Diploma Programme
Programme du diplôme
Programa del Diploma

Computer science
Higher level
Paper 1

27 October 2023

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]**.

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Section A

Answer **all** questions.

1. State **two** compatibility issues that may occur when two information technology (IT) systems are merged. [2]

2. Define the Boolean NAND operator. [1]

3. Identify **three** functions of the control unit (CU) in the central processing unit (CPU). [3]

4. State **three** pieces of information that a data packet must contain. [3]

5. These flower names should be inputted in the following order,

Gladiolus, Lantana, Hyacinth, Iris, Columbine

and inserted into a binary tree in such a way that an inorder traversal of the binary tree visits the nodes in alphabetical order of the names.

Sketch the resulting binary tree. [3]

6. Outline what is meant by a virtual machine. [2]

7. Identify **two** usability problems that can occur in a voice recognition system. [2]

8. (a) Outline what is meant by concurrent processing. [2]

(b) Identify **one** advantage of concurrent processing. [1]

9. Consider the following recursive method:

```
fun(N)
    if N > 0
        then
            return (N mod 10) + fun(N div 10)
        else
            return 0
    end if
end fun
```

(a) Determine the value of `fun(1216)`. Show all your working. [4]

(b) Deduce the purpose of this recursive method. [2]

Section B

Answer **all** questions.

10. The staff at a doctor's practice consist of a receptionist and a doctor.

The patients' medical records and payments, the doctor's appointment calendar, and other important data are stored in a database on the central computer.

(a) Outline **one** security measure that can be taken to prevent unauthorized access to the patients' data stored on the central computer. [2]

(b) (i) Identify **one** cause of data loss. [1]

(ii) Describe **one** method that can be used to prevent data loss. [2]

A new vaccine has been distributed that would be of benefit to some of the doctor's patients. A large number of personalized letters need to be written to these patients, inviting them to visit the doctor's practice to be vaccinated.

(c) Describe how these letters could be automatically generated by a word processing application. [3]

When the doctor visits a patient in their home, she needs to be able to access the patient's medical records stored on the central computer in the practice.

(d) Outline **two** reasons for the use of a virtual private network (VPN) in this situation. [4]

A mobile data connection enables the doctor to access internet resources while visiting patients in their homes. Sometimes the data transfer speeds are slow.

(e) Explain why the speed of data transmission across a mobile network can vary. [3]

11. A systems analyst has been employed to make proposals on how to improve the current operation of a design company.

To achieve this, the analyst decided to carry out interviews.

(a) (i) Identify **one** other method of obtaining information from the end-users. [1]

(ii) Outline **one** advantage of using the method identified in part (a)(i) in preference to interviews. [2]

(b) Outline the purpose of prototypes. [2]

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(Question 11 continued)

A software company has been employed to program and implement a new system proposed by the systems analyst.

(c) Explain why software testing is important at all stages of implementation. [3]

Using images in design may have ethical considerations.

(d) Explain **one** ethical problem associated with using images. [3]

Images are sometimes larger than the limit placed on email attachments. For example, a 60 MB image file needs to be sent by email without losing quality, but a file larger than 10 MB cannot be uploaded as an attachment.

(e) (i) Describe how large image files can be sent by email. [3]

(ii) State **one** other hardware or software problem associated with the use of images. [1]

12. Input devices that detect cars approaching a crossroads are connected to a microprocessor.

(a) (i) Identify **two** types of sensor that can be used to detect approaching cars. [2]

(ii) Outline why sensors are appropriate input devices in this situation. [2]

(b) Suggest the type of memory that could be used to store the control program in the microprocessor. [2]

The traffic lights at the crossroads are also connected to a microprocessor. A person who wishes to cross the road presses a button at a traffic light. This causes an interrupt.

(c) (i) Outline what is meant by an interrupt. [2]

(ii) Explain how the microprocessor can deal with this interrupt. [3]

Cameras are installed on the top of the traffic lights at the crossroads.

(d) (i) Outline **one** benefit of monitoring the traffic with cameras. [2]

(ii) Outline **one** concern about monitoring the traffic with cameras. [2]

13. A programmer is developing a program to record information about patients as they arrive at the emergency department of a hospital.

Due to the unplanned nature of patient attendance, the emergency department must provide treatment for a range of illnesses and injuries, some of which may be critical and require immediate attention.

The programmer decided to use a linked list for storing the patients' data.

(a) Describe the structure of a linked list. [2]

(b) Explain why a queue data structure is **not** suitable in this situation. [3]

The information about the most seriously ill patient is held at the beginning of the linked list.

The linked list should be updated as each new patient arrives at the emergency department.

(c) Describe how the linked list should be updated if a new patient arrives at the emergency department with more serious symptoms than all the other patients. [3]

(d) Describe how the linked list should be updated if a new patient arrives at the emergency department and has more serious symptoms than some patients but less serious symptoms than others. [4]

(e) Compare static and dynamic data structures. [3]

14. There are 20 gymnasts who took part in a gymnastics competition.

Competitors were assessed by 8 judges who each awarded a score in a range from 0–10. The judges were numbered 0–7. The competitors' names are stored in the one-dimensional array `NAMES`, and their scores are stored in the two-dimensional array `SCORES` (see **Figure 1**).

Figure 1: Data held in the `NAMES` array and the `SCORES` array

	NAMES
[0]	Evans, Lina
[1]	Tann, Mary
[2]	Bush, Lilly
[3]	Keon, Lea
[4]	Fox, Tea
[5]	Lobar, Tanya
	...
[18]	Lee, Mae
[19]	Burton, Sarah

	SCORES							
	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[0]	7.9	6.7	7.2	7.5	7.5	7.4	7.2	6.9
[1]	9.3	9.6	9.1	9.1	8.9	9.1	10.0	9.1
[2]	7.2	7.9	6.9	6.9	6.9	6.9	6.9	7.2
[3]	5.9	5.6	5.9	5.8	5.9	5.5	5.9	5.9
[4]	7.2	6.9	6.9	7.9	6.9	6.9	6.9	6.9
[5]	8.2	7.9	8.2	8.2	8.2	8.2	7.9	8.2
	...							
[18]	8.2	8.0	6.9	6.9	8.1	6.9	7.9	8.2
[19]	6.9	6.7	6.9	7.9	6.9	7.2	6.8	6.9

For example, the score that Judge 4 awarded to Mary Tann (`NAMES[1]`) is 8.9 and can be found in `SCORES[1][4]`.

(a) State the judge who awarded the highest score to the competitor Tea Fox. [1]

The highest attainable score in gymnastics is 10.0.

(b) Construct an algorithm that determines and outputs the number of times the highest attainable score was awarded in this competition. [4]

A competitor's final score is calculated by ignoring the highest and the lowest mark awarded and averaging the remaining marks.

For example, the highest mark awarded to Lilly Bush was 7.9, and the lowest mark was 6.9, so her final score was (7.2 + 6.9 + 6.9 + 6.9 + 6.9 + 7.2) / 6.

(c) Construct an algorithm in pseudocode to output the name and the final score for **every** competitor. [10]