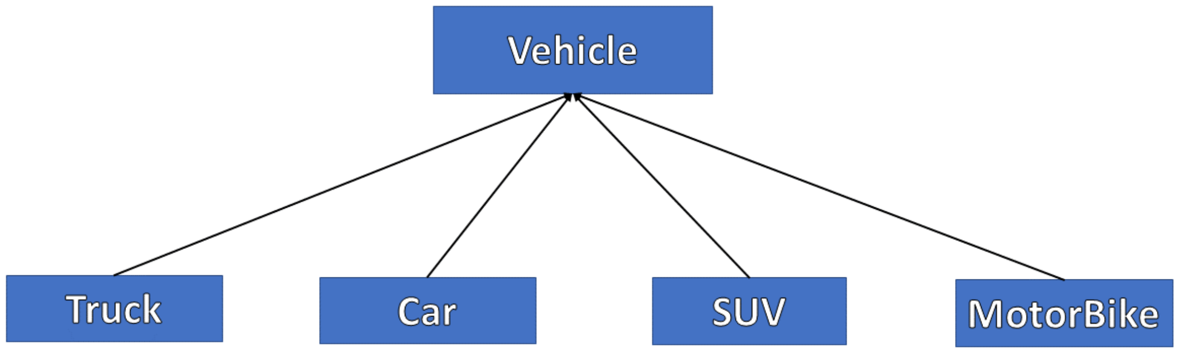
Due Date: 2/24/2024, 11:59pm

CMP_SC 3330 – Object-oriented Programming
Homework 4

Consider the following class diagram:



This assignment is a part of a vehicle showroom management system using Java Object-Oriented Programming principles. The assignment involves designing classes for different types of vehicles and implementing a singleton class for managing the vehicle information.

Class Definition:

Vehcile Class:

- Implement an **abstract** base class ***Vehicle*** with protected attributes/fields *brand*(**String**), *make*(**String**), *modelYear*(**long**), *price*(**double**), *color*(**VehicleColor**), *fuelType*(**FuelType**), *mileage*(**double**), *mass*(**double**), *cylinders*(**int**), *gasTankCapacity*(**double**), *startType*(**StartMechanism**). The *color, fuelType,* and *startType* must be represented using an enum.
- Create subclasses of the ***Vehicle*** class called ***Truck***, ***Car***, ***SUV***, and ***MotorBike***, each representing a different type of vehicle. Make sure that all classes have a constructor, especially the subclasses, which must use the super keyword to initialize the attributes. Also, implement the respective copy constructors and the respective setter and getter methods.
- Implement copy constructors for each vehicle to prevent information leaks.
- Implement the **toString()** method that will display all the field information.
- The following abstract methods are provided for implementation and overriding:
    - public abstract double calculateMaintenaceCost(**double** distance); // calculates maintenance cost for a specific vehicle
    - public abstract double calculateFuelEfficiency(**double** distance, **double** fuelPrice); // calculates the engine efficiency
    - public abstract void startEngine(); // prints how the vehicle starts

FuelType Enum:

- The types are:
    - GASOLINE,

    - DIESEL,
    - ELECTRIC,
    - HYBRID

StartMechanism Enum:

- The mechanisms are:
    - KEYSTART,
    - PUSHSTART,
    - KICKSTART,

VehicleColor Enum:

- The colors are:
    - BLACK,
    - RED,
    - BLUE,
    - BROWN,
    - WHITE,
    - YELLOW,
    - GRAY

Use the following table to implement the abstract methods for every class as described above:

Class	Method		
	calculateMaintenaceCost(**double** distance)	calculateFuelEfficiency(**double** distance, **double** fuelPrice)	startEngine();
Truck	maintenanceCost=distance * mass * (currentYear-modelYear) * cylinders * 0.002	fuelEfficiency = cylinders * gasTankCapacity * fuelPrice / distance * 0.1	KEYSTART
Car	maintenanceCost=distance * mass * (currentYear-modelYear) * cylinders * 0.0005	fuelEfficiency = cylinders * gasTankCapacity * fuelPrice / distance * 0.003	PUSHSTART
SUV	maintenanceCost=distance * mass * (currentYear-modelYear) * cylinders * 0.001	fuelEfficiency = cylinders * gasTankCapacity * fuelPrice / distance * 0.05	PUSHSTART
MotorBike	maintenanceCost=distance * mass * (currentYear-modelYear) * cylinders * 0.0002	fuelEfficiency = cylinders * gasTankCapacity * fuelPrice / distance * 0.001	KICKSTART

