: Web frame work for creating Java web applications.***

The **Spring Web** module provides the necessary components for building web applications, including support for both **traditional web applications** and **RESTful web services**. It includes various tools and libraries to simplify web development, enhance flexibility, and improve maintainability.

Key components of Spring Web include:

- **Spring Web MVC**: A framework for building web applications using the **Model-View-Controller** (MVC) pattern.
- **Spring WebFlux**: A reactive web framework for building asynchronous, non-blocking applications, introduced in Spring 5.
- **Spring WebSocket**: For enabling two-way communication between a client and server over WebSockets.
- **Spring REST**: A set of components and annotations that simplify the creation of RESTful APIs (e.g., @RestController, @RequestMapping).

Example:

```
@Controller
public class UserController {
  @GetMapping("/user")
  public String getUserInfo(Model model) {
    model.addAttribute("user", userService.getUser());
    return "user-info";
  }
}
```

- ***Spring MVC: Model-View-Controller framework for building web applications.***

Spring MVC is a robust, flexible, and well-established web framework that implements the **Model-View-Controller (MVC)** pattern. It is one of the most popular modules in the Spring Framework for building Java-based web applications.

The MVC design pattern separates an application into three main components:

- **Model**: Represents the application's data and business logic.
- **View**: The user interface (UI) component that renders the model’s data.
- **Controller**: Handles user input, updates the model, and selects the view to be rendered.

Spring MVC is highly configurable and allows developers to choose different view technologies (JSP, Thymeleaf, FreeMarker, etc.) and configure request mappings, data binding, and validation.

Key Features of Spring MVC:

- **DispatcherServlet**: The central controller that receives and processes incoming requests, delegating them to appropriate controllers.
- **View Resolvers**: Mechanisms to map views (like JSPs or Thymeleaf templates) to URLs.
- **Handler Mappings**: Used to map requests to appropriate controller methods.
- **Data Binding and Validation**: Automatically bind request parameters to Java objects and validate input data.

Example of Spring MVC Controller:

```
@Controller
public class HelloController {

  @RequestMapping("/hello")
  public String sayHello(Model model) {
    model.addAttribute("message", "Hello, Spring MVC!");
    return "hello";
  }
}
```

2.BeanFactoryandApplicationContext:

❖ ***BeanFactory vs. ApplicationContext:***

- ***WhatisBeanFactory?:***
  - ***AsimplecontainerformanagingSpringbeans.***
    the simplest container in the Spring Framework designed to manage Spring beans. It provides the core functionality for dependency injection (DI) and manages beans in a basic way. It serves as the foundational interface for more advanced containers like **ApplicationContext**.

  - ***ProsandconsofusingBeanFactory.***

Pros of Using BeanFactory:

1. **Memory Efficient**:
   - **Lazy Initialization**: Beans are created only when they are actually requested (lazy initialization). This can save memory, especially if some beans are never used during the application's lifecycle.
2. **Lightweight**:
   - BeanFactory is lightweight and requires fewer resources compared to ApplicationContext, making it suitable for resource-constrained environments (e.g., small applications or embedded systems).
3. **Faster Startup Time**:
   - Since it does not initialize all beans upfront, the startup time is typically faster compared to ApplicationContext, where all beans are eagerly created.

Cons of Using BeanFactory:

1. **Limited Functionality**:
   - BeanFactory only supports basic features like dependency injection and bean management. It lacks the extended capabilities found in ApplicationContext, such as event propagation, internationalization, and AOP (Aspect-Oriented Programming).
2. **No Advanced Features**:
   - For instance, features like **AOP**, **transaction management**, **internationalization (i18n)**, and **bean post-processing** are not available in BeanFactory. These features are essential in larger and more complex applications, and they are included in ApplicationContext.
3. **Not Suitable for Large Applications**:
   - Because BeanFactory lacks several advanced functionalities, it is not ideal for enterprise-level applications or larger projects where features like event handling, AOP, and other advanced features are needed.

