

THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATIONS BCS Level 4 Certificate in IT

SOFTWARE DEVELOPMENT

17th October 2006, 2.30 p.m.-4.30 p.m.
Time: TWO hours.

Both Section A and Section B carry 50% of the marks. You are advised to spend about 1 hour on Section A (30 minutes per question) and 1 hour on Section B (12 minutes per question).

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

Calculators are NOT ALLOWED in this examination.
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SECTION A

Answer TWO questions out of FOUR. Each question carries 30 marks.

- The serial file <rpifile> contains a sequence of records. Each record contains a year (integer) and its retail price index (real), starting from 1947.
 - Write a record and file description for <rpifile>. State which language you use. **(5 marks)**
 - Develop an algorithm which accepts two year values, startyr and endyr, reads the appropriate retail price index data from <rpifile> and prints a table (see below) of Inflation Factors (IF) between startyr and endyr. Each IF entry in the table is computed by $rpi[\text{across year}] / rpi[\text{down year}]$. Thus if the startyr was 1960 and endyr was 1965 the table would be as shown below. Particularly note the diagonal line of '1.00' values, which means that £1.00 was worth £1.00 in the same year. The algorithm must have at least two stages of development and need not be developed beyond the point at which coding/testing would be possible. **(25 marks)**

	1960	1961	1962	1963	1964	1965
1960	1.00	0.96	0.92	0.91	0.86	0.84
1961	1.05	1.00	0.97	0.95	0.90	0.88
1962	1.08	1.03	1.00	0.98	0.93	0.91
1963	1.10	1.05	1.02	1.00	0.94	0.93
1964	1.17	1.12	1.08	1.06	1.00	0.98
1965	1.19	1.14	1.10	1.08	1.02	1.00

Table of Inflation Factors

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2. a) The code given below incorporates <testrange>, a procedure which is called recursively. Dry run the code with input values num = 7 lo = 3 hi = 5; use the line numbers in your answer. **(18 marks)**

Line number

```

1  PROCEDURE testrange (n, r1, r2 : INTEGER;  inrg:BOOLEAN)
2  IF r1 = n THEN inrg = TRUE
3  ELSE IF r1 > r2 THEN inrg = FALSE
4  ELSE { p1 = NEXT( r1) }
5  testrange( n,p1,r2,inrg )
6  END {recursive procedure}
7  BEGIN {top level – execution begins here}
8  READ( num, lo, hi )
9  testrange( num, lo, hi, test )
10 IF test = TRUE THEN PRINT (num “lies inside range”)
11 ELSE PRINT (num “lies outside range”)
12 END.
```

Information: NEXT(number) is the value following <number> in its sequence. Thus NEXT(3) = 4.

- b) Re-write the given code with better identifier names and input prompts to make it generally more meaningful. State which language you use. **(12 marks)**

3. a) Choose either version A (written in C) or version B (written in Pascal) which perform identical operations and state the final values of the variables v, w, x, y, z. **(15 marks)**

Version A	Version B
<pre> v=0; w=0; x=0; y=0; z=0; for(i=0;i<10;i++){ v++; w=w+i; } if(v>=10) x=5; for(i=0;i<10;i++){ if(i>x) y++; } for(i=10;i>5;i--) z=z+i;</pre>	<pre> v:=0; w:=0; x:=0; y:=0; z:=0; for i:=0 step 1 to 9 do begin v:=v+1; w:=w+i; end; if v>=10 then x:=5; for i:=0 step 1 to 9 do begin if i>x then y:=y+1 end; for i:=10 step -1 to 6 do z:=z+i</pre>
<p>Note: In this example, after each time through the loop, the loop variable i is incremented by 1.</p>	

- b) All the entries in an array SHUFFLE need to be moved one place earlier except the first entry which needs to be moved to the end.

SHUFFLE									
Before									
20	4	44	3	18	5	6	57	9	7
After									
4	44	3	18	5	6	57	9	7	20

- Write a section of code to accomplish this task in a programming language known to you. **(15 marks)**

4. a) What is the key difference between a compiler and an interpreter? **(5 marks)**
- b) Give an example of a simple conditional (if statement) with a syntax error in it and give the expected error message that might be obtained from a compiler or interpreter. **(5 marks)**
- c) Give an example of a simple assignment statement that will cause a run-time error and give the expected error message that might be obtained from a compiler or interpreter. **(5 marks)**
- d) State ONE advantage of using a compiler in preference to an interpreter. **(5 marks)**
- e) State ONE advantage of using an interpreter in preference to a compiler. **(5 marks)**
- f) A programmer submits a program containing many syntax errors first to a compiler and then to an interpreter. If you saw the responses of the systems, how could you decide which was the compiler and which was the interpreter? **(5 marks)**

SECTION B

Answer FIVE questions out of eight. Each question carries 12 marks.

