Assignment 1. Java Programming Language, CSE3040 & AIE3052

Student Name: 이예준

Student ID: 20212022

Q1. Vehicle management system.

Task Requirements:

1. Create a base class named Vehicle. This class should have private fields for common vehicle attributes: brand, model, and year.

- Use encapsulation to control access to these fields by providing appropriate getter and setter methods.
- The constructor should take the brand, model, and year as parameters and initialize the fields.
- Override the toString() method to print the vehicle's details in a readable format.

2. Create two subclasses: Car and Motorcycle, which both inherit from the Vehicle class.

- The Car class should have an additional field seats (number of seats). Provide getter and setter methods for this field.
- The Motorcycle class should have a field hasSidecar (whether the motorcycle has a sidecar). Provide getter and setter methods for this field.

3. Implement a custom exception class named InvalidVehicleDetailException to handle invalid vehicle details.

- For example, throw this exception if the year is earlier than 1886, or if the seats number is less than or equal to zero.

4. Create a class named VehicleManager that allows adding, removing, and searching for vehicles.

- Use a list to manage multiple vehicles.
- Throw a custom exception DuplicateVehicleException when attempting to add a vehicle that already exists in the list.
- Throw a custom exception VehicleNotFoundException if a vehicle is searched for but does not exist in the list.

Vehicle Class

```
public class Vehicle {
    private String brand;
    private String model;
    private int year;

    public Vehicle(String brand, String model, int year) throws InvalidVehicleDetailException {
        // Fill in this line
        // Answer
        ////////////////////////////////////////////////////////////////////////////////////////////
        if(year < 1886) throw new InvalidVehicleDetailException("Year must be 1886 or later");
        this.brand = brand;
        this.model = model;
        this.year = year;
        ////////////////////////////////////////////////////////////////////////////////////////////
    }

    public String getBrand() {
        return brand;
    }

    public String getModel() {
        return model;
    }

    public int getYear() {
        return year;
    }

    public void setYear(int year) throws InvalidVehicleDetailException {
        // Fill in the if statement and throw exception if necessary
        // Answer:
        ////////////////////////////////////////////////////////////////////////////////////////////
        if(year < 1886) throw new InvalidVehicleDetailException("Year must be 1886 or later");
        this.year = year;
        ////////////////////////////////////////////////////////////////////////////////////////////
    }

    @Override
    public String toString() {
        // Fill in return statement
        // Answer
        ////////////////////////////////////////////////////////////////////////////////////////////
        return String.format("%s %s (%d)", brand, model, year);

        ////////////////////////////////////////////////////////////////////////////////////////////
    }
}
```

Car Class

```
public class Car extends Vehicle{
    private int seats;

    public Car(String brand, String model, int year, int seats) throws InvalidVehicleDetailException {
        super(brand, model, year);
        // Fill in this line
        // Answer
        ////////////////////////////////////////////////////////////////////////////////////////////
        if(seats <= 0) throw new InvalidVehicleDetailException("Number of seats must be positive");
        this.seats = seats;

        /////////////////////////////////////////////////////////////////////////////////////////////////////

    }

    public int getSeats() {
        return seats;
    }

    public void setSeats(int seats) throws InvalidVehicleDetailException {
        // Fill in the if statement and throw exception if necessary
        // Answer:
        /////////////////////////////////////////////////////////////////////////////////////////////////////
        if(seats <= 0) throw new InvalidVehicleDetailException("Number of seats must be positive");
        this.seats = seats;

        /////////////////////////////////////////////////////////////////////////////////////////////////////
    }

    @Override
    public String toString() {
        // Fill in return statement
        // Answer

        ////////////////////////////////////////////////////////////////////////////////////////////
        return String.format("Car: %s, Seats: %d", super.toString(), seats);


        /////////////////////////////////////////////////////////////////////////////////////////////////////
    }
}
```

Motorcycle Class

```
public class Motorcycle extends Vehicle {
    private boolean hasSidecar;

    public Motorcycle(String brand, String model, int year, boolean hasSidecar) throws InvalidVehicleDetailException {
        super(brand, model, year);
        this.hasSidecar = hasSidecar;
    }

    public boolean isHasSidecar() {
        return hasSidecar;
    }

    public void setHasSidecar(boolean hasSidecar) {
        this.hasSidecar = hasSidecar;
    }

    @Override
    public String toString() {
        // Fill in return statement
        // Answer:
        ////////////////////////////////////////////////////////////////////////////////////////////////////////
        return String.format("Motorcycle: %s, Has Sidecar: %s", super.toString(), hasSidecar ? "Yes" : "No");


        ////////////////////////////////////////////////////////////////////////////////////////////////////////
    }
}
```

