Syllabus Content:

8.1. Programming Concepts (Procedures & Functions)

- 6 (a) Understand what is meant by procedures, functions and parameters
- (b) Define and use procedures and functions, with or without parameters
- (c) Understand and use local and global variables.

Notes and guidance

- Procedures and functions may have up to two

8.1. Programming Concept (Procedures & Functions)

Algorithm design involves developing **step-by-step** instructions to solve a problem and subroutines are to **modularize the solution**.

Initially, a program was written as one monolithic block of code. The program started at the first line of the program and continued to the end.

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Program languages have now been developed to be structured. A problem can be divided into a number of smaller subroutines (also called **procedures**). From within one subroutine, another subroutine can be called and executed:

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PROCEDURE or Subroutine:

A **PROCEDURE** is a self-contained section of program code which performs a specific task and is referenced by a name. Procedures can be **CALLED** repeatedly throughout a program by keyword **CALL**. **PROCEDURE** can contain its own local variables, data types, labels, and constant declarations.

FUNCTION: is a self contained program code which **performs a specific task** and is referenced by a name. **FUNCTION always return a value**..FUNCTION is a sequence of steps that is given an identifier and returns a single value; function call is made by the keyword **CALL**

Parameter of Procedure or Function:

A **variable applied to a procedure or function** that allows one to **pass in a value** for the **procedure/function** to **use.**

Header (Procedure or Function): the first statement in the definition of a procedure or function, which contains its name, any parameters passed to it, and, for a function, the type of the return value.

Argument – the value passed to a procedure or function.

Local and global variables

A **global variable** can be used by any part of a program – its **scope** covers the whole program. **Global Variables are DECLARED above and outside** the **Main Program**, **Procedures or Functions**

A **local variable** can only be used by the part of the program it has been **declared inside** – its **scope** is **restricted to that part of the program.**

For example, in this algorithm the variables **num1**, **num2** and **answer** are declared globally.

```
DECLARE num1, num2, answer : Integer

     PROCEDURE userinput()
          OUTPUT("Enter number 1")
          INPUT num1
          OUTPUT("Enter number 2")
          INPUT num2
     END PROCEDURE

     PROCEDURE Calculation()
          answer = num1 * num2
     END PROCEDURE

     PROCEDURE useroutput()
          OUTPUT("the product of ", num1 ," and ", num2 ," is ")
          OUTPUT (CALL answer)
     END PROCEDURE
 BEGIN
   CALL userinput
   CALL Calculation
   CALL useroutput
 END
```

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Subroutines or Procedures

Subroutine

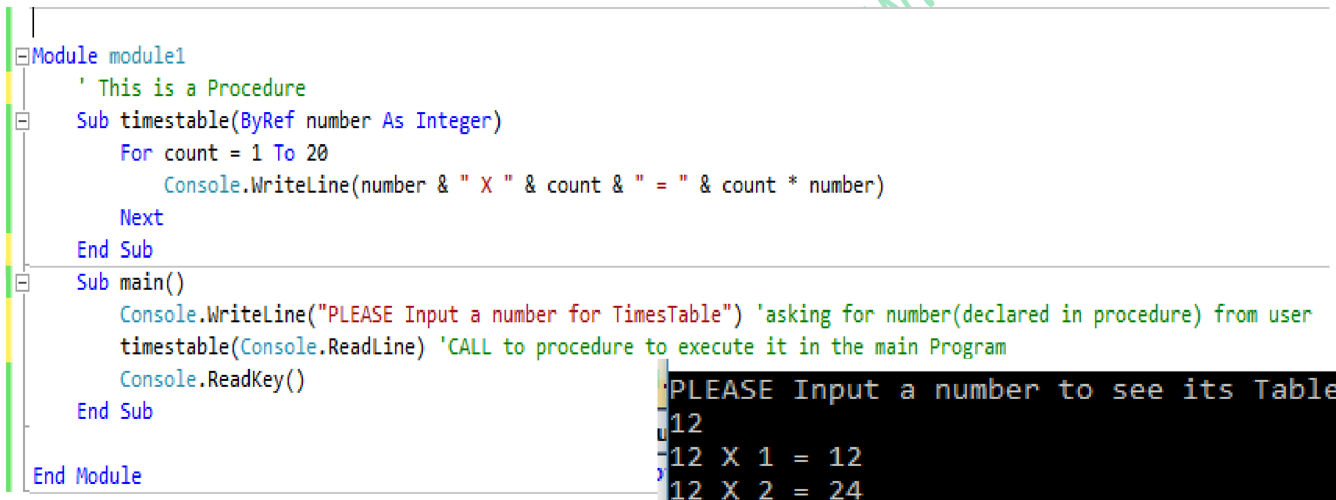
A subroutine is another name of PROCEDURE. It is a self-contained section of program code that performs a specific task, as part of the main program.

