THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION
Certificate

SOFTWARE DEVELOPMENT

17th October 2003, 2.30 p.m.-4.30 p.m.
Time: 2 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. The following table contains data for SLR lenses available from a photographic dealer:

Focal length/mm	28	35	50	300
Wait time/weeks	0	3	0	6
Price/£ sterling	120	165	67	270
Weight/kg	0.25	0.26	0.31	0.64
Supplier/10 characters	Supplier-1	Supplier-2	Supplier-1	Supplier-3

a) Define a data structure suitable for holding the data in one column of the above table. Define a table/array capable of holding up to 50 such entries. <u>State the language you have used</u>. **(5 marks)**

b) Write the code to initialise the table/array defined in part *a)*. The data values will be preceded by an integer value which defines the number of table/array entries to be read in. **(7 marks)**

c) Using this table/array, develop an <u>algorithm</u> for the following interactive process:

A customer is asked how many lenses with different focal lengths they wish to enquire about. For each focal length the customer is invited to input a specific focal length. The table/array is then searched for this focal length. If it is present the algorithm displays *"lens is available"* and if the wait time is zero it displays *"from stock"*, otherwise it displays the wait time from the table followed by *"weeks"*. It then invites the customer to order the lens. If the reply is "**Y**" the price is added to the total. If the entry is not present in the table, it displays *"not available – sorry"*.

When all the enquiries have been processed, the algorithm displays the total cost of the ordered lenses.

Develop this algorithm to a stage where translation to the target language is straightforward. **(18 marks)**

The answers given in parts *a)* and *b)* should not be repeated in *c);* just indicate where they would be placed in the algorithm.

2. Part of a structured text analysis program is given below in pseudocode:

PROCEDURE *Findword* has one parameter which is the input file name
    Assumption – always at least one character to be read
BEGIN
    Define a local character variable – *ch*
    REPEAT
        Read the next character from the input file into *ch*
    UNTIL *ch* is a letter
END

PROCEDURE *Skipword* has three parameters; one is the input file name, the second is an integer
    parameter *(letter_ct)* capable of returning a value and the third *(last_ch)* is a character parameter
    capable of returning a value;
    Assumption – always at least one character to be read
    Assumption – input is terminated by a standard punctuation mark
BEGIN
    Define a local character variable – *ch*
    REPEAT
        Read the next character from the input file into *ch*
        ADD 1 to the parameter *letter_ct*
    UNTIL ch is NOT a letter
    Set *last_ch* to *ch*
END

{top level – execution begins here}
BEGIN
    ASSIGN the input file
    Declare integer variables *letter_ct* and *word_ct* and set them to ZERO
    Declare a character variable *last_ch* and set it to a space character
    REPEAT
        Call *Findword* with the input file as the parameter
        Call *Skipword* with the input file, *letter_ct* and *last_ch* as parameters
        ADD 1 to *word_ct*
    UNTIL a punctuation mark is reached
    Output the average word length; i.e. *letter_ct/word_ct*
    CLOSE the input file
END

a) Dry run this code with the characters **ab□c.** from the input file: [□ represents a "space"]. **(18 marks)**

b) State what the expected result would be and why the code does not reproduce this result. **(8 marks)**

c) Show how to implement the conditions "*ch* is a letter" and "a punctuation mark is reached" in a procedural language. State which language you are using. **(4 marks)**

3. *a)* Write a function that implements a hashing algorithm to perform a table-lookup of the following data without searching. The function should return an integer value that is the array position of the given value calculated by the hashing algorithm – in this problem the array position is in the range 1 to 5.

For example, if the function is called HASH, then HASH (6945) would return the value 5.

4213
5321
9526
1778
1634
6945

(15 marks)

b) Describe how the collisions happen when using hash-coded table lookup. Give an example to illustrate your answer. **(9 marks)**

c) Describe how collision avoidance reduces the efficiency of a hash-coded table look-up. **(6 marks)**

4. *a)* Describe the operation of a queue, including how elements are inserted and removed. Be sure to include the special cases of inserting in to a full queue and removing from an empty queue. **(15 marks)**

b) Describe the operation of any piece of system software that might use a queue data structure as part of its data store. Illustrate your answer with a description of what the system software does and draw suitable diagrams. **(15 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 rubber ball is dropped on to a hard flat surface from a height "H". Each bounce returns it to height "P" percent of the previous bounce height where P is less than 100%. Eventually the height of the ball reached is less than an input minimum, "U".

Develop the logic and write a short program to implement this problem and count the number of bounces made before the height is less than "U".

Incorporate a feature which stops the program running should the bounce count exceed 10000. **(12 marks)**

6. Accurate values of the cosine function(X) are calculated from the infinite series thus:

$$Cos(X) = 1 - X^2 / fact(2) + X^4 / fact(4) + X^6 / fact(6) - X^8 / fact(8) + \dots$$

where $fact(N) = N*(N-1)*(N-2)*\dots*2$ i.e. factorial (N).

a) Write a FUNCTION to calculate fact(N) where N is a REAL number. Any method may be used. **(3 marks)**

b) Show how each term in the series may be derived from its predecessor by an appropriate multiplier. Hence show that a separate factorial function is not needed to evaluate the series. **(3 marks)**

c) Write an algorithm OR function to obtain cos(X) to a precision of 10 decimal places. **(6 marks)**

7. A serial file 'datafile' has a sequence of records R_1, R_2, ..., R_N. A file pointer is used to manage operations with this file.

   a) Draw a diagram showing how the records are laid out in the file. Include the file pointer's position before any records are read from the file. **(4 marks)**

   b) Show diagrammatically or describe how the END-OF-FILE (datafile) condition is detected. **(4 marks)**

   c) Write a program loop which opens the file, counts how many records are in the file and then closes it. State which language you have used. **(4 marks)**

8. a) Define a suitable data structure to hold a node of a linked list with one pointer and 3 data items, these being the title of a book (up to 20 characters), the price (dollars and cents) and the number of books sold. **(3 marks)**

   b) Write a PROCEDURE 'onend' to add a new node at the end of the list. **(5 marks)**

   b) Input the values for a new node interactively with suitable prompts and invoke your procedure 'onend' with appropriate parameters. Assume that the list is set up beforehand by PROCEDURE 'invoke' which you are not expected to write; show where it is invoked in your code. **(4 marks)**

9. a) Describe the form of file organisation that you would use for a file of invoices that need to be printed for posting to relevant customers. Be sure to include in your answer the reasons why this form of file organisation is suitable for this application. **(6 marks)**

   b) Describe the form of file organisation that you would use for a file of accounts that need to be queried interactively as customers telephone in to ask about their account status. Be sure to include in your answer the reasons why this form of organisation is suitable for this application. **(6 marks)**

10. You are asked to design the Concepts and Facilities Guide for a small-sized database contact-management application. Describe the sections of the Guide that you think are important and useful to the User. Give your reasons. **(12 marks)**

11. Describe THREE GUI features that you expect to find in the design of an interactive website for an e-commerce company that sells books. Give your reasons. **(12 marks)**

12. Briefly describe the roles of:
    a) Database Administrator (DBA) **(4 marks)**
    b) Network Administrator **(4 marks)**
    c) Systems Programmer **(4 marks)**