# Exercise 1: Employee Management System - Overview and Setup

**1. Initializing a Spring Boot Project**

To begin setting up the Spring Boot project, follow these steps:

1. **Launch Spring Initializr:**
   * Open [Spring Initializr](https://start.spring.io/) in your browser.
   * Complete the project details:
     + **Project Type**: Maven Project
     + **Language**: Java
     + **Spring Boot Version**: Select the latest stable release
     + **Project Metadata**:
       - Group: com.example
       - Artifact: EmployeeManagementSystem
       - Name: EmployeeManagementSystem
       - Package Name: com.example.employeemanagementsystem
       - Packaging: Jar
       - Java: 17 or higher
   * **Include Dependencies**:
     + Spring Web
     + Spring Data JPA
     + H2 Database
     + Lombok
   * After filling in the details, click **Generate** to download the project as a zip file.
   * Extract the zip file, then open the project in your preferred IDE (e.g., IntelliJ IDEA, Eclipse).

**2. Application Properties Configuration**

Next, configure the H2 database by editing the application.properties file located in src/main/resources/:

# H2 Database Configuration

spring.datasource.url=jdbc:h2:mem:testdb

spring.datasource.driver-class-name=org.h2.Driver

spring.datasource.username=sa

spring.datasource.password=password

spring.jpa.database-platform=org.hibernate.dialect.H2Dialect

# Enable H2 Console (useful for debugging)

spring.h2.console.enabled=true

spring.h2.console.path=/h2-console

# Hibernate JPA Configuration

spring.jpa.hibernate.ddl-auto=update

**Exercise 2: Employee Management System - Defining Entities**

**1. Building JPA Entities**

Create the Employee and Department entities within the com.example.employeemanagementsystem.model package

1. \*\*Employee Entity:\*\*

```java

package com.example.employeemanagementsystem.model;

import jakarta.persistence.\*;

import lombok.Data;

@Data

@Entity

@Table(name = "employees")

public class Employee {

@Id

@GeneratedValue(strategy = GenerationType.IDENTITY)

private Long id;

private String name;

private String email;

@ManyToOne

@JoinColumn(name = "department\_id")

private Department department;

}

```

2. \*\*Department Entity:\*\*

```java

package com.example.employeemanagementsystem.model;

import jakarta.persistence.\*;

import lombok.Data;

import java.util.List;

@Data

@Entity

@Table(name = "departments")

public class Department {

@Id

@GeneratedValue(strategy = GenerationType.IDENTITY)

private Long id;

private String name;

@OneToMany(mappedBy = "department", cascade = CascadeType.ALL, fetch = FetchType.LAZY)

private List<Employee> employees;

}

# Creating Repositories

Define JPA repositories to handle CRUD operations for the entities.

1. \*\*Employee Repository:\*\*

```java

package com.example.employeemanagementsystem.repository;

import com.example.employeemanagementsystem.model.Employee;

import org.springframework.data.jpa.repository.JpaRepository;

import org.springframework.stereotype.Repository;

@Repository

public interface EmployeeRepository extends JpaRepository<Employee, Long> {

}

```

2. \*\*Department Repository:\*\*

```java

package com.example.employeemanagementsystem.repository;

import com.example.employeemanagementsystem.model.Department;

import org.springframework.data.jpa.repository.JpaRepository;

import org.springframework.stereotype.Repository;

@Repository

public interface DepartmentRepository extends JpaRepository<Department, Long> {

}

```

### Implementing Services

Develop service classes to manage the business logic for the Employee and Department entities.

1. \*\*Employee Service:\*\*

```java

package com.example.employeemanagementsystem.service;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.repository.EmployeeRepository;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.stereotype.Service;

import java.util.List;

import java.util.Optional;

@Service

public class EmployeeService {

@Autowired

private EmployeeRepository employeeRepository;

public List<Employee> getAllEmployees() {

return employeeRepository.findAll();

}

public Optional<Employee> getEmployeeById(Long id) {

return employeeRepository.findById(id);

}

public Employee saveEmployee(Employee employee) {

return employeeRepository.save(employee);

}

public void deleteEmployee(Long id) {

employeeRepository.deleteById(id);

}

}

```

2. \*\*Department Service:\*\*

```java

package com.example.employeemanagementsystem.service;

import com.example.employeemanagementsystem.model.Department;

import com.example.employeemanagementsystem.repository.DepartmentRepository;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.stereotype.Service;

import java.util.List;

import java.util.Optional;

@Service

public class DepartmentService {

@Autowired

private DepartmentRepository departmentRepository;

public List<Department> getAllDepartments() {

return departmentRepository.findAll();

}

public Optional<Department> getDepartmentById(Long id) {

return departmentRepository.findById(id);

}

public Department saveDepartment(Department department) {

return departmentRepository.save(department);

}

public void deleteDepartment(Long id) {

departmentRepository.deleteById(id);

}

}

```

### Implementing Controllers

Create REST controllers to expose endpoints for managing employees and departments.

1. \*\*Employee Controller:\*\*

```java

package com.example.employeemanagementsystem.controller;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.service.EmployeeService;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.http.ResponseEntity;

import org.springframework.web.bind.annotation.\*;

import java.util.List;

import java.util.Optional;

@RestController

@RequestMapping("/employees")

public class EmployeeController {

@Autowired

private EmployeeService employeeService;

@GetMapping

public List<Employee> getAllEmployees() {

return employeeService.getAllEmployees();

