International Baccalaureate®
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COMPUTER SCIENCE
HIGHER LEVEL
PAPER 1

Friday 16 May 2014 (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. Identify **two** features that need to be considered when planning a new computing system for an organization. *[2]*

2. Explain what is meant by *beta testing*. *[2]*

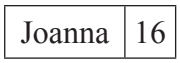
3. Describe **one** advantage and **one** disadvantage of using observations to gather information when planning a new system. *[4]*

4. Outline **one** usability issue associated with the design of mobile devices. *[2]*

5. Distinguish between the use of **two** types of primary memory. *[2]*

6. Consider the following linked list which is maintained in alphabetical order.

With the aid of diagrams, explain how the node



would be inserted into the linked list. *[3]*

7. Outline how a colour can be represented in a computer. *[2]*

8. Identify **two** key features of a peer-to-peer (P2P) network. *[2]*

9. Outline the role of paging in the management of primary memory. *[2]*

10. Outline **two** distinct features of autonomous agents. *[4]*

SECTION B

*Answer **all** questions.*

11. A builder is renovating a series of apartments and is considering integrating a few electrical devices in each apartment into an automatic programmable system. One example is the integration of lighting, heating, ventilation and air conditioning.

(a) Identify **two** groups of users that might find this integrated technology particularly appealing. *[2]*

(b) Discuss **two** advantages, offered by this technology, that could be used in an advertisement for the apartments. *[4]*

(c) Evaluate **two** ways users can access the functionality of the integrated system at home. *[6]*

The same technology is adapted and used for intensive chicken farming; in this context a decentralized control is preferred.

(d) Describe how this could be achieved. *[3]*

12. An international organization has offices located across several countries. For some of its activities, for example human resource management, it has been decided to adopt a "Software-as-a-Service" (SaaS) solution in order to keep the running costs low.

(a) Describe the features of SaaS. *[3]*

(b) Discuss the limitations of SaaS in relation to security. *[6]*

Each office makes some data available to external customers through the use of an extranet and allows employees to work from home through a VPN.

(c) Define the term *extranet.* *[2]*

(d) Distinguish between a VPN and an extranet. *[4]*

13. The faceplate of a car stereo has six buttons for selecting one of six preferred radio stations. As part of the internal representation of a microprocessor there is an array with six positions, carrying the information about the radio frequencies, as follows.

Radio

[0]	[1]	[2]	[3]	[4]	[5]
100.4	88.7	90.2	104.5	93.8	106.2

(a) State the information at `Radio[2]`. *[1]*

(b) Outline how a numerical frequency could be stored in a fixed-length string. *[2]*

(c) Construct an algorithm in pseudocode that calculates the range of frequencies (*ie* the difference between the highest and lowest frequencies) of any set of six selected radio stations. *[6]*

The two-dimensional array `Stats` provides an indication of how often a specific station is listened to by the user. For each button in the faceplate it records how often it has been clicked in the last 48 hours. `Stats` is ordered by the second column.

Stats

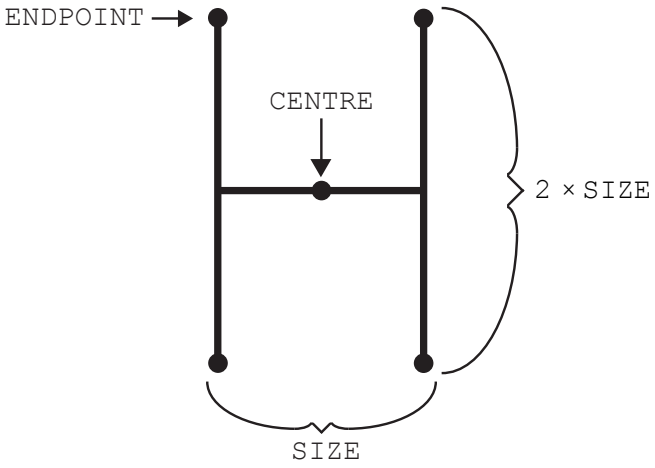
5	13
4	9
0	8
3	4
1	3
2	2

Both `Radio` and `Stats` are used by a procedure that allows the user to access the radio frequencies that are listened to most often, as recorded in `Stats`, by flicking a lever on the steering wheel. The frequencies are accessed cyclically, *ie* after the least used frequency the procedure returns to the most used. For this reason a queue **Q** is used.

