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0795 Computer Science 3

CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD
General Certificate of Éducation Examination

JUNE 2019 **ADVANCED LEVEL**

Subject Title	**Computer Science**
Paper No.	**3 - Practical**
Subject Code No.	**0795**

Two Hours

Carry out ALL the tasks given. For your guidance, the approximate mark for each part of a task is indicated in brackets.

Great importance is attached to the accuracy, layout and labelling of drawings and computer generated outputs.

You are reminded of the necessity for good English and orderly presentation of your answers.

Write algorithms in the answer booklet provided. Also record in your answer booklet any information requested or that you believe would make it easier to understand how you carried out tasks or answered questions.

*You are **expected to print** out a single copy of relevant fragments of your program at **different times. Please notify the instructor of any required printout that was not done!***

When an imperative programming language is required to write program code, either **Standard [ISO]** Pascal or the **[ANSI] C or C11** programming languages may be used.

If need be, supervisors will assist you in recording details of intermediate work carried out on the computer.

Do not write on the first page of your answer booklet. It is reserved for administrative purposes.

Where information is provided as soft copy, notify the instructors if it is not found in your machine or has not been made available to you.

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Task 1

A two-dimensional array, A, has N rows and N columns, where N is a positive integer.
The following algorithm is written to fill array A with the numbers 1,2,3,.., N^2.

```
N=input('Enter an integer greater than zero')
K=1
loop for ROW=O to N-1
loop for COLUMNS to N-1
A[ROW][COLUMN]=K
K=K+1
end loop
end loop
```

Figure 1.

1 In your answer booklet, give the values laid out in a 2 - D array, for N=3, as obtained from the algorithm. In other words, use the algorithm to insert values in the array, and give a trace of the order in which the values are inserted into the array.

(5 marks)

Task 2

2. There are many different ways of placing the numbers 1 to N^2 into an N x N two-dimensional array. The following two-dimensional array, with dimensions 5X5, has been filled in a circular (spiral) pattern with numbers 1 to 5^2.
   An algorithm to fill an NXN two-dimensional array, in a circular (spiral) pattern, with numbers from 1 to N^2 is given as follows:
   - initialize Z= 1,
   - initialize TOP, BOTTOM, LEFT and RIGHT.
   - iterate until the whole array is filled.
   - each time Z is placed correctly increase the value of Z by 1.
   - fill the elements of the TOP row starting from LEFT to RIGHT.
   - increase TOP by 1 before filling the elements of the RIGHT column.
   - fill the elements of the RIGHT column starting from TOP to BOTTOM.
   - decrease RIGHT by 1 before filling the elements of the BOTTOM row.
   - and continue filling the BOTTOM row and LEFT column in a similar way. adjusting TOP, RIGHT, BOTTOM and LEFT accordingly.

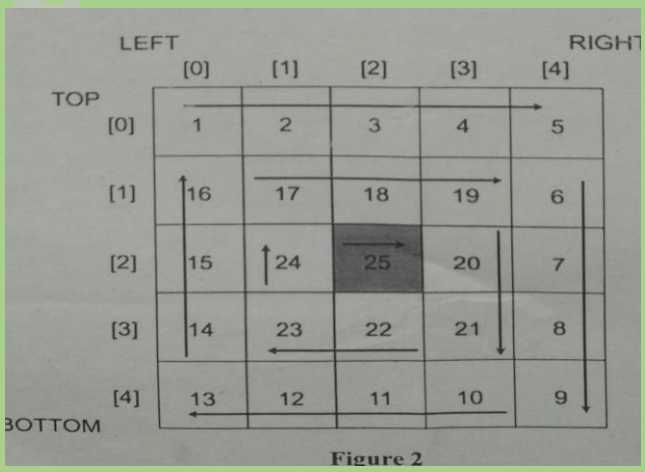


Figure 2

Figure 2

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(i) your answer booklet, State the initial values for TOP, BOTTOM, LEFT and RIGHT. **(1 mark)**

(ii) State the consequence of not increasing TOP by 1 before starting to fill the elements of the RIGHT column. **(1** mark)

(iii) In the algorithm described above, state the indices (subscripts) of the first and the last element to be filled in the BOTTOM row. **(1** mark)

Task 3 (18 marks)

3. Write, in a programming language (PL), a program to fill an NxN two-dimensional array, in a circular (spiral) pattern, with numbers from 1 to N^2 as described above.
You can do that by writing first the following functions/procedures which you will call in the main program.

