Subroutines and Functions
in VB.NET

< Part II >

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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,
  - Arrays,
  - Subroutines and functions,
  - Structures, classes and objects,
  - Files
Topics to Cover

- Array in Methods
- Random number generation
Arrays in Methods

- As arguments to methods
  - Indexed variables
    - An individual "element" of an array can be method parameter
  - Entire array
    - All array elements can be passed as "one entity"

- As return value from method
  - Possible too, but not covered in this course
Indexed Variables as Arguments

- Indexed variable handled same as simple variable of array base type

- Given this method header:

- And these declarations:
  
  Dim i, As Integer
  Dim a(4), n As Double

- Can make these function calls:
Subtlety of Indexing

Consider:
myMethod(a(i));
  - Value of i is determined first
    - It determines which indexed variable is sent
myMethod(a(i*2));
  - Perfectly_________, from compiler’s view
  - ______________________________________
Exercise

Consider the following method:

```vba
Private Sub tripler(ByRef n As Integer)
    n *= 3
End Sub
```

And the following declarations:

```vba
Dim a() As Integer = {0, 1, 2, 3}
Dim number As Integer = 2
```

Which of the following are acceptable method calls?

- `tripler(a(2));`
- `tripler(a(4));`
- `tripler(a(number));`
- `tripler(a(number*2-1))`
- `tripler(a);`
- `tripler(number);`
Entire Array as Argument

- Formal parameter can be entire array
  - Argument then passed in method call is array name
  - Called "array parameter"

- Example:
  - A method to display an integer array
    ```vbnet
    Private Sub DisplayArray(ByVal someArray() As Integer)
    End Sub
    ```
  - A method to modify an integer array
    ```vbnet
    Private Sub ModifyArray(ByVal someArray() As Integer)
    End Sub
    ```
  - How to make a call using array parameter?
    ```vbnet
    Dim arrayOne(5) As Integer
    DisplayArray(arrayOne)
    ```
  - Arrays are always passed by reference!
Random Number Generator

- Return "randomly chosen" number
- Used for simulations, games
- Computer can only produce pseudorandom numbers
  - Appear to be random, but really are not.
  - Computers use complex mathematical formulas to generate values which look random
- Using built-in function Rnd()
Random Number Generator

- **Rnd()**
  - Returns a single type value in the range of [0, 1)
  - i.e., 0 <= Rnd() < 1
  - Each time the Rnd() function is called, a new psuedo-random value is returned.

- What if want integer in the range of [1, 100]?
  - CInt(Math.Floor(100 * Rnd()) + 1)

- What if want integer in the range of [10, 20]?
  - CInt(Math.Floor(11 * Rnd()) + 10)
Random Number Generator

- Generally, if want random integer in range of `[lowestValue, highestValue]`
  - `CInt(Math.Floor((highestValue - lowestValue + 1) * Rnd()) + lowestValue)`

- Can write a function for that purpose:
  ```vb
  ' returns a random integer in the range of [lowestValue, highestValue]
  Private Function Rand(ByVal LowestValue As Integer, ByVal highestValue As Integer) As Integer
      Return CInt(Math.Floor((highestValue - LowestValue + 1) * Rnd()) + LowestValue)
  End Function
  ```

- Can use this function to simulate such things as dealing cards or rolling dice
  - `dieValue = Rand(1, 6)`
  - `cardValue = Rand(1, 52)`
Random Number Seed

- Each time a program is run, the pseudo-random values returned by `Rnd()` are always the same
  - Obviously, this is very predictable and not random at all!

- Can use "seed" to alter sequence
  Randomize(seed_value)
  - Receives one argument, the "seed“, integer type
  - Can use any seed value
  - If you start the random number generator with the same seed, over and over, then each time it will produce the same sequence of numbers!
  - If use with no argument, then the system timer is used as the new seed value
Random Examples

- More about Rnd() function