



Class and Interface

.NET

Class is the most fundamental of C#'s types. A **class** is a data structure that combines state (fields) and actions (methods) into a single unit.

Classes support inheritance and polymorphism. A **Class** is a blueprint for a **Class** Object.

Class

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects>

Classes are defined using class declarations.

A class declaration starts with a header that specifies

- the attributes and modifiers of the class,
- the name of the class,
- the base class (if given), and
- the interfaces implemented by the class.

The header is followed by the class **body**, which consists of a list of member declarations written between curlyBrackets { }.

Body

```
public class Point  Header
{
    public int x, y;
    public Point(int x, int y)
    {
        this.x = x;
        this.y = y;
    }
}
```

Class – Instance Instantiation

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects>

Instances of classes are created using the ***new*** operator, which

- allocates memory for a new instance,
- invokes a constructor to initialize the instance
- returns a reference to the instance.

The memory occupied by an object is automatically reclaimed by the ***Garbage Collector*** when the object is no longer reachable.

```
Point p1 = new Point(0, 0);  
Point p2 = new Point(10, 20);
```

Class - Members

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects>

Members of a class are:

- Constructors - To initialize instances of the class
- Constants - Constant values
- Fields - Variables
- Methods - Computations/actions that can be performed
- Properties - Fields combined with the actions associated with reading/writing them
- Types - Nested types declared by the class

Class members can be:

- static - belong to classes.
Invoked with:
ClassName.MethodName();
- instance - belong to instances of classes. Invoked with:
InstanceName.MethodName();

Accessibility of Classes

<https://docs.microsoft.com/en-us/dotnet/csharp/programming-guide/classes-and-structs/access-modifiers>

- ***Classes*** and ***structs*** declared directly in a ***namespace*** (not nested in another class or struct) can be either ***public*** or ***internal***.
- ***Derived*** classes can't have greater accessibility than their base class.
- ***Internal*** is default if no access modifier is specified.

Class – Member Accessibility

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects#accessibility>

Access Modifiers control the regions of program text that can access the member.

- private - This class only.
- protected - derived classes.
- private protected - This class or derived classes only.
- internal - current assembly (.exe, .dll).
- protected internal - This class, child classes, or classes within the same assembly.
- public - Access isn't limited.

Class – Local Variables

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects#method-body-and-local-variables>

Local variables are declared inside the body of the method. They must have a type name and a variable name. All variables get a default value.

- `Int == 0;`
- `String == "";`

```
using System;
class Squares
{
    public static void WriteSquares()
    {
        int i = 0;
        int j;
        while (i < 10)
        {
            j = i * i;
            Console.WriteLine($"{i} x {i} = {j}");
            i = i + 1;
        }
    }
}
```


Class – Methods

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects#methods>

There are two categories of methods:

- **Static** – accessed directly through the class
- **Instance** – accessed through instances of a class.

Methods have a **Method Signature** which consists of:

- the name of the method,
- The (optional) **type** parameters,
- its parameters.

*The signature of a method doesn't include the return type.

```
static void Swap(ref int x, ref int y)
{
    int temp = x;
    x = y;
    y = temp;
}
```

```
// Methods
public void Add(T item)
{
    if (count == Capacity) Capacity = count * 2;
    items[count] = item;
    count++;
    OnChanged();
}
```

Class – Static and Instance Methods

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects#static-and-instance-methods>

static method –

- declared with a ***static*** modifier.
- doesn't operate on a specific class instance.
- can only directly access ***static*** members.
- Cannot use '*this*'

instance method –

- declared without the ***static*** modifier.
- operates on a specific class instance only.
- can access both ***static*** and ***instance*** members.
- Can use '*this*'.

```
class Entity
{
    static int nextSerialNo;
    int serialNo;
    public Entity()
    {
        serialNo = nextSerialNo++;
    }
    public int GetSerialNo()
    {
        return serialNo;
    }
    public static int GetNextSerialNo()
    {
        return nextSerialNo;
    }
    public static void SetNextSerialNo(int value)
    {
        nextSerialNo = value;
    }
}
```

Value and ref Parameters

<https://docs.microsoft.com/en-us/dotnet/csharp/language-reference/keywords/ref>

Parameters are used to receive values or variable references from method calls. There are five types:

```
static void Divide(int x, int y,
{
    result = x / y;
    remainder = x % y;
}
```

1. value parameter

- a copy of the argument passed. Changes don't affect the original argument. Can be options by specifying a default value.

```
using System;
class RefExample
{
    static void Swap(ref int x, ref int y)
    {
        int temp = x;
        x = y;
        y = temp;
    }
    public static void SwapExample()
    {
        int i = 1, j = 2;
        Swap(ref i, ref j);
        Console.WriteLine($"{i} {j}");    // Outputs "2 1"
    }
}
```

2. reference parameter

- declared with the '**ref**' modifier. Used for passing value arguments by reference. The argument must be a variable with a definite value. Changes take place on the original value.

out and params parameters

<https://docs.microsoft.com/en-us/dotnet/csharp/language-reference/keywords/out-parameter-modifier>
<https://docs.microsoft.com/en-us/dotnet/csharp/language-reference/keywords/params>

- **3. output parameter** - declared with the **out** modifier. Used for passing arguments by reference. An explicitly assigned value is not allowed before the method call.
- **4. parameter array** - permits a variable number of arguments to be passed to a method. Declared with the **params** modifier. Must be the last parameter and be a 1-D array. **Write()** and **WriteLine()** methods use parameter arrays.

```
public class Console
{
    public static void Write(string fmt, params object[] args) { }
    public static void WriteLine(string fmt, params object[] args) { }
    // ...
}
```

```
using System;
class OutExample
{
    static void Divide(int x, int y, out int result, out int remainder)
    {
        result = x / y;
        remainder = x % y;
    }
    public static void OutUsage()
    {
        Divide(10, 3, out int res, out int rem);
        Console.WriteLine("{0} {1}", res, rem); // Outputs "3 1"
    }
}
```

```
Console.WriteLine("x={0} y={1} z={2}", x, y, z);
```

in parameter

<https://docs.microsoft.com/en-us/dotnet/csharp/language-reference/keywords/in-parameter-modifier>

The **in** keyword causes arguments to be passed by reference but ensures the argument is not modified. It makes the formal parameter an alias for the argument, which must be a variable.