(d) Construct an algorithm in pseudocode that, by using the structures `Radio` and `Stats`, performs the following steps:

- it inserts the radio frequencies in the queue **Q**, following the actual order of preference; and then
- it uses the queue **Q**, cyclically, to output an element each time the lever is flicked. *[6]*

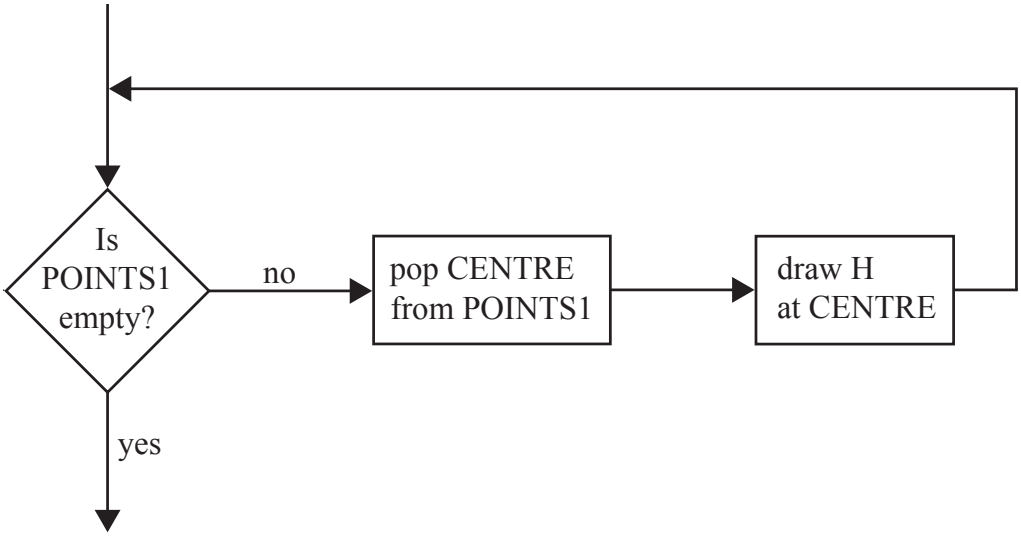
14. Consider the following diagram and pseudocode for drawing on a display screen.




```
ENDPOINTS = drawH(CENTRE, SIZE)
```

The method `drawH(CENTRE, SIZE)` will draw an "H" located at `CENTRE` with width of `SIZE` and height of `2 × SIZE`, as shown. It returns an array containing the four **endpoints** of the vertical lines.

In the following flowchart, POINTS1 is a stack.



(a) Construct pseudocode corresponding to the flowchart. *[3]*

(This question continues on the following page)

(Question 14 continued)

(b) Construct the drawing that would be produced by the flowchart on page 6 if it is preceded by the following steps.

```
SIZE = 20
CENTRE = the middle of the user's display
POINTS1 is a stack, initially empty
ENDPOINTS = drawH(CENTRE, SIZE)
loop COUNT from 0 to 3
  POINTS1.push(ENDPOINTS[COUNT])
end loop
SIZE = SIZE / 2
```

[2]