}

@GetMapping("/{id}")

public ResponseEntity<Employee> getEmployeeById(@PathVariable Long id) {

Optional<Employee> employee = employeeService.getEmployeeById(id);

return employee.map(ResponseEntity::ok).orElseGet(() -> ResponseEntity.notFound().build());

}

@PostMapping

public Employee createEmployee(@RequestBody Employee employee) {

return employeeService.saveEmployee(employee);

}

@PutMapping("/{id}")

public ResponseEntity<Employee> updateEmployee(@PathVariable Long id, @RequestBody Employee employeeDetails) {

Optional<Employee> employee = employeeService.getEmployeeById(id);

if (employee.isPresent()) {

Employee updatedEmployee = employee.get();

updatedEmployee.setName(employeeDetails.getName());

updatedEmployee.setEmail(employeeDetails.getEmail());

updatedEmployee.setDepartment(employeeDetails.getDepartment());

return ResponseEntity.ok(employeeService.saveEmployee(updatedEmployee));

} else {

return ResponseEntity.notFound().build();

}

}

@DeleteMapping("/{id}")

public ResponseEntity<Void> deleteEmployee(@PathVariable Long id) {

employeeService.deleteEmployee(id);

return ResponseEntity.noContent().build();

}

}

```

2. \*\*Department Controller:\*\*

```java

package com.example.employeemanagementsystem.controller;

import com.example.employeemanagementsystem.model.Department;

import com.example.employeemanagementsystem.service.DepartmentService;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.http.ResponseEntity;

import org.springframework.web.bind.annotation.\*;

import java.util.List;

import java.util.Optional;

@RestController

@RequestMapping("/departments")

public class DepartmentController {

@Autowired

private DepartmentService departmentService;

@GetMapping

public List<Department> getAllDepartments() {

return departmentService.getAllDepartments();

}

@GetMapping("/{id}")

public ResponseEntity<Department> getDepartmentById(@PathVariable Long id) {

Optional<Department> department = departmentService.getDepartmentById(id);

return department.map(ResponseEntity::ok).orElseGet(() -> ResponseEntity.notFound().build());

}

@PostMapping

public Department createDepartment(@RequestBody Department department) {

return departmentService.saveDepartment(department);

}

@PutMapping("/{id}")

public ResponseEntity<Department> updateDepartment(@PathVariable Long id, @RequestBody Department departmentDetails) {

Optional<Department> department = departmentService.getDepartmentById(id);

if (department.isPresent()) {

Department updatedDepartment = department.get();

updatedDepartment.setName(departmentDetails.getName());

return ResponseEntity.ok(departmentService.saveDepartment(updatedDepartment));

} else {

return ResponseEntity.notFound().build();

}

}

@DeleteMapping("/{id}")

public ResponseEntity<Void> deleteDepartment(@PathVariable Long id) {

departmentService.deleteDepartment(id);

return ResponseEntity.noContent().build();

}

}

```

**Testing the Application**

1. **Run the Application:**
   * Start the application by executing the main method in the EmployeeManagementSystemApplication class.
2. **Access the H2 Console:**
   * Navigate to http://localhost:8080/h2-console to open the H2 database console.
   * Enter the following credentials:
     + **JDBC URL**: jdbc:h2:mem:testdb
     + **Username**: sa
     + **Password**: password
3. **Test the Endpoints:**
   * Utilize tools like Postman or cURL to test the RESTful APIs:
     + **GET** /employees: Fetch all employees.
     + **GET** /employees/{id}: Fetch an employee by ID.
     + **POST** /employees: Add a new employee.
     + **PUT** /employees/{id}: Update an existing employee.
     + **DELETE** /employees/{id}: Remove an employee.
     + **GET** /departments: Fetch all departments.
     + **GET** /departments/{id}: Fetch a department by ID.
     + **POST** /departments: Add a new department.
     + **PUT** /departments/{id}: Update an existing department.
     + **DELETE** /departments/{id}: Remove a department.

This configuration provides a functional Employee Management System with essential CRUD operations for managing employees and departments.

**Exercise 3: Employee Management System - Defining Repositories**

**1. Overview of Spring Data Repositories**

**Advantages of Using Spring Data Repositories:**

* **Simplicity**: Spring Data repositories streamline development by offering default methods for CRUD operations, minimizing boilerplate code.
* **Consistency**: Repository interfaces standardize data access patterns across your application.
* **Custom Queries**: Define custom queries effortlessly by declaring method signatures within repository interfaces.
* **Pagination and Sorting**: Built-in support for pagination and sorting simplifies result management.

**2. Defining Repositories**

Create repository interfaces for Employee and Department entities by extending JpaRepository.

1. \*\*Employee Repository:\*\*

```java

package com.example.employeemanagementsystem.repository;

import com.example.employeemanagementsystem.model.Employee;

import org.springframework.data.jpa.repository.JpaRepository;

import org.springframework.stereotype.Repository;

import java.util.List;

@Repository

public interface EmployeeRepository extends JpaRepository<Employee, Long> {

// Derived query method to find employees by department name

List<Employee> findByDepartmentName(String departmentName);

// Derived query method to find employees by name

List<Employee> findByNameContainingIgnoreCase(String name);

}

```

2. \*\*Department Repository:\*\*

```java

package com.example.employeemanagementsystem.repository;

import com.example.employeemanagementsystem.model.Department;

import org.springframework.data.jpa.repository.JpaRepository;

import org.springframework.stereotype.Repository;

