EA Practice midterm

Question 1 [10 points] {10 minutes}

a. Suppose we have a Spring application with the following given XML configuration

```
<bean id="customerService" class="basic.CustomerService">
   <constructor-arg ref="emailService"/>
</bean>
<bean id="emailService" class="basic.EmailService">
   <constructor-arg ref="customerService"/>
</bean>
```

When we run the application, Spring gives an error. Explain clearly why Spring gives an error based on the given XML configuration. Answer:

The error occurs due to a circular dependency between the two beans defined in the Spring XML configuration.

When Spring tries to create the customer Service bean, it sees that it requires an instance of email Service. It then attempts to create the email Service bean, which in turn requires an instance of customer Service. Since customer Service is not yet fully constructed and email Service cannot be constructed without customer Service, Spring cannot resolve the dependencies, resulting in a circular reference error.

b. Explain why we need an **init()** method in Spring Boot.

Answer:

1. There might be certain tasks you want to execute when your application starts, such as loading initial data, performing configuration checks, or logging startup information.
2. It keeps your startup logic separate from other parts of your application.
3. If your application needs to set up resources such as database connections, file systems, or external services, it provides a convenient place to perform this setup.

Question 2

[15 points] {20 minutes}

Suppose we need to write a **Spring Boot** application that allow us to store and find Products. A Product consists of the following attributes: productNumber, name, price and categoryName. A categoryName is something like “clothing” or “toys” or “electronics” The application should allow us to store new Products and we should be able to find products with the following functionality:

- Give all products with a price bigger than a given amount
- Give all products from a certain category

Write **ALL** necessary Java code including annotations. Do **NOT** write the Application class (that contains the main() method). Do **NOT** write imports and do **NOT** write getter and setter methods. Also do **NOT** write constructors.

Use all the best practices we learned in this course.

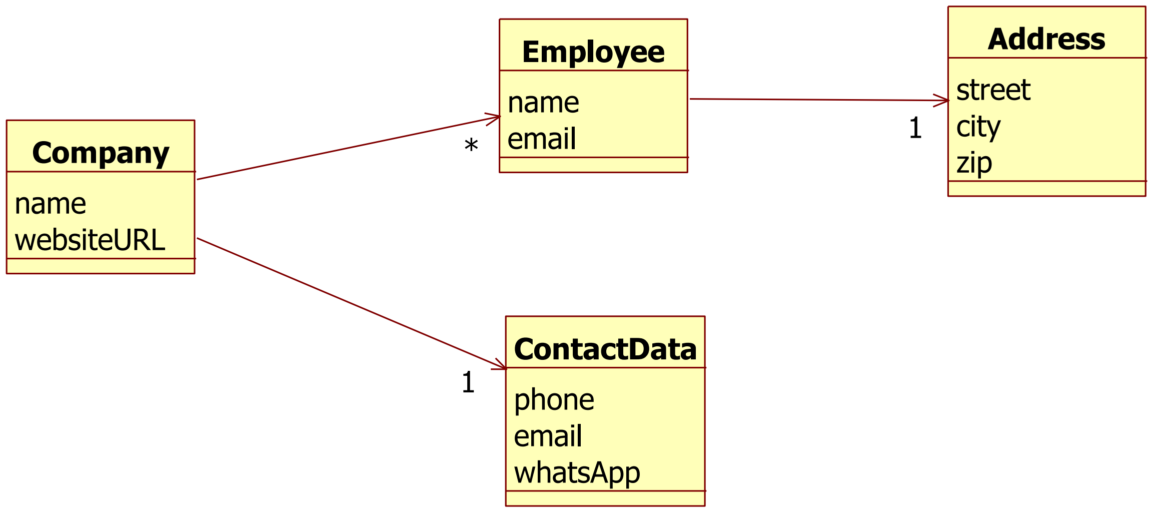
```
@Entity
public class Product {
   @Id
   @GeneratedValue(strategy = GenerationType.IDENTITY)
   private Long id;
   private String productNumber;
   private String name;
   private double price;
   private String categoryName;
}


public interface ProductRepository extends JpaRepository<Product, Long> {
   List<Product> findByPriceGreaterThan(double price);
   List<Product> findByCategoryName(String categoryName);
```

Question 3

[15 points] {15 minutes}

Suppose we have the following JPA entities:



We need to write the following queries:

These queries should be defined by the method name in the repository:

- **Give all Companies with a given name. Name is a parameter.**
- **Give all streets given a certain city and a certain zip**

These queries should be defined by **@Query** in the repository:

- **Give the name of all companies from a given city**
- **Give the name of the company given a certain phone number**
- **Give all Companies where an employee works with a certain given name.**

