L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

**ADVANCED MATRICULATION LEVEL
2024 FIRST SESSION**

SUBJECT:	**Computing**
PAPER NUMBER:	I
DATE:	21st May 2024
TIME:	9:00 a.m. to 12:05 p.m.

Directions to Candidates

· Answer **ALL** questions.
· Good English and orderly presentation are important.
· All answers are to be written on the booklet provided.
· The use of flowchart templates is permitted but calculators may **not** be used.

1. Given an 8-bit binary number representation, perform the following tasks.

   a. Convert the binary number 10110101 to its decimal equivalent. (1)
   b. Add the binary numbers 01101011 and 10110100 using binary arithmetic. (1)
   c. Calculate the range of numbers that can be represented using sign and magnitude representation in an 8-bit system. (1)
   d. Explain the concept of overflow and provide an example using 8-bit binary numbers. (2)

   (Total: 5 marks)

2. Consider the following logic statement:

   "If the temperature is above 30°C and the humidity is below 60%, or if the system is in manual mode, then turn on the cooling fan."

   a. Draw a logic circuit diagram that represents the entire given statement using appropriate logic gates. (2)
   b. Create a truth table for the combined logic circuit representing the given conditions. (2)
   c. Write the Boolean function for the given logic statement. (1)

   (Total: 5 marks)

3. Consider the following code snippet:

```
public class AddingFifty {

    public static void main(String[] args) {

        int result = 0;

        for (int i = 0; i < 10; i++) {

            result = result + constantAddition();

        }

        System.out.println("The result is: " + result);

    }


    public static String constantAddition() {

        String a = "5";

        return a;

    }

}
```

Question continues on the next page.

a. Name **ONE** error in the code above and state which phase of the compilation process would detect the error. (2)
b. Mention **ONE** optimisation that could be applied to this code and produce a version of the code with the code optimisation being applied. (3)

(Total: 5 marks)

4. Consider the following assembly code snippet written for an 8086 processor:

```
MOV AX, 0300H;  Initialise AX with the value 0300H
ADD BX, AX;     Add the contents of AX to BX
MOV [BX], CX;   Move the value in CX to the memory address pointed to by BX
SUB DX, [SI];   Subtract the value at the memory address pointed to by SI from DX
JMP Label;      Unconditional Jump to the label 'Label'
```

Identify and explain the addressing modes used in **each** instruction. (5)

(Total: 5 marks)

5. The IT department of a growing organisation has assigned you the role of a Network Consultant to enhance their existing network infrastructure. The goal is to optimise data transmission, minimise errors, and ensure a reliable and efficient communication environment.

a. What factors differentiate shielded and unshielded twisted pair cables? In your answer consider the factors of maximum length, speed, and EMI immunity. (3)
b. What are the primary factors leading to errors in data transmission, with a focus on EMI and noise? Explain the potential consequences of these factors on the reliability of network communication. (2)

(Total: 5 marks)

6. The IT department of a multinational organisation is tasked with enhancing the data integrity of its network communication system. The focus is on implementing error detection measures through parity and checksum checks.

a. Provide a brief comparison between parity checks and checksum checks in terms of their effectiveness as error detection measures. (2)
b. Propose a specific scenario within the organisation where implementing parity checks would be instrumental in maintaining data integrity. Justify your choice. (2)
c. Name **ONE** limitation or consideration associated with parity checks. (1)

(Total: 5 marks)

7. As the designated project manager for the implementation phase of a new Customer Relationship Management (CRM) system in a medium-sized retail company, the organisation aims to enhance customer interactions and streamline sales processes by transitioning from a legacy system. Your task is to carefully plan and execute the implementation phase, considering the tasks, changeover techniques, and potential challenges associated with the transition.

a. Identify and describe the specific tasks that need to be addressed before the changeover to the CRM system is considered complete. (2)
b. Outline the fundamental concept of **each** changeover technique, namely Direct, Parallel, and Phased Pilot. (3)

(Total: 5 marks)

8. A shop in Valletta maintains a database of products that it sells to customers. Now it wants to develop an e-commerce system and connect it to its database so it can sell products online. The company aims to streamline its operations, enhance decision-making processes, and improve overall efficiency. Your task is to conduct a comprehensive feasibility study to determine whether proceeding with the implementation of the e-commerce system is viable.

