Diploma Programme
Programme du diplôme
Programa del Diploma

# Computer science
# Higher level
# Paper 1

28 October 2024

**Zone A** afternoon | **Zone B** afternoon | **Zone C** afternoon

2 hours 10 minutes

## Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer all questions.
- The maximum mark for this examination paper is **[100 marks]**.

8824 – 6904

7 pages

## Section A

Answer **all** questions.

**1.** State **two** features of spreadsheets. [2]

**2.** Outline why beta testing is useful. [2]

**3.** Describe the role of end users in the process of replacing an old computer system with a new one. [2]

**4.** Outline the purpose of a system flow chart. [2]

**5.** Describe the role of a firewall. [3]

**6.** State **two** benefits of using subprograms within a computer program. [2]

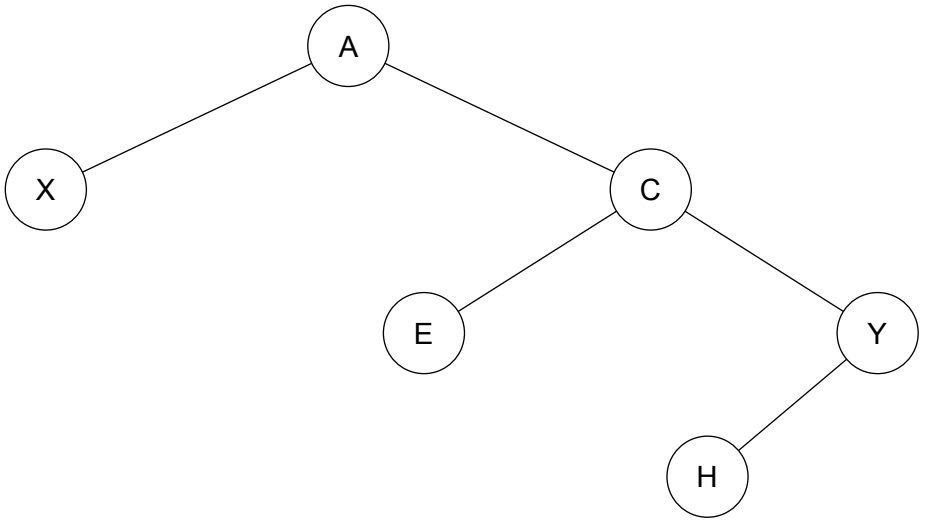
**7.** Consider the following recursive method:

```
rec(A,B)
    if B=0
        then
            return A
        else
            return rec(B,A mod B)
    end if
end rec
```

Determine the value of `rec(20,12)`. Show all your working. [4]

**8.** Outline **one** advantage of using robots in the manufacturing of cars. [2]

**9.** Consider the following binary tree:




(a) State the result of postorder traversal of the binary tree. [1]

(b) State the result of inorder traversal of the binary tree. [1]

**10.** Outline **two** operations on a queue data structure. [4]

## Section B

Answer **all** questions.

**11.** Laptops are used daily for data storage, web browsing, gaming, and email.

(a) State **one** precaution a user can take to secure their data in case their laptop is stolen. [1]

(b) Outline **one** feature of the operating system that is required when running a program on a laptop. [2]

(c) Justify the decision of the laptop manufacturer to include both wired **and** wireless network connection capability. [4]

A data packet is a basic unit of communication over a computer network.

(d) Describe the structure of a data packet. [2]

(e) Outline **three** reasons why protocols are necessary on a computer network. [6]

**12.** (a) Consider the following expression:

$$(X > 6) \text{ OR } (Y > 3) \text{ AND } ((X + Y) < 20)$$

(i) State **all** the Boolean operators in this expression. [1]

(ii) State **all** the constants in this expression. [1]

(iii) Determine the value of this expression when X is 6 and Y is 6. Show all your working. [2]

A student plans to create an alarm system for their room. The room has one door and one window.

Three sensors will be used in the system:
- A sensor to detect movement in the room.
- A sensor to detect if the door is locked or unlocked.
- A sensor to detect if the window is open or closed.

The student knows that this practical problem can be expressed in terms of Boolean logic and presented in a truth table.

The student considers the following three inputs:
1. MOTION, where true (1), represents that movement is detected in the room and false (0) represents no movement is detected.
2. DOOR, where true (1), represents that the door is locked and false (0) represents an unlocked door.
3. WINDOW, where true (1), represents that the window is open and false (0) represents a closed window.