Write the queries in the corresponding repositories. Write the **complete Java code** of all necessary repositories including the methods and the annotations. **Do not write Java imports**

Question 4

```
@Entity
public class Company {
   @Id
   @GeneratedValue(strategy = GenerationType.IDENTITY)
   private Long id;
   private String name;
   private String websiteURL;
   @OneToMany
   @JoinColumn(name = "company_id")
   private List<Employee> employees;

  @ManyToOne
   @JoinColumn(name = "contact_data_id")
   private ContactData contactData;
}

@Entity
public class Employee {
   @Id
   @GeneratedValue(strategy = GenerationType.IDENTITY)
   private Long id;
   private String name;
   private String email;
   @ManyToOne
   @JoinColumn(name = "address_id")
   private Address address;
}

@Entity
public class Address {
   @Id
   @GeneratedValue(strategy = GenerationType.IDENTITY)
   private Long id;
   private String street;
   private String city;
   private String zip;

}
```

Question 5

```
@Entity
public class ContactData {
   @Id
   @GeneratedValue(strategy = GenerationType.IDENTITY)
   private Long id;

   private String phone;
   private String email;
   private String whatsApp;

}
```

```
public interface CompanyRepository extends JpaRepository<Company, Long> {

   // Method name-based query
   List<Company> findByName(String name);

   // @Query-based queries

   @Query("SELECT  c.name FROM Company c JOIN c.employees e WHERE e.address.city = :city")
   List<String> findCompanyNamesByEmployeeCity(@Param("city") String city);

   @Query("SELECT DISTINCT  c.name FROM Company c WHERE c.contactData.phone = :phone")
   Company findCompanyByPhoneNumber(@Param("phone") String phone);


   @Query("SELECT c FROM Company c JOIN c.employees e WHERE e.name = :name")
   List<Company> findCompaniesByEmployeeName(@Param("name") String name);
}

public interface AddressRepository extends JpaRepository<Address, Long> {
   // Method name-based query

   List<String> findStreetByCityAndZip(String city, String zip);
}
```

Question 6

[20 points] {20 minutes}

Given are the following entities:

```
public abstract class Vehicle {
     private long id;
private String brand;
private String color;

   public Vehicle() { }

   public Vehicle(String brand, String color) {
this.brand = brand;       this.color = color;
   } }



public abstract class Car extends Vehicle{
private String licencePlate;    public
Car() { }
   public Car(String brand, String color, String licencePlate) {
super(brand, color);
      this.licencePlate = licencePlate;
   } }


public class RentalBycicle extends Vehicle{
private double pricePerHour;    public
RentalBycicle() {    }
   public RentalBycicle(String brand, String color, double pricePerHour) {
super(brand, color);
      this.pricePerHour = pricePerHour;
   }
}
```

```java
public class SellableCar extends Car
{    private double sellPrice;
 public SellableCar() { }
   public SellableCar(String brand, String color, String licencePlate,
double sellPrice) {
      super(brand, color, licencePlate);
this.sellPrice = sellPrice;
   }
}


  public class RentalCar extends
Car {    private double
pricePerDay;    public RentalCar()
{   }
   public RentalCar(String brand, String color, String licencePlate, double
pricePerDay) {
      super(brand, color, licencePlate);
this.pricePerDay = pricePerDay;
   }
}
public interface RentalBycicleRepository extends JpaRepository<RentalBycicle,
Long> { }
public interface RentalCarRepository extends JpaRepository<RentalCar, Long> {
}
public interface SellableCarRepository extends JpaRepository<SellableCar,
Long> {
}

@SpringBootApplication
public class Application implements CommandLineRunner {
   @Autowired
   RentalCarRepository rentalCarRepository;
   @Autowired
   SellableCarRepository sellableCarRepository;
   @Autowired
   RentalBycicleRepository rentalBycicleRepository;

   public static void main(String[] args) {
      SpringApplication.run(Application.class,   args);
}

   @Override
   public void run(String... args) throws Exception {
      RentalCar rentalCar = new RentalCar("BMW", "Black", "KL-980-1", 67.00);
rentalCarRepository.save(rentalCar);
      SellableCar sellableCar = new SellableCar("Audi", "White", "KM-956-2",
45980.00);
      sellableCarRepository.save(sellableCar);
      RentalBycicle rentalBycicle = new RentalBycicle("Moof", "Grey", 10.50);
rentalBycicleRepository.save(rentalBycicle);
   }
```

