Methods and Enums

Methods or Functions

- Official C# terminology makes a distinction between functions and methods.
- In C# terminology, the term “function” includes not only methods, but also other non-data members of a class or struct.
- This includes methods, properties, constructors, indexers, operators, destructors.

- On the contrast, data members are: fields, constants, and events.

Methods in C#

- A method is a group of statements that together perform a task.
- Every C# program has at least one class with a method named `Main`.

- To use a method, you need to:
  - Define the method
  - Call the method

Defining Methods in C#

- When you define a method, you basically declare the elements of its structure.
- The syntax for defining a method in C# is as follows:

```
<Access Modifier> <Return Type> <Method Name>(Parameter List)
{
      Method Body
}
```

Defining Methods in C#

```
<Access Modifier> <Return Type> <Method Name>(Parameter List)
{
      Method Body
}
```

Following are the various elements of a method:

- Access Modifier: This determines the visibility of a variable or a method from another class.
- Return Type: A method may return a value. The return type is the data type of the value the method returns. If the method is not returning any values, then the return type is `void`.
- Method Name: Method name is a unique identifier and it is case sensitive. It cannot be same as any other identifier declared in the class.
- Parameter List: Enclosed between parentheses, the parameters are used to pass and receive data from a method. Parameters are optional.
- Method Body: This contains the set of instructions needed to complete the required activity.

Examples of Methods

- Method without parameters and without return type:

```
public void Add()
{
      int a = 10;
      int b = 20;

      int sum = a + b;

      Console.WriteLine("Sum is " + sum);
}
```

Examples of Methods

- Method with parameters and without return type:

```
public void Add(int x, int y)
{
      int sum = x + y;
      Console.WriteLine("Sum is " + sum);
}
```

Examples of Methods

- Method without parameters and with return type:

```
public int Add()
{
      int x = 10;
      int y = 20;

      int sum = x + y;

      return sum;
}
```

Examples of Methods

- Method with parameters and with return type:

```
public int Add(int x, int y)
{
      int sum = x + y;

      return sum;
}
```

Method Parameters

- When method with parameters is called, you need to pass the parameters to the method.
- There are different ways that parameters can be passed to a method:
- Value Parameters:
  - This method copies the actual value of an argument into the formal parameter of the method.
  - In this case, changes made to the parameter inside the method have no effect on the argument.
- Reference Parameters:
  - This method copies the reference to the memory location of an argument into the formal parameter.
  - This means that changes made to the parameter affect the argument.
- Output Parameters:
  - This method helps in returning more than one value.
- Parameter Array:
  - You can pass **n** number of parameters to a method.

Example of Passing By Value and Reference

```
public static void Main()
{
      int i = 0;
      string s = "hello";
      int[] a = { 0, 1, 2, 4, 8 };

      Console.WriteLine("Before Changes:");
      Console.WriteLine("i = " + i);
      Console.WriteLine("s = " + s);
      Console.WriteLine("a[0] = " + a[0]);

      ChangeValues(i, s, a);
      Console.WriteLine("\nAfter Changes:");
      Console.WriteLine("i = " + i);
      Console.WriteLine("s = " + s);
      Console.WriteLine("a[0] = " + a[0]);
}
static void ChangeValues(int num, string str, int[] array)
{
      num = 100;        str = "bye";      array[0] = 100;
}
```

```
Output:

Before Changes:
i = 0
s = hello
a[0] = 0

After Changes:
i = 0
s = hello
a[0] = 100
```

Passing Parameters by Value

- In this mechanism, when a method is called, a new storage location is created for each value parameter.
- The values of the actual parameters are copied into them.
- Hence, the changes made to the parameter inside the method have no effect on the argument.
- Example on the next slide demonstrates the concept.

Passing Parameters by Value

```
static void Main(string[] args)
{
      int a = 10, b = 20;

      Console.WriteLine("Before swapping:");
      Console.WriteLine("a: " + a);
      Console.WriteLine("b: " + b);

      Swap(a, b);

      Console.WriteLine("\nAfter swapping:");
      Console.WriteLine("a: " + a);
      Console.WriteLine("b: " + b);
}

static void Swap(int x, int y)
{
      int temp = x;    // save the value of x
      x = y;           // put y into x
      y = temp;        // put temp into y
}
```

```
Output:

Before swapping:
a: 10
b: 20

After Swapping:
a: 10
b: 20
```

Passing Parameters by Reference

- A reference parameter is a reference to a memory location of a variable.
- When you pass parameters by reference, unlike value parameters, a new storage location is not created for these parameters.
- The reference parameters represent the same memory location as the actual parameters that are supplied to the method.
- You can pass value type parameters as reference parameters using the `ref` keyword.
- Example on the next slide demonstrates the concept.

