A290 - Tools for Computing

By:

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What do we need to learn in order to write computer programs?

- Fundamental programming constructs:
  - Variables,
  - Arithmetic operators,
  - Input and output
  - Conditionals,
  - Loops,
  - Procedures and functions,
  - Arrays (Searching and Sorting the Array),
  - Structures, classes and objects,
  - Files
Operations on an Array:

- Initializing the array
- Inserting data in the array
- Displaying the cell contents of the array
- Searching an Array
- Sorting an Array
Operations on an Array:

- Initializing the array:

  Dim Index As Integer
  Dim Score(10) As Double

  For Index = 0 To 10
    Score(Index) = 0.0
  Next Index
Operations on an Array:

☐ Inserting data into the array:

For Index = 0 To 10

    Console.Write("Enter array element ")
    Console.Write(Index)
    Console.Write(": ")
    Score(Index) = CDbl(Console.ReadLine())

Next Index

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Operations on an Array:

- Displaying the cell contents of the array:

  For Index = 0 To 10
  Console.WriteLine(Score(Index))
  Next Index
Operations on an Array:

- Searching an Array: (Linear Search)

```vbnet
Dim value As Double
Console.Write("Enter the value to search for:")
value = CDb(Console.ReadLine()) 'value to search for

For Index = 0 To 10
    If Score(Index) = value Then
        Console.WriteLine("Location {0}, Found it!", Index)
    Else
        Console.WriteLine("Location {0}, Not Found..", Index)
    End If
Next Index
```

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Consider the following Array:

- Linear Search of the array:

```
search(17)
```

```
0  1  2  3  4  5  6  7  8  9  10
```

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Linear Search:

Dim value As Double
Console.Write("Enter the value to search for:")
value = CDbl(Console.ReadLine()) 'value to search for

For Index = 0 To 10
    If Score(Index) = value Then
        Console.WriteLine("Location (0), Found it!", Index)
    Else
        Console.WriteLine("Location (0), Not Found.", Index)
    End If
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Linear Search:

Dim value As Double
Console.Write("Enter the value to search for:")
value = CDb(_console.ReadLine()) 'value to search for

For Index = 0 To 10
    If Score(Index) = value Then
        Console.WriteLine("Location (0), Found it!", Index)
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        Console.WriteLine("Location (0), Not Found..", Index)
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    Else
        Console.WriteLine("Location (0), Not Found.", Index)
    End If
Next Index

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Operations on an Array:

- Binary Search

Private Function BinarySearch(ByVal value As Integer, ByRef TheArray() As Integer) As Integer
    Dim Low, High, Middle As Integer
    Low = 0
    High = TheArray.GetUpperBound(0)

    Do While Low <= High
        Middle = (Low + High) \ 2
        If value = TheArray(Middle) Then 'It's a match!!
            Return M
        Else If value < TheArray(Middle) Then 'Search the low end of array
            High = Middle - 1
        Else
            Low = Middle + 1
        End If
    Loop
    Return -1 'return -1 to indicate the value was not found
End Function

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Consider the following Array:

- Binary Search of the array:

  BinarySearch(17)

  ![Array Diagram]

  - Remember the array must be sorted first.
Binary Search:

Private Function BinarySearch(ByVal value As Integer, ByVal TheArray() As Integer) As Integer
    Dim Low, High, Middle As Integer
    Low = 0
    High = TheArray.GetUpperBound(0)

    Do While Low <= High
        Middle = (Low + High) \ 2

        If value = TheArray(Middle) Then  ' It's a match!
            Return (Middle)
        ElseIf value < TheArray(Middle) Then  ' Search the low end of array
            High = Middle - 1
        Else
            Low = Middle + 1
        End If
    Loop

    Return (-1)  ' return -1 to indicate the value was not found
End Function

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Binary Search:

Private Function BinarySearch(ByVal value As Integer, ByVal TheArray() As Integer) As Integer
    Dim Low, High, Middle As Integer
    Low = 0
    High = TheArray.GetUpperBound(0)
    Do While Low <= High
        Middle = (Low + High) \ 2
        If value = TheArray(Middle) Then 'It's a match!
            Return (Middle)
        Else If value < TheArray(Middle) Then 'Search the low end of array
            High = Middle - 1
        Else 'Search the high end of array
            Low = Middle + 1
        End If
    Loop
    Return (-1) 'Return -1 to indicate the value was not found
End Function

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Binary Search:

Private Function BinarySearch(ByVal value As Integer, ByVal Array() As Integer) As Integer
 Dim Low, High, Middle As Integer
 Low = 0
 High = Array.GetUpperBound(0)

 Do While Low <= High
     Middle = (Low + High) \ 2
     If value = Array(Middle) Then  ' It's a match!
         Return (Middle)
     Else
         If value < Array(Middle) Then  ' Search the low end of array
             High = Middle - 1
         Else
             Low = Middle + 1
         End If
     End If
 Loop
 Return (-1) ' return -1 to indicate the value was not found
 End Function