@Repository

public interface DepartmentRepository extends JpaRepository<Department, Long> {

// Derived query method to find department by name

Department findByName(String name);

}

```

**Exercise 4: Employee Management System - Implementing CRUD Operations**

**1. Implementing CRUD Operations**

Leverage JpaRepository methods to perform basic CRUD operations for employees and departments. Additionally, expose these operations via RESTful endpoints using the EmployeeController and DepartmentController.

* **Create**: Add new employees and departments.
* **Read**: Retrieve existing employees and departments.
* **Update**: Modify details of existing employees and departments.
* **Delete**: Remove employees and departments from the system.

The RESTful controllers will provide endpoints to handle these operations and interact with the service layer, facilitating seamless data management.

##### Employee Service

```java

package com.example.employeemanagementsystem.service;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.repository.EmployeeRepository;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.stereotype.Service;

import java.util.List;

import java.util.Optional;

@Service

public class EmployeeService {

@Autowired

private EmployeeRepository employeeRepository;

public List<Employee> getAllEmployees() {

return employeeRepository.findAll();

}

public Optional<Employee> getEmployeeById(Long id) {

return employeeRepository.findById(id);

}

public Employee saveEmployee(Employee employee) {

return employeeRepository.save(employee);

}

public Employee updateEmployee(Long id, Employee employeeDetails) {

return employeeRepository.findById(id).map(employee -> {

employee.setName(employeeDetails.getName());

employee.setEmail(employeeDetails.getEmail());

employee.setDepartment(employeeDetails.getDepartment());

return employeeRepository.save(employee);

}).orElseThrow(() -> new RuntimeException("Employee not found with id " + id));

}

public void deleteEmployee(Long id) {

employeeRepository.deleteById(id);

}

public List<Employee> getEmployeesByDepartmentName(String departmentName) {

return employeeRepository.findByDepartmentName(departmentName);

}

public List<Employee> searchEmployeesByName(String name) {

return employeeRepository.findByNameContainingIgnoreCase(name);

}

}

```

##### Department Service

```java

package com.example.employeemanagementsystem.service;

import com.example.employeemanagementsystem.model.Department;

import com.example.employeemanagementsystem.repository.DepartmentRepository;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.stereotype.Service;

import java.util.List;

import java.util.Optional;

@Service

public class DepartmentService {

@Autowired

private DepartmentRepository departmentRepository;

public List<Department> getAllDepartments() {

return departmentRepository.findAll();

}

public Optional<Department> getDepartmentById(Long id) {

return departmentRepository.findById(id);

}

public Department saveDepartment(Department department) {

return departmentRepository.save(department);

}

public Department updateDepartment(Long id, Department departmentDetails) {

return departmentRepository.findById(id).map(department -> {

department.setName(departmentDetails.getName());

return departmentRepository.save(department);

}).orElseThrow(() -> new RuntimeException("Department not found with id " + id));

}

public void deleteDepartment(Long id) {

departmentRepository.deleteById(id);

}

public Department getDepartmentByName(String name) {

return departmentRepository.findByName(name);

}

}

```

#### 2. Implement RESTful Endpoints

##### Employee Controller

```java

package com.example.employeemanagementsystem.controller;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.service.EmployeeService;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.http.ResponseEntity;

import org.springframework.web.bind.annotation.\*;

import java.util.List;

import java.util.Optional;

@RestController

@RequestMapping("/employees")

public class EmployeeController {

@Autowired

private EmployeeService employeeService;

@GetMapping

public List<Employee> getAllEmployees() {

return employeeService.getAllEmployees();

}

@GetMapping("/{id}")

public ResponseEntity<Employee> getEmployeeById(@PathVariable Long id) {

Optional<Employee> employee = employeeService.getEmployeeById(id);

return employee.map(ResponseEntity::ok).orElseGet(() -> ResponseEntity.notFound().build());

}

@PostMapping

public Employee createEmployee(@RequestBody Employee employee) {

return employeeService.saveEmployee(employee);

}

@PutMapping("/{id}")

public ResponseEntity<Employee> updateEmployee(@PathVariable Long id, @RequestBody Employee employeeDetails) {

try {

Employee updatedEmployee = employeeService.updateEmployee(id, employeeDetails);

return ResponseEntity.ok(updatedEmployee);

} catch (RuntimeException e) {

return ResponseEntity.notFound().build();

}

}

@DeleteMapping("/{id}")

public ResponseEntity<Void> deleteEmployee(@PathVariable Long id) {

employeeService.deleteEmployee(id);

return ResponseEntity.noContent().build();

}

@GetMapping("/search")

public List<Employee> searchEmployeesByName(@RequestParam String name) {

return employeeService.searchEmployeesByName(name);

}

@GetMapping("/department/{departmentName}")

public List<Employee> getEmployeesByDepartment(@PathVariable String departmentName) {

return employeeService.getEmployeesByDepartmentName(departmentName);

}

}

```

##### Department Controller

```java

package com.example.employeemanagementsystem.controller;

import com.example.employeemanagementsystem.model.Department;

import com.example.employeemanagementsystem.service.DepartmentService;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.http.ResponseEntity;

import org.springframework.web.bind.annotation.\*;

import java.util.List;

import java.util.Optional;

@RestController

@RequestMapping("/departments")

public class DepartmentController {

@Autowired

private DepartmentService departmentService;