Passing Parameters by Reference

```
static void Main(string[] args)
{
      int a = 10, b = 20;

      Console.WriteLine("Before swapping:");
      Console.WriteLine("a: " + a);
      Console.WriteLine("b: " + b);

      Swap(ref a, ref b);

      Console.WriteLine("\nAfter swapping:");
      Console.WriteLine("a: " + a);
      Console.WriteLine("b: " + b);
}

static void Swap(ref int x, ref int y)
{
      int temp = x;     // save the value of x
      x = y;            // put y into x
      y = temp;         // put temp into y
}
```

```
Output:

Before swapping:
a: 10
b: 20

After Swapping:
a: 20
b: 10
```

Passing Parameters by Reference

- When the code on the previous slide is compiled and executed, it produces the following result:

```
Before swapping:
a: 10
b: 20

After Swapping:
a: 20
b: 10
```

- This shows that the values have changed inside the `Swap` method and this change reflects in the `Main` method.

- You also need to add the `ref` keyword when you invoke the method `Swap(ref a, ref b);`

- *Always remember, any variable must be initialized before it is passed into a method, whether it is passed in by value or by reference.*

Output Parameters

- C# requires that variables be initialized with a starting value before they are accessed, whether they are passed by value or passed by reference.
- Often, the starting value of the variable that is passed by reference is unimportant.
- That value will be overwritten by the method, which may never even look at the previous value.
- However, there is a way to circumvent the C# compiler's insistence on initial values for input arguments.
- You do this with the `out` keyword.
- When a method's input argument is prefixed with `out`, that method can be passed a variable that has not been initialized.
- The variable is passed by reference, so any changes that the method makes to the variable will persist when control returns from the called method.
- You must use the `out` keyword when you call the method, as well as when you define it.

Output Parameters

- A `return` statement is used for returning only one value from a method.
- Sometimes, there is a need for methods to be able to output more than one value.
- Again, this can be accomplished by using the output parameters.

Output Parameters

```
static void Main(string[] args)
{
    int a = 10, b = 20, sum, mul; // sum and mul aren’t initialized

    Calculate(a, b, out sum, out mul);

    Console.WriteLine("Sum = " + sum);
    Console.WriteLine("Mul = " + mul);
}

static void Calculate(int a, int b, out int sum, out int mul)
{
    sum = a + b;
    mul = a * b;
}
```

```
Output:

Sum = 30
Mul = 200
```

Exercise

- Write a method TestString that finds out if a string has period and/or comma.
- The TestString method accepts a string and two bool output parameters: hasPeriod and hasComma.
- The output parameters are set true if a period and/or comma is found in the string, false otherwise.

- You can check for a character in a string by using the Contains() method on a string, like this:

```
if (str.Contains(',')) { … }
```

- Incorporate the TestString method into an app that receives a string from the user and provide the appropriate outputs.

Exercise - Solution

```csharp
static void Main(string[] args)
{
      Console.Write("Enter a string that might contain a period and/or comma: ");
      string s = Console.ReadLine();

      TestString(s, out bool hasPeriod, out bool hasComma);

      if (hasPeriod || hasComma)
            Console.WriteLine("The string contains a period and/or comma");
      else
            Console.WriteLine("The string doesn't contain a period and/or comma");
}

static void TestString(string str, out bool hasPeriod, out bool hasComma)
{
      hasPeriod = hasComma = false;
      if (str.Contains('.'))
            hasPeriod = true;
      if (str.Contains(','))
            hasComma = true;
}
```

Parameter Arrays

- Some methods can benefit from having an unbounded number of arguments passed to them.
- `Console.WriteLine` method is an example of this.
- The first argument is a format string, which is a string with placeholders.
- The remainder arguments to fill in those placeholders depends on the string itself.