VehicleManager Class:

- Implement a class ***VehicleManager*** for managing the inventory of the shop.
- Similar to homework 3, the ***VehicleManager*** class should read the initial vehicle inventory from a CSV file (***vehicleList.csv***) during initialization, update existing items, add new items, remove items, and save the updated inventory back to the CSV file.

- The ***VehicleManager*** class should have a String field called *vehicleFilePath,* which is initialized to the relative path to the ***vehicleList.csv*** file, including the file name. However, make sure that the field does not leak any information and is closed for modification.
- An ArrayList <Vehicle> vehicleList which stores the list of all the vehicles as read from the file.

Program Requirements:

VehicleManager Methods: [Hint: in some of the methods, you may want to use instanceof or getClass()]

- `public boolean readFromFile(String fileName):`
  - Reads the data from a CSV file located at *vehicleFilePath*. Initialize each of the Vehicle objects (**Hint:** Consider using the split() method for tokenization. Check the type of each object and instantiate the exact class. Store the objects into vehicleList).
  - Return ***true*** if the read file and initialization are successful.
  - Return ***false*** if cannot read/find the file.
- `public void VehicleManager(String fileName)`**:**
  - Constructor that reads the data from a CSV file located at *vehicleFilePath*. Initialize each of the Vehicle objects (**Hint:** call readFromFile).
- `public void displayAllCarInformation() :`
  - This will display the information, including maintenance cost, fuel efficiency, and how the vehicle starts, of all the cars present in the vehicleList.
  - If the vehicle is not found, then print an appropriate error message.
- `public void displayAllTruckInformation() :`
  - This will display the information, including maintenance cost, fuel efficiency, and how the vehicle starts, of all the trucks present in the vehicleList.
  - If the vehicle is not found, then print an appropriate error message.
- `public void displayAllSUVInformation() :`
  - This will display the information, including maintenance cost, fuel efficiency, and how the vehicle starts, of all the SUVs present in the vehicleList.
  - If the vehicle is not found, then print an appropriate error message.
- `public void displayAllMotorBikeInformation() :`
  - This will display the information, including maintenance cost, fuel efficiency, and how the vehicle starts, of all the motor bikes present in the vehicleList.
  - If the vehicle is not found, then print an appropriate error message.
- `public void displayVehicleInformation(Vehicle v) :`
  - This will display the vehicle information, including maintenance cost, fuel efficiency, and how the vehicle starts, of a **Vehicle** v which is present in the vehicleList.
  - If the vehicle is not found, then print an appropriate error message.
- `public void displayAllVehicleInformation():`
  - This will print the information, including maintenance cost, fuel efficiency, and how the vehicle starts, of all the vehicles in the vehicleList.
  - Print an appropriate message if the list is empty.
- `public boolean removeVehicle(Vehicle vehicle):`
  - Removes the given vehicle from the vehicleList.
  - Returns **true** if the removal is successful, **false** otherwise.