   Consider the following aspects in your feasibility study:
   i. Technical Feasibility;
   ii. Operational Feasibility;
   iii. Timeliness Feasibility.

   a. Evaluate the compatibility with existing infrastructure, potential technical challenges, and the feasibility of integration with current systems. (3)
   b. Identify potential disruptions during the implementation phase and assess the ease of adaptation by end-users. (2)

   (Total: 5 marks)

9. A local library system is looking to improve its database management system (DBM's). The library maintains information about books and authors. Each book is written by one author, but an author can write multiple books. Design an Entity-Relationship (ER) diagram for these two entities with reasonable attributes, relationships and keys. (5)

   (Total: 5 marks)

10. In the evolving landscape of DBM's, understanding the strengths and weaknesses of various database models is crucial for effective data organisation and retrieval.

   a. Compare and contrast the hierarchical, network, and relational database models. Provide a brief scenario where **each** model might be most suitable. (3)
   b. Explain the key characteristics of object-oriented database models. In what scenarios would an object-oriented database be preferred over a relational database? (2)

   (Total: 5 marks)

11. Imagine you are tasked with designing a new computer system based on the Von Neumann architecture for a specialised application in scientific research.

   a. Discuss the specific features or enhancements you would incorporate into the CPU to maximise processing power and efficiency within the constraints of scientific computations. (2)
   b. Outline strategies to optimise the main memory to accommodate large datasets and ensure fast access times, considering the demands of scientific research applications. (2)
   c. Describe your approach to optimising the connectivity between the CPU, main memory, and Input/Output Subsystems through the System Bus, considering the unique requirements of scientific data transfer and external device interactions. (1)

   (Total: 5 marks)

Please turn the page.

12. A smart home automation system requires efficient communication between the various devices connected to it.

    a. In the context of a smart home system, explain how optimising the Address Bus, Data Bus, and Control Bus contributes to effective communication between different devices.   (2)
    b. What would be the strategies you embark on to enhance system attributes that are specific to a smart home? Take into consideration:
        *   Bus size considerations in relation to Data Bus and Address Bus widths.
        *   The significance of the System Clock in ensuring timely interactions.
        *   How devices like sensors, lights and thermostats are interconnected to a common bus using decoders to improve overall home automation efficiency.   (3)

        (Total: 5 marks)

13. An engineering team is designing a computer system with a focus on I/O peripherals.

    a. Name **ONE** difference between USB ports and flash RAM. How can the two be used together?   (2)
    b. Provide a brief example to differentiate between serial data transmission, synchronous data transmission and asynchronous data transmission.   (3)

        (Total: 5 marks)

14. A large organisation has complex operations requiring an integrated computer system that utilises different types of operating systems for various purposes.

    a. Describe a specific scenario within the organisation where a batch operating system could optimise workflow and resource utilisation.   (2)
    b. How can an online operating system enhance real-time collaboration and communication among employees? Provide a brief example to illustrate its practical application.   (2)
    c. Identify **ONE** critical aspect of the organisation where a real-time operating system is important.   (1)

        (Total: 5 marks)

15. You have been employed as a consultant for a company seeking to understand more about interrupt handling and Direct Memory Access (DMA).

    a. Briefly explain the significance of interrupt handling in computer systems and how it contributes to overall system efficiency.   (2)
    b. Contrast software polling and vectored interrupts. Mention the pros and cons associated with both approaches.   (3)

        (Total: 5 marks)

16. Consider the following matrix of integer values:

5	2
3	1

    a. What data structure would best be used to store the above matrix in Java?   (1)
    b. Produce a Java code snippet which stores the values in a data structure and then, using loops, prints out the contents in a list as follows:

    ```
    5
    2
    3
    1
    ```

    (4)

    (Total: 5 marks)

17. The electoral register contains the details of all the people who are eligible to vote in the next election. This currently stands at around 400,000 people. Authorities asked you to store the details in a list and provide a linear search functionality to look up an individual voter's details using their ID card number. You think this will be too inefficient.

    a. Recommend a different search algorithm which is more efficient. State a prerequisite for the use of this algorithm.   (2)
    b. What other data structure can be used which provides very efficient data retrieval? Briefly explain how it works, how data is stored and retrieved.   (3)

                                                                                        (Total: 5 marks)

18. An online quiz platform allows users to participate in quiz competitions whereby they need to answer questions within a specific amount of time. They are then given a score and the system displays a leaderboard showing the ranking of all the players who participated. Different programming paradigms can be used to implement different features of this system.

    a. Explain, with an example, how an imperative programming approach would be beneficial in implementing a feature of your choice for the quiz platform.   (3)
    b. Identify a feature where functional programming characteristics can contribute to efficiency. Elaborate on how functional programming principles can enhance the development of this feature.   (2)

                                                                                        (Total: 5 marks)

19. Maltese ID card numbers consist of 8 digits followed by one of the letters M, L, G, or A. Formalise this definition using Backus-Naur Form (BNF) notation.   (5)

                                                                                        (Total: 5 marks)

20. You are developing a simple task manager application Java which enables users to maintain a list of tasks that they need to do, and then mark them as complete when they are done. A task consists of a task title, description, number of days in which to complete the task, and an indication of whether it has been completed or not. Every task starts off as being incomplete by default. Design a class named `Task` that represents a single task. The class should have the following components:

    a. Appropriate instance variables to store the task properties using correct datatypes.   (2)
    b. A constructor to intialise these properties using parameters for the initial values.   (2)
    c. A method called `completeTask()`, which marks the task as completed.   (1)

    There is no need to create code for getters and setters.