- For example:

```
Console.WriteLine("{0} + {1} = {2}", a, b, a + b);
```

- The use of format strings comes in handy when dealing with quite a bit of formatting, where string concatenation would become very ugly and unreadable:

```
Console.WriteLine(a + " + " + b + " = " + (a + b));
```

Parameter Arrays

```
Output:

Number of elements: 3
101 102 103

Number of elements: 10
0 1 2 3 4 5 6 7 8 9
```

```
static void Main(string[] args)
{
    int[] numbers = {101, 102, 103};

    PrintArray(numbers);                              // passing an array
    PrintArray(0, 1, 2, 3, 4, 5, 6, 7, 8, 9);  // passing comma-
                                               separated arguments
}
static void PrintArray (params int[] num)
{
    Console.WriteLine("Number of elements: " + num.Length);

    foreach(int i in num)
        Console.Write(i + " ");
}
```

Named Arguments

- Invoking methods, the variable name need not be added to the invocation.
- However, if you have a method signature like the following to move a rectangle:

```
public void MoveAndResize(int x, int y, int width, int height)
{
        // method body
}
```

- And you invoke it with the following code snippet, it’s not clear from the method call what numbers are used for what:

```
rect.MoveAndResize(30, 40, 20, 40);
```

- You can change the invocation to make it immediately clear what the numbers mean:

```
rect.MoveAndResize(x: 30, y: 40, width: 20, height: 40);
```

Named Arguments

- Typically, parameters need to be passed into a method in the same order that they are defined.
- Named arguments allow you to pass in parameters in any order.

```
static string PersonInfo(string name, int age)
{
     Console.WriteLine("Name = " + name);
     Console.WriteLine("Age = " + age);
}
```

- The following two method calls will result in the same output:

```
PersonInfo("John", 34);
PersonInfo(age: 34, name: "John");
```

Optional Arguments

- Arguments can also be optional.
- While defining the method, supply a default value for optional parameters, which must be the last ones defined.

```
static void PersonInfo(string name, int age = 21)
{
     Console.WriteLine("Name = " + name);
     Console.WriteLine("Age = " + age);
}
```

- Different ways to call this method:

```
PersonInfo("John", 34);
PersonInfo("John");   // only passing the name; age will be 21
```

Optional Arguments

- Different ways to call a method with optional arguments.

```
static void PersonInfo(string name = "John", int age = 21)
{
        Console.WriteLine("Name = " + name);
        Console.WriteLine("Age = " + age);
}
```

```
// Omit the optional parameters
PersonInfo();

// Omit second optional parameter
PersonInfo("Mark");

// You can't omit the first but keep the second
// PersonInfo(37); // Not allowed

// Classic calling syntax
PersonInfo("Mark", 37);

// Specify one named parameter
PersonInfo(age: 37);

// Specify both named parameters
PersonInfo(age: 37, name: "Mark");
```

Expression-Bodied Methods

- If the implementation of a method consists of just one statement, C# gives a simplified syntax to method definitions: expression-bodied methods.
- You don’t need to write curly brackets and the `return` keyword with the new syntax.
- The operator `=>` (lambda operator) is used to distinguish the declaration of the left side of this operator to the implementation that is on the right side.

- **Link:**
- https://docs.microsoft.com/en-us/dotnet/csharp/programming-guide/statements-expressions-operators/expression-bodied-members

Expression-Bodied Methods

- The right side of the lambda operator defines the implementation of the method.
- Curly brackets and a `return` statement are not needed.
- What’s returned is the result of the statement, and the result needs to be of the same type as the method declared on the left side, which is a `double` in this code snippet:

```
public double FindSquare(double num) => num * num;
```

- The above code is same as:

```
public double FindSquare(double num)
{
        return num * num;
}
```

