Exercise 6 Elementary Algorithms

6. Write a C++ program for implementation of following elementary algorithms.

a) Compute GCD (greatest common divisor) of two given positive integers.

b) Factorial of given number using recursion

c) Procedure to calculate sum of squares of two integer numbers

d) Program to find the maximum and minimum in set of n integer elements.

Objective: the objective of this exercise enable you to perform GCD of two numbers, factorial of given number, sum of squares of two integer numbers, maximum and minimum in set of n integer elements.

Procedure and Description:

a) GCD of two positive integers:

In mathematics, the greatest common divisor (gcd), also known as the greatest common factor (gcf), of two non-zero integers, is the largest positive integer that divides the numbers without a remainder. For example, the GCD of 8 and 12 is 4.

Algorithm GCD – Euclid (m, n)

//m,n:Positive integers

This algorithm computes the greatest common divisor of two given positive integer

Step 1: begin {of algorithm}

Step 2: while $n \neq 0$ do

begin {of while loop}

$r \leftarrow m \bmod n$;{r:a new variable is used to store the remainder which is obtained by dividing m by n, with $0 \leq r < m$}

$m \leftarrow n$;

{the value of n is assigned as new value of m; but at this stage, value of n remains unchanged}

$n \leftarrow r$,

{the value of r becomes the new value of n and the value

of r remains unchanged}
end {of while loop}

Step 3: return (n)

Step 4: end; {of algorithm}

Expected Output:

After executing the program enter two positive integer numbers to find gcd. Resultant value is output.

Example: Enter two positive integers: 20 16

Output: GCD of two numbers is: 4

b) Factorial of given number using recursion:

In a simple language we can define recursion as a programming technique in which a function may call itself.

Algorithm: Procedure factorial (n) //n:integer number

Step 1: fac; integer:
begin

Step 2: fac ← 1

Step 3: if n equals 1 then return fac

Step 4: else begin
fac ← n * factorial (n – 1)
return (fac)
end;

Step 5: Exit

Expected Output:

After executing the programs enter an integer number .Program takes the input and executes the factorial recursion function then final factorial function value is resultant output.

Example: enter a number: 4

Output: factorial of given number is: 24

c) Sum of squares of two integer numbers

This program gives the steps to calculate sum of squares of two integer numbers

Algorithm:

Step 1: Procedure sum-square (a, b: integer) integer;

{denoted the inputs a and b integers and the output is also an integer}

Step 2: S: integer;
{to store the required number}
Step 3: begin
Step 4: $S \leftarrow a^2 + b^2$
Step 5: Returns (S)
Step 6: end

Expected Output:

After executing the program enter two integer numbers then by performing algorithm steps, it calculates the sum of squares of two integer numbers, the resultant value is output.

Example: enter two integer numbers: 6 8

Output: sum of squares of two integer numbers: 100

d) The maximum and minimum in set of n integer elements

This program gives the steps for finding maximum value and minimum value in set of n integer elements.

Algorithm:

Step 1: procedure SMAXMIN (max, min) //max,min:integer numbers
Step 2: integer i, max, min; //i: used as index
Step 3: max ← min ← A(1);//A: contains set of elements
Step 4: for I ←2 to n do
Step 5: if A(i)>max then max ← A(i)
Step 6: else if A(i)<min then min ← A(i)
Step 7: end if
Step 8: end if
Step 9: repeat
Step 10: end SMAXMIN

Expected Output:

After executing the program. Enter set of n integer numbers. Before that enter n value. Then program executes algorithm steps and gives the output values i.e. the maximum value and minimum value.

Example: Enter n value: 8

Enter set of integer values: 4 8 12 16 3 10 21 7

Output: the maximum and minimum values: 21 3