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SUBJECT:	<b>Computing</b>
PAPER NUMBER:	I
DATE:	28 <sup>th</sup> April 2023
TIME:	9:00 a.m. to 12:05 p.m.

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### 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
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1. Consider the following snippet of Java code:

```

1  public class Wizard {
2      public void castSpell () {
3          System.out.println("Wizard spell casted");
4      }
5  }
6  public class HalfBloodWizard extends Wizard{
7      @Override
8      public void castSpell() {
9          System.out.println("Expelliarmus");
10     }
11 }
12 public class Main {
13     public static void main(String[] args) {
14         Wizard harryPotter = new HalfBloodWizerd();
15         harryPotter.castSpell();
16     }
17 }
```

- a. Which OOP principle is being used in the code above? How is it being done? (2)
- b. Modify the code snippet above to encapsulate **TWO** properties of a Wizard - its name and its surname. (3)

**(Total: 5 marks)**

***Please turn the page.***

2. Laura is a programmer who wants to show numbers from 1 to 5. The following code compiles:

```

1  public static void main(String[] args) {
2      int i = 0;
3      do {
4          System.out.println("This is number: " + i);
5      } while (i < 10);
6  }
```

- What is the output of this code? Explain the reasoning behind your answer. (2)
- Rewrite the code with any modifications to satisfy Laura's requirements. (2)
- Modify the code to stop after displaying the third number without changing the while condition. (1)

**(Total: 5 marks)**

3. Peter is building his own computer.

- He would like to change the code on his ROM but is not succeeding. Explain why this is the case. (1)
- Mention **TWO** types of ROM chips that allow Peter to do this. (2)
- Speed is an important consideration for Peter. Recommend and justify which type of RAM he should use. (2)

**(Total: 5 marks)**

4. MaltaX is in a collaboration to build a module to be used in space exploration. This module needs a CPU to continuously run a small number of instructions that are executed very quickly.

- Which is the best CPU architecture in this case? Explain the reasoning behind your choice. (2)
- State the **THREE** main differences between the two predominant CPU architectures. (3)

**(Total: 5 marks)**

5. Consider the following list of numbers: 32 20 26 45 40 15 60.

- Create a binary tree representation of this list. (3)
- Which tree traversal produces the following output: 15 26 20 40 60 45 32? (2)

**(Total: 5 marks)**

- 6.

- Mention and give a brief definition of the **THREE** types of system buses. (3)
- What is the difference between synchronous and asynchronous data transfer, in terms of computer architecture? (2)

**(Total: 5 marks)**

7. A team is developing a new programming language called "NewLang". This language has a syntax similar to Java. You have been asked to write a tool to parse programs written in the language and convert them to machine code.

- What is the term used to describe the tool that you have been asked to develop? Explain the reason for your answer. (2)
- Describe the key stages of the process in language translation through which actions such as removal of redundant text, code parsing and optimization is carried out. (3)

**(Total: 5 marks)**

8. Use a parse tree to show that the string "the eagle is flying" is correct in the following grammar expressed in BNF:

<sentence> ::= <noun-phrase> <verb> <predicate>

<noun-phrase> ::= <article> <noun>

<article> ::= an | a | the

<noun> ::= girl | boy | eagle

<verb> ::= is | was

<predicate> ::= crying | flying | playing

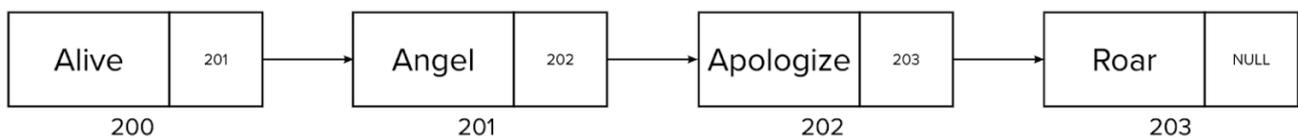
(5)

**(Total: 5 marks)**

9. You are writing a simple program that needs to store the running total of numbers in a file. There are two types of CPU registers that can be used.
- Which register is used to store the numbers as they are read from the file? (1)
  - Briefly describe how this register is different from the other type of CPU Registers. (2)
  - Mention **TWO** examples of the other type of CPU Registers described in part (b). (2)

**(Total: 5 marks)**

10. A music player stores songs in a data structure which allows listeners to skip to the next song if they do not like the current song:



- What is this data structure called? (1)
- A new requirement requires the user to be able to go back to the previous song. What new data structure is required here? Draw an illustration to show how this would look different than the above data structure. (2)
- Describe **TWO** main differences between the data structure used in part (a) and the data structure used in part (b). (2)

**(Total: 5 marks)**

11. Digital computing is used in various computing circuits for motherboards, hard drive storage and other components. When information travels through them, it is in the form of a synapse wave. At one point, the value is 0, while at the other, it is 1.
- Which gates are known as universal gates? Explain why this is the case. (2)
  - Use the laws of Boolean algebra to show that:

$$X + Z = X + \bar{X}.Z + Y.Z \quad (3)$$

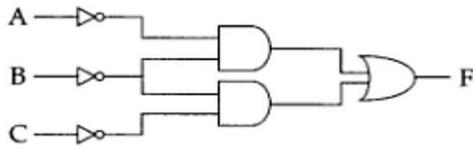
**(Total: 5 marks)**

**Please turn the page.**

12. The following Boolean algebra expression is given as:

$$Q = (A + B + C)(A + \bar{B} + C)(\bar{A} + B + \bar{C})(A + \bar{B} + \bar{C})$$

- a. Use a truth table to show **all** the possible combinations of input conditions that will produce a **0** output. (2)
- b. Write the equivalent Boolean expression for the following logic circuit. (1)



- c. Represent the expression  $\bar{X}.Y + \bar{Y}.Z + \bar{Z}.X$  using NAND gates. (2)

**(Total: 5 marks)**

13. Despite the prevalence of high-level languages that are mainly used for the development of applications and software programs, the importance of assembly language in today's world cannot be understated.

- a. What is an assembly language instruction, and how does it work? (1)
- b. Define the fetch-execute cycle as it relates to a computer processing a program. Your definition should describe the primary purpose of each phase. (2)
- c. Differentiate between the Control Unit and the Arithmetic logic unit in a CPU. (2)

**(Total: 5 marks)**

14. Consider the following assembly language program.

```
MOV AX, 01h    ;Move 01h into register AX
MOV BX, 02h    ;Move 02h into register BX
MOV CX, 03h    ;Move 03h into register CX
ADD AX, BX     ;Add BX to the contents of AX and store in AX
ADD AX, CX     ;Add CX to the contents of AX and store in AX
MOV DX, AX     ;Move the value of register AX into register DX
```

- a. What is the purpose of this program? (1)
- b. Name and describe **TWO** of the instructions used in this program. (2)
- c. What is the value stored in DX after the program is executed? (1)
- d. What is a cross assembler used for? (1)

**(Total: 5 marks)**

15. A company is having a sixteen-station Local Area Network (LAN) installed.

- a. Describe what is meant by the term Local Area Network. (1)
- b. Give **TWO** suitable topologies for the LAN, and for each one, draw a labelled diagram to show its structure. (2)
- c. State **FOUR** hardware and/or software items that could be needed if the LAN is connected to the Internet. (2)

**(Total: 5 marks)**

16. Computers can use different methods of transmission to send data from one computer to another. Parallel data transmission is one method that can be used.
- Explain what is meant by parallel data transmission. (1)
  - Give **ONE** benefit and **ONE** drawback of parallel transmission, compared to serial data transmission, over short distances. (2)
  - Give **ONE** example where parallel data transmission is used. (1)
  - Which transmission mode allows data to travel in both directions but only one direction at a time? (1)

**(Total: 5 marks)**

17. The self-insured health insurance program needs to project expenses for the following year based on past claims, changes in employee demographics, and estimated increases in health care costs.
- Describe the purpose of systems analysis and its importance. (1)
  - Interviews are an important way of gathering information during the systems analysis stage. Mention the main advantage of interviews over questionnaires. (1)
  - Give **ONE** reason why a questionnaire may be better than an interview, using an example of a real-life scenario. (2)
  - Describe the purpose of a Unified Modelling Language (UML) diagram. (1)

**(Total: 5 marks)**

18. Decomposing a system into subsystems reduces the complexity developers must deal with by simplifying the parts and increasing their coherence. Decomposing a system into simpler parts usually results in increasing a different kind of complexity: Simpler parts also means a larger number of parts and interfaces.
- List and explain **FOUR** advantages of using a modular design. (4)
  - Distinguish between bottom-up design and top-down design. (1)

**(Total: 5 marks)**

19. A wholesaler prides itself on having up-to-date information on the processing and current location of each shipped item. To do this, the wholesaler relies on a company-wide information system.