PSEUDOCODE of PROCEDURE

```
PROCEDURE timestable(number As INTEGER) //This is a Procedure
   FOR count = 1 To 20
       OUTPUT(number & " X " & count & " = " & count * number)
   NEXT
END PROCEDURE

BEGIN
OUTPUT("PLEASE Input number for TimesTable") //asking for number(in
procedure) from user
CALL timestable //CALL to procedure to execute it in the main Program
END
```

VB CODE Of PROCEDURE



```
Module module1
    ' This is a Procedure
    Sub timestable(ByRef number As Integer)
        For count = 1 To 20
            Console.WriteLine(number & " X " & count & " = " & count * number)
        Next
    End Sub
    Sub main()
        Console.WriteLine("PLEASE Input a number for TimesTable") 'asking for number(declared in procedure) from user
        timestable(Console.ReadLine) 'CALL to procedure to execute it in the main Program
        Console.ReadKey()
    End Sub

End Module
```

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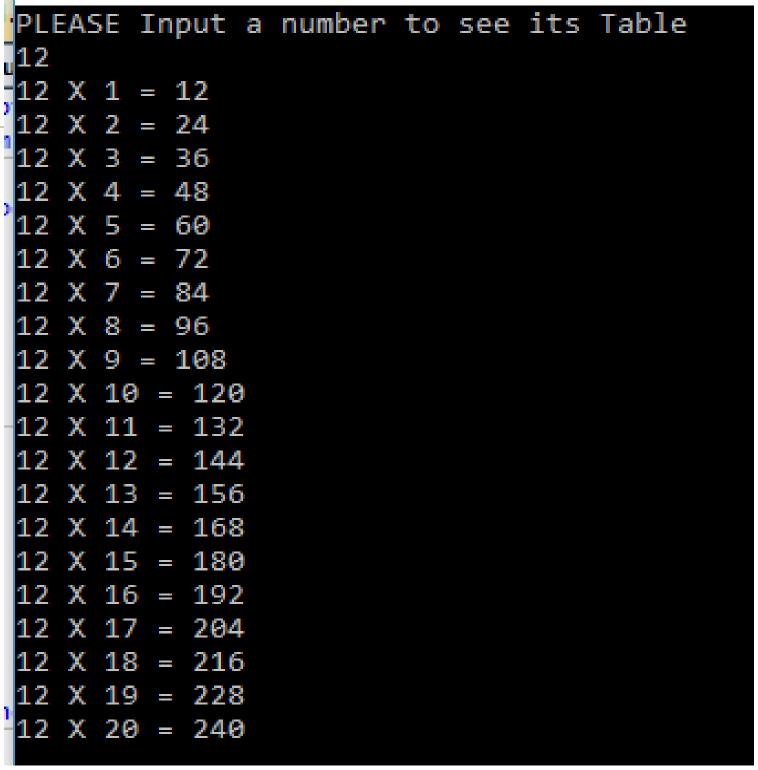
OUTPUT is shown in COLSOLE WINDOW:



```
PLEASE Input a number to see its Table
12
12 X 1 = 12
12 X 2 = 24
12 X 3 = 36
12 X 4 = 48
12 X 5 = 60
12 X 6 = 72
12 X 7 = 84
12 X 8 = 96
12 X 9 = 108
12 X 10 = 120
12 X 11 = 132
12 X 12 = 144
12 X 13 = 156
12 X 14 = 168
12 X 15 = 180
12 X 16 = 192
12 X 17 = 204
12 X 18 = 216
12 X 19 = 228
12 X 20 = 240
```

