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**COMPUTER SCIENCE  
HIGHER LEVEL  
PAPER 1**

Friday 16 May 2014 (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. 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.  

Jean	9	→	Mario	7	→	Phoebe	2	→	Roman	6	→	Samira	8
------	---	---	-------	---	---	--------	---	---	-------	---	---	--------	---

With the aid of diagrams, explain how the node

Joanna	16
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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.

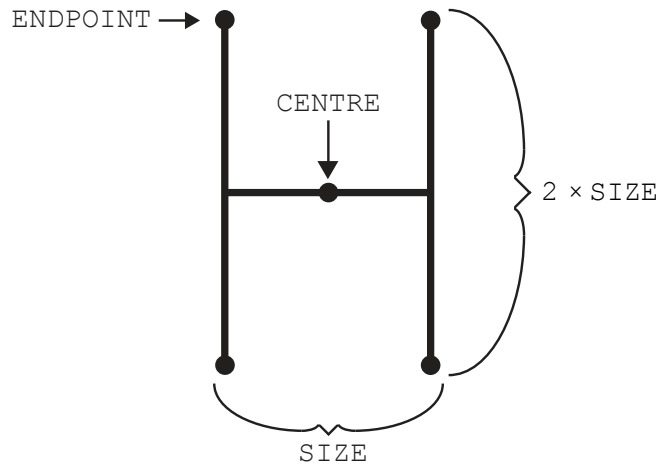
**Stats**

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]

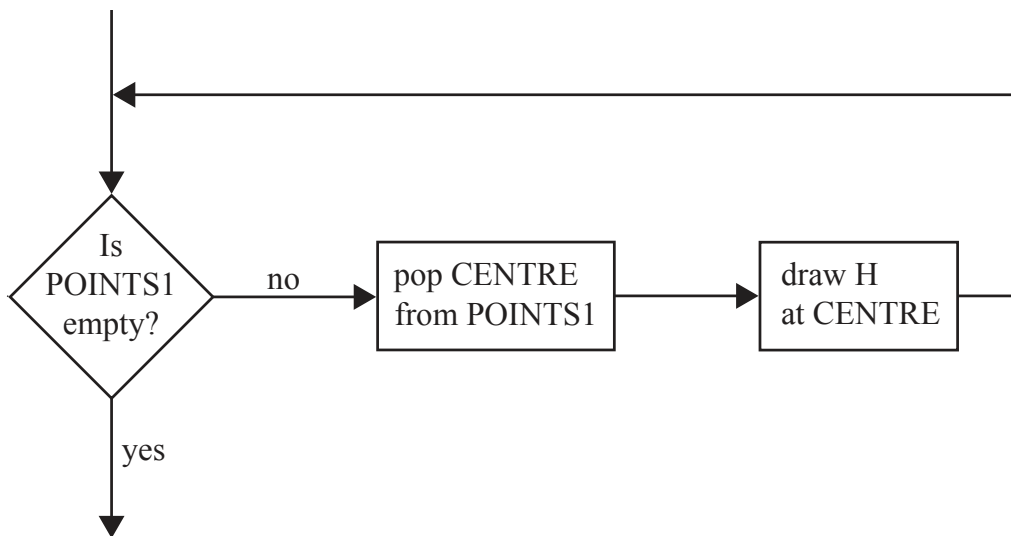
14. Consider the following diagram and pseudocode for drawing on a display screen.



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

The method `drawH(CENTRE, SIZE)` will draw an “H” located at `CENTRE` with width of `SIZE` and height of  $2 \times \text{SIZE}$ , 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.

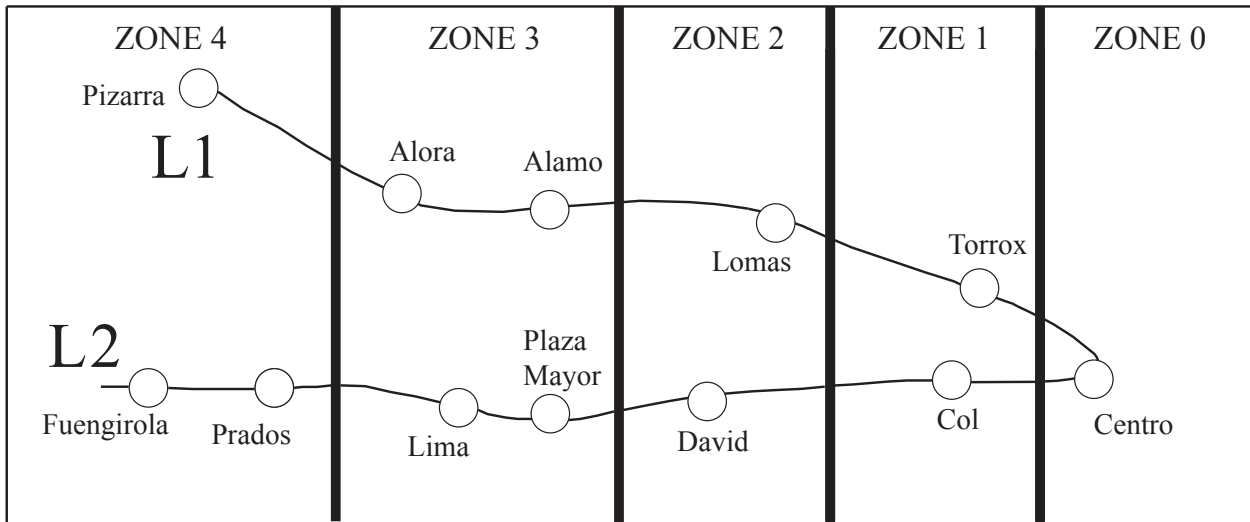
```
SIZE = 20
CENTRE = the middle of the user's display
POINTS1 is a stack, initially empty
ENDPOINTS = drawH(CENTRE, SIZE)
loop COUNT from 0 to 3
  POINTS1.push(ENDPOINTS[COUNT])
end loop
SIZE = SIZE / 2
```

[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]

*(This question continues on the following page)*



(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.

<b>FARES</b>	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]