Shipped items are the heart of the company's product tracking information system. These items can be characterised by item number (unique), weight, dimensions, insurance amount, destination, and final delivery date. They are received into the company's system at a single retail centre. Retail centres are characterised by their type, uniqueID, and address. Shipped items make their way to their destination via one or more standard transportation events (i.e., flights, truck deliveries). These transportation events are characterised by a unique scheduleNumber, a type (e.g, flight, truck) and a deliveryRoute.

- Explain the purpose of an Entity Relationship diagram. (1)
- Create an Entity Relationship diagram that captures information about the wholesaler system. Indicate identifiers and cardinality constraints. (4)

**(Total: 5 marks)**

***Please turn the page.***

20. While it is true that not every software needs a database system, the large majority of software needs a place to store data.

- a. Name **TWO** advantages of DBMS. (2)
- b. Explain why it is still necessary to have at least some familiarity with file processing systems, even though it has become evident that traditional file processing systems have a number of shortcomings and limitations. (1)
- c. Distinguish between primary keys and foreign keys. (2)

**(Total: 5 marks)**




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SUBJECT:	<b>Computing</b>
PAPER NUMBER:	II
DATE:	2 <sup>nd</sup> May 2023
TIME:	9:00 a.m. to 12:05 p.m.

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### 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.

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1. You are alive in the 1940's and you want to explain to your friends the architecture of this new machine that can store numbers, do complex operations faster than humans and will probably change the world in the coming years. In order to help in your explanation, you decide to use the Von Neumann model.
    - a. Using the Von Neumann model draw the architecture scheme of a typical computer. (2)
    - b. Write a description of all the key components illustrated in part (a). (6)

Your friends get excited about all this and start to wonder how all these parts can pass information to each other and synchronise the work together harmoniously.

- c. Briefly describe the element that takes care of this function. (1)
- d. Buses and registers are used by the CPU to process instructions. Describe this process, with references to the used buses and registers. (7)

Considering the following memory address map for a computer system:

```
0x00000000 - 0x000FFFFFF: kernel space
0x00100000 - 0x7FFFFFFF: user space
0x80000000 - 0xFFFFFFFF: stack
```

- e. Which segment of this memory is used for dynamic memory allocation in this memory map? (1)
- f. Explain the key differences between static and dynamic memory allocation. (3)

**(Total: 20 marks)**

***Please turn the page.***

2. MaltaX is growing in its collaboration on Space Exploration and is now focusing on building Luna, a robot to explore the moon surface. This lunar robot needs to operate in a remote and harsh environment. Therefore, Luna requires a number of sensors to be able to guide its decisions fast and give priority to the most important tasks as it is exploring the moon.
- a. Given these requirements, which type of operating system is better suited for Luna? Support your answer by describing the characteristics of the chosen operating system and comparing it to **TWO** other operating systems. (6)

As Luna is receiving information from the different sensors, the operating system needs to understand this information and handle any interrupts.

- b. Describe how an operating system handles interrupts. (2)
- c. The engineers are not sure on which is the best approach to schedule these interrupts. Compare and contrast **TWO** scheduling algorithms, indicating which one would you choose for Luna and why. (4)
- d. As Luna is processing these instructions, a deadlock might occur. What is a deadlock and how can this be prevented? (4)
- e. Given that this operating system prioritises real-time performance and needs fast access to files, what block allocation method would you suggest for file management? Support your answer with reasons for your choice. (4)

**(Total: 20 marks)**

3. Consider the following arithmetical expression:  $20+3+(2-1)-4$ .
- a. Write the steps that take place on a stack in order to express this in RPN. Clearly identify the different operations that are taking place in the stack. Use a table with the following three columns to illustrate this:
- i. Expression Token
  - ii. Contents in Stack
  - iii. Operation
- (10)
- b. How do the stack and queues differ in the way elements are accessed? (2)
- c. Explain the importance of Postfix notation when processing mathematical expressions in computing. Compare and contrast this to the Prefix notation. (4)
- d. Differentiate between Interpreters and Just-In-Time (JIT) compilers, with a focus on performance when executing code. (4)