PROCEDURE of Fahrenheit to Celsius

```
PROCEDURE Celsius (temp : REAL)
     temp = (temp -32)/1.8
     OUTPUT("Celsius = " , temp)
END PROCEDURE
BEGIN
     DECLARE MyTemp : REAL
     OUTPUT("Input temperature in Fahrenheit ")
     INPUT MyTemp
     CALL Celsius(MyTemp) //CALL to procedure to execute
END
```

Using Global variable (Pseudocode)

```
DECLARE num1, num2, answer As Integer
     PROCEDURE input_sub()
          OUTPUT("Enter number 1")
          INPUT num1 = Console.ReadLine
          OUTPUT("Enter number 2")
          INPUT num2
     END PROCEDURE
     PROCEDURE Calculation()
          answer = num1 * num2
     END PROCEDURE
     PROCEDURE output_sub()
          OUTPUT("the product of " & num1 & " and " & num2 & " is ")
          OUTPUT (answer)
     END PROCEDURE
    BEGIN
        CALL  input_sub()
        CALL  Calculation()
        CALL  output_sub()
    END
```

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Example Program – Procedures (VB Code)

```
Dim num1 As Integer
Dim num2 As Integer
Dim answer As Integer
```

Global Variables declared

```
  Sub input_sub()
        Console.Clear()
        Console.WriteLine("Enter number 1")
        num1 = Console.ReadLine
        Console.WriteLine("Enter number 2")
        num2 = Console.ReadLine
  End Sub
  Sub Calculation()
        answer = num1 * num2
  End Sub
Sub output_sub()
  Console.Write("the product of " & num1 & " and " & num2 & " is ")
  Console.WriteLine(answer)
  Console.ReadLine()
End Sub
Sub Main()
    input_sub()
    Calculation()
    output_sub()
End Sub
```

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Parameters

As mentioned above, **local variables** only have a **lifespan of the procedure.**
Sometimes it is useful to **pass a value from one procedure to another**.
This is done by using **parameters (or arguments)**
A parameter can be passed from one procedure to another by value or by reference.

Defining a Function

The Function statement is used to declare the name, parameter and the body of a function. The syntax for the Function statement is:

```
FUNCTION FunctionName [(ParameterList)] As ReturnType

    [Statements]
```

```
End Function
```

Functions

Functions are similar to Procedure, except that they always return a value..

```
FUNCTION square(num : INTEGER) : RETURNS INTEGER
        square = num * num
     RETURN square
END FUNCTION

FUNCTION sum (a :INTEGER, b : INTEGER) RETURNS INTEGER
        sum = a + b
     RETURN sum
END FUNCTION

BEGIN
     DECLARE number, value1, value2 : INTEGER
     PRINT ("Please Input a number for its square")
     INPUT number
     PRINT ("Square of number is: ")
     PRINT (CALL square(number))
     PRINT ("Please Input a num1 and num2 for sum ")
     INPUT value1, value2
     PRINT ("Sum is" (CALL sum(value1, value2))
END
```