5. A serial file named <primenos> contains a series of <limit> values, each of which is how many prime numbers there are below a particular value. Write a program to read the number of primes between <st> and <fin> values where <st> and <fin> are requested interactively and compare it to the value obtained from FUNCT(limit) which is defined as $\text{limit} / \text{LOG}(\text{limit})$. **(12 marks)**
6. Write a program which reads interactively the area of a rectangle (Area) and its perimeter (Perim) and which calculates the associated sides called a and b. The necessary equations are:
 $a = \text{Area} / b$
 $b = (\text{Perim} + \text{SQRT}(\text{Perim} * \text{Perim} - 16 * \text{Area})) / 4$
 Note: SQRT returns the positive square root value. **(12 marks)**
7. a) A linked list has two data items and one pointer. Show how it may be represented by a diagram with appropriate pointers. **(3 marks)**
- b) Such a list contains a name (20 characters) and a telephone number (six digits). Give a declaration for a member of this list. State which language you use. **(3 marks)**
- c) Write code to search the list for a particular telephone number requested interactively. If the number is found the name is to be output otherwise the message 'unable to find number' is output. **(6 marks)**
8. A part-time lecturer's pay is fixed for the year with a quoted standard number of worked hours for each of the months September through to May. This data is stored on a file <payfile> where each record contains:
 month name (3 characters)
 hours worked (integer)
 calculated pay (real number)
- a) Write a suitable data structure to hold this information. **(3 marks)**
- b) The lecturer keeps a monthly tally of actual hours worked to compare with the quoted hours. Develop a program which compares the expected monthly pay to that expected from hours actually worked, and the difference in pay between what he/she actually gets from the quoted hours and what he/she ought to have from the hours actually worked. The hours actually worked for a particular month are input interactively. **(9 marks)**

Turn over]

9. A typical web page is divided up with a narrow strip at the top and bottom and at each side leaving a large area in the middle.
- Sketch this layout and describe one way that it can be achieved. **(4 marks)**
 - Give a typical use for the parts of the page by considering the homepage of an e-commerce site selling to the general public. **(4 marks)**
 - State briefly another way in which the same layout effect can be achieved and give a reason why this method might not be favoured. **(4 marks)**
10. Suppose there are 300 employees in a company and an address list is maintained using a sequential file with the name of the employee being the key field. Suppose (for simplicity) that the names are evenly distributed over the alphabet.
- give (or estimate) the minimum, maximum and average number of keys that will need to be accessed to find the address of a particular employee from the sequential file. **(4 marks)**
 - Now suppose that the file is made into an indexed sequential file with a single level index. The index groups are defined by initial letter of name, with 3 initial letters per group, i.e. A-C, D-F, G-I, etc.
 - give (or estimate) the minimum, maximum and average number of keys that will need to be accessed to find the correct group in the index. **(4 marks)**
 - give (or estimate) the minimum, maximum and average number of keys that will need to be accessed to find the address in the main file once the index has been consulted. **(4 marks)**
11. Consider the following function called findmax together with a single test case:

```
int findmax(int low, high){
/* specification: find smallest value in array v
  between index low and index high inclusive */
int max; /* holds the maximum value found so far */
int i; /* loop counter */
max=100;
for ( i=low; i<high; i++)
  if( v[i] > max )
    max=v[i];
return(max);
}
```

test case: v[1]=55; v[2]=4; v[3]=16; low=1; high=3;

- What is the essential difference between black-box and white-box testing the function findmax? **(6 marks)**
 - In what way would the error in the function findmax show up under black-box testing? **(3 marks)**
 - In what way would the error in the function findmax show up under white-box testing? **(3 marks)**
12. a) Name and briefly describe the main function of TWO items of system software. **(6 marks)**
- b) Name and briefly describe the main function of TWO items of application software. **(6 marks)**