**(Total: 20 marks)**

4. Consider the following Java code.

```
1 public abstract class SuperHero {
2     public abstract void run();
3     public abstract void fly ();
4 }

5 public class IronMan extends SuperHero {
6     public void run() {
7         System.out.println("I would rather fly");
8     }
9     public void fly() {
10        System.out.println("That's easy.");
11    }
12 }

13 public class SuperIronMan extends IronMan {
14     public void goStealth() {
15         System.out.println("No radar can detect me now.");
16     }
17 }

18 public class Hulk extends SuperHero {
19     public void getAngry() {
20         System.out.println("You would not like me when I am angry");
21     }
22     public void run() {
23         System.out.println("I might break things in the way.");
24     }
25     public void fly() {
26         System.out.println("I can only jump really high.");
27     }
28 }

29 public class MCU {
30     public static void main(String[] args) {
31         SuperHero joeBorg = new SuperHero();
32         IronMan tonyStark = new IronMan();
33         SuperIronMan jamesRhodes = new SuperIronMan();
34         Hulk bruceBanner = new Hulk();
35         List<SuperHero> avengers = new ArrayList<>();
36     }
37 }
```

**Question continues on next page.**

- a. Define the concept of classes and objects, giving **ONE** example of each from the code above. (2)
- b. What is the difference between `class SuperIronMan extends IronMan` (line 13) and `class IronMan extends SuperHero` (line 5). Briefly describe the two OOP principles being used here. (5)
- c. Why is there a problem with `SuperHero joeBorg = new SuperHero()` on line 31? (2)
- d. The Avengers are to be assembled. Use an `ArrayList` to add the given heroes to the Avengers. (3)
- e. The Chitauri are attacking the Earth and the Avengers need to fly around and fight the invaders. Write code which loops through the `ArrayList` defined in part (d) and instructs all superheroes to fly. (3)
- f. This code snippet is using OOP. Explain **THREE** differences between OOP and Imperative programming. (3)
- g. In imperative programming, variable assignment can lead to unexpected side effects, especially when there are dependencies between variables. Demonstrate this challenge by writing a short snippet of Java code using **TWO** variables of type `int`. (2)

**(Total: 20 marks)**

5. OSI (Open Systems Interconnect) serves as a guide model for data communication. It is made up of several layers, with each layer defining a particular facet of how network devices connect and speak with one another.
  - a. How many layers are in the OSI model? Explain each of the layers with the aid of a diagram. (10)
  - b. Which layers of the OSI model perform error detection and flow control? (1)
  - c. What is HTTPS and which port does it typically use? (2)
  - d. Briefly explain the difference between non-persistent and 1-persistent CSMA/CD. (2)
  - e. Name and describe the **THREE** different types of network switching protocols. (3)
  - f. What is the difference between a MAC address and an IP address? (2)

**(Total: 20 marks)**

6. Answer the following questions about digital logic.

- a. How many Boolean functions can be defined on  $n$  input variables? (2)
- b. Consider the function:  $Y = (A.B) + \overline{(A.C)}. \overline{B}$
- Draw a combinational logic circuit that implements this function. (2)
  - Draw a truth table for this function. (4)
- c. Using 7-bit binary and a sign bit, what is the 1's complement representation of -73? (2)
- d. What is the difference between a full adder and a half adder? Design a full adder using half adder blocks. (4)
- e. The following truth table is the conversion of a 4-bit input Binary code (ABCD) into the Gray code output (WXYZ).

Binary Code (Input)				Gray Code (Output)			
A	B	C	D	W	X	Y	Z
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	1	1	0
0	1	0	1	0	1	1	1
0	1	1	0	0	1	0	1
0	1	1	1	0	1	0	0
1	0	0	0	1	1	0	0
1	0	0	1	1	1	0	1
1	0	1	0	1	1	1	1
1	0	1	1	1	1	1	0
1	1	0	0	1	0	1	0
1	1	0	1	1	0	1	1
1	1	1	0	1	0	0	1
1	1	1	1	1	0	0	0

- Draw a K-map to obtain a minimised expression for **each** output. (4)
- Draw a logic circuit using the minimised expression for **each** output. (2)

**(Total: 20 marks)**

## 7. Consider the following problem description for an Airline Reservation System.

AM Airlines runs regular flights between Ankara and 7 other cities in Turkey. There are several daily numbered flights on a regular schedule. The reservation system keeps track of passengers who will be flying in specific seats on various flights and people who will form the crew.

