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**COMPUTER SCIENCE  
HIGHER LEVEL  
PAPER 2**

Monday 17 November 2008 (morning)

2 hours 15 minutes

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**INSTRUCTIONS TO CANDIDATES**

- Do not open this examination paper until instructed to do so.
- Answer all the questions.

Answer *all* the questions.

1. The following code represents a partial implementation of a stack.

```
public class Node
{
    private String name;
    private Node next;
    public Node()
    {
        name = null;
        next = null;
    }
    public void setName(String n){ name = n; }
    public void setNext(Node n){ next = n; }
    public String getName(){ return name; }
    public Node getNext(){ return next; }
}
public class Stack
{
    private Node top;
    public Stack()
    {
        top = null;
    }
    public void push(String name)
    {
        Node temp = new Node();
        temp.setName(name);
        temp.setNext(top);
        top = temp;
    }
}
```

(a) Outline the steps involved in executing the following statement.

```
Node temp = new Node();
```

[3 marks]

(b) Draw a diagram showing the structure and content of the stack nodes after the following statements have been executed.

```
Stack s = new Stack();
s.push("Lisa");
s.push("Creighton");
s.push("Annabel");
```

[3 marks]

*(This question continues on the following page)*

(Question 1 continued)

- (c) Construct the method, `pop`, which pops a name from the stack. Return an error message and an empty `String` if the stack is empty. [7 marks]

An array, `names`, with six elements, contains the following data.

index	[0]	[1]	[2]	[3]	[4]	[5]
contents	"Elissa"	"Margaret"	"Shannon"	"Kevin"	"Joe"	"Sophie"

You are going to construct an algorithm which reverses the names in the array so that the new contents are as follows.

index	[0]	[1]	[2]	[3]	[4]	[5]
contents	"Sophie"	"Joe"	"Kevin"	"Shannon"	"Margaret"	"Elissa"

- (d) Construct an algorithm that could be used to reverse the contents of this array using the `Stack` class. You may assume it contains a correct implementation of the method `pop`. [3 marks]
- (e) Describe **two** other methods that could usefully be added to the `Stack` class. [4 marks]

2. An array, `words`, is used to store a list of words (eight elements are shown below).

index	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]
contents	"blue"	"green"	"eyes"	"hair"	"mouth"	"red"	-	-

▲  
last

The identifier `last`, is an `int` value and points to the last entry in the array. In the above example `last` has the value 5.

(a) Construct a method with the following signature that returns the element number of the `String` parameter `word`. If `word` is not found in the array, a value of `(last + 1)` should be returned.

```
public int getPosition(String[] words, String word, int last) [6 marks]
```

(b) State the maximum possible length of the array if `last` were declared to be `byte` rather than `int`. [1 mark]

The above array could be viewed as a stack, with `last` being a pointer to the top of the stack.

(c) Outline **one** advantage and **one** disadvantage of using an array for the stack, as opposed to a dynamic data structure. [4 marks]

Recall that the method of the `String` class, `compareTo(String)`, can be used to compare two `Strings` for equality, as in the following statement.

```
int n = string1.compareTo(string2);
```

The integer `n` will be negative if `string1` precedes the parameter `string2` or positive if `string1` follows the parameter `string2`. The result will be zero if the strings are equal. For example, the following statement returns a positive integer.

```
int n = "mouth".compareTo("eyes");
```

The array is now sorted in ascending order between elements 0 and `last`.

(d) Re-write the method `getPosition` as a binary recursive search. [9 marks]

3. An application is required that can store up to 10 000 large size images. The application also has to store an ID number, title, photographer, date and time, and location for each image. The file is ordered by ID number.
- (a) Discuss the implications of storing this data where
    - (i) the images are stored in one direct access file and other data is stored in another direct access file; [4 marks]
    - (ii) the images and other data are stored in the same direct access file. [4 marks]
  - (b) The data cannot be held in the main memory. Explain how the file could still be sorted. [4 marks]

The date is stored as a number in the format `ddmmyyyy`. Thus, a photograph taken on 14 January 2006 will be represented as 14012006.

Since the file is most often searched by date, it is decided to store the records in a *hash table* with 10 000 entries using this date number. The hash function is a simple modulo of the number with the table size. The above photograph will therefore be stored at position 2006 in the table.

- (c) State the position in which the photograph taken on 16 March 2004 will be stored. [1 mark]
- (d) State the BigO notation for the access speed to this table under favourable circumstances. [1 mark]

The proposed system was found to be unsatisfactory.

- (e) Discuss any **two** ways in which the system is unsatisfactory and outline how performance could be improved for each of these problems. [6 marks]

*This question requires the use of the Case Study.*

4. (a) Outline **three** ways in which text-to-speech systems can assist disabled people. [6 marks]
- (b) A disabled person wants to write a letter using a word processor. Describe a software technology that could make this task easier for
- (i) a person with limited hand movement; [4 marks]
- (ii) a person who is visually impaired. [4 marks]
- (c) Outline **two** steps every web designer should take to improve accessibility for all disabled users. [4 marks]
- (d) An airline company is building a new booking system. The staff using it must search a text-based flights database, enter customer information and print tickets.
- (i) Outline **two** suitable adaptations of, or replacements for, the standard input devices (mouse, keyboard) for a person who has no fine hand control. [4 marks]
- (ii) Outline **two** suitable adaptations of, or replacements for, the standard output devices (screen, printer) for a person who is completely blind. [4 marks]
- (e) A person has no use of their limbs or digits and only limited head movement. Suggest a system that could help them explore the Internet and use a chat room. [5 marks]
- (f) Discuss **three** consequences of the “digital divide” for disabled computer users. [9 marks]
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