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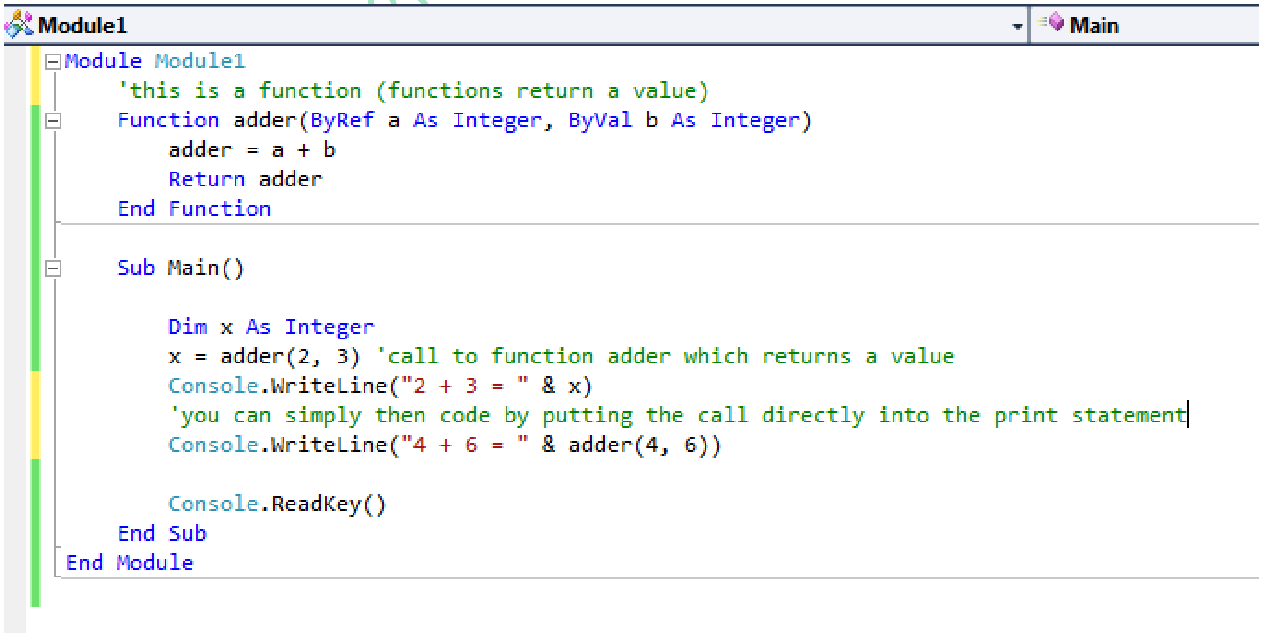
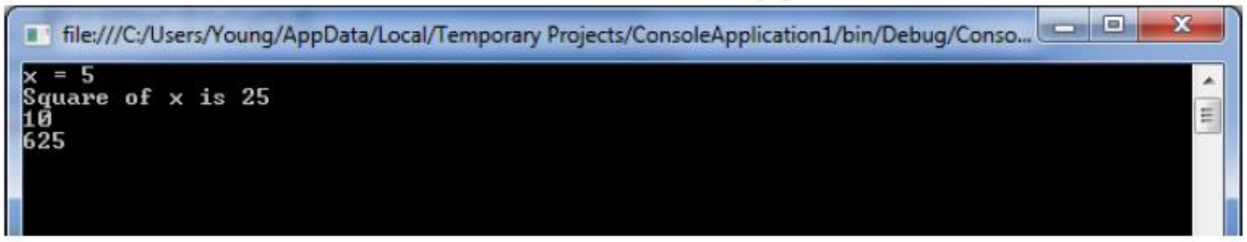
Example Program in VB - Functions



```
Module Module1
    'this is a function (functions return a value)
    Function adder(ByRef a As Integer, ByVal b As Integer)
        adder = a + b
        Return adder
    End Function

    Sub Main()

        Dim x As Integer
        x = adder(2, 3) 'call to function adder which returns a value
        Console.WriteLine("2 + 3 = " & x)
        'you can simply then code by putting the call directly into the print statement
        Console.WriteLine("4 + 6 = " & adder(4, 6))

        Console.ReadKey()
    End Sub
End Module
```

```
Module Module1
    Function square(ByVal x As Integer) As Integer
        square = x * x
    End Function

    Function sum(ByRef a As Integer, ByRef b As Integer) As Integer
        sum = a + b
    End Function

    Sub Main()
        Dim number As Double = 5
        Console.WriteLine("x = " & number)
        Console.WriteLine("Square of x is " & square(number))
        Console.WriteLine(sum(3, 7))
        Console.WriteLine(square(sum(16, 9)))
        Console.ReadLine()
    End Sub
End Module
```


file:///C:/Users/Young/AppData/Local/Temporary Projects/ConsoleApplication1/bin/Debug/Conso...

```
x = 5
Square of x is 25
10
625
```

