344/01

COMPUTING CP4

SOFTWARE AND SYSTEM DEVELOPMENT

P.M. FRIDAY, 15 June 2007

(2 hours)

ADDITIONAL MATERIALS

In addition to this examination paper, you will need a 12 page answer book.

INSTRUCTIONS TO CANDIDATES

Answer **all** questions.

The intended marks for questions or parts of questions are given in brackets [ ]. You are advised to divide your time accordingly. The total number of marks available is 70.

You are reminded of the necessity for good written communication and orderly presentation in your answers.

2

1. When developing a new computer system, programmers sometimes use a software package rather than a traditional programming language.

   (i) Describe **two** possible benefits of this package-based approach compared with the use of a programming language. [2]

  (ii) Describe **one** possible drawback of this package-based approach compared with the use of a programming language. [1]

2.   (i) Explain, using a diagram, the term *stack* as used in a computer system. [2]

  (ii) Explain what should happen when an attempt is made to add an item to a full stack. [1]

  (iii) Describe a computer application which would normally use a stack.
Why is a stack appropriate in this case? [2]

3.   *(a)* *Handwriting recognition* is increasingly used as a form of human computer interface (HCI).

   (i) Describe **two** possible benefits of this type of HCI compared with keyboard input. [2]

  (ii) Describe **two** possible drawbacks of this type of HCI compared with keyboard input. [2]

  (b) Describe how the design of an HCI should be evaluated. [1]

4. *(a)* What term is used to describe *a group of related data items*? [1]

(b) The following binary tree has been produced by inserting the names
Lisa, **Osian**, **Nicola**, **Javed**, **David**, **Fu** and **Paula**, in that order.

In each case, the right pointer indicates the condition: *later on in the alphabet*
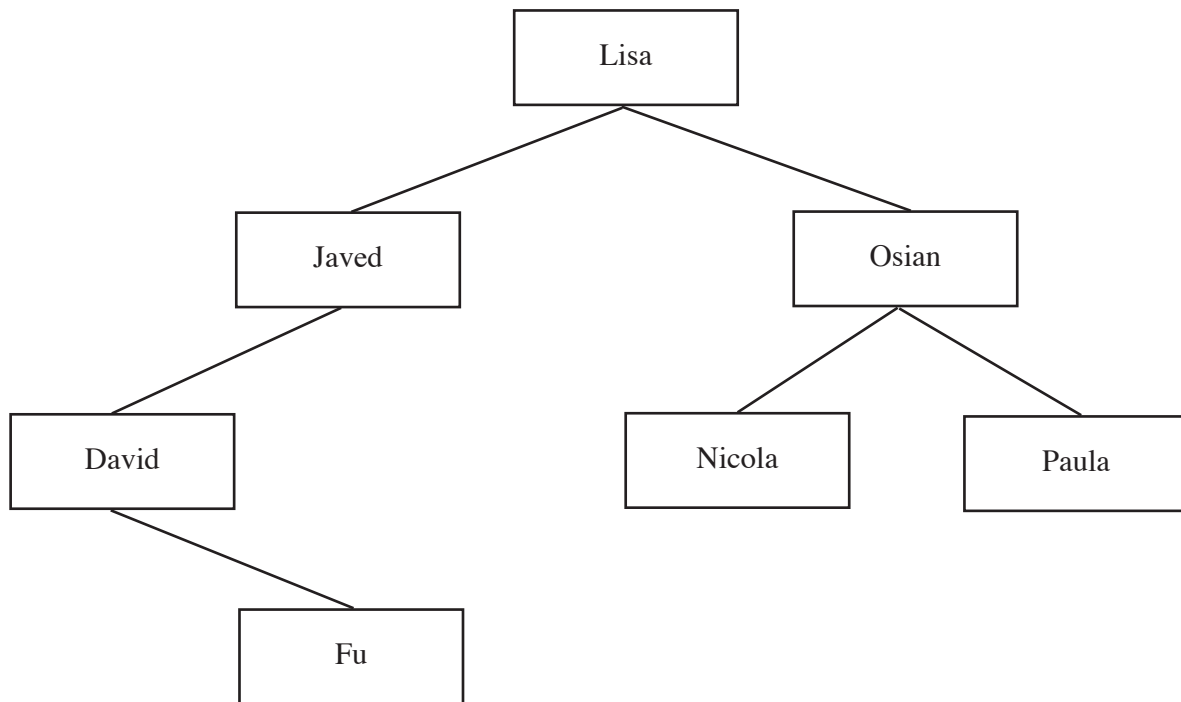
    (i) Write down the name contained in the root node. [1]

