**Objectives**

* Explain the need and benefit of ORM
  + ORM (Object-Relational Mapping), makes it easier to develop code that interacts with database, abstracts the database system, transactionality
    - ORM Pros and Cons - https://blog.bitsrc.io/what-is-an-orm-and-why-you-should-use-it-b2b6f75f5e2a
    - What is ORM? - https://en.wikipedia.org/wiki/Object-relational\_mapping

* Demonstrate the need and benefit of Spring Data JPA
  + Evolution of ORM solutions, Hibernate XML Configuration, Hibernate Annotation Configuration, Spring Data JPA, Hibernate benefits, open source, light weight, database independent query
    - With H2 in memory database - https://www.mkyong.com/spring-boot/spring-boot-spring-data-jpa/
    - With MySQL - https://www.mkyong.com/spring-boot/spring-boot-spring-data-jpa-mysql-example/
    - XML Configuration Example -https://www.tutorialspoint.com/hibernate/hibernate\_examples.htm
    - Hibernate Configuration Example -https://www.tutorialspoint.com/hibernate/hibernate\_annotations.htm

* Explain about core objects of hibernate framework
  + Session Factory, Session, Transaction Factory, Transaction, Connection Provider
    - Hibernate Architecture Reference - https://www.tutorialspoint.com/hibernate/hibernate\_architecture.htm

* Explain ORM implementation with Hibernate XML Configuration and Annotation Configuration
  + XML Configuration - persistence class, mapping xml, configuration xml, loading hibernate configuration xml file; Annotation Configuration - persistence class, @Entity, @Table, @Id, @Column, hibernate configuration xml file Loading hibernate configuration and interacting with database get the session factory, open session, begin transaction, commit transaction, close session
    - XML Configuration Example - https://www.tutorialspoint.com/hibernate/hibernate\_examples.htm
    - Hibernate Configuration Example - https://www.tutorialspoint.com/hibernate/hibernate\_annotations.htm

* Explain the difference between Java Persistence API, Hibernate and Spring Data JPA
  + JPA (Java Persistence API), JPA is a specification (JSR 338), JPA does not have implementation, Hibernate is one of the implementation for JPA, Hibernate is a ORM tool, Spring Data JPA is an abstraction above Hibernate to remove boiler plate code when persisting data using Hibernate.
    - Difference between Spring Data JPA and Hibernate - https://dzone.com/articles/what-is-the-difference-between-hibernate-and-sprin-1
    - Intro to JPA - https://www.javaworld.com/article/3379043/what-is-jpa-introduction-to-the-java-persistence-api.html

* Demonstrate implementation of DML using Spring Data JPA on a single database table
  + Hibernate log configuration and ddl-auto configuration, JpaRepsitory.findById(), defining Query Methods, JpaRespository.save(), JpaRepository.deleteById()
    - Spring Data JPA Ref Repository methods - https://docs.spring.io/spring-data/jpa/docs/2.2.0.RELEASE/reference/html/#repositories.core-concepts
    - Query methods - https://docs.spring.io/spring-data/jpa/docs/2.2.0.RELEASE/reference/html/#repositories.query-methods

**Hands on 1**

**Spring Data JPA - Quick Example**   
  
**Software Pre-requisites**

* MySQL Server 8.0
* MySQL Workbench 8
* Eclipse IDE for Enterprise Java Developers 2019-03 R
* Maven 3.6.2

**Create a Eclipse Project using Spring Initializr**

* Go to <https://start.spring.io/>
* Change Group as “com.cognizant”
* Change Artifact Id as “orm-learn”
* In Options > Description enter "Demo project for Spring Data JPA and Hibernate"
* Click on menu and select "Spring Boot DevTools", "Spring Data JPA" and "MySQL Driver"
* Click Generate and download the project as zip
* Extract the zip in root folder to Eclipse Workspace
* Import the project in Eclipse "File > Import > Maven > Existing Maven Projects > Click Browse and select extracted folder > Finish"
* Create a new schema "ormlearn" in MySQL database. Execute the following commands to open MySQL client and create schema.

> mysql -u root -p

mysql> create schema ormlearn;

* In orm-learn Eclipse project, open src/main/resources/application.properties and include the below database and log configuration.