- `public boolean addVehicle(Vehicle vehicle):`
    - Adds the given vehicle into the vehicleList.
    - Returns **true** if the addition is successful, **false** otherwise.
- `public boolean saveVehicleList():`
    - Saves the updated vehicleList back to the CSV file located at *vehicleFilePath*.
    - Overwrites the existing file with the updated data.
    - Returns **true** if the saving is successful, **false** otherwise (file does not exist, or file empty).
- `private boolean isVehicleType(Vehicle v, Class clazz):`
    - Checks if the given vehicle is a specific type of Vehicle subclass.
    - If the given vehicle object is the object type, then return **true**, otherwise return **false**.
    - Use **instanceof** or **getClass()** to count the number.
    - Call example: `isVehicleType(vehicleObj, Truck.class);`
- `public int getNumberOfVehichlesByType(Class clazz):`
    - Returns the number of objects in the vehicle list based on the object vehicle type
    - Use the `isVehicleType(Vehicle v, Class clazz)` method.
    - Call example: `getNumberOfVehichlesByType(SUV.class);`
- `public Vehicle getVehicleWithHighestMaintenanceCost(`**`double`**` distance):`
    - Calculate the maintenance cost for each vehicle in the vehicle list and return the vehicle with the **highest maintenance cost**.
    - If multiple vehicles have the same maintenance cost, **randomly** return one of the vehicles (Use the Random class for random selection).
- `public Vehicle getVehicleWithLowestMaintenanceCost(`**`double`**` distance):`
    - Calculate the maintenance cost for each vehicle in the vehicle list and return the vehicle with the lowest maintenance cost.
    - If multiple vehicles have the same maintenance cost, **randomly** return one of the vehicles (Use the Random class for random selection).
- `public ArrayList<Vehicle> getVehicleWithHighestFuelEfficiency(`**`double`**` distance, `**`double`**` fuelPrice):`
    - Calculate the fuel efficiencies for each vehicle in the vehicle list and return the vehicle with the highest fuel efficiency.
    - If multiple vehicles have the same highest fuel efficiency, return vehicles with the same highest fuel efficiency in an ArrayList.
- `public ArrayList<Vehicle> getVehicleWithLowestFuelEfficiency(`**`double`**` distance, `**`double`**` fuelPrice):`
    - Calculate the fuel efficiencies for each vehicle in the vehicle list and return the vehicle with the lowest fuel efficiency.
    - If multiple vehicles have the same lowest fuel efficiency, return vehicles with the same lowest fuel efficiency in an ArrayList.
- `public double getAverageFuelEfficiencyOfSUVs(`**`double`**` distance, `**`double`**` fuelPrice):`

- Calculate the average/mean of the fuel efficiency of SUVs in the vehicle list.
- Use the `isVehicleType(Vehicle v, Class clazz)` method.
- If no SUVs exist in the list return -1.0 as an error code that indicates there is no SUVs in the list to calculate the average fuel efficiency.

Main Class:

```
public class Main {
  public static void main(String[] args) {
    // Instantiate vehicleManager, perform operations based on the requirements.
    VehicleManager vehicleManager = new VehicleManager();

    // Read vehicle data from the vehcileList.csv file and initialize objects.
    // TODO

    // Display all vehicle information.
    // TODO

    // Display all car information.
    // TODO

    // Display all motorbike information.
    // TODO

  }
}
```

Submission Guidelines:

- Each team is required to create a GitHub repository [GroupName-CS3330-Hw4] for the project. Eg: A-CS3330-Hw4
- Submit the link to the repository.
- The repository should include all the required Java files (Main.java, Vehicle.java, Truck.java, Car.java, SUV.java, MotorBike.java, VehicleColor.java, FuelType.java, and VehicleManager.java) and any other necessary files to run the program.
- Team members are expected to contribute equally to the project.
- Each team member should make meaningful contributions, and commit messages must be descriptive and related to the changes made. Your grades will be affected by your commits.
- The GitHub repository should demonstrate good version control practices, with commits logically organized and documenting the evolution of the code.
- Make sure to include a README.md file providing clear instructions on how to run the program, any dependencies, and a brief explanation of the project. Also, include here, a detailed account of the contributions made by each team member.
- Verify that the repository is accessible and properly organized, allowing anyone to clone and run the program without additional configuration.
- Your program must use the classes with described methods, given prototypes and signatures exactly. You are allowed to implement additional helper methods and classes.
- Late submission between 0hrs < late <= 24hrs will lose half of the grade. After 24 hours, submissions will receive a grade of 0 for the assignment.
- **Not following the submission guidelines will result in a penalty on your grades.**

Note:

- Ensure that your program handles cases where the file is not found or if there are any issues during file reading.
- Make use of the concepts you've learned, such as constructors, getter/setter methods, static fields/methods, and the toString() method.
- Test your program with different scenarios, including cases where the object is not found and the update is unsuccessful.