4. **Manual Bean Management**:
   - With BeanFactory, you would need to manually configure certain aspects, like event handling, and rely on the user to manage more sophisticated tasks, which can be error-prone.

- ***WhatisApplicationContext?:***

the **ApplicationContext** is a more advanced version of the **BeanFactory** container. It's used for the configuration and management of beans in a Spring-based application. It includes everything the **BeanFactory** offers, with added features that make it more powerful and suitable for larger applications.

- ***A moreadvancedcontainerthatincludesfeatureslikeeventpropagation, declarativemechanisms,andAOPsupport.***

- **Event Propagation**: It supports event handling within the application. You can publish events to notify different parts of the application about specific actions or state changes.
- **Declarative Mechanisms**: It allows declarative programming through annotations or XML configuration. For instance, you can declare aspects, transactions, and other concerns without the need to manually configure them in code.
- **AOP (Aspect-Oriented Programming) Support**: It provides built-in support for AOP, allowing you to define aspects like logging, security, or transaction management that can be applied to your beans, without modifying the actual business logic.
- **Bean Lifecycle Management**: It manages the lifecycle of beans, including instantiation, dependency injection, and initialization.
- **Internationalization (i18n) Support**: It includes features for internationalization, such as message resolution for different languages or locales.

- ***Differences between BeanFactory andApplicationContext (e.g.,lazyinitializationin BeanFactory vs. eagerinitializationinApplicationContext).***

1. Initialization Behavior

- **BeanFactory**:
  - **Lazy Initialization** by default.
  - Beans are created (instantiated) only when they are requested for the first time. This can be beneficial for memory management, as beans are not created until they are needed.
- **ApplicationContext**:
  - **Eager Initialization** by default.

  - All beans are created when the context is initialized, regardless of whether they are actually used. This is useful in most Spring applications as it ensures that beans are ready to be injected and available during the application startup.

2. Functionality

- **BeanFactory**:
  - It's a simple and basic container that provides only the fundamental functionality for bean creation and dependency injection.
  - It is suitable for lightweight applications that don't require advanced features.
- **ApplicationContext**:
  - A more feature-rich container that extends **BeanFactory** and includes additional functionality like event propagation, internationalization (i18n), and AOP (Aspect-Oriented Programming) support.
  - It's typically used in larger, more complex applications where you need more advanced capabilities.

3. Event Handling

- **BeanFactory**:
  - Does **not** provide any built-in event handling capabilities. It's focused on bean management and dependency injection only.
- **ApplicationContext**:
  - Provides **event propagation** and allows you to publish and listen for application events. You can use @EventListener annotations or implement the ApplicationListener interface to handle events.

4. AOP Support

- **BeanFactory**:
  - Does **not** directly support Aspect-Oriented Programming (AOP). If you want AOP functionality, you'd need to configure it manually or use other mechanisms.
- **ApplicationContext**:
  - Provides **built-in support** for AOP. You can easily configure cross-cutting concerns like logging, security, and transactions without modifying your business logic.

5. Internationalization (i18n)

- **BeanFactory**:
  - Does **not** provide support for internationalization (i18n) directly.
- **ApplicationContext**:
  - Includes **i18n** support, which makes it easier to manage and resolve messages from different locales or languages.

6. Bean Definition

- **BeanFactory**:
  - Primarily focuses on bean creation and dependency injection. It doesn't provide the more advanced features that ApplicationContext offers.
- **ApplicationContext**:
  - Extends **BeanFactory** and adds additional features like the ability to easily configure beans for more advanced use cases such as annotation-based configurations (@Configuration, @Component), among others.

7. Use Cases

- **BeanFactory**:
  - Ideal for **lightweight** or memory-constrained applications, or when you only need basic bean creation and dependency injection.
- **ApplicationContext**:
  - Preferred for **most Spring applications** as it provides a rich set of features like event handling, AOP, internationalization, and more, making it suitable for larger and more complex enterprise applications.

