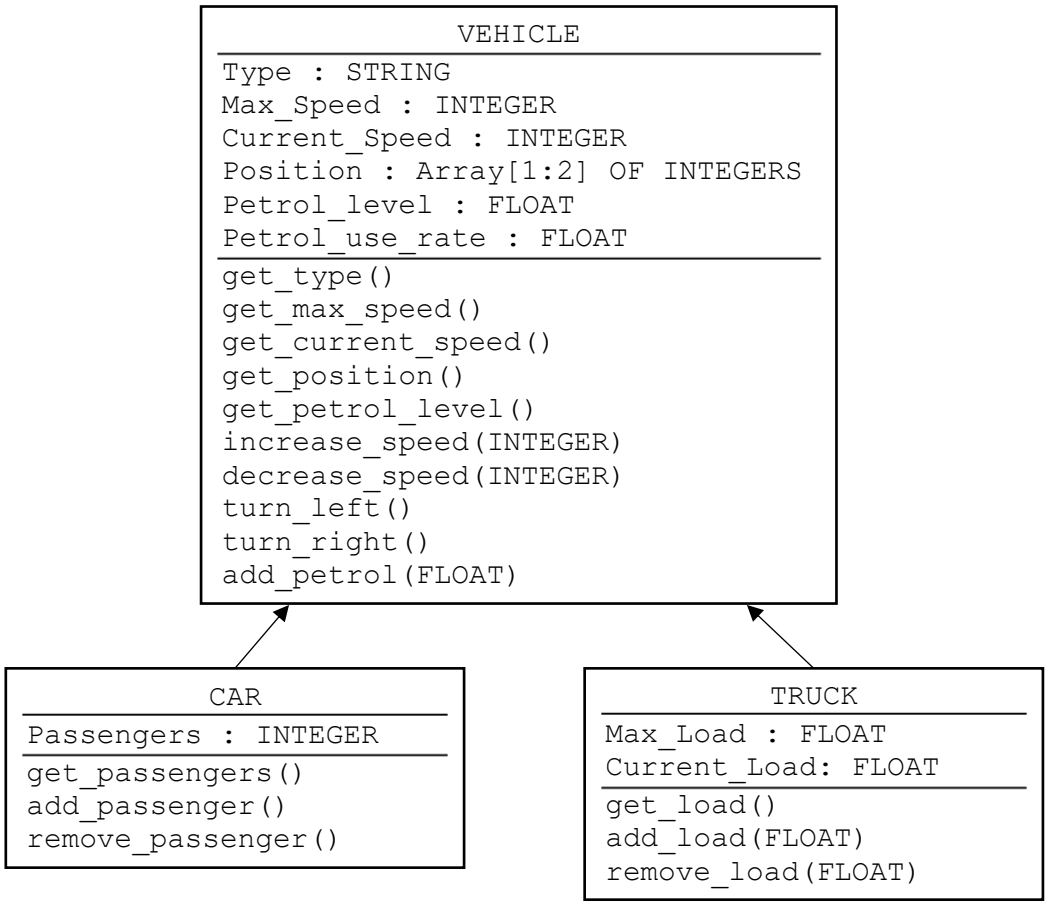
UML Modeling Exercises

ACJC 2021 Prelim paper 1

2. A driving simulator is programmed using Object-Oriented Programming (OOP).

The diagram below shows a UML Class Diagram with **some** of the classes, attributes, and methods used in the simulator.



(a) State the relationship between the `CAR` class and the `VEHICLE` class. [1]

(b) Explain briefly, in this context, how each of the following features of Object-Oriented Programming help the simulation to be developed more efficiently.

(i) Abstraction [2]

(ii) Inheritance [2]

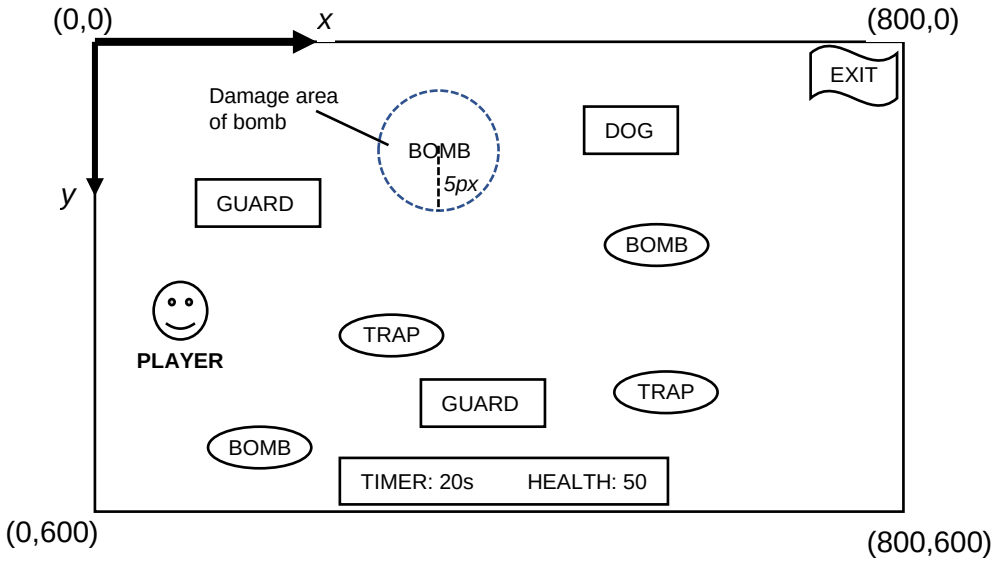
(c) The petrol use rate depends on the speed at which the vehicle is travelling, as well as the mass of the vehicle and the contents of the vehicle – the number of passengers in a car, or the mass of the load in a truck. Explain how polymorphism can be used in this case to write the simulation. [2]