Custom Exception Classes

```
public class InvalidVehicleDetailException extends Exception {
    public InvalidVehicleDetailException(String message) {
        super(message);
    }
}

public class DuplicateVehicleException extends Exception {
    public DuplicateVehicleException(String message) {
        super(message);
    }
}

public class VehicleNotFoundException extends Exception {
    public VehicleNotFoundException(String message) {
        super(message);
    }
}
```

VehicleManager Class

```
import java.util.ArrayList;
import java.util.List;

public class VehicleManager {
      private List<Vehicle> vehicles = new ArrayList<>();

      public void addVehicle(Vehicle vehicle) throws DuplicateVehicleException {
            // Fill in the duplicate check and throw exception if necessary
            // Answer:
            ////////////////////////////////////////////////////////////////////////////////////////////////////
            if(vehicles.contains(vehicle)) throw new DuplicateVehicleException("Vehicle already exists");
            vehicles.add(vehicle);

            ////////////////////////////////////////////////////////////////////////////////////////////////////
      }

      public Vehicle searchVehicle(String brand, String model) throws VehicleNotFoundException {
            // Fill in the search logic and throw exception if necessary
            // Answer:
            ////////////////////////////////////////////////////////////////////////////////////////////////////
            for(Vehicle v : vehicles){
                  if(v.getBrand().equals(brand) && v.getModel().equals(model)) return v;
            }
            throw new VehicleNotFoundException("Vehicle not found");
            ////////////////////////////////////////////////////////////////////////////////////////////////////
      }

      public void removeVehicle(Vehicle vehicle) throws VehicleNotFoundException {
            // Fill in the remove logic and throw exception if necessary
            // Answer:
            ////////////////////////////////////////////////////////////////////////////////////////////////////
            if(!vehicles.remove(vehicle)) throw new VehicleNotFoundException("Vehicle not found");

            ////////////////////////////////////////////////////////////////////////////////////////////////////
      }

      public void printAllVehicles() {
            // Fill in the print logic
            // Answer:
            ////////////////////////////////////////////////////////////////////////////////////////////////////
            for(Vehicle v : vehicles){
                  System.outprintln(v.toString());
            }
            ////////////////////////////////////////////////////////////////////////////////////////////////////
      }
}
```

Q2. Bank account management system

Task Requirements:

1. Create a base class named BankAccount. This class should have private fields for accountNumber and balance.

- The constructor should take the account number and an initial balance as parameters to initialize the fields.
- Implement methods deposit() and withdraw() to perform deposit and withdrawal operations. If a withdrawal amount exceeds the available balance, throw a custom exception InsufficientBalanceException.

2. Create two subclasses: SavingsAccount and CheckingAccount, which both inherit from BankAccount.

- SavingsAccount should have an additional field interestRate. Implement a method applyInterest() that adds interest to the account's balance.
- CheckingAccount should have an additional field overdraftLimit. Modify the withdraw() method so that the account can overdraw up to the overdraft limit.

3. Implement a BankManager class to manage multiple bank accounts.

- When adding a new account, throw a custom exception DuplicateAccountException if an account with the same account number already exists.
- Implement methods to search for an account by account number and perform deposit and withdrawal operations. If an account is not found, throw an AccountNotFoundException.
- Ensure that the balance can only be modified through deposit() and withdraw() methods to maintain encapsulation.