(i) The procedure ***FillRowForward(A, top, left, right, z)*** which takes the array **A** the **top, left** and **right** as parameters and iterates through top row from left to right to fill the row. z is as used in the algorithm. **(3 marks)**

(ii) The procedure ***Fill RowBacward(A, bottom, left, right,*** z) which takes the array A the **bottom, left** and **right** as parameters and iterates through bottom row from right to left to fill the row. **(3 marks)**

(iii) The procedure ***Fill Column Downward(A, top, bottom, right,*** z) which takes the array **A** the **top, bottom** and **right** as parameters and iterates through the right column from top to bottom to fill the column. **(3 marks)**

(iv) The procedure ***FillColumnUpward (A, top, bottom, left,*** z) which takes the array **A** the **top, bottom** and **left** as parameters and iterates through the left column from bottom to top to fill the column. **(3 marks)**

4. Write the PL function/procedure that calls the functions above appropriately, while adjusting variables **top, bottom, left** and **right** accordingly; these four variables and the 2-D array should be global variables. The end result should be the array (matrix) filled in a spiral manner. You may use the pseudo-code in ***figure 2.*** **(6 marks)**

```
SpiralOrder                    *
Begin
k=1; initialise top, bottom, left and right;
while k<N*N do
        call FillRowForward(A, top, left, right, k);
        increment Top by 1;
      call FillColumnDownward(A, top, bottom, right, k);
        decrement right by 1;
        call FillRowBacward(A, bottom, left, right, k);
        decrementBottom by 1;
        call FillColumnUpward (A, top, bottom, left, k);
        incrementLeft by 1;
Endwhile
End
```

Figure 3.

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Task 4

To test your program;

5. Modify and implement the algorithm in Figure 1, such that instead of inserting the numbers into the matrix, it should print the numbers already inserted in the matrix, line after line, with equal spaces between the numbers. After each line is printed the cursor should go to the next line. **(4 marks)**

6. Save and print your code, run the program and print the output. **(2 marks)**

7. Adapt the PL procedures in 3i, ii, iii and iv such that instead of inserting the number z into the array cells, they should rather print the values found in the cells. That is:
   - Adapt ***FillRowForward(A, top,left,right, z)*** to ***PrintRowForward(A, top,left,right)*** so that it prints the top row. **(2 marks)**
   - Adapt ***FillRowBacward(A, bottom, left, right, z)*** to ***PrintRowBacward(A, bottom, left, right)*** so that it prints the bottom row. **(2 marks)**
   - Adapt ***FillColumnDownward(A, top, bottom, right, z)*** to ***PrintColumnDownward(A, top, bottom, right)*** so that it prints the right column. **(2 marks)**
   - Adapt ***FillColumnUpward(A, top, bottom, left, z)*** to ***PrintColumnUpward(A, top, bottom, left)*** so that it prints the left column. **(2 marks)**

8. Adapt the **PL** function **(SpiralOrder),** implemented in (4) above to **PrintSpiralOrder** such that it rather calls the adapted functions ***PrintRow Forward, PrintRowBacward, PrintColumnDownward, PrintColumn Upward*** *respectively in places where their Fillprocedure/functions were called.* **(5 marks)**

9. **Save** and print the code of **PrintSpiralOrder.** Run the program once more and do a screenshot of the output when **PrintSpiralOrder** is called. Print output. **(2 marks)**

Task 5

10. **In your answer booklet, explain briefly how you would adapt each of the printprocedures: *PrintRowForward, PrintRowBacward, PrintColumnDownward, PrintColumnUpward*** such that printing is done in the reverse order of insertion. **(4 marks)**

11. Put the print procedures mentioned in(10) in the order in which they should be called to the procedure **PrintSpiralOrder,** such that the printing effectively is in the reverse order when the program runs. **(1 mark)**

END

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