It is like the **ref** or **out** keywords, except that **in** arguments cannot be modified by the called method. Whereas **ref** arguments may be modified, **out** arguments must be modified by the called method, and those modifications are observable in the calling context.

```
int readonlyArgument = 44;
InArgExample(readonlyArgument);
Console.WriteLine(readonlyArgument);    // value is still 44

void InArgExample(in int number)
{
    // Uncomment the following line to see error CS8331
    //number = 19;
}
```

Class – Method Overloading

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects#method-overloading>

Method overloading

- permits multiple methods in the same class to have the same name
- Methods must each have unique parameter lists.
- The compiler uses ‘overload resolution’ to determine the specific method to invoke.
- ‘Overload resolution’ finds the one method that best matches the arguments or reports an error if none is found.
- A method can be selected by explicitly **casting** the arguments to the exact parameter types.

```
using System;
class OverloadingExample
{
    static void F()
    {
        Console.WriteLine("F()");
    }
    static void F(object x)
    {
        Console.WriteLine("F(object)");
    }
    static void F(int x)
    {
        Console.WriteLine("F(int)");
    }
    static void F(double x)
    {
        Console.WriteLine("F(double)");
    }
    static void F<T>(T x)
    {
        Console.WriteLine("F<T>(T)");
    }
    static void F(double x, double y)
    {
        Console.WriteLine("F(double, double)");
    }
    public static void UsageExample()
    {
        F();           // Invokes F()
        F(1);          // Invokes F(int)
        F(1.0);         // Invokes F(double)
        F("abc");       // Invokes F<string>(string)
        F((double)1);   // Invokes F(double)
        F((object)1);   // Invokes F(object)
        F<int>(1);       // Invokes F<int>(int)
        F(1, 1);        // Invokes F(double, double)
    }
}
```

Optional Parameters and Default Parameter Values

<https://docs.microsoft.com/en-us/dotnet/csharp/programming-guide/classes-and-structs>

A parameter can be *optional*. Any call must provide arguments for all required parameters but can omit arguments for *optional* parameters.

Each *optional* parameter has a default value as part of its definition. If no argument is sent for that parameter, the default value is used.

```
public void ExampleMethod(int required, string optionalstr = "default string",  
    int optionalint = 10)
```

Optional parameters are at the end of the parameter list after all required parameters. The caller must provide arguments for all required parameters before any optional parameters.

Interface

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/interfaces>

<https://docs.microsoft.com/en-us/dotnet/csharp/language-reference/keywords/interface>

- An **interface** defines a **contract** that can be implemented by classes and structs.
- An **interface** can contain methods, properties, events.
- An **interface** does NOT provide implementations. It specifies the members that must be implemented by classes or structs that implement the interface.
- **Interface** implementation is NOT inheritance. It is intended to express a "can do" relationship between an interface and its implementing type.
- **Interfaces** are used to simulate **multiple inheritance**.

```
interface IControl
{
    void Paint();
}

interface ITextBox : IControl
{
    void SetText(string text);
}

interface IListBox : IControl
{
    void SetItems(string[] items);
}

interface IComboBox : ITextBox, IListBox { }
```


Interface

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/interfaces>

Interfaces may employ multiple inheritance.

```
interface IControl
{
    void Paint();
}
interface ITextBox: IControl
{
    void SetText(string text);
}
interface IListBox: IControl
{
    void SetItems(string[] items);
}
interface IComboBox: ITextBox, IListBox {}
```

Classes and structs can implement multiple interfaces.

```
interface IDataBound
{
    void Bind(Binder b);
}
public class EditBox: IControl, IDataBound
{
    public void Paint() { }
    public void Bind(Binder b) { }
}
```

Are Paint() and Bind() defined?

Class – Type Parameters

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects#type-parameters>

Type Parameters

- are used to define a *generic* class type.
- follow the class name and are inside `<>`.
- are used to define the members of the class.

```
public class Pair<TFirst,TSecond>
{
    public TFirst First;
    public TSecond Second;
}
```

```
Pair<int,string> pair = new Pair<int,string> { First = 1, Second = "two" };
int i = pair.First;    // TFirst is int
string s = pair.Second; // TSecond is string
```

Class – Base (inherited) Classes

<https://docs.microsoft.com/en-us/dotnet/csharp/tour-of-csharp/classes-and-objects#base-classes>

A class declaration specifies inheritance of a base class by following the class name (and type parameters) with...

: [baseClassName]

```
public class Point
{
    public int x, y;
    public Point(int x, int y)
    {
        this.x = x;
        this.y = y;
    }
}
public class Point3D: Point
{
    public int z;
    public Point3D(int x, int y, int z) :
        base(x, y)
    {
        this.z = z;
    }
}
```