

Final Examination 2018 / 2019

Exam Period:	18F8W2
Exam Code:	1SED1, 1SED2, 1SED3, 1DSE1, 1CPC
Exam:	Diploma Software Engineering; MSc Software Engineering & Database Technologies Continuous Professional Development
Module Code:	MCT619
Module Name:	Object Oriented Programming
External Examiner:	Dr. Jacob Howe
Internal Examiner:	Professor Michael Madden
Facilitator:	Mr. Chris O' Toole

- Instructions:**
- Please ensure your name is on all your examination documents.
 - Only one examination submission will be accepted from each student.
 - For the programming questions, you must include design (e.g. pseudo-code, flow-chart) and testing documentation as well as a copy of the code included in the Word file.
 - No submissions will be accepted after the final submission date.
 - All work must be your own. Collaboration is not permitted.
 - Include your submissions as **one** zip folder containing your exam script and java code files. Use the following file naming convention: if your name is John White, the files will be named as follows:
 - 18F8W2_WhiteJohn_CT619_FinalExam_zip

Submission Date: Exam must be submitted to BlackBoard by midnight your local time on 16th Dec 2018

No. of Pages: 6

Department: Information Technology, NUI, Galway

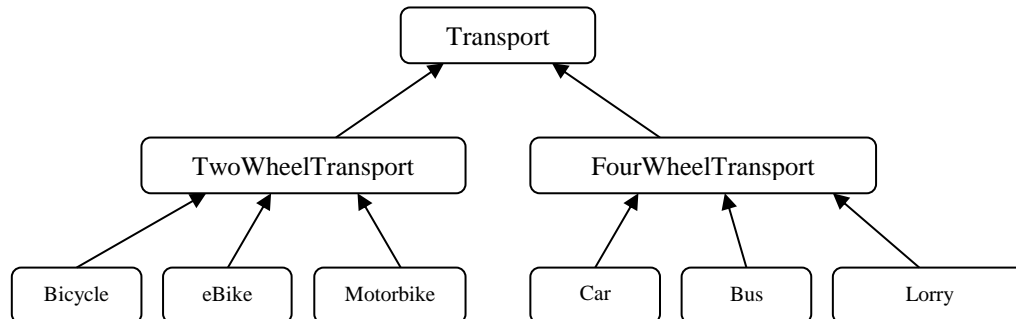
Answer all 4 questions

Question 1

[30 marks]

(a)

Develop a Java program to implement the transport hierarchy shown below.



The **Transport** class should contain methods:

- **getDateTime** to get the date and time of the last service in the form of calendar date and time
- **getEntertainment** to get the transport entertainment type e.g. radio, CD.

Each **TwoWheelTransport** should contain a method:

- **getSpeed** to get the speed of the two-wheel transport.

Each **FourWheelTransport** should contain methods:

- **getSpeed** to get the speed
- **getSeats** to get the seat capacity

Write a program that creates one object of each of the concrete classes and creates an array with references to all of these objects. Using the `toString()` method, the program should print a text description of the object to which each array element refers. Also, in the loop that processes all the transport types in the array, determine whether each type of transport is a **TwoWheelTransport** or a **FourWheelTransport**. If a transport type is a **TwoWheelTransport**, display its speed and how many times slower it is than the slowest **FourWheelTransport**. If a transport type is a **FourWheelTransport**, display its speed and seat capacity. It should also indicate the date and time in the form of elapsed days, hours, minutes and seconds since the last service. Properties of concrete classes should be initialised using a series of methods to set the value for the given object. Methods for getting speed, seat capacity, etc. should be implemented using a series of public methods. Include your Java code into your solution document.

[15 marks]

Continued Overleaf

(b)

Develop a multi-threaded Java application as described below.

Five Data Entry applicants take part in a speed typing test on a 480 minute (8 hour) long day. Each applicant has their strengths and weaknesses:

- Alan's typing speed is 260 words per minute and takes a break every 30 minutes
- Bryan's typing speed is 220 words per minute and takes a break every 60 minutes
- Claire's typing speed is 210 words per minute and takes a break every 70 minutes
- Diane's typing speed is 230 words per minute and takes a break every 50 minutes
- Eric's typing speed is 150 words per minute and takes a break every 100 minutes

Write a multithreaded Java application to simulate a typical day's data processing of 210 450 word documents. Display a message in the terminal when each applicant has finished the test. The application should stop once the test is finished (i.e. after 480 minutes).