                                                                                        (Total: 5 marks)

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2024 FIRST SESSION

L-Università
ta' Malta

SUBJECT:	**Computing**
PAPER NUMBER:	II
DATE:	21st May 2024
TIME:	4:00 p.m. to 7:05 p.m.

Directions to Candidates

· Answer **any FIVE** questions.
· Good English and orderly presentation are important.
· All answers are to be written on the booklet provided.
· The use of flowchart templates is permitted but calculators may **not** be used.

1. Imagine you are tasked with designing a combinational logic circuit for an automated greenhouse monitoring system. The system has four input sensors: Temperature Sensor (A), Humidity Sensor (B), Light Sensor (C), and Soil Moisture Sensor (D). The objective is to control various actuators based on specific environmental conditions for optimal plant growth.

   The system has three output variables, each controlling a different actuator:
   - Temperature Control (T): Activate the temperature control system if the temperature is too high.
   - Light Control (L): Adjust the artificial light source if natural light is insufficient.
   - Moisture Control (M): Activate the irrigation system if the soil moisture level is low.

   To simplify the design process, you are provided with the following truth table:

A	B	C	D	T	L	M
0	0	0	0	0	0	0
0	0	0	1	1	1	0
0	0	1	0	0	0	0
0	0	1	1	0	0	1
0	1	0	0	0	0	0
0	1	0	1	0	0	1
0	1	1	0	1	1	0
0	1	1	1	1	1	1
1	0	0	0	0	0	0
1	0	0	1	1	1	0
1	0	1	0	0	0	0
1	0	1	1	0	0	1
1	1	0	0	0	0	0
1	1	0	1	0	0	1
1	1	1	0	1	1	0
1	1	1	1	1	1	1

   a. Develop separate Karnaugh maps for **each** output variable (T, L, M). Clearly label the rows and columns of the Karnaugh maps. (6)
   b. Utilise the Karnaugh maps to derive simplified Boolean expressions for **each** output variable (T, L, M). Show the step-by-step process of grouping and simplification. (6)
   c. Design a combinational logic circuit using the simplified Boolean expressions. (3)

Please turn the page.

You are now required to integrate a seven-segment display into the greenhouse monitoring system. The display will serve as a visual indicator of the current environmental conditions or any alerts. Assume that the temperature range is from 0 to 9 degrees Fahrenheit. Each segment of the display is labelled a, b, c, d, e, f, and g.

Consider the binary input labelled ABCD provided to the decoder. The segments needed to form each digit are as follows:

Digit	INPUT				OUTPUT						
	A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	0
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	0	1	1

d. Derive the simplified Boolean expressions for the first 3 outputs (a, b, c) using Karnaugh maps. For other input combinations, it is acceptable to designate the output as 'don't care' (X), as there are no additional digits to display. (5)

(Total: 20 marks)

2. Infra Corp operates in multiple geographical locations, and efficient communication is crucial for the seamless functioning of its diverse departments. The current communication infrastructure, while functional, is showing signs of ageing and is not fully aligned with emerging technological trends. The company is determined to enhance its existing communication infrastructure to meet the evolving demands of a dynamic business environment.

As part of this initiative, you have been assigned the responsibility of formulating a comprehensive plan for the complete revamp of the organisation's networking and data communication systems.

a. Define computer network. Explain its significance in modern computing. (2)
b. Differentiate between point-to-point data communications and multipoint data communications. Provide **ONE** example of each. (4)
c. Compare serial and parallel data communication, highlighting their basic differences and specifying scenarios where **each** technology is more suitable. (4)
d. Define and distinguish between simplex, half duplex, and full duplex data communications. Illustrate scenarios where **each** mode is appropriate. (6)
e. Differentiate between analogue and digital data communication. Use diagrams to explain key differences. (2)
f. Describe the role of modems in data communication, emphasising analogue wave modulation and demodulation. (2)

(Total: 20 marks)

3. A university currently faces challenges with its Student Enrolment System. The existing system, while functional, operates on outdated technology, resulting in inefficiencies and delays in the enrolment process. As the university continues to grow, it becomes increasingly evident that a modernised and streamlined enrolment system is crucial to meet the evolving needs of students and administrative staff.