Example

Following code snippet shows a function *FindMax* that takes two integer values and returns the larger of the two.

```
Function FindMax(ByVal num1 As Integer, ByVal num2 As Integer) As Integer ' local
variable declaration
    Dim result As Integer
    If (num1 > num2) Then
        result = num1
    Else
        result = num2
    End If
    FindMax = result
End Function
```

Function Returning a Value

In VB.Net, a function can return a value to the calling code in two ways:

- By using the return statement
- By assigning the value to the function name

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Function & Procedure in one Program (Pseudocode).

```
PROCEDURE grades(num As Integer)
    Case OF num
           >= 90 : OUTPUT ("A*")
           >= 80 : OUTPUT ("A")
           >= 70 : OUTPUT ("B")
           >= 60 : OUTPUT ("C")
        OTHERWISE OUTPUT ("Need improvement")
    End CASE
End PROCEDURE

PROCEDURE pass (number As Integer)
    IF number >= 50 THEN
        OUTPUT ("Pass")
    ELSE
        OUTPUT ("Fail")
    END IF
END PROCEDUE

FUNCTION regular (n: INTEGER) RETURNS : STRING
    IF n >= 60 THEN
        regular = ("Regular admission from school")
    ELSE
        regular = ("Appears as a Private candidate")
    END IF
    RETURN regular
END FUNCTION

BEGIN
    DECLARE marks : Integer
    OUTPUT ("Enter your marks")
    INPUT marks

    WHILE marks > 100 OR marks < 0
        OUTPUT ("Error, Re-Enter marks between 0 to 100")
        INPUT marks
    END WHILE

    CALL grades(marks)
    CALL pass(marks)
    OUTPUT (CALL regular(marks))
END
```

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The following example demonstrates *FindMax* function in VB (Console mode):

```
Module module1
    Function FindMax(ByVal num1 As Integer, ByVal num2 As Integer) As Integer
        ' local variable declaration */
        Dim result As Integer
        If (num1 > num2) Then
            result = num1
        Else
            result = num2
        End If
        FindMax = result
    End Function
    Sub Main()
        Dim a, b, res As Integer
        Console.WriteLine("Write value number 1")
        a = Console.ReadLine()
        Console.WriteLine("Write value number 2")
        b = Console.ReadLine()

        res = FindMax(a, b)
        Console.WriteLine("Max value is : {0}", res)
        Console.ReadLine()
    End Sub
End Module
```

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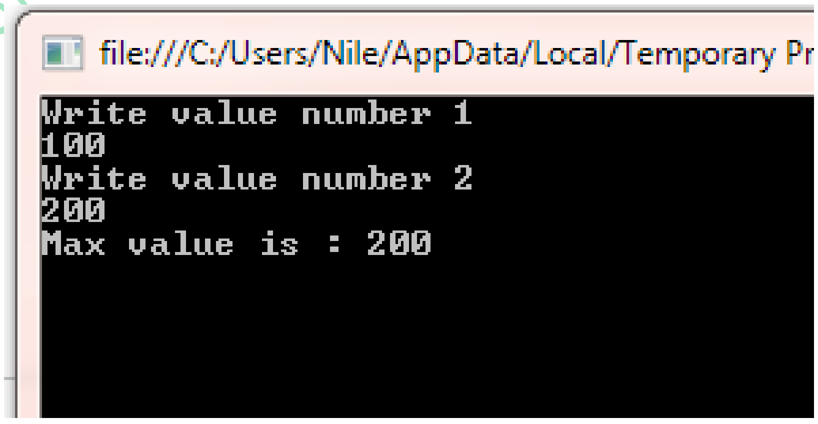
When the above code is compiled and executed, it takes value 1 & value 2 as input and produces the maximum value for example:



```
Write value number 1
100
Write value number 2
200
Max value is : 200
```

References:
Visual Basics Console Cook Book by
VB.NET Console Book by ***Dough Semple***
https://www.tutorialspoint.com/vb.net/vb.net_functions.htm
https://docs.microsoft.com/en-us/dotnet/visual-basic/language-reference/statements/function-statement