Question 8

}

a. In the given code above, add **all the necessary mapping annotations** so that the whole inheritance hierarchy is mapped according the **single table per hierarchy** strategy. Do **NOT** rewrite any code. Only write the correct annotations in the given code.

```
 @Entity
@Inheritance(strategy = InheritanceType.SINGLE_TABLE)
@DiscriminatorColumn(name = "VEHICLE_TYPE", discriminatorType = DiscriminatorType.STRING)
public abstract class Vehicle {
@Id
@GeneratedValue
private long id;
private String brand;
private String color;

   public Vehicle() { }

   public Vehicle(String brand, String color) {
this.brand = brand;       this.color = color;
   } }


@Entity
@DiscriminatorValue("CAR")
public abstract class Car extends Vehicle{
private String licencePlate;    public
Car() { }
   public Car(String brand, String color, String licencePlate) {
super(brand, color);
      this.licencePlate = licencePlate;
   } }


@Entity
@DiscriminatorValue("RENTAL_BICYCLE")
public class RentalBycicle extends Vehicle{
private double pricePerHour;    public
RentalBycicle() {    }
   public RentalBycicle(String brand, String color, double pricePerHour) {
super(brand, color);
      this.pricePerHour = pricePerHour;
   }
}
```

```
@Entity
@DiscriminatorValue("SELLABLE_CAR")
public class SellableCar extends Car
{    private double sellPrice;
 public SellableCar() { }
   public SellableCar(String brand, String color, String licencePlate, double
sellPrice) {
      super(brand, color, licencePlate);
this.sellPrice = sellPrice;
   }
}
```

```
  @Entity
 @DiscriminatorValue("RENTAL_CAR")
  public class RentalCar extends Car
{    private double pricePerDay;
public RentalCar() {   }
   public RentalCar(String brand, String color, String licencePlate, double
pricePerDay) {
      super(brand, color, licencePlate);
this.pricePerDay = pricePerDay;
   }
}
```

b. Explain **ALL** advantages and disadvantages we learned about the **single table per hierarchy** strategy.

Answer:

Advantage

1. Only one table is needed to represent the entire hierarchy, simplifying the schema design and making it easier to understand and maintain.
2. Good performance on all queries, polymorphic and non-polymorphic
3. Adding a new type in the hierarchy typically involves adding a new discriminator value without requiring new tables or significant schema changes.

Disadvantage

1. Nullable columns / de-normalized schema
2. As the table grows, both in terms of the number of columns and rows, it can become less performant and harder to scale.

c. Draw the corresponding database table with all the columns and corresponding data if we run Application.java.

Id	vehicle_type	brand	color	licencePlate	pricePerHour	pricePerDay	sellPrice
1	RentalCar	BMW	Black	KL-980-1	NULL	67.00	NULL
2	SellableCar	Audi	White	KM-956-	NULL	NULL	45980.00
3	RentalBycicle	Moof	Grey	NULL	10.50	NULL	NULL

d. Suppose we map the given inheritance hierarchy with the strategy **Joined Tables**. Draw the corresponding database tables with all the columns and corresponding data if we use the strategy **Joined Tables**

Table: Vehicle

id	**brand**	**color**
1	**BMW**	**Black**
2	**Audi**	**White**
3	**Moof**	**Grey**

Table: Car

id	licencePlate
1	KL-980-1
2	KM-956-2

Table: RentalBycicle

id	pricePerHour
3	10.50

Table: SellableCar

id	sellPrice
2	45980.00

Table: RentalCar

id	pricePerDay
1	67.00

e. Suppose we map the given inheritance hierarchy with the strategy **Table per concrete class**. Draw the corresponding database tables with all the columns and corresponding data if we use the strategy **Table per concrete class**

Table: RentalCar

id	**brand**	**color**	**licencePlate**	**pricePerDay**
1	**BMW**	**Black**	**KL-980-1**	**67.00**

Table: SellableCar

id	**brand**	**color**	**licencePlate**	**sellPrice**
2	**Audi**	**White**	**KM-956-2**	**45980.00**

Table: RentalBycicle

id	**brand**	**color**	**pricePerHour**
3	**Moof**	**Grey**	**10.50**

Question 5 [10 points] {15 minutes}

Circle all statements that are correct:

a. When we add a version attribute to an entity and we annotate this with @Version then you will never have the dirty read problem on this entity.
b. If we do not allow the phantom read problem in our application, we cannot run 2 transactions at the same time.
c. In a Spring boot application that uses JPA, you cannot use dependency injection on JPA entities.
d. When you make one method of a Spring bean transactional the 2 phase commit protocol will never be used. If you make 2 or more methods of a Spring bean transactional the 2 phase commit protocol will be used.
e. Cascading is only applicable for inserts, updates and deletes.
f. In JPA, a @OneToOne relation is stored in the database as a @ManyToOne relation.
g. A named query cannot contain a join.
h. An entity class in a Spring Boot JPA application is always a singleton.

i. With the TransactionReadCommitted isolation level, you can never have the lost update problem
j. In databases that use sequences, every table contains a sequence column.