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Project: E-commerce Website for Sporty Shoes

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Project GitHub link: https://github.com/AryamannMishraFR/Aryamann-Mishra-course3-end-project

Project overall + Core concepts used:

1. Spring Framework Basics

- **Dependency Injection (DI):**
  - **Purpose:** Dependency Injection is a core principle in Spring Framework where the framework is responsible for injecting the dependencies of a class.
  - **Usage in Project:** In your project, @Autowired annotation is used to inject dependencies. For example, in ProductController, ProductService is injected using @Autowired.
- **Inversion of Control (IoC):**
  - **Purpose:** Inversion of Control is a design principle where the control of object creation and lifecycle management is delegated to a container or framework (Spring in this case).
  - **Usage in Project:** Spring IoC container manages the lifecycle of beans (@Controller, @Service, etc.) and their dependencies. You define components and Spring manages their instantiation and wiring.

2. Spring MVC (Model-View-Controller)

- **Controller Layer:**
  - **Purpose:** Handles incoming HTTP requests, processes them, and prepares a model for the view layer.
  - **Usage in Project:**
    - @Controller annotation on ProductController marks it as a controller.
    - @GetMapping, @PostMapping, @DeleteMapping annotations define methods to handle HTTP GET, POST, and DELETE requests respectively.
- **Model Layer:**
  - **Purpose:** Represents data and business logic in the application.
  - **Usage in Project:**
    - Product entity class represents a product with attributes like name, category, and price.

        - ProductService encapsulates business logic for managing products such as save, delete, and findAll.
- **View Layer:**
    - **Purpose:** Responsible for rendering data to the user interface.
    - **Usage in Project:** Thymeleaf templates (product-list.html, product-form.html) are used for rendering dynamic HTML pages with data from the backend (${products} and ${product}).

3. Spring Data JPA

- **Purpose:** Simplifies the implementation of data access layers by providing a set of APIs and reducing boilerplate code.
- **Usage in Project:**
    - **Entity Class (Product):** Annotated with @Entity to map to a database table. Attributes are annotated (@Id, @GeneratedValue) to define primary key and auto-generation.
    - **Repository Interface (ProductRepository):** Extends JpaRepository<Product, Long> to inherit CRUD operations (save, deleteById, findAll, etc.). Spring Data JPA automatically implements these methods at runtime.

4. Thymeleaf

- **Purpose:** Server-side Java template engine for web and standalone environments.
- **Usage in Project:** Thymeleaf templates (product-list.html, product-form.html) are used to dynamically generate HTML views with data from the backend (${products} and ${product}). Thymeleaf expressions (th:each, th:text) are used for data binding and rendering.

5. HTTP Methods and Form Handling

- **Purpose:** Defines how clients (browsers, in this case) interact with the web application.
- **Usage in Project:**
    - @GetMapping, @PostMapping, and @DeleteMapping annotations in the ProductController define methods to handle HTTP GET, POST, and DELETE requests.
    - <form> tags in Thymeleaf templates with hidden _method input field (_method="delete") simulate DELETE requests for browser compatibility.

6. Object-Oriented Programming (OOP) Principles

- **Purpose:** Facilitates modular and maintainable code using OOP principles such as encapsulation, inheritance, and polymorphism.
- **Usage in Project:**
    - **Entity (Product):** Encapsulates data related to products (name, category, price) and provides getter/setter methods.

    - **Service (ProductService):** Encapsulates business logic related to products (e.g., CRUD operations on Product entities).

7. SQL Concepts and Database Interaction

- **Purpose:** Interaction with a relational database to store and retrieve data.
- **Usage in Project:**
    - **Entity (Product):** Annotated with JPA annotations (@Entity, @Table, @Id, etc.) to map to a database table (product).
    - **Repository (ProductRepository):** Extends JpaRepository<Product, Long> provided by Spring Data JPA, which handles SQL queries for CRUD operations.
    - **Database Configuration:** Typically configured in application.properties or application.yml to specify database connection details (spring.datasource.url, spring.datasource.username, spring.datasource.password).

8. API Handling and Thymeleaf Templates

- **Purpose:** Integrates backend logic (controllers, services) with frontend views (HTML templates).
- **Usage in Project:**
    - **Controller (ProductController):** Handles HTTP requests (GET, POST, DELETE) and prepares data for rendering in views.
    - **Thymeleaf Templates (product-list.html, product-form.html):** Render dynamic HTML views using data from backend (${products}, ${product}).
    - **Form Submission:** Uses <form> tags in Thymeleaf templates to submit data to the backend (@ModelAttribute Product in addProduct method).