**(This question continues on the following page)**

**(Question 12 continued)**

A siren will make a warning noise when the door is locked and **either** of the following occur:
- Movement is detected.
- The window is open.

(b) Copy and complete the truth table for this alarm system. [4]

| MOTION | DOOR | WINDOW | SIREN |
|---|---|---|---|
| 0 | 0 | 0 | |
| | | | |

The central processing unit (CPU) executes a program that is stored as a sequence of machine language instructions in primary memory. It does this by repeatedly fetching an instruction from primary memory, decoding that instruction, executing and storing the result.

(c) (i) Identify the CPU register that holds data to be transferred to primary memory. [1]

(ii) Identify the part of the CPU that performs decoding. [1]

(iii) State where the calculations will be executed. [1]

(iv) Explain the role of buses in the execution of a machine language instruction. [4]

**13.** Cell phones are used to make phone calls and send text messages. They can also browse the internet and run apps.

An incoming call will interrupt an app being executed.

(a) Describe how a stack data structure can be used to resume the app that was initially running. [2]

(b) Describe **one** way a cell phone app can help the user improve their health. [2]

(c) Outline why a higher screen resolution leads to higher quality images on a cell phone screen. [2]

(d) (i) Explain what is meant by GPS (global positioning system). [4]

(ii) Outline **one** concern of cell phone apps sharing the location of the user. [2]

(e) Explain **one** advantage of using a dedicated operating system on a cell phone instead of a generic operating system. [3]

**14.** An application requires a list of students' names to be held in alphabetical order, from A to Z, in the primary memory.

The application must allow for insertion and deletion of names.

(a) Outline **two** advantages of using a linked list rather than a static array in this scenario. [4]

(b) Explain how a specified student's name could be found in a linked list. [5]

A double linked list would be preferred over a single linked list for applications that require the ability to move forward (from A to Z) and backward (from Z to A) through the list of names.

(c) (i) Describe the structure of a double linked list. [4]

(ii) State **two** applications of double linked lists in computing. [2]

**15.** The two-dimensional array `MAT` is used to store randomly generated integers in the range from 0 to 9.

In the `MAT` array, some numbers can be repeated multiple times and other numbers may not appear at all (see **Figure 1**).

**Figure 1: Example data stored in the `MAT` array**

| | [0] | [1] | [2] | [3] | [4] | [5] | [6] |
|---|---|---|---|---|---|---|---|
| [0] | 0 | 2 | 5 | 9 | 3 | 6 | 1 |
| [1] | 0 | 2 | 9 | 0 | 7 | 0 | 0 |
| [2] | 4 | 2 | 7 | 9 | 5 | 7 | 1 |
| [3] | 7 | 2 | 3 | 1 | 5 | 4 | 0 |
| [4] | 3 | 6 | 3 | 9 | 9 | 6 | 0 |
| [5] | 7 | 4 | 3 | 1 | 7 | 9 | 3 |
| [6] | 3 | 9 | 6 | 4 | 2 | 2 | 4 |

**(This question continues on the following page)**

**(Question 15 continued)**

The one-dimensional COUNT array will show how many times each of the randomly generated numbers is found in the MAT array (see **Figure 2**).

**Figure 2: The content of the COUNT array**

| [0] | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
|---|---|---|---|---|---|---|---|---|---|
| 7 | 4 | 6 | 7 | 5 | 3 | 4 | 6 | 0 | 7 |

**Figure 2** shows that number 4 occurs 5 times (COUNT[4]=5) in the MAT array.

(a) Construct an algorithm in pseudocode to create the COUNT array as described. You may assume that the MAT array is created and the COUNT array is initialized with zero values. [4]

In **Figure 2**, COUNT[8]=0 because the number 8 does not appear in the MAT array.

(b) Construct an algorithm in pseudocode that uses the COUNT array to output the numbers that do not appear in the MAT array. If all of the numbers from 0 to 9 are present, then it will output an appropriate message. [5]

The mode is the number that appears most often in the MAT array. There can be more than one mode.

0, 3 and 9 are the modes of the numbers stored in the MAT array (see **Figure 2**).

(c) Construct an algorithm in pseudocode that uses the COUNT array to output the mode(s) of the numbers stored in the MAT array. [6]