    Current challenges include:

    *   Technological Obsolescence: The existing enrolment system relies on outdated technology, leading to slow processing times and occasional system downtimes.
    *   Complex Processes: The enrolment process involves multiple steps, paperwork, and manual verification, leading to an increased likelihood of errors and delays.
    *   Communication Gaps: Communication between different departments involved in the enrolment process is not seamless, causing misunderstandings and hindrances.
    *   Limited Accessibility: Students face challenges accessing the enrolment system remotely, affecting the overall user experience and convenience.

    You are tasked with analysing and modelling a new system for the university.

    a. Create a Level 1 Data Flow Diagram (DFD) to represent the Student Enrolment System. Ensure **not** to exceed the detail of a Level 1 diagram. (4)
    b. Develop a Use-Case Diagram (UCD) illustrating the various actors and use cases within the Student Enrolment System. (4)
    c. Design a Class Diagram for the Student Enrolment System, considering classes related to students, courses, and enrolment. (4)
    d. Explain how UML diagrams, including DFDs, UCDs, and Class Diagrams, aid a system analyst in modelling different aspects of a software solution. (2)
    e. List and briefly describe **THREE** advantages of employing a modular design approach. (3)
    f. Explain the concept of prototyping and its significance in system development. Discuss a situation where using prototyping might be particularly beneficial for the Student Enrolment System. (3)

    (Total: 20 marks)

4.
    a. Select either RISC or CISC architecture. Provide a detailed explanation of the chosen instruction set, highlighting key features and differences from the other architecture. Emphasize practical considerations in programming and execution. (7)
    b. Explain in detail the functions of the Control Unit (CU) and the Arithmetic Logic Unit (ALU) in a CPU. Provide examples of scenarios where each unit plays a crucial role in instruction execution. How do these components contribute to overall system performance? (4)
    c. List and explain the steps involved in the "fetch," "decode," and "execute" cycles of a CPU. Emphasize the role of buses and registers during each phase. Discuss the implications for program efficiency. (4)
    d. Describe a practical application of a stack structure in the context of subroutine transfer. How does the stack facilitate efficient management of program execution flow? (3)
    e. Imagine you are a software architect tasked with optimising the performance of a complex software application. Briefly explain how a deep understanding of CPU architecture, including instruction sets, registers, control units, ALUs, and the fetch-decode-execute cycle, would influence your decisions in optimising the software. (2)

    (Total: 20 marks)

Please turn the page.

5. As a seasoned database architect, you've been assigned to develop a sophisticated database system for a multinational e-commerce platform specialising in electronics. The system must efficiently handle information about products, suppliers, customers, orders, and shipment tracking.

    Entities:
    *   **Products:** Each product has a unique product ID, name, description, price, stock information, and details about its specifications.
    *   **Suppliers:** Each supplier has a unique supplier ID, name, contact details, and a list of products they supply.
    *   **Customers:** Each customer has a unique customer ID, name, email address, shipping address, and order history.
    *   **Orders:** Record details of each customer's order, including order ID, product(s) purchased, quantity, total amount, and order status.
    *   **Shipments:** Track information about shipments, including shipment ID, order ID, shipping date, expected delivery date, and delivery status.

    a. Create a comprehensive E-R model illustrating the relationships between Products, Suppliers, Customers, Orders, and Shipments. Indicate cardinality and participation constraints, considering the complexity of interactions. (5)
    b. Transform the detailed E-R model into a relational database design. Define tables for Products, Suppliers, Customers, Orders, and Shipments. Ensure appropriate use of primary keys, foreign keys, attributes, and complex table relationships. (5)
    c. Explain **TWO** responsibilities assumed by the role of a database administrator. (2)
    d. Discuss the role of HAVING in SQL queries. How does it differ from WHERE, and in what situations is HAVING preferred? (3)
    e. Describe the basic objectives of database normalisation. How does normalisation contribute to efficient data management? (2)
    f. What is the Third Normal Form (3NF)? Explain the conditions that must be met for a table to be in 3NF. (3)

    (Total: 20 marks)

6. In operating systems, processes go through different states - run, wait, and suspend - each playing a very important role in system efficiency. Moreover, scheduling also adds a dynamic layer to process orchestration.