8. Common Implementations

- **BeanFactory**:
  - The most common implementation of **BeanFactory** is XmlBeanFactory (deprecated in favor of **ApplicationContext**).
- **ApplicationContext**:
  - Common implementations include:
    - ClassPathXmlApplicationContext (XML-based configuration)
    - AnnotationConfigApplicationContext (Java-based configuration using annotations)
    - GenericWebApplicationContext (Web applications)

❖ ***SpringBeans:***

- ***DefinitionofabeaninSpring.***

A **bean** in Spring is simply an object that is managed by the Spring IoC (Inversion of Control) container. It is created, configured, and managed by the container. Beans are the building blocks of a Spring application and are usually created and wired together based on the configuration provided (either through XML, annotations, or Java-based configuration).

- **Example of a simple bean in Spring** (using annotations):

```
@Component
public class MyBean {
   public void doSomething() {
      System.out.println("Doing something!");
   }
}
```

- ***Scopeofbeans:Singleton,Prototype,Request,Session.***

Spring provides several types of bean scopes, which define the lifecycle and visibility of beans in the Spring container.

- **Singleton**: This is the default scope. Only one instance of the bean is created in the Spring container, and it is shared across the entire application context.
  - **Example**:

```
java
Copy
@Scope("singleton")
@Component
public class SingletonBean {
   // Only one instance of this bean exists
}
```

- **Prototype**: A new instance of the bean is created every time it is requested.
  - **Example**:

```
java
Copy
@Scope("prototype")
@Component
public class PrototypeBean {
   // New instance created each time
}
```

- **Request**: The bean is created once per HTTP request. It is used in web applications and is typically scoped to a single request.
  - **Example**:

```
java
Copy
@Scope("request")
@Component
public class RequestBean {
   // New instance for each HTTP request
}
```

- **Session**: The bean is created once per HTTP session. It lives throughout the user's session.
  - **Example**:

```
@Scope("session")
@Component
public class SessionBean {
   // New instance for each HTTP session
}
```

- ***Beanlifecycle:Initializationanddestructionofbeans***.

The **lifecycle of a Spring bean** defines the stages a bean goes through from creation to destruction. The Spring container is responsible for managing this lifecycle.

- **Initialization**: The initialization process occurs after the bean has been instantiated but before it is used. You can customize this process by defining an init-method in XML or using the @PostConstruct annotation in Java configuration.
  - **Using @PostConstruct**:

```
@Component
public class MyBean {

   @PostConstruct
   public void init() {
      System.out.println("Bean is initialized!");
   }
}
```

- **Destruction**: The destruction process happens when the container is shutting down. You can define a custom destroy-method in XML or use the @PreDestroy annotation to handle this lifecycle stage.
  - **Using @PreDestroy**:

```
java
Copy
@Component
public class MyBean {

   @PreDestroy
   public void destroy() {
      System.out.println("Bean is destroyed!");
   }
}
```

Introduction to Spring Framework ***(Theory)***

3.ContainerConceptsinSpring :

The Spring Framework's core is based on concepts like **Inversion of Control (IoC)** and **Dependency Injection (DI)**. These concepts are fundamental to how Spring manages the creation, configuration, and interaction of objects. By adopting these principles, Spring enables developers to create highly flexible, decoupled, and maintainable applications.

❖ ***SpringIoC(InversionofControl):***

- ***UnderstandingIoCandhowSpringusesittomanageobjectcreationand dependencies.***

- ▯ **Inversion of Control (IoC)** is a design principle where the control of object creation and dependency management is shifted from the application to a container or framework. In the case of **Spring Framework**, it uses IoC to manage how objects are created and how they are injected with dependencies.
- ▯ In Spring, the **IoC container** is responsible for creating objects, wiring them together, configuring them, and managing their entire lifecycle. The most commonly used container is the **ApplicationContext**.