# Spring Framework and application log

logging.level.org.springframework=info

logging.level.com.cognizant=debug

# Hibernate logs for displaying executed SQL, input and output

logging.level.org.hibernate.SQL=trace

logging.level.org.hibernate.type.descriptor.sql=trace

# Log pattern

logging.pattern.console=%d{dd-MM-yy} %d{HH:mm:ss.SSS} %-20.20thread %5p %-25.25logger{25} %25M %4L %m%n

# Database configuration

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

spring.datasource.url=jdbc:mysql://localhost:3306/ormlearn

spring.datasource.username=root

spring.datasource.password=root

# Hibernate configuration

spring.jpa.hibernate.ddl-auto=validate

spring.jpa.properties.hibernate.dialect=org.hibernate.dialect.MySQL5Dialect

* Build the project using ‘mvn clean package -Dhttp.proxyHost=proxy.cognizant.com -Dhttp.proxyPort=6050 -Dhttps.proxyHost=proxy.cognizant.com -Dhttps.proxyPort=6050 -Dhttp.proxyUser=123456’ command in command line
* Include logs for verifying if main() method is called.

import org.slf4j.Logger;

import org.slf4j.LoggerFactory;

private static final Logger LOGGER = LoggerFactory.getLogger(OrmLearnApplication.class);

public static void main(String[] args) {

SpringApplication.run(OrmLearnApplication.class, args);

  LOGGER.info("Inside main");

}

* Execute the OrmLearnApplication and check in log if main method is called.

SME to walk through the following aspects related to the project created:

1. src/main/java - Folder with application code
2. src/main/resources - Folder for application configuration
3. src/test/java - Folder with code for testing the application
4. OrmLearnApplication.java - Walkthrough the main() method.
5. Purpose of @SpringBootApplication annotation
6. pom.xml
   1. Walkthrough all the configuration defined in XML file
   2. Open 'Dependency Hierarchy' and show the dependency tree.

**Country table creation**

* Create a new table country with columns for code and name. For sample, let us insert one country with values 'IN' and 'India' in this table.

create table country(co\_code varchar(2) primary key, co\_name varchar(50));

* Insert couple of records into the table

insert into country values ('IN', 'India');

insert into country values ('US', 'United States of America');

**Persistence Class - com.cognizant.orm-learn.model.Country**

* Open Eclipse with orm-learn project
* Create new package com.cognizant.orm-learn.model
* Create Country.java, then generate getters, setters and toString() methods.
* Include @Entity and @Table at class level
* Include @Column annotations in each getter method specifying the column name.

import javax.persistence.Column;

import javax.persistence.Entity;

import javax.persistence.Id;

import javax.persistence.Table;

@Entity

@Table(name="country")

public class Country {

  @Id

    @Column(name="code")

    private String code;

    @Column(name="name")

    private String name;

// getters and setters

  // toString()

}

*Notes:*

* @Entity is an indicator to Spring Data JPA that it is an entity class for the application
* @Table helps in defining the mapping database table
* @Id helps is defining the primary key
* @Column helps in defining the mapping table column

**Repository Class - com.cognizant.orm-learn.CountryRepository**

* Create new package com.cognizant.orm-learn.repository
* Create new interface named CountryRepository that extends JpaRepository<Country, String>
* Define @Repository annotation at class level

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

import org.springframework.stereotype.Repository;

import com.cognizant.ormlearn.model.Country;

@Repository

public interface CountryRepository extends JpaRepository<Country, String> {

}

**Service Class - com.cognizant.orm-learn.service.CountryService**

* Create new package com.cognizant.orm-learn.service
* Create new class CountryService
* Include @Service annotation at class level
* Autowire CountryRepository in CountryService
* Include new method getAllCountries() method that returns a list of countries.
* Include @Transactional annotation for this method
* In getAllCountries() method invoke countryRepository.findAll() method and return the result

**Testing in OrmLearnApplication.java**

* Include a static reference to CountryService in OrmLearnApplication class

private static CountryService countryService;

* Define a test method to get all countries from service.

    private static void testGetAllCountries() {

        LOGGER.info("Start");

        List<Country> countries = countryService.getAllCountries();

        LOGGER.debug("countries={}", countries);

        LOGGER.info("End");

    }

* Modify SpringApplication.run() invocation to set the application context and the CountryService reference from the application context.

        ApplicationContext context = SpringApplication.run(OrmLearnApplication.class, args);

        countryService = context.getBean(CountryService.class);

        testGetAllCountries();

* Execute main method to check if data from ormlearn database is retrieved.