    a. Explain the run, wait, and suspend states, highlighting the characteristics and activities associated with each state. (3)
    b. Provide a real-world scenario where a process transitions between these states. Explain the significance of these transitions in terms of system efficiency. (4)
    c. Explain the concept of Round Robin scheduling in process management. Highlight key characteristics including time slicing and circular queue. (3)
    d. Explain the concept of Priority scheduling in process management. Discuss how processes are prioritised and selected for execution. (3)
    e. Describe a scenario where Round Robin scheduling would be more suitable for process management. Justify your choice based on the nature of the tasks and system requirements. (3)
    f. Discuss the trade-off involved in choosing between Round Robin and Priority scheduling. Consider factors such as responsiveness, resource utilisation, and system efficiency. (2)
    g. Define what a deadlock is in the context of operating system process management and describe **ONE** method an operating system can use to prevent or avoid it. (2)

    (Total: 20 marks)

7. You are a new developer at a games development company and you are tasked with designing a futuristic space simulation game. The first thing that you need to do is to model the various spaceships that will be part of this game.

   a. Create a base class named `Spaceship` with important attributes like `name` and `fuelCapacity`. Include a constructor to initialise these attributes. (3)
   b. Implement a method named `launch()` that prints a message indicating the spaceship's launch. (2)
   c. Create two subclasses `FighterJet` and `CargoShip`, both extending the `Spaceship` class. In the `FighterJet` class add a unique attribute `weaponry` and a method called `attack()`. In the `CargoShip` add an attribute `cargoCapacity` and a method `loadCargo()`. (6)
   d. Introduce an abstract class named `SpaceshipPart` with an abstract method `activate()`. (2)
   e. Create **TWO** concrete classes that extend `SpaceshipPart`: `Engine` and `Shield`. Implement the `activate()` method differently in each subclass. (5)
   f. Overload the `launch()` method in the Spaceship class to take another parameter called destination. (2)

   (Total: 20 marks)

8. A team has been tasked with implementing a new programming language. Their goal is to design and integrate language translators to make the language executable on various platforms. Demonstrate your understanding of language translators, virtual machine concepts, and related topics through the following challenges:

   a. Explain the key differences between assemblers and compilers, highlighting their roles in the translation process. Provide a real-world scenario where each is preferable. (4)
   b. Outline the main characteristics of interpreters and how they differ from compilers. Discuss a situation where using an interpreter would be advantageous over a compiler. (4)
   c. Briefly describe the functions of macro pre-processors, cross-compilers, and p-code compilers. Highlight a specific use case for each type. (6)
   d. Provide an overview of virtual machines in the context of programming languages. Explain how virtual machines facilitate platform independence and their role in executing high-level code. (3)
   e. Explore the concept of just-in-time compilation. Discuss its advantages in terms of performance and memory usage. Provide an example where the just-in-time compilation is particularly beneficial. (3)

   (Total: 20 marks)

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2024 SESSION

SUBJECT:	Computing Practical Tasks
PAPER NUMBER:	Task 1
DATE:	25th January 2023
TIME:	2 hours 5 minutes

- Answer **all** questions.

- This task should be completed within 2 hours 5 minutes. The first 5 minutes are reading and noting time.

- The paper consists of **THREE** questions which carry a total of 30 marks.

- Only the "BlueJ" programming environment shall be used throughout the practical task.

- Candidates are **not** allowed to make use of the Math class throughout the paper.

- The path where the project folder should be created and saved is to be set to the Computer Desktop or as otherwise instructed. It should be named to *Name Surname Id Card Number* (e.g. Joe Borg 123456M). All work must be saved in this project folder.

- Candidates are requested to include an inline comment with their name, surname and ID card number before starting each question.

- At the end of the exam, candidates are to print a copy with the help of the technician and save a copy of their project folder on the USB stick provided by MATSEC.

- Candidates are to sign each of their printouts.

- Before leaving, candidates are to sign the attendance sheet, write down the time at which they leave the examination room (Time Out) and the username, if any, on the attendance sheet.

- Marks will only be awarded if the above instructions are followed.

1. *Include an inline comment with your details before starting the question. Good practice such as brief inline comments, indentation and naming standards are expected.* (1)

   You are to write a simple multi-player guessing game. Design and implement a program using one class called `Task1Question1` which performs the following:

   a. Prompts "Player 1" to enter a secret number. It then accepts an integer number from the user and stores the number in an appropriate data type. (2)
   b. Using a loop, prints 200 empty lines to scroll the secret number out of view. (2)
   c. Accepts a number as a guess from "Player 2" and stores it in an appropriate data type. It then compares the guessed number to the secret number and informs the player whether they have guessed right, or the guess is too big, or the guess is too small. (3)
   d. Using an appropriate loop, allows "Player 2" to keep guessing till they get the number right. (2)

   (Total: 10 marks)