@GetMapping

public List<Department> getAllDepartments() {

return departmentService.getAllDepartments();

}

@GetMapping("/{id}")

public ResponseEntity<Department> getDepartmentById(@PathVariable Long id) {

Optional<Department> department = departmentService.getDepartmentById(id);

return department.map(ResponseEntity::ok).orElseGet(() -> ResponseEntity.notFound().build());

}

@PostMapping

public Department createDepartment(@RequestBody Department department) {

return departmentService.saveDepartment(department);

}

@PutMapping("/{id}")

public ResponseEntity<Department> updateDepartment(@PathVariable Long id, @RequestBody Department departmentDetails) {

try {

Department updatedDepartment = departmentService.updateDepartment(id, departmentDetails);

return ResponseEntity.ok(updatedDepartment);

} catch (RuntimeException e) {

return ResponseEntity.notFound().build();

}

}

@DeleteMapping("/{id}")

public ResponseEntity<Void> deleteDepartment(@PathVariable Long id) {

departmentService.deleteDepartment(id);

return ResponseEntity.noContent().build();

}

@GetMapping("/name/{name}")

public ResponseEntity<Department> getDepartmentByName(@PathVariable String name) {

Department department = departmentService.getDepartmentByName(name);

if (department != null) {

return ResponseEntity.ok(department);

} else {

return ResponseEntity.notFound().build();

}

}

}

```

### Testing the Application

1. \*\*Run the Application:\*\*

- Run the `EmployeeManagementSystemApplication` class to start the Spring Boot application.

2. \*\*Use Postman or cURL:\*\*

- Test the RESTful endpoints for employees and departments:

- `GET /employees` - Retrieve all employees.

- `GET /employees/{id}` - Retrieve an employee by ID.

- `POST /employees` - Create a new employee.

- `PUT /employees/{id}` - Update an existing employee.

- `DELETE /employees/{id}` - Delete an employee.

- `GET /employees/search?name={name}` - Search employees by name.

- `GET /employees/department/{departmentName}` - Get employees by department name.

- `GET /departments` - Retrieve all departments.

- `GET /departments/{id}` - Retrieve a department by ID.

- `POST /departments` -

Create a new department.

- `PUT /departments/{id}` - Update an existing department.

- `DELETE /departments/{id}` - Delete a department.

- `GET /departments/name/{name}` - Retrieve a department by name.

# Exercise 5: Employee Management System - Defining Query Methods

**1. Creating Custom Query Methods**

**Custom Query Methods with Method Name Conventions:**

Spring Data JPA enables the creation of custom queries through method name conventions in repository interfaces. Enhance the EmployeeRepository by adding query methods to retrieve employees based on specific criteria.

For example:

* Find employees by department name.
* Search for employees by name with partial matching.

These custom query methods will leverage Spring Data JPA's capability to generate queries automatically based on method names.

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```java

package com.example.employeemanagementsystem.repository;

import com.example.employeemanagementsystem.model.Employee;

import org.springframework.data.jpa.repository.JpaRepository;

import org.springframework.data.jpa.repository.Query;

import org.springframework.data.repository.query.Param;

import org.springframework.stereotype.Repository;

import java.util.List;

@Repository

public interface EmployeeRepository extends JpaRepository<Employee, Long> {

// Derived query method to find employees by department name

List<Employee> findByDepartmentName(String departmentName);

// Derived query method to find employees by name

List<Employee> findByNameContainingIgnoreCase(String name);

// Custom query using @Query annotation

@Query("SELECT e FROM Employee e WHERE e.email = :email")

Employee findEmployeeByEmail(@Param("email") String email);

// Custom query method to find employees by department id using JPQL

@Query("SELECT e FROM Employee e WHERE e.department.id = :departmentId")

List<Employee> findByDepartmentId(@Param("departmentId") Long departmentId);

}

```

#### 2. Named Queries

Named queries are defined at the entity level and allow us to reuse queries across the application. Here's how you can define and use them:

\*\*Define Named Queries:\*\*

```java

package com.example.employeemanagementsystem.model;

import jakarta.persistence.\*;

@Entity

@Table(name = "employees")

@NamedQueries({

@NamedQuery(name = "Employee.findByDepartmentNameNamedQuery",

query = "SELECT e FROM Employee e WHERE e.department.name = :departmentName"),

@NamedQuery(name = "Employee.findByEmailNamedQuery",

query = "SELECT e FROM Employee e WHERE e.email = :email")

})

public class Employee {

@Id

@GeneratedValue(strategy = GenerationType.IDENTITY)

private Long id;

private String name;

private String email;

@ManyToOne

@JoinColumn(name = "department\_id")

private Department department;

// Getters and setters...

}

```

\*\*Use Named Queries:\*\*

To execute named queries, use `EntityManager`:

```java

package com.example.employeemanagementsystem.service;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.repository.EmployeeRepository;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.stereotype.Service;

import jakarta.persistence.EntityManager;

import jakarta.persistence.PersistenceContext;

import jakarta.persistence.TypedQuery;

import java.util.List;

import java.util.Optional;

@Service

public class EmployeeService {

@Autowired

private EmployeeRepository employeeRepository;

@PersistenceContext

private EntityManager entityManager;

public List<Employee> getEmployeesByDepartmentNameNamedQuery(String departmentName) {

TypedQuery<Employee> query = entityManager.createNamedQuery("Employee.findByDepartmentNameNamedQuery", Employee.class);

query.setParameter("departmentName", departmentName);

return query.getResultList();

}

public Employee findEmployeeByEmailNamedQuery(String email) {

TypedQuery<Employee> query = entityManager.createNamedQuery("Employee.findByEmailNamedQuery", Employee.class);

query.setParameter("email", email);

return query.getSingleResult();

}

// Other service methods...

}

```

# Exercise 6: Employee Management System - Implementing Pagination and Sorting

**1. Implementing Pagination**

To add pagination support, utilize the Page and Pageable interfaces offered by Spring Data JPA.