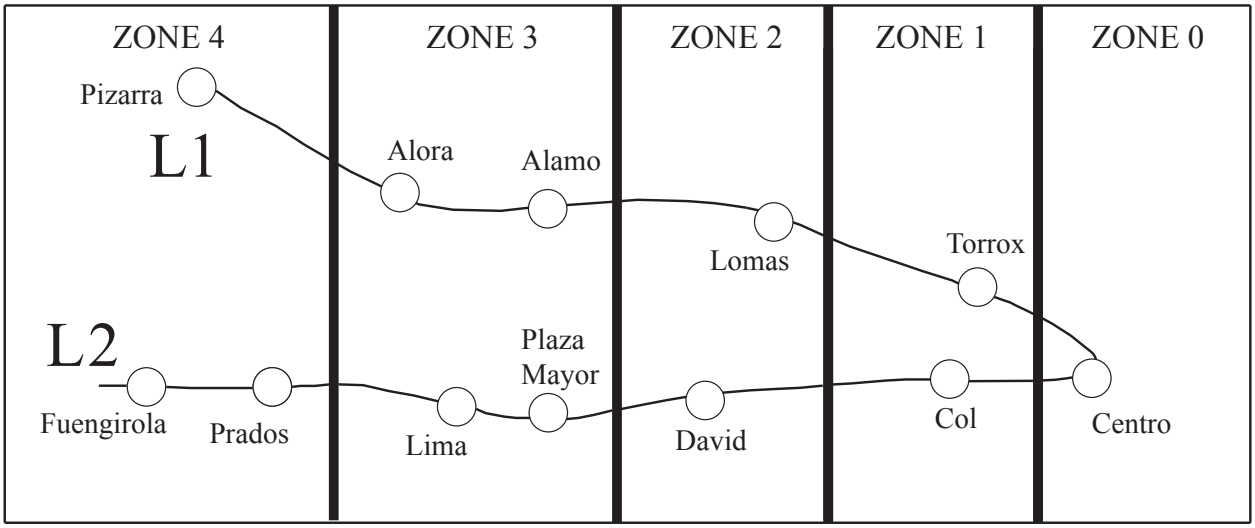
The pattern of drawing a new set of H's, which have a `SIZE` value that is half the `SIZE` value of the previous H, can be repeated. Each set of H's of the same size is called a generation.

(c) Construct an algorithm that will draw an initial H in the centre of the display and three generations after that. *[6]*

(d) State how many endpoints there will be after the initial H and three generations have been drawn, without any consideration of the size. *[1]*

(e) Suggest how drawing this pattern of H's could be done recursively. *[3]*

15. A suburban railway system for a large city in Southern Europe consists of two lines **L1** and **L2**, which meet at the station Centro, where passengers can change from one line to the other. The system is shown below.



Each station is located in a particular zone, and the total number of zones in which the journey takes place determines the train fare. Note, if a passenger starts in **Zone 1**, goes to **Zone 0** and then back to **Zone 1**, the journey has taken place in **three** zones. Examples of the number of zones are shown below for different journeys.

Travelling from	Travelling to	Number of zones
Lima	Plaza Mayor	1
Alora	Plaza Mayor	7
Lomas	Col	4

(a) State the number of zones in which the journey takes place when travelling from Alora to Fuengirola. *[1]*

The data for each station (station name, line, zone) is stored on the system's server in the collection `TRAIN_DATA`. There are 12 stations in total. The first part of the collection is shown below.

```
Centro, L1, 0, Alora, L1, 3, Torrox, L1, 1, Col, L2, 1, ...
```

From this we can see that Alora is part of line L1 and is located in Zone 3.

At the start of each day, the data in `TRAIN_DATA` is read in to the binary tree `TREE`, in which each node will hold the data for one station. The binary tree will be used to search for a specific station's name.

(b) Sketch the binary tree after the station data from the first part of the collection, given above, has been added. *[3]*

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(Question 15 continued)

The `TRAIN_DATA` collection is also used to construct the one-dimensional array `STATIONS` (which only contains the list of station names sorted into alphabetical order), where `STATIONS[0] = Alamo`.

(c) State the value of `STATIONS[4]`. *[1]*

The two data structures (`STATIONS` and `TREE`) are now used to construct the two-dimensional array `FARES` containing the fares between stations, partly shown below. Note that the fare for travelling in **each** zone is €1.00.

FARES	Alamo	Alora	Centro	Col	...
Alamo	0	1.00	4.00	5.00	...
Alora	1.00	0	4.00	5.00	...
Centro	4.00	4.00	0	2.00	...
Col	5.00	5.00	2.00	0	...
...	...	...	...	...	... *etc*

(d) Calculate the fare for travelling from Torrox to Lima. *[1]*

(e) Construct the algorithm that would calculate the fares for this two-dimensional array. You can make use of the following two sub-procedures:

```
• TREE.getZone(STATION) // which returns the zone in which the
                        // station is located
• TREE.getLine(STATION) // which returns the line on which the
                        // station is located
```

Your algorithm should make as few calculations as possible. *[9]*