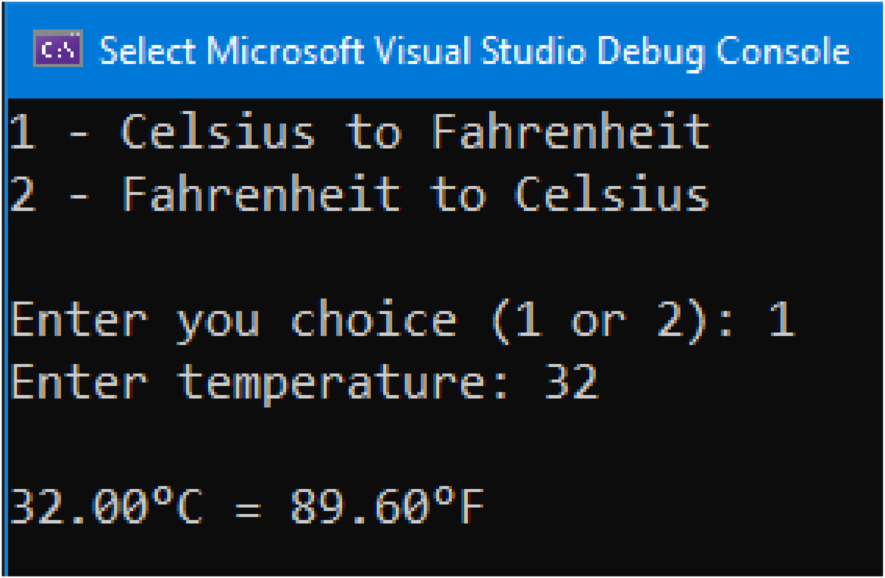
Do It Yourself!

- **Exercise: Temperature Conversions:**
- Implement the following methods:
  a) Method `Fahrenheit` returns the Fahrenheit equivalent of a Celsius temperature, using the calculation:

```
f = 9.0 / 5.0 * c + 32;
```

  b) Method `Celsius` returns the Celsius equivalent of a Fahrenheit temperature, using the calculation"

```
c = 5.0 / 9.0 * ( f - 32 );
```



```
1 - Celsius to Fahrenheit
2 - Fahrenheit to Celsius

Enter you choice (1 or 2): 1
Enter temperature: 32

32.00°C = 89.60°F
```

- Use the methods from parts (a) and (b) to write an app that enables the user either to enter a Celsius temperature and display the Fahrenheit equivalent or enter a Fahrenheit temperature and display the Celsius equivalent.
- Round off the output to 2 decimal places and display the unit (°F or °C).
- Display a degree symbol as well. (Unicode: `\u00B0`)

🛠 Do It Yourself!

- Exercise: **Parking Charges:**
- A parking garage charges a $2.00 minimum fee to park for up to three hours.
- The garage charges an additional $0.50 per hour for each hour or part thereof in excess of three hours.
- The maximum charge for any given 24-hour period is $10.00.
- Assume that no car parks for longer than 24 hours at a time.
- Write an app that calculates and displays the parking charges for each customer who parked in the garage.
- You should enter the hours parked for each customer. The app should display the charge for the current customer and should calculate and display the running total of previous receipts.
- The app should use method `CalculateCharges` to determine the charge for each customer.

Do It Yourself!

- Exercise: **Exponentiation:**
- Write a method `IntegerPower( base, exponent )` that returns the value of base^{exponent}.
- For example, `IntegerPower(3, 4)` calculates 3^4 (or 3 * 3 * 3 * 3).
- Assume that exponent is a positive integer and that base is an integer.
- Method `IntegerPower` should use a `for` or `while` loop to control the calculation.
- ***Do not use any Math-library methods.***
- Incorporate this method into an app that reads integer values for base and exponent and performs the calculation with the `IntegerPower` method.

🛠 Do It Yourself!

- **Exercise: Coin Tossing:**
- Write an app that simulates coin tossing.
- The app should call a method `Flip` that takes no arguments and returns `false` for tails and `true` for heads.
- Display the result.

- Upgrade the app by using loop which keeps asking the user whether they want to flip a coin again.
- Count the number of times each side of the coin appears.

🛠 Do It Yourself!

- Exercise: **Perfect Numbers:**
- An integer number is said to be a perfect number if its factors, including 1 (but not the number itself), sum to the number.
- For example, 6 is a perfect number, because 6 = 1 + 2 + 3.
- Write method `Perfect` that determines whether parameter value is a perfect number.
- Use this method in an app that determines and displays all the perfect numbers between 2 and 1000.

- Enhance the app so that it displays the factors of each perfect number to confirm that the number is indeed perfect.

🛠 Do It Yourself!