\*\*Repository Update:\*\*

```java

package com.example.employeemanagementsystem.repository;

import com.example.employeemanagementsystem.model.Employee;

import org.springframework.data.domain.Page;

import org.springframework.data.domain.Pageable;

import org.springframework.data.jpa.repository.JpaRepository;

import org.springframework.stereotype.Repository;

@Repository

public interface EmployeeRepository extends JpaRepository<Employee, Long> {

// Other query methods...

// Pagination method

Page<Employee> findAll(Pageable pageable);

}

```

\*\*Service Method for Pagination:\*\*

```java

package com.example.employeemanagementsystem.service;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.repository.EmployeeRepository;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.data.domain.Page;

import org.springframework.data.domain.Pageable;

import org.springframework.stereotype.Service;

@Service

public class EmployeeService {

@Autowired

private EmployeeRepository employeeRepository;

public Page<Employee> getEmployeesWithPagination(Pageable pageable) {

return employeeRepository.findAll(pageable);

}

// Other service methods...

}

```

\*\*Controller Endpoint for Pagination:\*\*

```java

package com.example.employeemanagementsystem.controller;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.service.EmployeeService;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.data.domain.Page;

import org.springframework.data.domain.Pageable;

import org.springframework.web.bind.annotation.\*;

@RestController

@RequestMapping("/employees")

public class EmployeeController {

@Autowired

private EmployeeService employeeService;

@GetMapping("/page")

public Page<Employee> getAllEmployeesWithPagination(Pageable pageable) {

return employeeService.getEmployeesWithPagination(pageable);

}

// Other endpoints...

}

```

#### 2. Sorting

Add sorting functionality to the queries using the `Sort` object.

\*\*Repository Update:\*\*

```java

package com.example.employeemanagementsystem.repository;

import com.example.employeemanagementsystem.model.Employee;

import org.springframework.data.domain.Page;

import org.springframework.data.domain.Pageable;

import org.springframework.data.domain.Sort;

import org.springframework.data.jpa.repository.JpaRepository;

import org.springframework.stereotype.Repository;

@Repository

public interface EmployeeRepository extends JpaRepository<Employee, Long> {

// Other query methods...

// Sorting and Pagination method

Page<Employee> findAll(Pageable pageable);

List<Employee> findAll(Sort sort);

}

```

\*\*Service Method for Sorting:\*\*

```java

package com.example.employeemanagementsystem.service;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.repository.EmployeeRepository;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.data.domain.Page;

import org.springframework.data.domain.Pageable;

import org.springframework.data.domain.Sort;

import org.springframework.stereotype.Service;

import java.util.List;

@Service

public class EmployeeService {

@Autowired

private EmployeeRepository employeeRepository;

public Page<Employee> getEmployeesWithPaginationAndSorting(Pageable pageable) {

return employeeRepository.findAll(pageable);

}

public List<Employee> getEmployeesWithSorting(Sort sort) {

return employeeRepository.findAll(sort);

}

// Other service methods...

}

```

\*\*Controller Endpoint for Pagination and Sorting:\*\*

```java

package com.example.employeemanagementsystem.controller;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.service.EmployeeService;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.data.domain.Page;

import org.springframework.data.domain.Pageable;

import org.springframework.data.domain.Sort;

import org.springframework.web.bind.annotation.\*;

import java.util.List;

@RestController

@RequestMapping("/employees")

public class EmployeeController {

@Autowired

private EmployeeService employeeService;

@GetMapping("/page")

public Page<Employee> getAllEmployeesWithPaginationAndSorting(Pageable pageable) {

return employeeService.getEmployeesWithPaginationAndSorting(pageable);

}

@GetMapping("/sorted")

public List<Employee> getAllEmployeesWithSorting(Sort sort) {

return employeeService.getEmployeesWithSorting(sort);

}

// Other endpoints...

}

```

### Testing Pagination and Sorting

1. \*\*Pagination:\*\*

- Use the endpoint `GET /employees/page` with query parameters like `?page=0&size=5` to fetch paginated results.

2. \*\*Sorting:\*\*

- Use the endpoint `GET /employees/sorted` with a `Sort` parameter like `?sort=name,asc` or `?sort=name,desc` to fetch sorted results.

3. \*\*Combined Pagination and Sorting:\*\*

- Combine both pagination and sorting using the endpoint `GET /employees/page` with parameters like `?page=0&size=5&sort=name,asc`.

**Exercise 7: Employee Management System - Enabling Entity Auditing**

Entity auditing helps track who created or modified an entity and when these actions took place. To implement this, use Spring Data JPA's auditing features.

**1. Activating Auditing**

To enable auditing in a Spring Boot application, configure it in your application and annotate the entity classes accordingly.

