Diploma Programme
Programme du diplôme
Programa del Diploma

# Computer science
# Higher level
# Paper 1

Friday 2 November 2018 (afternoon)

2 hours 10 minutes

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**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.** (a) Outline what is meant by the term computer network. [2]

(b) Describe **one** problem resulting from low bandwidth in a computer network. [2]

**2.** Direct observation is a technique used by a system analyst to determine user requirements for updating a computer system.

(a) Identify **one** advantage of direct observation. [1]

(b) Identify **one** disadvantage of direct observation. [1]

**3.** Construct a logic diagram for the following expression.

NOT A OR (A AND B) [3]

**4.** An international company is in the process of moving its Head Office from Europe to Asia.

(a) Identify **two** possible compatibility issues as a part of data migration. [2]

(b) Outline how a virtual private network (VPN) will allow employees who are in Europe to communicate with the Head Office in Asia. [2]

(c) Outline **one** social issue associated with this process. [2]

**5.** Describe how data is transmitted by packet switching. [4]

**6.** Explain the importance of the method `isEmpty()` when constructing an algorithm which performs operations on a stack data structure. [3]

**7.** Distinguish between the use of time slicing and priorities in the scheduling of processes by an operating system. [3]

## Section B

Answer **all** questions.

**8.** (a) (i) Distinguish between random access memory (RAM) and read only memory (ROM). [3]

(ii) Outline the function of an operating system in managing primary memory. [2]

(b) Explain the roles of the data bus and the address bus in the machine instruction cycle. [4]

(c) (i) State how the data stored in the following byte will be represented in hexadecimal. [1]

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |

(ii) State how many integers could be represented in this byte. [1]

(iii) Outline why this byte could not be used to represent characters such as those used in Chinese. [2]

(d) Construct a truth table with two input variables. If input variables are equal the value of output variable should be True, False otherwise. [2]

**9.** (a) Outline the need for higher level languages. [2]

(b) Explain **two** benefits of using sub-procedures within a computer program. [4]

(c) Identify **three** characteristics of a collection. [3]

Collection `NUMBERS` already exists and stores real numbers.

(d) Construct in pseudocode an algorithm, using the access methods of a collection, which will iterate through the collection `NUMBERS` and count how many elements stored in the collection are in the interval [–1,1].

The final answer should be output. [6]

**10.** An oil and gas company has a networked computer system for use of their employees in the Head Office.

(a) (i) Identify **one** hardware security measure that will ensure that confidential data from the Head Office cannot be accessed. [1]

(ii) Identify **one** software security measure that will ensure that confidential data from the Head Office cannot be accessed. [1]

The company also uses the internet to enable communication with employees working on exploration and production in many remote geographical areas.

(b) Identify **one** network security measure. [1]

The sub-sea oil and gas exploration and production unit of the company relies on thousands of kilometres of pipeline which are monitored by a computer control system which can detect leaks.

(c) Explain the environmental benefit of using a computer control system to monitor the pipeline. [3]

The process of detecting leaks is carried out by sensors which are continuously monitoring changes in the flow and pressure of the liquids in the pipes.

This data is processed on a computer in the office.

If any of sensor values are outside of the acceptable parameters stored on a disk in the office, the following error routines are performed:

- an alarm is sounded on the computer at the office
- an email message is sent to managers in the Head Office.

A member of staff can also configure the system.

(d) Explain the relationship between sensors, output transducers and processor in this situation. [4]

(e) Construct a system flowchart to represent the process described above. [5]

**11.** The names of vegetables must be always held in **alphabetical** order in a list in the main memory.

The application program should allow insertion and deletion of the names of vegetables from this list.

(a) Compare the use of a dynamic linked list for holding these names of vegetables with a static one-dimensional array. [3]

Given the following vegetables: potato, asparagus, lettuce, radish.