    (ii) Write down the order in which the nodes would be accessed to reach the name **Nicola**. [1]

    (iii) The name **Ed** is not in the above diagram. Explain the steps that would take place if a search was made for this name. [1]

    (iv) Copy the diagram then add the name **Carys** in the correct place on the diagram. (You may use just the initial letter of all names if you wish). [1]

    (v) This tree diagram is reasonably well balanced in shape. What would happen to access times if the tree was much less well balanced? [1]

Turn over.

5. *(a)* Using eight bits and two's complement form, convert the number -9_{10} to binary. [1]

(b) Computer systems often *truncate* numbers. Explain the term *truncate* giving an example. [2]

(c) In many computers, characters are stored using a standard code.

(i) In one standard code, the character "4" is stored as 0110100. The character "5" is stored as the next higher binary code (0110101) and so on. How will the character "8" be stored? [1]

(ii) What is the advantage of using a standard code of this type? [1]

(d) Write down the effect of carrying out an **arithmetic shift left by three places** on the positive integer 00001010 [1]

Explain the effect of this operation on the number. [1]

6. *(a)* Explain what is meant by the term *algorithm*. [2]

(b) (i) Describe **two** features of a *recursive* algorithm. [2]

(ii) Describe **one** advantage of a *recursive* algorithm. [1]

(iii) Give **one** example of a *recursive* algorithm. [1]

7. *(a)* Write down the truth table for:

(i) the **AND** operation; [2]

(ii) the **EXCLUSIVE OR (XOR)** operation. [2]

(b) (i) Carry out the **XOR** operation on the following:

      A = 10001101
      K = 10101111 [2]

(ii) State what the results would be if you carried out a **XOR** on your answer to part *(b)*(i) and the number **K**. [1]

(iii) State a security application which this operation might be used for. [1]

8. *(a)* (i) Describe the difference between a *compiler* and an *interpreter*. [2]

   (ii) Describe the *lexical analysis* stage of compilation, ensuring you make the output of this stage clear. [2]

   (iii) Describe the *semantic analysis* stage of compilation. [2]

(b) Explain the term *relocatable code*. [1]

(c) A debugging tool contains a *program trace* facility and a *store dump* facility.
Explain **each** of the two terms:

   (i) a *program trace* facility; [1]

   (ii) a *store dump* facility. [1]

9. *(a)* What is the purpose of Backus Naur Form (BNF)? [1]

(b) One way of defining a decimal number is:

   • no sign or a plus sign or a minus sign
     followed by
   • one or more digits
     followed by
   • a decimal point
     followed by
   • one or more digits

For instance, the following are covered by this definition:

   +23·5   23·5   -0·5   0·0   +0·728

Produce an appropriate BNF definition for a decimal number as defined above. [4]

10. Marks obtained by candidates in an examination are terminated with a rogue value of –99.

An example of a set of examination marks (including the rogue value) is shown below,

62 71 48 35 76 61 54 38 52 –99

For this particular examination:
   • candidates scoring 70 or more marks are given a **Distinction** grade
   • candidates scoring 40 to 69 marks (inclusive) are given a **Pass** grade
   • candidates scoring fewer than 40 marks are given a **Fail** grade

Design an algorithm which will read in a set of marks of this type and will output the number of candidates being given each of the three grades. [4]

Turn over.

11. **In the following question, additional credit (up to 3 marks) will be gained if your answer demonstrates skill in written communication.**

A programmer is developing a set of programs and needs to make a number of decisions.

One decision relates to the human computer interface (HCI), and whether this should:
- be a graphical user interface
- be a text-based interface
- use speech recognition
- use speech synthesis

Another decision is the type of programming language to be used, for instance whether to use:
- a visual programming language
- a fourth generation language
- an object oriented language

Describe **in detail** the features of the different HCI types in the first list which might influence the choice of HCI type.

Also describe **in detail** the features of the different programming languages in the second list which might influence the choice of language.

[9+3]