**Step 1: Activate Auditing in Configuration**

Begin by adding the @EnableJpaAuditing annotation to your main application class to enable JPA auditing.

```java

package com.example.employeemanagementsystem;

import org.springframework.boot.SpringApplication;

import org.springframework.boot.autoconfigure.SpringBootApplication;

import org.springframework.data.jpa.repository.config.EnableJpaAuditing;

@SpringBootApplication

@EnableJpaAuditing

public class EmployeeManagementSystemApplication {

public static void main(String[] args) {

SpringApplication.run(EmployeeManagementSystemApplication.class, args);

}

}

```

\*\*Step 2: Configure AuditorAware\*\*

Implement the `AuditorAware` interface to return the current user. For simplicity, we'll return a hardcoded value. In a real-world application, you would integrate this with your security context to get the actual user.

```java

package com.example.employeemanagementsystem.config;

import org.springframework.context.annotation.Configuration;

import org.springframework.data.domain.AuditorAware;

import java.util.Optional;

@Configuration

public class AuditorAwareImpl implements AuditorAware<String> {

@Override

public Optional<String> getCurrentAuditor() {

// Return a hardcoded username for demonstration purposes

return Optional.of("admin");

}

}

```

\*\*Step 3: Add Auditing Annotations to Entities\*\*

Annotate the `Employee` and `Department` entities with auditing annotations.

```java

package com.example.employeemanagementsystem.model;

import jakarta.persistence.\*;

import org.springframework.data.annotation.CreatedBy;

import org.springframework.data.annotation.CreatedDate;

import org.springframework.data.annotation.LastModifiedBy;

import org.springframework.data.annotation.LastModifiedDate;

import org.springframework.data.jpa.domain.support.AuditingEntityListener;

import java.time.LocalDateTime;

@Entity

@Table(name = "employees")

@EntityListeners(AuditingEntityListener.class)

public class Employee {

@Id

@GeneratedValue(strategy = GenerationType.IDENTITY)

private Long id;

private String name;

private String email;

@ManyToOne

@JoinColumn(name = "department\_id")

private Department department;

@CreatedBy

private String createdBy;

@CreatedDate

private LocalDateTime createdDate;

@LastModifiedBy

private String lastModifiedBy;

@LastModifiedDate

private LocalDateTime lastModifiedDate;

// Getters and setters...

}

@Entity

@Table(name = "departments")

@EntityListeners(AuditingEntityListener.class)

public class Department {

@Id

@GeneratedValue(strategy = GenerationType.IDENTITY)

private Long id;

private String name;

@CreatedBy

private String createdBy;

@CreatedDate

private LocalDateTime createdDate;

@LastModifiedBy

private String lastModifiedBy;

@LastModifiedDate

private LocalDateTime lastModifiedDate;

// Getters and setters...

}

```

With these configurations, your application will automatically track the `createdBy`, `createdDate`, `lastModifiedBy`, and `lastModifiedDate` fields for each entity.

# Exercise 8: Employee Management System - Creating Projections

Projections enable you to retrieve specific fields from entities rather than fetching entire objects. You can define projections using either interfaces or classes.

**1. Defining Projections**

**Interface-Based Projection:**

Create interfaces to specify projections for the Employee and Department entities.

```java

package com.example.employeemanagementsystem.projection;

public interface EmployeeProjection {

Long getId();

String getName();

String getEmail();

String getDepartmentName();

}

public interface DepartmentProjection {

Long getId();

String getName();

}

```

\*\*Class-Based Projection:\*\*

Create DTO classes for class-based projections.

```java

package com.example.employeemanagementsystem.dto;

public class EmployeeDTO {

private Long id;

private String name;

private String email;

private String departmentName;

public EmployeeDTO(Long id, String name, String email, String departmentName) {

this.id = id;

this.name = name;

this.email = email;

this.departmentName = departmentName;

}

// Getters and setters...

}

public class DepartmentDTO {

private Long id;

private String name;

public DepartmentDTO(Long id, String name) {

this.id = id;

this.name = name;

}

// Getters and setters...

}

```

#### 2. Use Projections in Repository Methods

\*\*Using Interface-Based Projection:\*\*

Define methods in your repositories that return interface-based projections.

```java

package com.example.employeemanagementsystem.repository;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.projection.EmployeeProjection;

import org.springframework.data.jpa.repository.JpaRepository;

import org.springframework.data.jpa.repository.Query;

import org.springframework.stereotype.Repository;

import java.util.List;

@Repository

public interface EmployeeRepository extends JpaRepository<Employee, Long> {

// Other query methods...

// Interface-based projection

@Query("SELECT e.id as id, e.name as name, e.email as email, e.department.name as departmentName FROM Employee e")

List<EmployeeProjection> findAllEmployeeProjections();

}

```

\*\*Using Class-Based Projection:\*\*

Define methods in your repositories that return class-based projections using constructor expressions.

```java

package com.example.employeemanagementsystem.repository;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.dto.EmployeeDTO;

import org.springframework.data.jpa.repository.JpaRepository;

import org.springframework.data.jpa.repository.Query;

import org.springframework.stereotype.Repository;

import java.util.List;

@Repository

public interface EmployeeRepository extends JpaRepository<Employee, Long> {

// Other query methods...

// Class-based projection using constructor expression

@Query("SELECT new com.example.employeemanagementsystem.dto.EmployeeDTO(e.id, e.name, e.email, e.department.name) FROM Employee e")

List<EmployeeDTO> findAllEmployeeDTOs();

}