Create a data applicant class. The constructor accepts two integers for typing speed and break frequency, a reference to a break object and a String for its name. The applicant class should also have members that store a word count and duration in minutes.

The canteen for breaks can only be occupied by one data entry applicant at a time and it is occupied at the start of the test for 15 minutes. This will require synchronisation between threads and the use of locks. If a data entry applicant needs to take a break but another applicant is already in the canteen they must skip their break until their next scheduled break. As a result, their performance suffers and their throughput reduces by half until they have the opportunity to break again.

Include your Java code into your solution document.

[15 marks]

Continued Overleaf

Question 2

[30 marks]

CM Safety Ltd. has recently employed you as a consultant software engineer in its R&D department.

You have been contracted to help design and develop data collection and analysis software to monitor domestic Carbon Monoxide (CM) levels in order to help Ireland meet the EU Directive on CM safety. In the project scope, it is required that multiple CM monitors will be placed around the test site and each monitor will capture test data.

(a) Develop a class “CMMonitor” to model the monitored data via an array and methods operating on the array. The class should have the following members:

- An array that can hold integer values;
- A constant that specifies the maximum number of values that can be stored in the array;
- A constructor with one argument that initialises the constant in the previous point and initialises the array to be able to store whole numbers;
- A method that adds a number to the array;
- A method that returns the value at a given position in the array. The position is specified by the value of the argument;
- A method call that will add all elements currently in the array and return the result;
- A method which overrides the inherited toString method and returns a string that appends the size of the array to the value returned by the inherited toString method;

Include your Java code into your solution document.

[5 marks]

(b) Develop the implementation of a ‘Compliant’ method that will compare the contents of the Monitor object’s integer array with the contents of the argument (EU compliant) object’s array. The contents of the monitor object is deemed to be compliant if both objects’ respective arrays are of the same size and corresponding numbers are less than or equal.

Include your Java code for the ‘compliant’ method into your solution document.

[5 marks]

Continued Overleaf

- (c) Add a method to the CMMonitor class called `recordCMReading` which writes all numbers in the int array to a file specified by the String argument. For example, the call `recordCMReading ("monitordata.txt")` will write to the file `monitordata.txt`. Each number written to the file should be separated from the next by a blank space.

Include your Java code for the `recordCMReading` method into your solution document.

[5 marks]

- (d) Add a method to the CMMonitor class called `loadCMDData` that reads int numbers from a target file (the file name is specified by the String argument). So the call `loadCMDData ("monitordata.txt")` will read the int numbers in the file `monitordata.txt` into the int array within CMMonitor.

Include your Java code for the `loadCMDData` method into your solution document.

[5 marks]

- (e) Write a class "TestCMMonitor" with a main method that will create a number of CMMonitor objects. Your code should fully test all the functionality of the CMMonitor class including the 'Compliant' method.

Include your Java code and the resulting output into your solution document.

[5 marks]

- (f) You discover that the monitor produces additional data points under certain conditions, for example, near gas central heating systems. Briefly explain the changes you need to make to the CMMonitor class and why. In your answer, refer to each of the below collection types and explain whether it is well-suited to replacing the int array in the CMMonitor class:

- ArrayList
- HashMap
- TreeSet

[5 marks]

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Question 3:

[20 marks]

Compare Java's automatic garbage collection to a similar strategy in an OO language of your choice (C#, Objective-C). Why, do you think, do some OO languages (such as Ada and C++) not implement such a strategy?

(Limit your answer to 1000 words. All citations and references must be in APA style.)

Question 4:

[20 marks]

“As well as providing a comprehensive range of data storage structures and related algorithms, Java's Collections Framework also illustrates many of the concepts and principles of good object-oriented software development”. Discuss, with supporting justification.

(Limit your answer to 1000 words. All citations and references must be in APA style.)