(b) Sketch a single linked list holding these vegetables. [2]

(c) (i) List the steps required to insert cabbage into the linked list. [4]

(ii) Explain why deleting the first node in this list is different to deleting other nodes. [2]

(d) State the dynamic data structure suitable for maintaining this list of vegetables which will allow faster searching for a given vegetable name. [1]

The vegetable names are input in the following order

potato, asparagus, lettuce, radish.

(e) Sketch the data structure suggested in part (d) containing the vegetable names sorted in **alphabetical** order. [3]

**12.** The following method, `swap(A,B)` is written to exchange the values of variables A and B.

```
swap(A,B)
  TEMP = A
  B = TEMP
  A = B
end swap
```

(a) (i) Assume `A = 3` and `B = 5`.

State the values of `A` and `B` after execution of `swap(A,B)`. [1]

(ii) Suggest how the algorithm used in method `swap()` would need to be modified to successfully exchange the values of variables `A` and `B`. [2]

Method `swapRows(MAT,K,L)` swaps the elements of two rows (row `K` and row `L`) in the two-dimensional array `MAT`.

For example,

The initial contents of the two-dimensional array `MAT`

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

`swapRows(MAT,1,4)` →

The contents of the two-dimensional array `MAT` after execution of method `swapRows(MAT,1,4)`

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

(b) Use pseudocode to construct an algorithm for the method `swapRows()`. [4]

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

**(Question 12 continued)**

A game consists of four rounds. In each round a player can score up to 100 points.

The data about the game is sorted in alphabetical order of names and stored in the memory as follows

PLAYERS

| | |
|---|---|
| [0] | Annie |
| [1] | Boris |
| [2] | Hugh |
| [3] | Paul |
| [4] | Robby |
| [5] | Tammy |

ROUNDS

| | [0] | [1] | [2] | [3] |
|---|---|---|---|---|
| [0] | 70 | 10 | 23 | 3 |
| [1] | 40 | 0 | 50 | 90 |
| [2] | 60 | 38 | 42 | 90 |
| [3] | 45 | 0 | 0 | 60 |
| [4] | 55 | 0 | 15 | 10 |
| [5] | 51 | 60 | 20 | 90 |

TOTALS

| | |
|---|---|
| [0] | 106 |
| [1] | 180 |
| [2] | 230 |
| [3] | 105 |
| [4] | 80 |
| [5] | 221 |

Where
`PLAYERS` is a one-dimensional array holding names of players (currently sorted in alphabetical order).
`ROUNDS` is a two-dimensional array holding players' scores.
`TOTALS` is a one-dimensional array holding total scores.

For example,
`PLAYER[1]` is Boris. The total number of points he scored is 180 and this can be found in `TOTALS[1]`.
Boris scored 40 points in the first round which can be found in `ROUNDS[1][0]`.
The value stored in `ROUNDS[1][2]` is 50 which means that Boris scored 50 points in the third round.

(c) (i) State Paul's total score. [1]

(ii) State where Hugh's score in the fourth round can be found. [1]

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

**(Question 12 continued)**

All the data stored in memory should be sorted in ascending order of total score using selection sort.

For example, after sorting, the data given opposite will be held in memory as follows

PLAYERS

| | |
|---|---|
| [0] | Hugh |
| [1] | Tammy |
| [2] | Boris |
| [3] | Annie |
| [4] | Paul |
| [5] | Robby |

ROUNDS

| | [0] | [1] | [2] | [3] |
|---|---|---|---|---|
| [0] | 60 | 38 | 42 | 90 |
| [1] | 51 | 60 | 20 | 90 |
| [2] | 40 | 0 | 50 | 90 |
| [3] | 70 | 10 | 23 | 3 |
| [4] | 45 | 0 | 0 | 60 |
| [5] | 55 | 0 | 15 | 10 |

TOTALS

| | |
|---|---|
| [0] | 230 |
| [1] | 221 |
| [2] | 180 |
| [3] | 106 |
| [4] | 105 |
| [5] | 80 |

(d) Construct an algorithm that will sort all the data in ascending order.

In your solution you should call methods `swap()` and `swapRows()` given in part (a) and part (b). [6]