```

#### 3. Fetching Projections in the Service Layer

Use the defined projection methods in the service layer.

```java

package com.example.employeemanagementsystem.service;

import com.example.employeemanagementsystem.dto.EmployeeDTO;

import com.example.employeemanagementsystem.projection.EmployeeProjection;

import com.example.employeemanagementsystem.repository.EmployeeRepository;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.stereotype.Service;

import java.util.List;

@Service

public class EmployeeService {

@Autowired

private EmployeeRepository employeeRepository;

public List<EmployeeProjection> getAllEmployeeProjections() {

return employeeRepository.findAllEmployeeProjections();

}

public List<EmployeeDTO> getAllEmployeeDTOs() {

return employeeRepository.findAllEmployeeDTOs();

}

// Other service methods...

}

```

#### 4. Fetching Projections in the Controller Layer

Define endpoints to return the projection data.

```java

package com.example.employeemanagementsystem.controller;

import com.example.employeemanagementsystem.dto.EmployeeDTO;

import com.example.employeemanagementsystem.projection.EmployeeProjection;

import com.example.employeemanagementsystem.service.EmployeeService;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.web.bind.annotation.\*;

import java.util.List;

@RestController

@RequestMapping("/employees")

public class EmployeeController {

@Autowired

private EmployeeService employeeService;

@GetMapping("/projections")

public List<EmployeeProjection> getEmployeeProjections() {

return employeeService.getAllEmployeeProjections();

}

@GetMapping("/dto")

public List<EmployeeDTO> getEmployeeDTOs() {

return employeeService.getAllEmployeeDTOs();

}

// Other endpoints...

}

```

### Testing Entity Auditing and Projections

1. \*\*Entity Auditing:\*\*

- Verify that the `createdBy`, `createdDate`, `lastModifiedBy`, and `lastModifiedDate` fields are populated and updated appropriately in the database.

2. \*\*Projections:\*\*

- Use the endpoints `GET /employees/projections` and `GET /employees/dto` to fetch data with projections.

- Ensure that the projection results only contain the specified fields.

# Exercise 9: Employee Management System - Customizing Data Source Configuration

In this exercise, we will explore how to configure Spring Boot to handle multiple data sources and externalize configuration properties.

**1. Spring Boot Auto-Configuration**

Spring Boot's auto-configuration feature makes it easy to set up data sources. It automatically configures a data source when it finds a database driver on the classpath and the appropriate configuration properties.

**Default Data Source Configuration:**

Define the default data source settings in the application.properties file:

```properties

# Default Data Source Configuration

spring.datasource.url=jdbc:h2:mem:testdb

spring.datasource.username=sa

spring.datasource.password=password

spring.datasource.driver-class-name=org.h2.Driver

spring.jpa.database-platform=org.hibernate.dialect.H2Dialect

spring.jpa.hibernate.ddl-auto=update

```

#### 2. Externalizing Configuration

\*\*Externalize Configuration in `application.properties`:\*\*

You can externalize your data source configurations in the `application.properties` file. Here's an example for an H2 and a MySQL data source:

```properties

# Default H2 Data Source Configuration

spring.datasource.url=jdbc:h2:mem:testdb

spring.datasource.username=sa

spring.datasource.password=password

spring.datasource.driver-class-name=org.h2.Driver

spring.jpa.database-platform=org.hibernate.dialect.H2Dialect

spring.jpa.hibernate.ddl-auto=update

# MySQL Data Source Configuration

app.datasource.mysql.url=jdbc:mysql://localhost:3306/employee\_db

app.datasource.mysql.username=root

app.datasource.mysql.password=yourpassword

app.datasource.mysql.driver-class-name=com.mysql.cj.jdbc.Driver

```

\*\*Manage Multiple Data Sources:\*\*

To manage multiple data sources, you can configure them in the application as follows:

```java

package com.example.employeemanagementsystem.config;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.boot.context.properties.ConfigurationProperties;

import org.springframework.boot.jdbc.DataSourceBuilder;

import org.springframework.context.annotation.Bean;

import org.springframework.context.annotation.Configuration;

import org.springframework.context.annotation.Primary;

import org.springframework.core.env.Environment;

import org.springframework.data.jpa.repository.config.EnableJpaRepositories;

import org.springframework.jdbc.datasource.DataSourceTransactionManager;

import org.springframework.orm.jpa.JpaTransactionManager;

import org.springframework.orm.jpa.LocalContainerEntityManagerFactoryBean;

import org.springframework.orm.jpa.vendor.HibernateJpaVendorAdapter;

import javax.sql.DataSource;

import java.util.HashMap;

@Configuration

@EnableJpaRepositories(

basePackages = "com.example.employeemanagementsystem.repository",

entityManagerFactoryRef = "entityManagerFactory",

transactionManagerRef = "transactionManager"

)

public class DataSourceConfig {

@Autowired

private Environment env;

@Primary

@Bean(name = "dataSource")

@ConfigurationProperties(prefix = "spring.datasource")

public DataSource dataSource() {

return DataSourceBuilder.create().build();

}

@Bean(name = "mysqlDataSource")

@ConfigurationProperties(prefix = "app.datasource.mysql")

public DataSource mysqlDataSource() {

return DataSourceBuilder.create().build();

}

@Primary

@Bean(name = "entityManagerFactory")

public LocalContainerEntityManagerFactoryBean entityManagerFactory() {

LocalContainerEntityManagerFactoryBean em = new LocalContainerEntityManagerFactoryBean();

em.setDataSource(dataSource());

em.setPackagesToScan("com.example.employeemanagementsystem.model");

HibernateJpaVendorAdapter vendorAdapter = new HibernateJpaVendorAdapter();

em.setJpaVendorAdapter(vendorAdapter);

em.setJpaPropertyMap(hibernateProperties());

return em;

}

@Bean(name = "mysqlEntityManagerFactory")

public LocalContainerEntityManagerFactoryBean mysqlEntityManagerFactory() {

LocalContainerEntityManagerFactoryBean em = new LocalContainerEntityManagerFactoryBean();

em.setDataSource(mysqlDataSource());

em.setPackagesToScan("com.example.employeemanagementsystem.model");

HibernateJpaVendorAdapter vendorAdapter = new HibernateJpaVendorAdapter();

em.setJpaVendorAdapter(vendorAdapter);

em.setJpaPropertyMap(hibernateProperties());

return em;

}

@Primary

@Bean(name = "transactionManager")

public JpaTransactionManager transactionManager() {

JpaTransactionManager transactionManager = new JpaTransactionManager();

transactionManager.setEntityManagerFactory(entityManagerFactory().getObject());

return transactionManager;

}

@Bean(name = "mysqlTransactionManager")

public DataSourceTransactionManager mysqlTransactionManager() {

DataSourceTransactionManager transactionManager = new DataSourceTransactionManager();

transactionManager.setDataSource(mysqlDataSource());

return transactionManager;

}

private HashMap<String, Object> hibernateProperties() {

HashMap<String, Object> properties = new HashMap<>();

properties.put("hibernate.hbm2ddl.auto", env.getProperty("spring.jpa.hibernate.ddl-auto"));

properties.put("hibernate.dialect", env.getProperty("spring.jpa.database-platform"));

return properties;

}

}