For the crew, the system needs to track what everyone does and who supervises whom. The organisation has three kinds of employees: pilots, hosts and ground personnel. Only the ground personnel use the reservation system. But the potential passengers may make reservations using the system's web interface.

There is also a frequent-flyer program showing flight points to frequent passengers who may use their points during reservation.

AM Airlines personnel sometimes fly as passengers on scheduled flights. For their reservations, the system only requests their personnel id number. Their other info is already in the system. They are given points for each flight they participate in as a crew. Then during their reservation, they may use these points against their purchases. Besides, there is a regular 50% discount for airline personnel and their families.

The system should be able to help to perform at least the following functions:

- Creating a new flight or modifying the attributes of a flight.
  - Searching for a particular flight.
  - Cancelling a flight on a specific day.
  - Making or cancelling a booking on a particular flight.
  - Reporting crew names and passengers (marking AM personnel separately) on a specific flight and their payment type/discounts (cash, credit card, flyer points, crew points, ...).
- a. Draw the use case diagram for the above system. (8)
- b. Derive the design class diagram for the above system. Make sure you do not duplicate information about people using an appropriate generalisation hierarchy in your class design. Use patterns when necessary to make your solution more concise. (8)
- c. What is the difference between:
- i. alpha testing and beta testing; (2)
  - ii. white-box testing and black-box testing. (2)

**(Total: 20 marks)**

8. Consider the following SQL table.

TABLE: HOSPITAL						
id	name	age	department	date_of_admission	charges	sex
1	Paul	65	Surgery	23/02/22	300	M
2	Sabrina	24	Orthopaedic	20/01/22	200	F
3	Joseph	45	Orthopaedic	19/02/22	200	M
4	Jonathan	12	Surgery	01/01/22	300	M
5	Matthew	36	ENT	12/02/22	250	M
6	Janica	16	ENT	24/02/22	300	F
7	Pamela	29	Cardiology	20/02/22	800	F
8	Stephanie	45	Gynecology	22/02/22	300	F
9	Steve	19	Cardiology	13/01/22	800	M
10	Mark	31	Nuclear Medicine	19/02/22	400	M

- a. Explain the use of the following SQL commands:
  - i. ORDER BY (1)
  - ii. HAVING (1)
  - iii. GROUP BY (1)
  - iv. JOIN (1)
- b. Give the output of the following SQL queries:
  - i. SELECT COUNT(DISTINCT department) FROM hospital (1)
  - ii. SELECT MAX(age) FROM hospital WHERE sex='M' (1)
  - iii. SELECT SUM(charges) FROM hospital WHERE date\_of\_admission < {12/02/22} (1)
- c. What is database normalisation? (2)
- d. Give **ONE** advantage and **ONE** disadvantage of database normalisation. (2)
- e. When is a relation said to be in second normal form? (1)
- f. Differentiate between a Data Definition Language and a Data Manipulation Language. (4)
- g. Describe the purpose and use of commercial and top-end database packages, and web-based database solutions. (4)

**(Total: 20 marks)**



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EXAMINATIONS BOARD

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2023 SESSION**

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SUBJECT:	Computing Practical Tasks
PAPER NUMBER:	Task 1
DATE:	26 <sup>th</sup> January 2022
TIME:	2 hours 5 minutes

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- 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)

Design and implement a program using one class called `Task1Question1` which performs the following:

- a. Prompts and accepts an integer number from the user and stores the number in an appropriate data type. (3)
- b. Using a loop, calculates the sum of positive integers up to that number. The program should store the number in another variable and print out the result. (3)
- c. Checks whether the result is odd or even, and prints out a statement. (3)

**(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 called `Task1Question2` that prompts the user to enter two numbers of type double and checks if both numbers lie between 0 and 1. If within the range, the program should display "The values are correct" otherwise the program should display "The values are incorrect". (4)
- b. Modify the program that you have developed in part a) such that if the values are correct, the program checks if the two numbers are equal and displays "The numbers are equal". (2)
- c. The program should ask the user to enter another number of type double. If the number is negative, it should be changed to positive and outputted on the screen. If the number is positive, the number is outputted without any modification. (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)

Design and implement a program using one class called `Task1Question3` which performs the following:

- a. Obtain a number from the user which will represent the side of a square. The perimeter and the area of the square are then calculated and printed on screen. (2)
- b. Obtain a number from the user and store it in a variable, called  $n$ . Write a piece of code to print the Fibonacci sequence (0, 1, 1, 2, 3, 5, 8...) up to the  $n^{\text{th}}$  term.  
Hint: The next number in the Fibonacci sequence is the sum of the previous two numbers.  
The first two numbers in the sequence are 0 and 1. (7)

**(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.*



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SUBJECT:	Computing Practical Tasks
PAPER NUMBER:	Task II
DATE:	25th May 2022
TIME:	2 hours 5 minutes

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**General Instructions:**

- Answer **ALL** questions.
- The paper consists of **THREE** questions which carry a total of 30 marks.
- This task should be completed within 2 hours 5 minutes. The first 5 minutes are reading and noting time.
- 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 practices such as brief inline comments, indentation and naming standards are expected.* (1)

Design and implement a program using one class called Task2Question1 which performs the following:

- a. Define an integer array of size 10, pre-loaded with the following numbers: [2, 9, 0, -5, 12, 24, 9, 8, 21, 7]. (1)
- b. Implement a method which computes the sum of the numbers in the array. Use this method to also calculate the average. (3)
- c. Define **TWO** arrays, having values of [1, 2, 3] and [4, 5, 6]. Write a method which concatenates these two arrays. (5)

**(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)

You are to design and implement a one-class programme called DIMS, short for Disease Information Management System. The DIMS class will be used to store the names of a number of diseases.

- a. The diseases need to be sorted alphabetically. Write a method which implements the Bubble Sort algorithm. It should take as parameter the diseases array, performs the bubble sort on the array, and returns the sorted array. (7)
- b. In the main method of the class, declare an array of an appropriate data type with the following 5 diseases: Influenza, COVID-19, Psittacosis, Bronchitis, Pneumonia and test the Bubble Sort algorithm. (2)

**(Total: 10 marks)**

3. *Good practice such as brief inline comments, indentation and naming standards are expected.* (1)  
*This question builds upon Question 2.*

- a. Create a new method called `searchDiseases` which implements the linear search function. This method should take two parameters: the array with the sorted diseases, and the search string. When called, this method should output the "Found" or "Not Found" together with the index number if found or -1 for the case when no match was found. (8)
- b. Test the method with two strings called "COVID-19" and "COVID-20". (1)

**(Total: 10 marks)**



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SUBJECT:	Computing Practical Tasks
PAPER NUMBER:	Task III
DATE:	8 <sup>th</sup> February 2023
TIME:	3 hours 5 minutes

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**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.
- 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.

You have been asked to work on developing a game called "Battles of Jaba", in which different characters battle to win control of the planet Jaba. Three classes have been identified for the initial version of the game.

- Character
- Monster
- Knight

The classes `Monster` and `Knight` are related, by single inheritance, to the class `Character`. Game characters all have an `Identification Number`, `Name`, and `Strength` attributes. `Strength` is a number between 1 and 100 which indicates how strong a character is. Players are also interested in knowing the colour of the horse in the case of `Knight` objects.

- Write code for **each** of these classes. Be sure to provide constructors, getters and setters for all attributes, as well as a `toString()` method to display details of each character. (10)
- Write a test class called `Main` which displays and performs the functionality of the following main menu:

```
Battles of Jaba
=====
1. Create a Monster
2. Create a Knight
3. Display all characters
4. Rename Character by ID
5. Change Character strength by ID
6. Hold a Battle
7. Exit
```

- After pressing (1) or (2), a new instance of `Monster` or `Knight` should be created, and the user should be allowed to input the `Identification Number`, `Name` and `Strength`. In the case of `Knights`, the horse colour should also be inputted. Ensure that `Strength` values are between 1 and 100 (inclusive).
- The `Main` class should hold created `Monsters` and `Knights` in the same data structure of your choice.
- If the user presses (3), a list of all characters created will be displayed.
- When the user presses (4) or (5), the user is asked to provide the character ID and then allowed to enter a new name or character strength respectively. Make sure to validate the range for strength.
- If the user presses 6, the user is asked to enter the IDs of two characters. It is important that the IDs for the first and second character are different. The user should also be informed if a character with a given ID does not exist. The game then compares strengths and displays a message saying which character wins the battle (i.e. the character with the highest strength). If both characters have the same strength, the game will be a draw.
- The program exits when (7) is pressed. (30)

**(Total: 40 marks)**