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# Binary Search:

Private Function BinarySearch(ByVal value As Integer, ByVal TheArray() As Integer) As Integer
Dim Low, High, Middle As Integer
Low = 0
High = TheArray.GetUpperBound(0)

Do While Low <= High
    Middle = (Low + High) \ 2
    If value = TheArray(Middle) Then 'It's a match!
        Return (Middle)
    Else If value < TheArray(Middle) Then 'Search the low end of array
        High = Middle - 1
    Else
        Low = Middle + 1
    End If
Loop
Return -1 'return -1 to indicate the value was not found
End Function

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Binary Search:

Private Function BinarySearch(ByVal value As Integer, ByVal TheArray() As Integer) As Integer
Dim Low, High, Middle As Integer
Low = 0
High = TheArray.GetUpperBound(1)
Do While Low <= High
    Middle = (Low + High) \ 2
    If value = TheArray(Middle) Then 'It's a match!
        Return (Middle)
    ElseIf value < TheArray(Middle) Then 'Search the low end of array
        High = Middle - 1
    Else
        Low = Middle + 1
    End If
Loop
Return (-1) 'return -1 to indicate the value was not found
End Function

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Low = 0
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    If value = TheArray(Middle) Then ' It's a match!
        Return (Middle)
    Else If value < TheArray(Middle) Then 'Search the low end of array
        High = Middle - 1
    Else
        Low = Middle + 1
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Return (-1) ' return -1 to indicate the value was not found
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    Middle = (Low + High) \ 2
    If value = TheArray(Middle) Then 'It's a match!
        Return (Middle)
    ElseIf value < TheArray(Middle) Then 'Search the low end of array
        High = Middle - 1
    Else
        Low = Middle + 1
    End If
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Return (-1) 'Return -1 to indicate the value was not found
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    Dim Low, High, Middle As Integer
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    Do While Low <= High
        Middle = (Low + High) \\ 2
        If value = TheArray(Middle) Then 'It's a match!
            Return (Middle)
        ElseIf value < TheArray(Middle) Then 'Search the low end of array
            High = Middle - 1
        Else
            Low = Middle + 1
        End If
    Loop
    Return (-1) 'return -1 to indicate the value was not found
End Function

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Operations on an Array:

- **Sorting an Array (Bubble Sort)**

  Private Sub BubbleSort(ByRef TheArray() As Integer)
  Dim Pass, Index, Hold As Integer
  For Pass = 1 To TheArray.GetUpperBound(0)
    For Index = 0 To TheArray.GetUpperBound(0) - 1
      If TheArray(Index) > TheArray(Index + 1) Then
        Hold = TheArray(Index)
        TheArray(Index) = TheArray(Index + 1)
        TheArray(Index + 1) = Hold
      End If
    Next Index
  Next Pass
  End Sub
Consider the following Array:

- Linear Search of the array:

    BubbleSort(TheArray)

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Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub
Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub
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Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub
Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray[Index] = TheArray(Index + 1)
                TheArray[Index + 1] = Hold
            End If
        Next Index
    Next Pass
End Sub

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Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
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            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub
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Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
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            End If
        Next Index
    Next Pass
End Sub

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Private Sub BubbleSort(ByRef TheArray() As Integer)
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                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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    For Index = 0 To TheArray.GetUpperBound(0) - 1
        If TheArray(Index) > TheArray(Index + 1) Then
            Hold = TheArray(Index)
            TheArray(Index) = TheArray(Index + 1)
            TheArray(Index + 1) = Hold
        End If
    Next Index
Next Pass
End Sub

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    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
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            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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Bubble Sort:

Private Sub BubbleSort(ByVal TheArray() As Integer) As Integer

    Dim Pass, Index, Hold As Integer

    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass

End Sub

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Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub
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Private Sub BubbleSort(ByRef TheArray() As Integer)
Dim Pass, Index, Hold As Integer

For Pass = 1 To TheArray.GetUpperBound(0)
    For Index = 0 To TheArray.GetUpperBound(0) - 1
        If TheArray(Index) > TheArray(Index + 1) Then
            Hold = TheArray(Index)
            TheArray(Index) = TheArray(Index + 1)
            TheArray(Index + 1) = Hold
        End If
    Next Index
Next Pass
End Sub

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End of First Pass

☐ Pass = 2
Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.UpperBound(0)
        For Index = 0 To TheArray.UpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
                swap
            End If
        Next Index
    Next Pass
End Sub

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Bubble Sort:

Private Sub BubbleSort(ByRef TheArray() As Integer)
    Dim Pass, Index, Hold As Integer
    For Pass = 1 To TheArray.GetUpperBound(0)
        For Index = 0 To TheArray.GetUpperBound(0) - 1
            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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            If TheArray(Index) > TheArray(Index + 1) Then
                Hold = TheArray(Index)
                TheArray(Index) = TheArray(Index + 1)
                TheArray(Index + 1) = Hold
            End If
        Next Index
    Next Pass
End Sub

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☐ And so on...