BankAccount Class

```
public class BankAccount {
    private String accountNumber;
    private double balance;

    public BankAccount(String accountNumber, double initialBalance) {
        this.accountNumber = accountNumber;
        this.balance = initialBalance;
    }

    public String getAccountNumber() {
        return accountNumber;
    }

    public double getBalance() {
        return balance;
    }

    public void deposit(double amount) {
        // Fill in deposit logic
        // Answer: balance += amount;
        ////////////////////////////////////////////////////////////////////////////////////////////////////////////////
        balance += amount;

        ////////////////////////////////////////////////////////////////////////////////////////////////////////////////

    }

    public void withdraw(double amount) throws InsufficientBalanceException {
        // Fill in the withdraw logic and throw exception if necessary
        // Answer:
        ////////////////////////////////////////////////////////////////////////////////////////////////////////////////
        if(balance < amount) throw new InsufficientBalanceException("Insufficient balance");
        balance -= amount;

        ////////////////////////////////////////////////////////////////////////////////////////////////////////////////
    }
}
```

SavingAccount Class

```
public class SavingAccount extends BankAccount {
    private double interestRate;

    public SavingAccount(String accountNumber, double initialBalance, double interestRate) {
        super(accountNumber, initialBalance);
        this.interestRate = interestRate;
    }

    public void applyInterest() {
        // Fill in the interest calculation and deposit logic
        // Answer:
        ////////////////////////////////////////////////////////////////////////////////////////////////////
        deposit(getBalance() * interestRate);


        ////////////////////////////////////////////////////////////////////////////////////////////////////
    }
}
```

CheckingAccount Class

```
public class CheckingAccount extends BankAccount {
    private double overdraftLimit;

    public CheckingAccount(String accountNumber, double initialBalance, double overdraftLimit) {
        super(accountNumber, initialBalance);
        this.overdraftLimit = overdraftLimit;
    }

    @Override
    public void withdraw(double amount) throws InsufficientBalanceException {
        // Fill in the overdraft check and withdraw logic
        // Answer:
        ////////////////////////////////////////////////////////////////////////////////////////////////////
        if(getBalance() + overdraftLimit < amount) throw new InsufficientBalanceException("Exceeds overdraft limit");
        super.deposit(-amount);
        ////////////////////////////////////////////////////////////////////////////////////////////////////
    }
}
```

Custom Exception Class

```
public class InsufficientBalanceException extends Exception {
    public InsufficientBalanceException(String message) {
        super(message);
    }
}

public class DuplicateAccountException extends Exception {
    public DuplicateAccountException(String message) {
        super(message);
    }
}

public class AccountNotFoundException extends Exception {
    public AccountNotFoundException(String message) {
        super(message);
    }
}
```

BankManager Class

```
import java.util.HashMap;
import java.util.Map;
public class BankManager {
    private Map<String, BankAccount> accounts = new HashMap<>();

    public void addAccount(BankAccount account) throws DuplicateAccountException {
        // Fill in the duplicate check logic and throw exception if necessary
        // Answer:
        ///////////////////////////////////////////////////////////////////////////////////////////////
        if(accounts.containsKey(account.getAccountNumber()))
            throw new DuplicateAccountException("Account already exists");
        accounts.put(account.getAccountNumber(), account);
        ///////////////////////////////////////////////////////////////////////////////////////////////
    }

    public BankAccount findAccount(String accountNumber) throws AccountNotFoundException {
        // Fill in the search logic and throw exception if necessary
        // Answer:
        ///////////////////////////////////////////////////////////////////////////////////////////////
        BankAccount account = accounts.get(accountNumber);
        if(account == null) throw new AccountNotFoundException("Account not found");
        return account;
        ///////////////////////////////////////////////////////////////////////////////////////////////
    }

    public void deposit(String accountNumber, double amount) throws AccountNotFoundException {
        // Fill in deposit logic
        // Answer:
        ///////////////////////////////////////////////////////////////////////////////////////////////
        findAccount(accountNumber).deposit(amount);
        ///////////////////////////////////////////////////////////////////////////////////////////////
    }

    public void withdraw(String accountNumber, double amount) throws AccountNotFoundException, InsufficientBalanceException {
        // Fill in withdraw logic
        // Answer:
        ///////////////////////////////////////////////////////////////////////////////////////////////
        findAccount(accountNumber).withdraw(amount);
        ///////////////////////////////////////////////////////////////////////////////////////////////
    }

    public void printAllAccounts() {
        // Fill in print logic
        // Answer:
        ///////////////////////////////////////////////////////////////////////////////////////////////
        for (BankAccount account : accounts.values()) {
            System.out.printf("[Account Type: %s] Account Number: %s, Balance: %.2f%n", account.getClass().getSimpleName(),
account.getAccountNumber(), account.getBalance());
        }
        ///////////////////////////////////////////////////////////////////////////////////////////////
    }
}
```