**Program:**

**pom.xml:**

<project xmlns="http://maven.apache.org/POM/4.0.0"

xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xsi:schemaLocation="http://maven.apache.org/POM/4.0.0

http://maven.apache.org/xsd/maven-4.0.0.xsd">

<modelVersion>4.0.0</modelVersion>

<groupId>com.cognizant</groupId>

<artifactId>orm-learn</artifactId>

<version>1.0.0</version>

<packaging>jar</packaging>

<name>orm-learn</name>

<description>Demo project for Spring Data JPA and Hibernate</description>

<parent>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-parent</artifactId>

<version>2.2.0.RELEASE</version>

<relativePath/>

</parent>

<properties>

<java.version>11</java.version>

</properties>

<dependencies>

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter</artifactId>

</dependency>

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-data-jpa</artifactId>

</dependency>

<dependency>

<groupId>com.h2database</groupId>

<artifactId>h2</artifactId>

<scope>runtime</scope>

</dependency>

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-devtools</artifactId>

<scope>runtime</scope>

<optional>true</optional>

</dependency>

<dependency>

<groupId>org.slf4j</groupId>

<artifactId>slf4j-api</artifactId>

</dependency>

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-test</artifactId>

<scope>test</scope>

</dependency>

</dependencies>

<build>

<plugins>

<plugin>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-maven-plugin</artifactId>

</plugin>

<plugin>

<groupId>org.codehaus.mojo</groupId>

<artifactId>exec-maven-plugin</artifactId>

<version>3.0.0</version>

<configuration>

<mainClass>com.cognizant.ormlearn.OrmLearnApplication</mainClass>

</configuration>

</plugin>

</plugins>

</build>

</project>

**application.properties:**

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

spring.datasource.driverClassName=org.h2.Driver

spring.datasource.username=sa

spring.datasource.password=

spring.jpa.hibernate.ddl-auto=create

spring.jpa.show-sql=true

spring.jpa.properties.hibernate.dialect=org.hibernate.dialect.H2Dialect

logging.level.org.hibernate.SQL=debug

**Country.java:**

package com.cognizant.ormlearn.model;

import javax.persistence.\*;

@Entity

@Table(name = "country")

public class Country {

@Id

@Column(name = "code")

private String code;

@Column(name = "name")

private String name;

public String getCode() {

return code;

}

public void setCode(String code) {

this.code = code;

}

public String getName() {

return name;

}

public void setName(String name) {

this.name = name;

}

@Override

public String toString() {

return "Country [code=" + code + ", name=" + name + "]";

}

}

**CountryRepository.java:**

package com.cognizant.ormlearn.repository;

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

import com.cognizant.ormlearn.model.Country;

public interface CountryRepository extends JpaRepository<Country, String> {

}

**CountryService.java:**

package com.cognizant.ormlearn.service;

import java.util.List;

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

import org.springframework.stereotype.Service;

import org.springframework.transaction.annotation.Transactional;

import com.cognizant.ormlearn.model.Country;

import com.cognizant.ormlearn.repository.CountryRepository;

@Service

public class CountryService {

@Autowired

private CountryRepository countryRepository;

@Transactional

public List<Country> getAllCountries() {

return countryRepository.findAll();

}

@Transactional

public void addSampleData() {

Country country1 = new Country();

country1.setCode("IN");

country1.setName("India");

countryRepository.save(country1);

Country country2 = new Country();

country2.setCode("US");

country2.setName("United States");

countryRepository.save(country2);

}

}

**OrmLearnApplication.java:**

package com.cognizant.ormlearn;

import java.util.List;

import org.slf4j.Logger;

import org.slf4j.LoggerFactory;

import org.springframework.boot.SpringApplication;

import org.springframework.boot.autoconfigure.SpringBootApplication;

import org.springframework.context.ApplicationContext;

import com.cognizant.ormlearn.model.Country;

import com.cognizant.ormlearn.service.CountryService;

@SpringBootApplication

public class OrmLearnApplication {

private static final Logger LOGGER = LoggerFactory.getLogger(OrmLearnApplication.class);

public static void main(String[] args) {

ApplicationContext context = SpringApplication.run(OrmLearnApplication.class, args);

CountryService countryService = context.getBean(CountryService.class);

LOGGER.info("Inside main");

countryService.addSampleData();

testGetAllCountries(countryService);

}

private static void testGetAllCountries(CountryService countryService) {

LOGGER.info("Start - Fetching all countries");

List<Country> countries = countryService.getAllCountries();

for (Country country : countries) {

LOGGER.info("Country: Code={}, Name={}", country.getCode(), country.getName());

}

LOGGER.info("End");

}

}

**.replit:**

language = "java"

entrypoint = "src/main/java/com/cognizant/ormlearn/OrmLearnApplication.java"

run = "mvn clean compile exec:java -Dexec.mainClass=com.cognizant.ormlearn.OrmLearnApplication"