NJC 2019 Promo Paper 1

3. A game has been designed to be played in a 2D coordinate system. Everything is measured in pixels and the coordinate system's origin is the top left corner of the screen. The x-axis starts at 0 there and goes right. The y-axis starts there as well and goes down. The maximum width is 800 pixels and the maximum height is 600 pixels. All entities in the game will be position with an *x* and *y* coordinates within the boundaries of the screen and and some entities will be able to move in four directions up, down, left and right within the boundaries of the screen. The game play is as follows:

- The player moves his/her character by moving the up,down,left and right arrow keys on the keyboard. The player starts with a **health score of 50**.
- The objective is to evades all the enemies and obstacles and reach the EXIT before the game timer reaches **0**. The game starts with a **game timer** value of **20 seconds** and will count down to **0 seconds.**
- The characters in the game are:
  - PLAYER: can be control and move by the user using the left, right, up and down keyboard keys.
  - GUARD, DOG: these 2 characters' movements are control by the program code.
  - BOMB, TRAP: these 2 characters **cannot** move.
- A GUARD can shoot and inflict damage (by **deducting up to 10 health points**) on you when you are within a distance of **10 pixels**.
- A DOG can bite you when it comes in contact with you and will inflict damage on you (by **deducting up to 5 health points**).
- A BOMB can explode randomly and will be able to inflict damage (by **deducting 10 health points**) when you are within a ***5 pixels radius*** from the bomb.
- When the PLAYER comes in contact with a TRAP. The player will freeze and cannot be move for 3 seconds.
- The game ends when the player is able to reach the EXIT before the game timer ends or when the player's health score drops to **0**.

The diagram below is a design of the game screen:



(a) Draw suitable UML class diagrams to model the game described above. You should include appropiate attributes and methods for each class. [5]

(b) Explain the object-oriented concept of inheritance and how it is used in your design. [3]

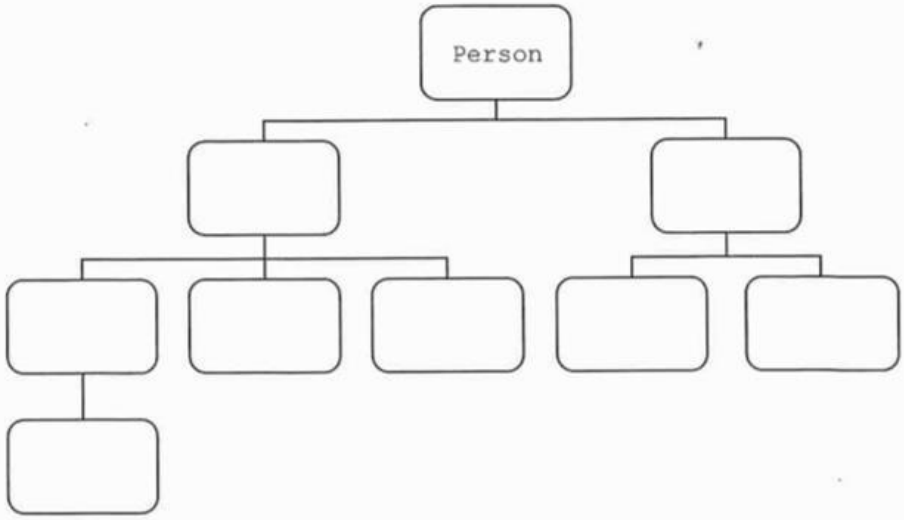
(c) Explain the object-oriented concept of polymorphism and how it is used in your design. [3]

3 **(a)** Explain what is meant by an object in object-oriented programming. [2]

(b) **(i)** A student is writing a program to represent people in a university. Tutors, office workers, lecturers and professors are all employed by the university. A professor is a senior lecturer. The university educates both undergraduate and graduate students.

The student's program contains a class with the identifier `Person`. Sub-classes share the characteristics of this class.

Copy and complete the following inheritance diagram by adding sub-classes `Professor`, `OfficeWorker`, `Lecturer`, `Undergraduate`, `Staff`, `Graduate`, `Student` and `Tutor`. [2]



(ii) Explain why inheritance is an important feature of object-oriented programming. [2]