- Instead of creating objects manually, Spring uses configuration metadata (either XML or annotations) to specify how the beans (objects) should be created and managed. Spring will then take care of all the instantiation, wiring, and lifecycle management for you.

- ***BenefitsofIoCinapplicationdesign(loosecoupling,modularity,andtestability).***

Loose Coupling:

- The IoC principle helps decouple components in an application. The components don't need to know how to create or configure their dependencies; they just receive the dependencies from the Spring container. This leads to better separation of concerns and reduces the dependencies between classes.

Modularity:

- By managing object creation and wiring, Spring promotes modular development. Components can be replaced easily with other implementations without affecting the rest of the application.

Testability:

- Since Spring manages the object creation and wiring, it becomes easier to replace components with mock objects during unit testing. This leads to better testability of individual components, as dependencies can be injected without having to modify the actual code.

❖ ***DependencyInjection(DI):***
- ***TypesofDependencyInjection:***
  - ***Constructor-basedDependencyInjection.***

- In constructor-based DI, the dependencies are provided to the class via the constructor. When an object is created, all its dependencies are passed as arguments to the constructor.
- Example:

java
Copy
```
@Component
```

```
public class Car {
    private Engine engine;

    // Constructor-based DI
    public Car(Engine engine) {
        this.engine = engine;
    }
}
```

- ***Setter-basedDependencyInjection.***
  - In setter-based DI, the dependencies are provided by calling setter methods on the object after its construction. Spring calls the setter methods and passes the necessary dependencies.
  - Example:

```
@Component
public class Car {
    private Engine engine;

    // Setter-based DI
    @Autowired
    public void setEngine(Engine engine) {
        this.engine = engine;
    }
}
```

- ***AdvantagesofDIinSpring.***

- **Decoupling**:
  - DI helps decouple components by injecting dependencies rather than requiring classes to create their own dependencies. This makes the system more flexible and maintainable.
- **Increased Flexibility**:
  - Dependencies can be changed without modifying the dependent class. For example, if you need to switch to a different implementation of a service or repository, you can do it easily by changing the configuration or annotation, without touching the class itself.
- **Improved Testability**:
  - Since dependencies are injected, it's easy to swap real dependencies with mock implementations in tests, which makes unit testing much easier.
- **Centralized Configuration**:
  - Spring provides a centralized configuration mechanism (either through XML or annotations), where all dependencies are declared. This makes it easy to configure and manage the entire system.

- **Life Cycle Management**:
    - Spring not only injects dependencies but also manages their lifecycle (singleton, prototype, etc.), ensuring that objects are created, used, and disposed of properly.

4.SpringDataJPATemplate :

❖ ***WhatisSpringDataJPA?:***

- ***IntroductiontoSpringDataJPAandhowitsimplifiesinteractionwithdatabases.***
  Spring Data JPA is part of the larger Spring Data project and provides a framework to work with JPA (Java Persistence API). It simplifies database interactions by handling a lot of boilerplate code needed for persistence operations. Spring Data JPA takes care of common tasks like CRUD (Create, Read, Update, Delete) operations and reduces the need for manually writing SQL queries. This allows developers to focus more on business logic rather than repetitive database operations.
- ***ExplanationofJPA(JavaPersistenceAPI)anditsroleinORM(ObjectRelational Mapping).***
  JPA is a Java specification that allows developers to map Java objects (entities) to database tables using annotations or XML. It handles the interaction between Java applications and relational databases by using Object-Relational Mapping (ORM). ORM is a technique that converts data between incompatible type systems (Java objects and relational databases). JPA abstracts away the database-specific details, providing a more object-oriented approach to persistence.
- ***BenefitsofusingSpringDataJPAovermanualSQLqueries.***
  ▯ **Automatic Query Generation:** Spring Data JPA automatically generates SQL queries based on method names, reducing the need for manual query writing.
  ▯ **Less Boilerplate Code:** No need to write the implementation for basic CRUD operations—Spring Data JPA provides automatic implementations for these.
  ▯ **Clear and Clean Code:** It reduces code clutter, making the code more readable and maintainable.
  ▯ **Database Independence:** It abstracts away vendor-specific SQL and makes it easier to switch databases.
  ▯ **Integration with Spring Framework:** It is well-integrated with Spring Boot and other Spring modules, making it easier to use Spring's features like transaction management, caching, etc.