**replit.nix:**

{ pkgs }: {

deps = [

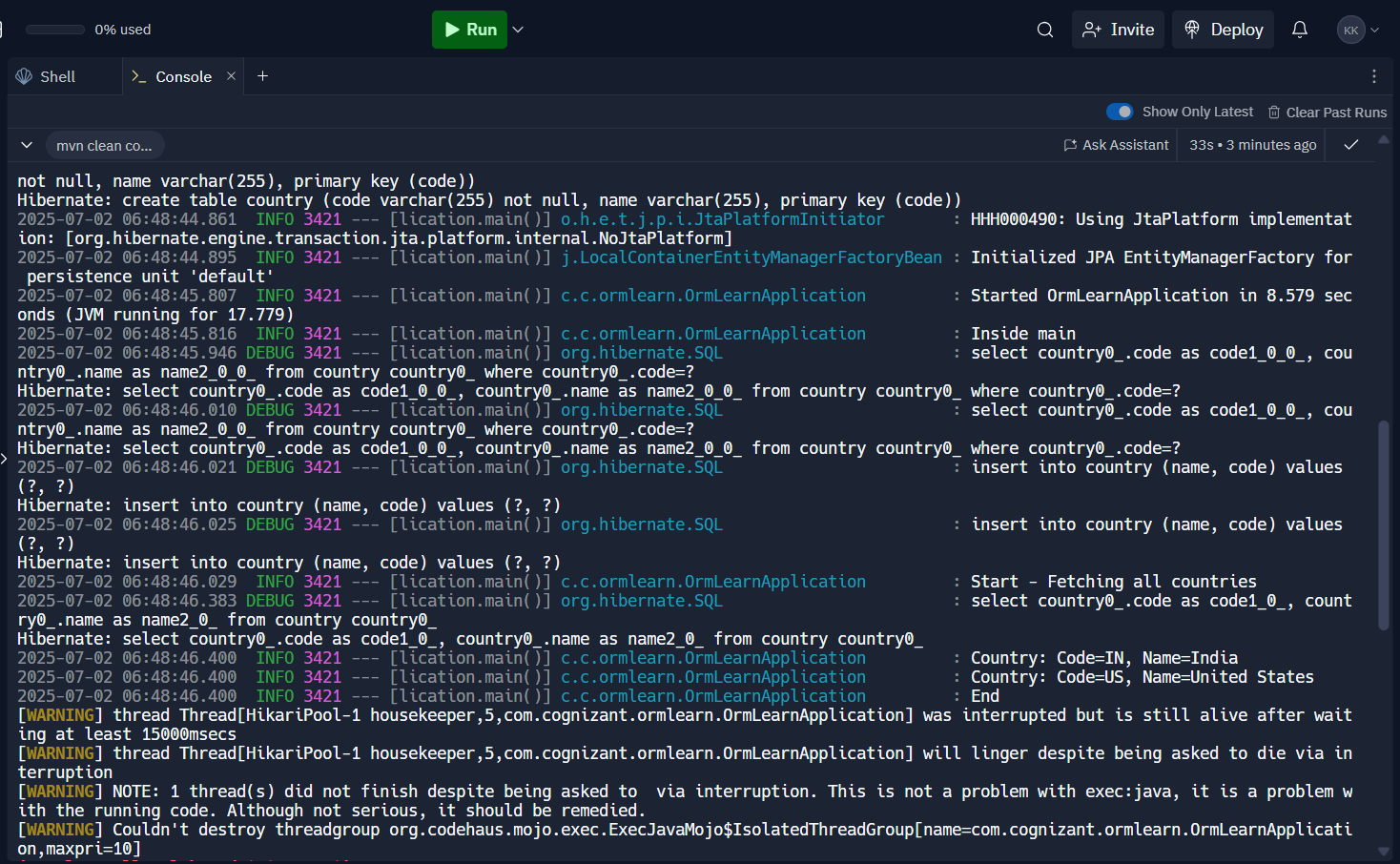
pkgs.maven

pkgs.openjdk11

];

}

**Output:**



**Hands on 4**

**Difference between JPA, Hibernate and Spring Data JPA**   
  
Java Persistence API (JPA)

* JSR 338 Specification for persisting, reading and managing data from Java objects
* Does not contain concrete implementation of the specification
* Hibernate is one of the implementation of JPA

Hibernate

* ORM Tool that implements JPA

Spring Data JPA

* Does not have JPA implementation, but reduces boiler plate code
* This is another level of abstraction over JPA implementation provider like Hibernate
* Manages transactions

**Refer code snippets below on how the code compares between Hibernate and Spring Data JPA  
Hibernate**

   /\* Method to CREATE an employee in the database \*/

   public Integer addEmployee(Employee employee){

      Session session = factory.openSession();