- **Exercise: Prime Numbers:**
- An integer is said to be prime if it’s greater than 1 and divisible by only 1 and itself.
- For example, 2, 3, 5 and 7 are prime, but 4, 6, 8 and 9 are not.
- Write a method that determines whether a number is prime.
- Use this method in an app that displays all the prime numbers less than 10,000.

Enumeration in C#

Introduction to Enums in C#

- An enumeration is a value type that contains a list of named constants, such as the `Color` type.
- The enumeration type is defined by using the `enum` keyword.

```
public enum Color
{
        Red,
        Green,
        Blue
}
```

Introduction to Enums in C#

- You can declare variables of `enum` types, such as the variable `c`, and assign a value from the enumeration by setting one of the named constants prefixed with the name of the `enum` type.

```
Color c = Color.Red;
Console.WriteLine(c);
```

```
Output:

Red
```

Introduction to Enums in C#

- In C#, `enum` is a value type data type.
- The `enum` is used to declare a list of named integer constants.
- It can be defined using the `enum` keyword directly inside a namespace, or class.
- The `enum` is used to give a name to each constant so that the constant integer can be referred using its name.
- By default, the first member of an `enum` has the value `0` and the value of each successive `enum` member is increased by `1`.
- You can also set your own custom integer values to `enum` members.
- `enum` allows us to create a new data type.

Why And When To Use Enums?

- Use `enum`s when you have values that you know aren't going to change, like months, days, colors, deck of cards, etc.

Introduction to Enums in C#

- By default, the first item of an enum has the value 0.
- The second has the value 1, and so on.

- To get the integer value from an item, you must explicitly convert the item to an int.

```
enum Day
{
        Sunday,         // 0
        Monday,         // 1
        Tuesday,        // 2
        Wednesday,      // 3
        Thursday,       // 4
        Friday,         // 5
        Saturday        // 6
}

static void Main(string[] args)
{
        Console.WriteLine((int)Day.Sunday);
        Console.WriteLine((int)Day.Monday);
}
```

```
Output:

0
1
```

Introduction to Enums in C#

- By default, the type behind the `enum` type is an `int`.
- The underlying type can be changed to other integral types (`byte`, `short`, `int`, `long` with signed and unsigned variants).

```
enum Day : short

{
        Sunday,                 // 0
        Monday,                 // 1
        Tuesday,                // 2
        Wednesday,              // 3
        Thursday,               // 4
        Friday,                 // 5
        Saturday                // 6
}
```

Introduction to Enums in C#

- We can specify custom constant values for the members of the `enum`.

```
enum Day

{
        Sunday = 10,              // 10
        Monday,                   // 11
        Tuesday,                  // 12
        Wednesday,                // 13
        Thursday,                 // 14
        Friday,                   // 15
        Saturday                  // 16
}
```

Introduction to Enums in C#

- You can also assign random integer values to `enum` members.

```
enum Day
{
      Sunday = 10,          // 10
      Monday = 2,           // 2
      Tuesday = 8,          // 8
      Wednesday = 15,       // 15
      Thursday = 4,         // 4
      Friday = 7,           // 7
      Saturday = 12         // 12
}
```

Day of the Week Example

```
enum Day
{
    Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday
}

class Program
{
    static void Main(string[] args)
    {
        Console.Write("Enter the day number (0-6): ");
        int dayNum = int.Parse(Console.ReadLine());

        Day d = (Day)dayNum; // type-cast int to enum Day

        Console.WriteLine("It is " + d);
    }
}
```

Output:

```
Enter the day number (0-6): 4
It is Thursday
```

Playing Cards Example

```
enum CardValue
{
      Two = 2,
      Three, Four, Five, Six, Seven, Eight, Nine, Ten, Jack, Queen, King, Ace
}

enum Suit
{
      Heart, Spade, Club, Diamond
}

class Program
{
      static void Main(string[] args)
      {
            Random rnd = new Random();
            CardValue cardValue = (CardValue)rnd.Next(2, 15);
            Suit suit = (Suit)rnd.Next(4);

            Console.WriteLine(cardValue + " of " + suit);
      }
}
```

```
Output 1:

Seven of Club
```

```
Output 2:

Ace of Diamond
```

Thank You

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References

Material has been taken from:

- Visual C# 2012: How to Program:
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