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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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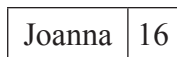
## SECTION A

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.



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.

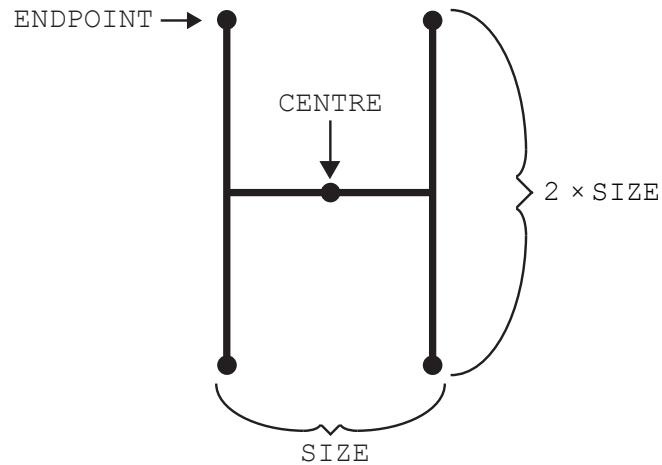
**Stats**

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]

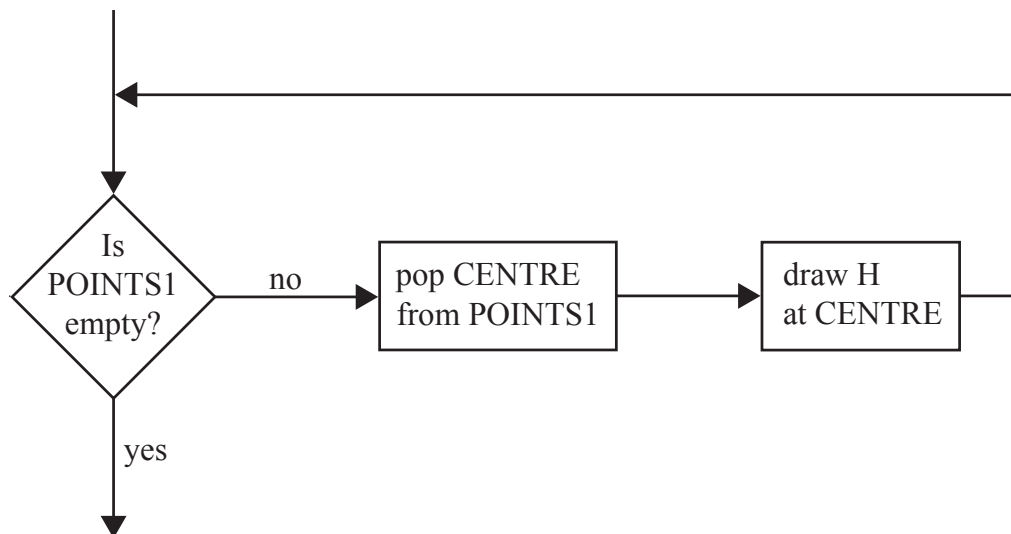
14. Consider the following diagram and pseudocode for drawing on a display screen.



`ENDPOINTS = drawH(CENTRE, SIZE)`

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

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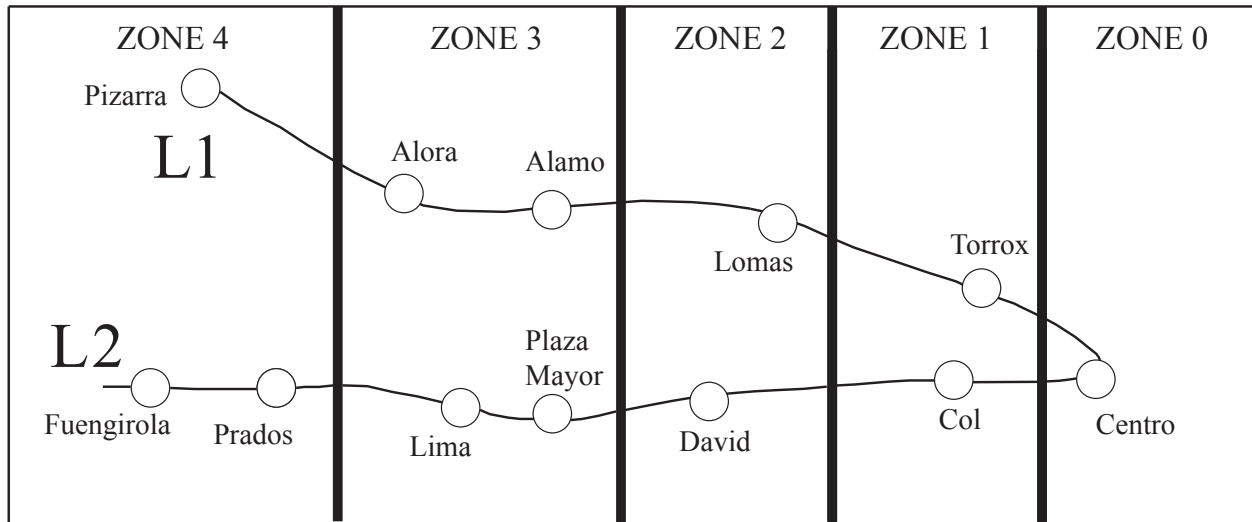
SIZE = 20
CENTRE = the middle of the user's display
POINTS1 is a stack, initially empty
ENDPOINTS = drawH(CENTRE, SIZE)
loop COUNT from 0 to 3
    POINTS1.push(ENDPOINTS[COUNT])
end loop
SIZE = SIZE / 2
    
```

[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]