



**COMPUTER SCIENCE
HIGHER LEVEL
PAPER 1**

Monday 15 November 2004 (afternoon)

2 hours

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all of Section A.
- Answer four questions from Section B.

SECTION A

Answer *all* questions.

1. (a) Describe **one** application of *sensors*. [2 marks]
- (b) Explain why the signal from a *sensor* requires conversion before processing in a computer. [2 marks]

2. The following algorithm is supposed to return the **last digit** of an integer.

For example: LASTDIGIT(12345) ==> 5
 LASTDIGIT(3) ==> 3

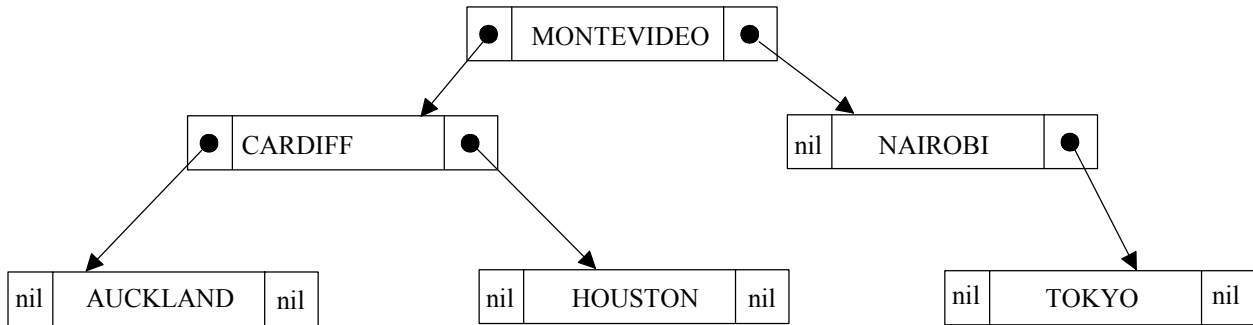
```
function LASTDIGIT(val NUMBER integer)
    result integer

    while (NUMBER >= 10) do
        NUMBER <-- NUMBER - 10
    endwhile

    return NUMBER
endfunction LASTDIGIT
```

- (a) Determine the value returned by the function for a negative input:
 LASTDIGIT (-27) [2 marks]
 - (b) The value returned for LASTDIGIT (-27) is incorrect. State whether this is a *syntax error*, a *logic error*, a *run-time error*, or none of these. [1 mark]
 - (c) Explain why the use of a *compiler* rather than an *interpreter* can reduce the number and severity of *run-time errors*. [2 marks]
3. (a) State the efficiency of the *bubble sort* algorithm in *BigO notation*. [1 mark]
 - (b) Outline the need for external sorting algorithms. [2 marks]
4. Define *handshaking*. [2 marks]
5. (a) Define *syntax* in relation to programming languages. [2 marks]
 - (b) Define *semantics* in relation to programming languages. [2 marks]
6. (a) Describe the function of an *interrupt register*. [2 marks]
 - (b) Explain how the processor which is currently servicing one *interrupt* could deal with another *interrupt*. [3 marks]

7. Given the following *binary tree* structure:



Draw an annotated diagram to show this *binary tree* structure stored as an *array of records*.

[5 marks]

8. A teacher stores graphics files on a server in a LAN. A student stores graphics files on a web-server.

(a) Outline **one** advantage and **one** disadvantage of LAN storage compared to storage on the Web-server.

[4 marks]

(b) Describe a reliable method the teacher could use to copy files from one LAN to a separate LAN which is not connected to the Internet

[2 marks]

9. Outline why users of the Internet use compressed files.

[2 marks]

10. Outline **one** application/use of:

(a) *stack* data structure

[2 marks]

(b) *queue* data structure

[2 marks]

SECTION B

Answer **four** questions.

11. (a) Define

(i) *kilobyte* (kB). [1 mark]

(ii) *megabyte* (MB). [1 mark]

(iii) *gigabyte* (GB). [1 mark]

(b) Suggest **one** appropriate device and explain why you would use it for each of the following tasks.

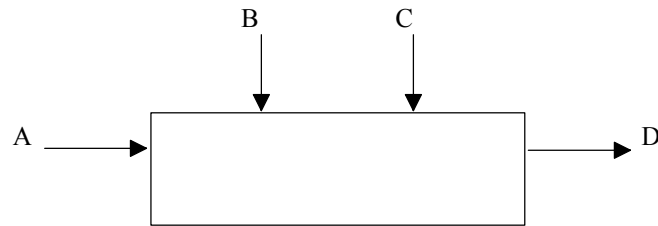
(i) Transferring a word processed document from one computer to another. [2 marks]

(ii) Distributing 600 MB of application software. [2 marks]

(iii) Backing up data on a computer network of a large capacity. [2 marks]

(c) State what *output device* a designer would use to produce very large drawings. [1 mark]

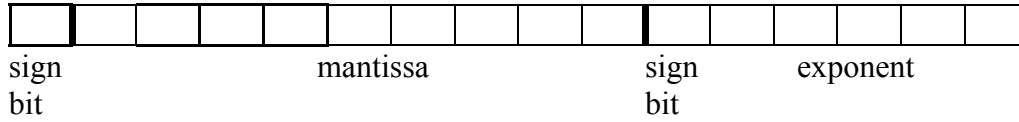
12. A logic circuit has three inputs A, B and C and one output D.



When a signal at A is “0” then the output at D is the same as input signal B;
when a signal at A is “1” then the output at D is the same as input signal at C.

- (a) Construct the *truth table* for this circuit. [4 marks]
- (b) From the results of the *truth table*, construct a *boolean expression* for the output D. [2 marks]
- (c) Simplify the expression for D. [2 marks]
- (d) Draw the logic circuit that corresponds to your answer to part (c). [2 marks]

13. Real numbers are stored in certain computers using two bytes which are divided into 10 bits for *mantissa* and *sign bit*; and 6 bits for *exponent*. The *exponent* is also held in two's complement.



For example, the number $16.25_{(10)} = 10000.01_{(2)} = 0.1000001 \times 2^5$ would be represented as follows:



- (a) Two bytes contain the hexadecimal number 403D. Calculate the decimal equivalent of this number. [3 marks]
- (b) Outline the representation of the largest positive number in this representation. [3 marks]
- (c) Define:
- (i) *overflow* [2 marks]
- (ii) *underflow* [2 marks]

14. (a) Define *recursion*. [2 marks]

(b) By tracing the following algorithm, or otherwise, show the output that would be produced for PRINT (3)

```

procedure PRINT (N is integer)
    if N>0 then
        PRINT (N-1)
        output (N)
    endif
endprocedure PRINT
    
```

Show all workings out. [4 marks]

(c) Explain **one** advantage and **one** disadvantage of *recursion*. [4 marks]

15. Once a week each employee has to fill in a job sheet which includes information on the duration of the job. The sheets are collected in *batches* over a period of one month. Each month all data is *verified* and entered via keyboard and stored onto the *direct access transaction file* held on disk. The transaction file is *validated* and the report of all invalid data is printed to be corrected and entered into the next batch of transactions. The transaction file is then sorted and used to prepare invoices for the work done. The preparation process requires some additional information about employees, which are stored on the *sequential master file*, held on magnetic tape.
- (a) Construct a *system flowchart*, which illustrates the process described above. [5 marks]
 - (b) (i) Outline the differences between *sequential* and *direct access* in relation to retrieving data (from the *master* and *transaction files*). [4 marks]
 - (ii) Suggest **one** reason for sorting the transaction file in the same order as *sequentially* organized *master file*. [1 mark]
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