

THE BRITISH COMPUTER SOCIETY
THE BCS PROFESSIONAL EXAMINATION
Certificate

SOFTWARE DEVELOPMENT

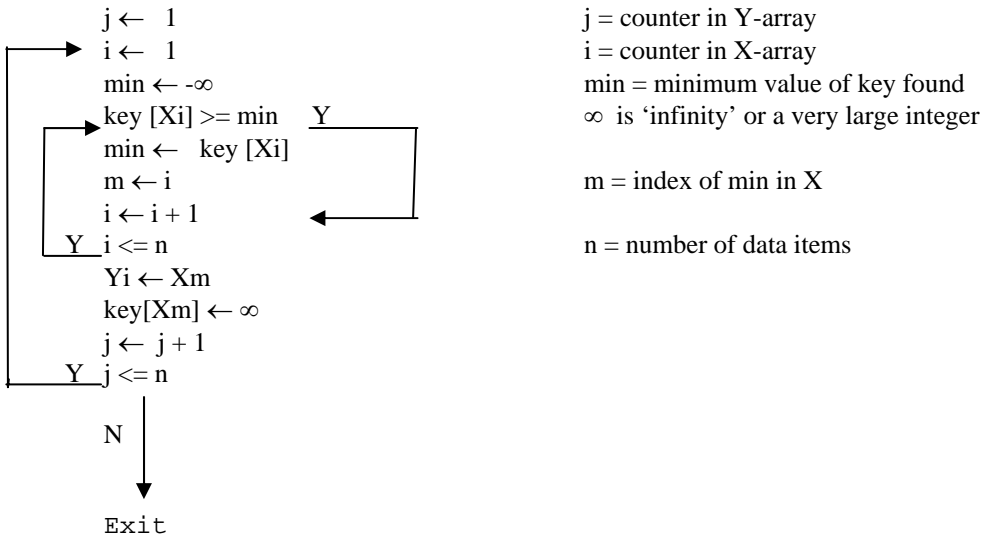
20th April 2004, 2.30 p.m.-4.30 p.m.
 Time: TWO hours

SECTION A

Answer TWO questions out of FOUR. All question carry equal marks.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

1. An algorithm (published 1962 by K. Iverson) for the selection sort method is given below:



a) Translate this algorithm literally into a procedural programming language. (Thus the transfers of control implied by \longrightarrow must be translated into 'GO TO label' statements.

State which language you are using. **(10 marks)**

b) State where this algorithm could be useful in today's programming world. Suggest why the algorithm is less useful now than when it was first available. **(6 marks)**

c) Modify the algorithm and translate it into PROCEDURE selectsort(...) which uses modern, structured code with meaningful variable names and without using labels. All external data values (input and output) must be passed to selectsort via parameters. **(14 marks)**

2. Data concerning professional musicians is held on computer files having the following information:

family name 20 characters
address 4 lines each of 20 characters
instrument 20 characters
section 20 characters (e.g. string, woodwind)
capability single-digit integer
appearance fee pounds and pence
available true or false
age positive integer between 16 and 70.

- a) Declare a record structure named “musician” to hold this information. (4 marks)
- b) Specify variable declarations for:
 - i) An array of these records called “player” capable of holding 100 items. (2 marks)
 - ii) A serial file called “londoners” which holds many such records. (2 marks)
- c) Write a program fragment and appropriate extra variable declarations to read the “londoners” file and select from it 100 string players who are available and aged under 25 to form a youth orchestra. (14 marks)
- d) Write another code fragment that reads the selection from c) and sorts them into ascending order of appearance fee and prints out the family name, address and instrument for each one. (8 marks)

3. a) Write a function, in Pseudocode, or Structured English, or a programming language with which you are familiar, that implements **searching** as follows:

The function should accept an integer parameter ITEM that is the item to be searched for.
The function should scan an array (name = LOCATED, size = LEN, both given as global values in the context of the function).
The result of the function should be the index position in LOCATED if ITEM is found, or zero if ITEM is not found. (18 marks)

b) Dry-run your pseudocode from a) above with the following data:

ITEM = 16
LEN = 6
LOCATED =

3
5
7
9
11
13

(12 marks)

4. a) Describe the principles of Modular Programming. Comment particularly on execution flow and the handling of parameter data. **(18 marks)**
- b) State TWO benefits of using Modular Programming methods. Give your reasons. **(12 marks)**

SECTION B

Answer FIVE questions out of EIGHT. All questions carry equal marks.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

5. a) An interactive program is to accept N real numbers and then evaluate and print the Arithmetic mean (A) and Geometric mean (G) defined by the following formulae:

$$A = (R_1 + R_2 + \dots + R_N) / N$$

$$G = (R_1 * R_2 * \dots * R_N)^{\uparrow (1 / N)} \quad [\uparrow \text{ means 'to the power of' }]$$

Develop the algorithm and write code for the program. State which programming language you have used. **(8 marks)**

- b) Some procedural languages do not have a 'power' operator. Show how you would implement the calculation for 'G' in this situation (e.g. Pascal). **(4 marks)**

6. A palindrome can be described as an array of characters in which the first and last letters are the same and those characters between them also form a palindrome. Examples are PEEP, RADAR.