      Transaction tx = null;

      Integer employeeID = null;

      try {

         tx = session.beginTransaction();

         employeeID = (Integer) session.save(employee);

         tx.commit();

      } catch (HibernateException e) {

         if (tx != null) tx.rollback();

         e.printStackTrace();

      } finally {

         session.close();

      }

      return employeeID;

   }

**Spring Data JPA**  
EmployeeRespository.java

public interface EmployeeRepository extends JpaRepository<Employee, Integer> {

}

EmployeeService.java

@Autowire

  private EmployeeRepository employeeRepository;

@Transactional

public void addEmployee(Employee employee) {

  employeeRepository.save(employee);

  }

​​​​​​​   
  
**Reference Links:**   
<https://dzone.com/articles/what-is-the-difference-between-hibernate-and-sprin-1>   
<https://www.javaworld.com/article/3379043/what-is-jpa-introduction-to-the-java-persistence-api.html>

**pom.xml:**

<project xmlns="http://maven.apache.org/POM/4.0.0"

xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xsi:schemaLocation="http://maven.apache.org/POM/4.0.0

http://maven.apache.org/xsd/maven-4.0.0.xsd">

<modelVersion>4.0.0</modelVersion>

<groupId>com.example</groupId>

<artifactId>spring-data-jpa-demo</artifactId>

<version>0.0.1-SNAPSHOT</version>

<packaging>jar</packaging>

<name>spring-data-jpa-demo</name>

<parent>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-parent</artifactId>

<version>2.7.13</version>

<relativePath/>

</parent>

<dependencies>

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-web</artifactId>

</dependency>

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-data-jpa</artifactId>

</dependency>

<dependency>

<groupId>com.h2database</groupId>

<artifactId>h2</artifactId>

<scope>runtime</scope>

</dependency>

</dependencies>

<properties>

<java.version>11</java.version>

</properties>

</project>

**EmployeeController.java:**

package com.example.demo.controller;

import com.example.demo.model.Employee;

import com.example.demo.service.EmployeeService;

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

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

import java.util.List;

@RestController

@RequestMapping("/api/employees")

public class EmployeeController {

@Autowired

private EmployeeService employeeService;

@PostMapping

public String addEmployee(@RequestBody Employee employee) {

employeeService.addEmployee(employee);

return "Employee saved successfully!";

}

@GetMapping

public List<Employee> getAllEmployees() {

return employeeService.getAllEmployees();

}

}

**Employee.java:**

package com.example.demo.model;

import javax.persistence.\*;

@Entity

@Table(name = "employees")

public class Employee {

@Id

@GeneratedValue(strategy = GenerationType.IDENTITY)

private Integer id;

@Column(nullable = false)

private String name;

private String department;

public Employee() {

}

public Employee(String name, String department) {

this.name = name;

this.department = department;

}

public Integer getId() {

return id;

}

public void setId(Integer id) {

this.id = id;

}

public String getName() {

return name;

}

public void setName(String name) {

this.name = name;

}

public String getDepartment() {

return department;

}

public void setDepartment(String department) {

this.department = department;

}

}

**EmployeeRepository.java:**

package com.example.demo.repository;

import com.example.demo.model.Employee;

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

public interface EmployeeRepository extends JpaRepository<Employee, Integer> {

}

**EmployeeService.java:**

package com.example.demo.service;

import com.example.demo.model.Employee;

import com.example.demo.repository.EmployeeRepository;

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

import org.springframework.stereotype.Service;

import javax.transaction.Transactional;

import java.util.List;

@Service

public class EmployeeService {

@Autowired

private EmployeeRepository employeeRepository;

@Transactional

public void addEmployee(Employee employee) {

employeeRepository.save(employee);

}

public List<Employee> getAllEmployees() {

return employeeRepository.findAll();

}

}

**DemoApplication.java:**

package com.example.demo;

import org.springframework.boot.SpringApplication;

import org.springframework.boot.autoconfigure.SpringBootApplication;

@SpringBootApplication

public class DemoApplication {

public static void main(String[] args) {

SpringApplication.run(DemoApplication.class, args);

}

}

**application.properties:**

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

spring.datasource.driverClassName=org.h2.Driver

spring.datasource.username=sa

spring.datasource.password=

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

spring.jpa.hibernate.ddl-auto=update

spring.h2.console.enabled=true

**.replit:**

run = "mvn spring-boot:run"

[nix]

packages = ["maven", "psmisc"]

[[ports]]

localPort = 80

externalPort = 3000

[[ports]]

localPort = 8080

externalPort = 80

**Output:**