2. *Include an inline comment with your details before starting the question. Good practice such as brief inline comments, indentation and naming standards are expected.* (1)

   a. Design and implement a program for a toy shop called `Task1Question2` that prompts the user to enter two inputs as follows: (i) the name of a toy; and (ii) the cost price of the toy (e.g. 17.53). Only a cost price greater than 0 should be accepted. If an incorrect value is inputted, the program should keep asking the user to enter the cost price until a valid one is inputted. (3)
   b. Modify the program to prompt and accept a profit margin percentage. For example, a profit margin of 7.5 would indicate that the shop wants to make 7.5% profit on this toy. The program then calculates the selling price of the toy by calculating the profit and adding it to the cost price. The formula for calculating the profit is (margin x price) ÷ 100. Store the profit and selling price in appropriate variables. (3)
   c. The program should print the toy name, cost price, profit and selling price. If the profit margin was negative, the program should print a message stating that the product is being sold at a loss. If the profit margin is 0, then a message saying that the product is not making any profit should be printed. (3)

   (Total: 10 marks)

3. *Include an inline comment with your details before starting the question. Good practices such as brief inline comments, indentation and naming standards are expected.* (1)

   The Trolls of Velmar are building a tower out of sand. Every day, the trolls pile **x** meters of sand onto their tower. Unfortunately, every 2 days, a gust of wind blows away **y** meters of sand.

   a. Design and implement a program using one class called `Task1Question3` which performs the following:
     i. Obtains values from the user for x and y (decimal points are allowed) and d, an integer representing the number of days that the trolls will build for. (2)
     ii. Generates a sequence of messages showing the progress of the trolls' building activities for **d** days. The messages should be similar to the following:
   ```
   Day 1:Trolls build 10.0m. The wind blew away 1.5m. The tower height is 8.5m.
   Day 2:Trolls build 10.0m. The tower height is 18.5m.
   Day 3:Trolls build 10.0m. The wind blew away 1.5m. The tower height is 27.0m.
   Day 4:Trolls build 10.0m. The tower height is 37.0m.
   ```
       Note: The tower height should never be less than 0. (5)
   b. Modify your program to cater for the trolls losing 5% of their building ability every day. (2)

   (Total: 10 marks)

   Print all your work (3 questions) and save a copy of your work on the pen drive provided by MATSEC. All printouts shall be signed.

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2023 SESSION

SUBJECT:	Computing Practical Tasks
PAPER NUMBER:	Task 2
DATE:	17th May 2023
TIME:	2 hours 5 minutes

- Answer **all** questions.

- This task should be completed within 2 hours 5 minutes. The first 5 minutes are reading and noting time.

- The paper consists of **THREE** questions which carry a total of 30 marks.

- The first two questions are linked to each other in that Question 2 builds on Question 1.

- Question 3 is disjoint from the other two questions.

- Only the "BlueJ" programming environment shall be used throughout the practical task.

- Candidates are **not** allowed to make use of the Math class throughout the paper.

- The path where the project folder should be created and saved is to be set to the Computer Desktop or as otherwise instructed. It should be named to *Name Surname Id Card Number* (e.g. Joe Borg 123456M). All work must be saved in this project folder.

- Candidates are requested to include an inline comment with their name, surname and ID card number before starting each question.

- At the end of the exam, candidates are to print a copy with the help of the technician and save a copy of their project folder on the USB stick provided by MATSEC.

- Candidates are to sign **each** of their printouts.

- Before leaving, candidates are to sign the attendance sheet, write down the time at which they leave the examination room (Time Out) and the username, if any, on the attendance sheet.

- Marks will only be awarded if the above instructions are followed.

1. *Include an inline comment with your details before starting the question. Good practice such as brief inline comments, indentation and naming standards are expected.* (1)

   A restaurant can take bookings for tables seating between 2 and 6 diners.

   a. Implement a class called `Restaurant` with **ONE** property: `numTables`, which indicates the total number of tables in the restaurant. Create an appropriate constructor to initialise `numTables` from a parameter. (2)
   b. Add a second property called `bookings`, using an appropriate data structure which stores the number of people booked for each table. Modify the constructor to initialise this data structure appropriately. (2)
   c. Create a method called `takeBooking` which takes a table number (you can assume a zero-based index) and number of people as parameters. The method should verify that the table exists and the number of people being booked is within the expected range. If all validation passes, the bookings data structure is updated. The method will return `true` if the booking is successful, `false` if it fails validation. (5)

   (Total: 10 marks)

2. This question builds on Question 1.

   a. Create another method called `verifyBooking` which takes two parameters indicating a table number and the number of people being booked. Ensure that this can only be called by other methods in the class. The method should check if a booking is valid as specified in Question 1c and return `true` only if verification passes. Modify the `takeBooking` method to use `verifyBooking` when verifying a booking. (4)
   b. Overload `verifyBooking` to take a third `boolean` parameter called `allowBookingChange`. If this parameter is set to `false`, then the booking will only be verified if the table number provided is currently not booked (i.e. the number of people booked on the table is **0**). (3)
   c. Create a new method called `editBooking` which has the same parameters as `takeBooking` but uses the overloaded version of `verifyBooking` to edit an existing booking. Similarly, ensure that the `takeBooking` can only make new bookings. (2)
   d. Create a new method called `cancelBooking` which takes a table number, verifies that the table exists and cancels any booking on that table. (1)

