2. A faculty in a private university wishes to computerise its student records system. The record of each student includes his or her name and the program he or she enrolls. The faculty offers several programs at postgraduate level such as "Master of Business Administration", "PhD of Social Science", and many more. Regardless of the program or degree, each student is appointed with a lecturer as his or her academic advisor. The role of the advisor is to guide the student on academic matters. As for the postgraduate programs either master or PhD degrees, they are conducted in fully research-based. Each postgraduate student has to have a research project and a lecturer to supervise his or her project.

Based on the given problem, answer the following questions:

a. Draw the UML class diagram for the above problem. Your design has to include the classes and their attributes and methods accordingly, as well as relationships between the classes. Each class has to provide a constructor, mutators, and assessors.

b. Then, write the C++ code to implement the design. Your implementation should apply object-oriented programming concepts including data hiding, composition and/ or aggregation.

c. Next, utilize the classes to store a list of postgraduate students. You need to use dynamic arrays for the list and fill it in with data read from an input file. Figure 7.8 shows the example of input file containing the list of postgraduate students. The first line in each file indicates the number of students the file contains. Following that is the record of a student in which each attribute is arranged in a line. The student records are separated by blank lines. Finally, print all the students from the arrays into another text file. Figure 7.9 shows an example of the output file.
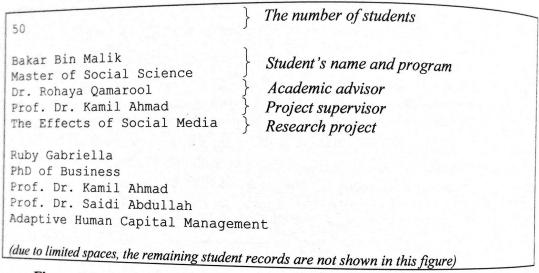
```
50                                    } The number of students


Bakar Bin Malik                       } Student's name and program
Master of Social Science
Dr. Rohaya Qamarool                   } Academic advisor
Prof. Dr. Kamil Ahmad                 } Project supervisor
The Effects of Social Media           } Research project


Ruby Gabriella
PhD of Business
Prof. Dr. Kamil Ahmad
Prof. Dr. Saidi Abdullah
Adaptive Human Capital Management
```
(due to limited spaces, the remaining student records are not shown in this figure)

Figure 7.8: An example of input file named "pgstudents.txt", for the list of postgraduate student records

Note that, the texts in *italic* are given to describe the fields accordingly. Also, only two records from the input file out of 50 are shown here due to limited spaces.
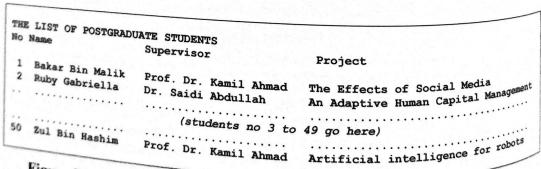
```
THE LIST OF POSTGRADUATE STUDENTS
No Name                  Supervisor
                                               Project
1  Bakar Bin Malik
2  Ruby Gabriella        Prof. Dr. Kamil Ahmad
   .............         Dr. Saidi Abdullah      The Effects of Social Media
                         .............           An Adaptive Human Capital Management
                                                 .............
..  .............              (students no 3 to 49 go here)
50  Zul Bin Hashim       .............
                         Prof. Dr. Kamil Ahmad    Artificial intelligence for robots
```

Figure 7.9: An example of the output file containing the lists of postgraduate students

Note that only some students are shown Figure 7.9 due to limited spaces.

3. Consider the class diagram in Figure 7.10 which shows the data model for a car rental company. Note that the company has set the rule that each customer can only rent one car at a time. Based on the class diagram, write a C++ program which performs the following tasks:
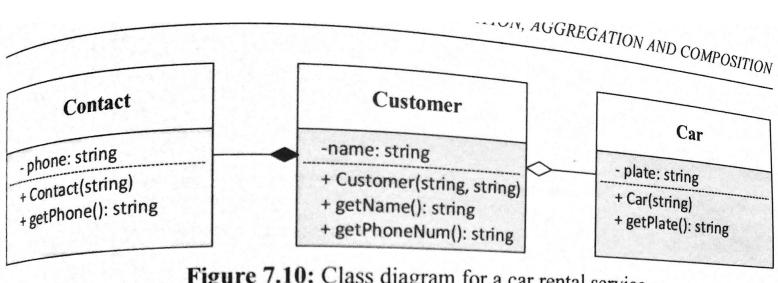
Figure 7.10: Class diagram for a car rental service

a. Implement all the three classes with the given attributes and operations. Note that, the purpose of each operation is as the name implies.

b. Test the classes by creating an object of **Car** and an array of customers with the following data:

Customer's Name	Phone Number	Rented Car Plate
Ahmad Kamal	015-75769800	JSQ245
Siti Nurdiana Abdullah	014-8889900	

Note that, the column **"Rented Car Plate"** for the second customer is empty because she does not rent any car at the moment.

c. Print the array of customers onto the screen. The screen output should look like as in Figure 7.11.

```
Customer's Name: Ahmad Kamal
Phone Number: 015-75769800
Rented Car   : JSQ245

Customer's Name: Siti Nurdiana Abdullah
Phone Number: 014-8889900
Rented Car   :
```

Figure 7.11: Screen output