Features of the application with explanation of implementation:

1. CRUD Operations

- **Purpose:** Allows users (Admin) to Create, Read, Update, and Delete products.
- **Implementation:**
    - **Create (Add Product):** Users (Admin) can add new products through a form (product-form.html) which submits data to the backend (@PostMapping("/add") in ProductController).
    - **Read (List Products):** Displays a list of all products (product-list.html) retrieved from the database (@GetMapping("/list") in ProductController).
    - **Update:** Not explicitly implemented in the provided snippets, but typically involves editing existing product details.
    - **Delete:** Allows users (Admin) to delete products by clicking a delete button (<form> in product-list.html with @DeleteMapping("/delete/{id}") in ProductController).

2. User Interface

- **Purpose:** Provides a user-friendly interface for interacting with product data.
- **Implementation:**
  - **HTML Templates (Thymeleaf):** Utilizes Thymeleaf templates (product-list.html, product-form.html) for rendering dynamic HTML pages.
  - **Navigation:** Links (<a> tags) between different views (/product/add for adding a new product, /product/list for listing products).

3. Backend Processing

- **Purpose:** Handles business logic and interacts with the database.
- **Implementation:**
  - **Controllers (ProductController):** Defines HTTP endpoints (@GetMapping, @PostMapping, @DeleteMapping) for handling user requests related to products.
  - **Service Layer (ProductService):** Contains business logic methods (save, findAll, delete) for manipulating product data.
  - **Repository (ProductRepository):** Uses Spring Data JPA interface (JpaRepository<Product, Long>) to perform CRUD operations on the Product entity.

4. Database Interaction

- **Purpose:** Persists and retrieves product data from a relational database.
- **Implementation:**
  - **Entity (Product):** Annotated with JPA annotations (@Entity, @Table, @Id, etc.) to define mapping to a database table (product).
  - **Database Configuration:** Typically configured in application.properties or application.yml to specify database connection details (spring.datasource.url, spring.datasource.username, spring.datasource.password).
  - **Repository (ProductRepository):** Extends JpaRepository<Product, Long> provided by Spring Data JPA to perform database operations.

5. Form Handling and Validation

- **Purpose:** Ensures data integrity and user input validation.
- **Implementation:**
  - **Form Submission (product-form.html):** Allows users (Admin) to submit new product data via a form (<form> tag) which is processed in the backend (@PostMapping("/add") in ProductController).
  - **Validation:** Not explicitly shown in provided snippets, but typically involves using annotations (@Valid, @NotBlank, etc.) on entity fields and handling validation errors.

6. Error Handling

- **Purpose:** Provides meaningful error messages to users.
- **Implementation:**

    - **Exception Handling:** Spring Boot provides default error handling (Whitelabel Error Page) for unhandled exceptions.
    - **Custom Error Pages:** Optionally, custom error pages (error.html, configured in application.properties) can be implemented for specific HTTP error codes.

7. Security (Not Explicitly Shown)

- **Purpose:** Protects sensitive operations and data.
- **Implementation:**
    - **Authentication and Authorization:** May involve Spring Security to secure endpoints and manage user roles and permissions.
    - **Secure Communication:** Ensure HTTPS and secure configurations (application.properties) for database credentials.

8. Deployment and Configuration

- **Purpose:** Configures the application for different environments (development, testing, production).
- **Implementation:**
    - **Configuration (application.properties or application.yml):** Defines database connection details, server port (server.port), and other application-specific settings.
    - **Deployment:** Packaged as a .jar or .war file for deployment to a servlet container (like Tomcat, embedded in Spring Boot).

Summary:

This Spring Boot project combines various Java concepts and frameworks to build a web application:

- **Spring Framework:** DI, IoC, MVC architecture.
- **Spring Data JPA:** Simplifies data access and manipulation.
- **Thymeleaf:** Templating engine for dynamic HTML rendering.
- **HTTP Methods and Form Handling:** Define how clients interact with the application.
- **Object-Oriented Programming:** Ensures modular and maintainable codebase.
- **SQL Concepts and Database Interaction:** Integration with a relational database using JPA and Spring Data JPA.
- **API Handling and Thymeleaf Templates:** Integration of backend logic with frontend views using controllers and Thymeleaf templates.
- This setup ensures efficient development and maintenance of a scalable web application in Java.