   (Total: 10 marks)

3. *Include an inline comment with your details before starting the question. Good practices such as brief inline comments, indentation and naming standards are expected.* (1)

Psychologists are carrying out a study about the amount of time that children spend playing on tablets every day. They collect data from 15 children by asking them how many minutes they think they spend on the tablet everyday.

You are to design a program called Task2Question3 which, using only the main method, performs the following:

   a. Allow the user to input the values collected from children and storing them in an appropriate data structure. (3)
   b. Sort the data in ascending order using a bubble sort algorithm. (4)
   c. Without using loops, display the minimum, maximum, and median values of the data. (2)

(Total: 10 marks)

Print all your work (3 questions) and save a copy of your work on the pen drive provided by MATSEC. All printouts shall be signed.

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
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ADVANCED MATRICULATION LEVEL
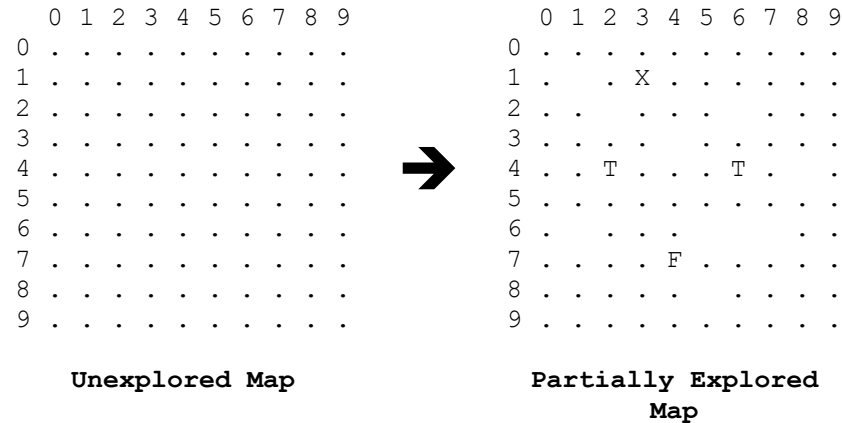**2024 SESSION**

SUBJECT:	Computing Practical Tasks
PAPER NUMBER:	Task III
DATE:	7th February 2024
TIME:	3 hours 5 minutes

General Instructions:

- The paper consists of **ONE** question which carries a total of 40 marks.

- This task should be completed within 3 hours 5 minutes. The first 5 minutes are reading and noting time.

- Only the "BlueJ" programming environment shall be used throughout the practical task.

- The path where the project folder should be created and saved is to be set to the Computer Desktop or as otherwise instructed. It should be named to *Name Surname Id Card Number* (e.g. Joe Borg 123456M). All work must be saved in this project folder.

- Candidates are requested to include an inline comment with their name, surname and ID card number before starting each question.

- At the end of the exam, candidates are to print a copy with the help of the technician and save a copy of their project folder on the USB stick provided by MATSEC.

- Candidates are to sign each of their printouts.

- Before leaving, candidates are to sign the attendance sheet, write down the time at which they leave the examination room (Time Out) and the username, if any, on the attendance sheet.

- Marks will only be awarded if the above instructions are followed.

You are working on a map-based game whereby, a player explores a map trying to find a hidden flag. The map has a square shape made up of 10 x 10 tiles. Each tile can either be empty [ ], a treasure [T], a danger [X] or the flag [F]. The player can choose which tile to explore by entering its `x` any `y` coordinates.

```
   0 1 2 3 4 5 6 7 8 9              0 1 2 3 4 5 6 7 8 9
0  . . . . . . . . . .           0  . . . . . . . . . .
1  . . . . . . . . . .           1  .   . X . . . . . .
2  . . . . . . . . . .           2  . .   . .   . . . .
3  . . . . . . . . . .     ➜     3  . . .     . . . . .
4  . . . . . . . . . .           4  . . T . . . T .   .
5  . . . . . . . . . .           5  . . . . . . . . . .
6  . . . . . . . . . .           6  .   . . .       . .
7  . . . . . . . . . .           7  . . . . F . . . . .
8  . . . . . . . . . .           8  . . . . .   . . . .
9  . . . . . . . . . .           9  . . . . . . . . . .
```

Unexplored Map   **Partially Explored
                                              Map**

The example above shows an unexplored map on the left, with all tiles marked as [.]. The map on the right has been partially explored, with the player having found some empty tiles [ ], a danger [X] at tile (3,1), a treasure [T] at tiles (2,4) and (6,4) and the flag [F] at tile (4,7).