Write a pseudocode function '**palcheck**' which takes as its parameter a character array and which returns 'TRUE' if the array contains a palindrome, otherwise returns 'FALSE'. You may use either an iterative or recursive method. **(algorithm 6 marks)**

(code 6 marks)

7. An ordered linked list has been set up with one *data item* and one pointer only in each *element* of the list.
- a) Draw a diagram of this linked list (with five *elements*) with a pointer to its head. Show the pointer movements when the second *element* of the list is deleted. **(3 marks)**
- b) Write a program declaration of the data structure needed. **(2 marks)**
- c) Write pseudocode for a procedure 'deleteitem', with appropriate parameters, to search for the *data item* held in the variable 'rejectitem' and delete the *element* holding that *data item* from the linked list. You can assume that an *element* holding the *data item* exists in the linked list. **(7 marks)**

8. You are asked to design the testing strategy for a spreadsheet that contains both simple data and text, and computed data.

- a) Give TWO examples of 'White Box' tests you would use. **(6 marks)**
- b) Give TWO examples of 'Black Box' tests you would use. **(6 marks)**

Turn over]

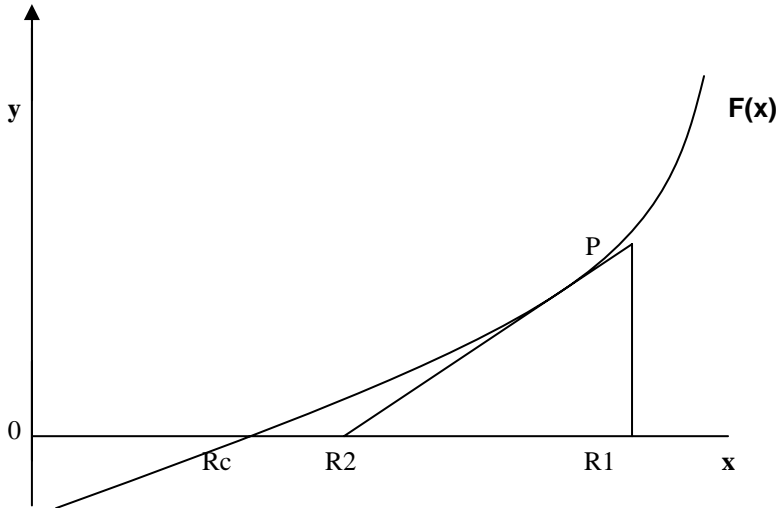


Figure 1

9. Figure 1 above shows a graph of a function $y = F(x)$ which has a real root at $x = R_c$.

If R_1 is a first approximation to this it can be shown that R_2 is a better approximation where

$$R_2 = R_1 - \frac{F(R_1)}{F'(R_1)}$$

Newton's formula
 $F'(x)$ being the first derivative of the function $F(x)$.

a) Develop an algorithm to find the three roots of the equation where

$$F(x) = Ax^3 + Bx^2 + Cx + D \text{ and}$$

$$F'(x) = 3Ax^2 + 2Bx + C$$

The approximate values of the roots (root1, root2 and root3) are to be input interactively. The algorithm should terminate when the positive difference between two successive root calculations is less than or equal to 0.001. **(6 marks)**

b) Write a FUNCTION 'newton' with appropriate parameters to apply this method. **(6 marks)**

10. Describe the operation of the index to a file. Illustrate your description with suitable diagrams, and include how the index is maintained as the file is updated. **(12 marks)**

11. Describe TWO web-site GUI features used for each of the following actions:

- a) Selection of items in a browser. **(6 marks)**
- b) Keeping navigation back to the primary web page always visible when clients click-through to go to other parts of the website. **(6 marks)**

12. Using suitable diagrams to illustrate your answer, briefly describe the operation of the following elements of system software:

- a) a scheduler **(6 marks)**
- b) a compiler **(6 marks)**