```

\*\*Switching Between Data Sources:\*\*

You can switch between the data sources by specifying the data source bean to use for different repositories or services.

**Exercise 10: Employee Management System - Hibernate-Specific Features**

Hibernate offers various features to improve performance and extend the functionality of your application. Here are some key features you can use:

**1. Hibernate-Specific Annotations**

Hibernate includes annotations for advanced mappings and configurations.

**Example of Hibernate-Specific Annotations:**

```java

package com.example.employeemanagementsystem.model;

import jakarta.persistence.\*;

import org.hibernate.annotations.Cache;

import org.hibernate.annotations.CacheConcurrencyStrategy;

import org.hibernate.annotations.CreationTimestamp;

import org.hibernate.annotations.UpdateTimestamp;

import java.time.LocalDateTime;

@Entity

@Table(name = "employees")

@Cache(usage = CacheConcurrencyStrategy.READ\_WRITE)

public class Employee {

@Id

@GeneratedValue(strategy = GenerationType.IDENTITY)

private Long id;

private String name;

private String email;

@ManyToOne(fetch = FetchType.LAZY)

@JoinColumn(name = "department\_id")

private Department department;

@CreationTimestamp

private LocalDateTime createdDate;

@UpdateTimestamp

private LocalDateTime lastModifiedDate;

// Getters and setters...

}

```

- `@Cache`: Configures caching for the entity.

- `@CreationTimestamp` and `@UpdateTimestamp`: Automatically manage timestamps for creation and update events.

#### 2. Configuring Hibernate Dialect and Properties

Configuring the Hibernate dialect is essential for ensuring compatibility with your database.

\*\*Configuring Hibernate Properties in `application.properties`:\*\*

```properties

# Hibernate Configuration

spring.jpa.hibernate.ddl-auto=update

spring.jpa.database-platform=org.hibernate.dialect.MySQL8Dialect

spring.jpa.properties.hibernate.format\_sql=true

spring.jpa.properties.hibernate.use\_sql\_comments=true

spring.jpa.properties.hibernate.show\_sql=true

```

These settings control how Hibernate generates SQL for your database.

#### 3. Batch Processing

Batch processing allows you to perform bulk operations more efficiently.

\*\*Enable Batch Processing:\*\*

Configure batch processing in `application.properties`:

```properties

# Hibernate Batch Processing

spring.jpa.properties.hibernate.jdbc.batch\_size=20

spring.jpa.properties.hibernate.order\_inserts=true

spring.jpa.properties.hibernate.order\_updates=true

```

\*\*Implementing Batch Processing:\*\*

Use batch processing for bulk operations in your service layer.

```java

package com.example.employeemanagementsystem.service;

import com.example.employeemanagementsystem.model.Employee;

import com.example.employeemanagementsystem.repository.EmployeeRepository;

import org.springframework.beans.factory.annotation.Autowired;

import org.springframework.stereotype.Service;

import jakarta.transaction.Transactional;

import java.util.List;

@Service

public class EmployeeService {

@Autowired

private EmployeeRepository employeeRepository;

@Transactional

public void saveAllEmployees(List<Employee> employees) {

employeeRepository.saveAll(employees);

}

// Other service methods...

}

```

Batch processing enhances performance by minimizing the number of database interactions needed for bulk operations.

**Testing Data Source Configuration and Hibernate Features**

1. **Data Source Configuration:**
   * Ensure the application can connect to and operate with multiple data sources.
   * Test CRUD operations across both data sources to confirm functionality.
2. **Hibernate Features:**
   * Verify that entity timestamps (createdDate and lastModifiedDate) are automatically updated.
   * Check that caching is effective by noting a reduction in database queries.
   * Utilize batch processing to insert or update multiple records and assess the performance improvements.

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