The designer has specified the following classes:

- `Player`
- `Tile`
- `EmptyTile`
- `TreasureTile`
- `DangerTile`
- `FlagTile`
- `Map`

The `Player` class contains information about a player, which for this version of the game will only consist of the `score` of their current game. The score should be defined as an integer.

The `Tile` class is an abstract class which has the following properties, constants and methods:

Properties and constants

- `tileType`: A string indicating whether the tile is "empty", "treasure", "danger" or "flag". The possible values should be stored as constants in the Tile and used in the code.
- `xPosition`: A value from 0 to 9 indicating the tile's position along the x-axis.
- `yPosition`: A value from 0 to 9 indicating the tile's position along the y-axis.
- `isExplored`: Indicating whether or not the player has explored the tile.
- `mapCharacter`: The character to be used to show the tile on the map (e.g. 'F' for flag).

Methods

- `printTile()`: Prints the tile at the current position on the screen. If the tile is explored, then printing involves printing the value of `mapCharacter`, otherwise a full stop [.] is printed. For the sake of aesthetics, a space character is to be printed as well after the `mapCharacter` or full stop.
- `adjustScore(Player p)`: An abstract method which is called when the Player object passed in a parameter explores the tile. The method increases, decreases or leaves the score as is. For example, a treasure might increase the score by 50 whilst a danger might decrease it by 50.

The classes `EmptyTile`, `TreasureTile`, `DangerTile` and `FlagTile` are all types of tiles. The `tileType` and `mapCharacter` properties of tiles should be set in the respective constructors. The empty tile leaves the player's score unchanged, the `FlagTile` increases the score by 250 points, the `TreasureTile` increases the score by 50, whilst the `DangerTile` reduces the points by 25%.

The Map class is a representation of the map. It contains a property called `initialised` and a property called `rows` of the type ArrayList<Tile[]>. The `initialised` property is set to true once a map is `initialised` (see part b below). The property `rows`, contains 10 arrays of 10 tiles each, forming the map. Therefore, if one wanted to access tile `(3,7)`, then first we would get the 7th row from the `rows` property, and then get the 3rd tile in that row. The `Map` class constructor should intialise the map full of empty tiles. It should also provide the methods: `getTile(x,y)` which retrieves the tile at those coordinates; and `setTile(x,y,tile)` which places the provided tile at `(x,y)`. The constructor of this class should fill the map with empty tiles and set the `initialised` property to `false`.

a. Write code for each of these classes. Be sure to provide getters and setters for **all** attributes. (21)

b. Create a method in the Map class called `initialise`, which takes two parameters: `numTreasures` and `numDangers`. The two parameters indicate how many treasures and dangers respectively should be on the map. The minimum value for both is `1` whilst the maximum value is `7`. If a number less than 1 is provided, then a value of 1 is assumed. If a value greater than 7 is provided, then a value of 7 is assumed. No errors are shown at this point. After validating parameter values, the method uses the `setTile()` method to place the required number of treasures and dangers. Before placing a treasure or danger, ensure that the target tile is empty. If it is not, generate new random `x` and `y` coordinates and try again. Finally, place the flag at a random empty position. **Hint:** to generate a random number between `0` and `9`, use `Math.random()` as follows:

    int x = (int) (Math.random() * 10)

When initialisation is complete, the `initialised` property is set to true.   (6)

c. Create a method called `display()` in the `Map` class which prints out the map in the format shown above. This should include the row and column numbering and should make use of the `printTile()` method in the `Tile` classes.   (3)

d.   Implement the game in a main class as follows:

1.   The user is asked to enter the number of treasures and dangers they want on the map. Inputs should be validated to be between 1 and 7. If the user enters an incorrect value, they are asked to enter it again. When the correct inputs are inputted, the map is initialised and the user is told that the operation was successful.
2.   The player's score is set to 0.
3.   The score is displayed, followed by the map being displayed.
4.   The user is asked to input x and y coordinates for the tile they want to explore. Only values between 0 and 9 should be accepted.
5.   If the tile indicated by the coordinates has already been explored, the user should be told this. Otherwise, the tile is marked as explored and the score adjusted accordingly.
6.   If the last explored tile was a flag tile, then the user is told they have won the game, the score and map are printed one last time, and the program terminates.
7.   Otherwise, go back to Step 3.
8.   This repeats until the user finds the flag.   (10)

(Total: 40 marks)