❖ ***SpringDataJPAComponents:***

- ***Repositories:HowSpringDataJPAauto-generatesrepositoryimplementations.***

Spring Data JPA provides a repository abstraction layer that simplifies data access. It automatically generates implementations for repository interfaces, meaning you don't have to manually write the database access code.

- A repository interface in Spring Data JPA extends JpaRepository (or another base interface such as CrudRepository or PagingAndSortingRepository).
- Spring Data JPA automatically provides implementations for common operations like save(), delete(), and findAll().
- You can define custom query methods by following Spring Data JPA's naming conventions (e.g., findById, findByName), and Spring will create the corresponding queries behind the scenes.

- ***Entities:MappingJavaobjectstodatabasetablesusingJPAannotations.***

Entities in JPA represent the tables in the database. Each entity is a Java class annotated with @Entity, and each field represents a column in the corresponding table.

- **@Entity:** Marks a class as an entity.
- **@Id:** Specifies the primary key of the entity.
- **@GeneratedValue:** Defines the strategy for generating primary key values (e.g., auto-increment).
- **@Column:** Maps a class field to a database column (if the name differs from the default).
- **@ManyToOne, @OneToMany, @OneToOne:** Defines relationships between entities (like foreign keys in relational databases).

```
@Entity
public class User {
  @Id
  @GeneratedValue(strategy = GenerationType.IDENTITY)
  private Long id;
  private String name;
  private String email;
  // Getters and setters
}
```

- ***QueryMethods:Creatingcustomqueriesusingmethodnamingconventions(e.g., findById,findByName).***

(e.g., findById, findByName): One of the great features of Spring Data JPA is its ability to create queries based on the method names in repository interfaces. By following specific conventions, you can let Spring automatically create queries for you, without needing to manually write JPQL (Java Persistence Query Language) or SQL.

For example:

- **findById:** Finds an entity by its ID.
- **findByName:** Finds entities based on their name.
- **findByAgeGreaterThan:** Finds entities where the age is greater than a specific value.

```
public interface UserRepository extends JpaRepository<User, Long> {
    List<User> findByName(String name);
    User findByEmail(String email);
}
```

In this case, findByName and findByEmail are automatically translated into queries like:

```
SELECT * FROM user WHERE name = ?;
SELECT * FROM user WHERE email = ?;
```

If more complex queries are needed, you can use the @Query annotation to define custom JPQL or SQL queries:

```
@Query("SELECT u FROM User u WHERE u.name = ?1")
List<User> findByCustomQuery(String name);
```

5.SpringMVC :

- ❖ **WhatisSpringMVC?:**
  - **OverviewoftheMVC(Model-View-Controller)designpattern.**
  - **ExplanationoftheSpringMVCframeworkandhowitsimplifieswebdevelopment.**
- ❖ **SpringMVCComponents:**
  - **Controller:HandlesHTTPrequestsandreturnsaresponse.**
  - **Model:Holdsthedatatobedisplayedontheview.**
  - **View:Rendersthedatafromthemodelinauser-friendlyformat(e.g.,JSP, Thymeleaf).**
  - **DispatcherServlet:CentralservletinSpringMVCthatmanagestherequestflow.**
- ❖ **RequestMappinginSpringMVC:**
  - **Using@RequestMapping,@GetMapping,and@PostMappingannotationstomap HTTPrequeststocontrollermethods.**