



Writing Object Oriented Software with C#

C# and OOP

- C# is designed for the .NET Framework
 - The .NET Framework is Object Oriented
- In C#
 - Your access to the OS is through objects
 - You have the ability to create first class objects
 - The FCL is designed for extension and integration by your code

Defining Classes

```
class Name: BaseType{  
    // Members  
}
```

```
Namespace NameName{  
    class Name: BaseType{  
    }  
}
```

```
class MyType{  
    public static String someTypeState;  
    public Int32 x;  
    public Int32 y;  
}
```

Accessibility

- In C#, `private` is the default accessibility
- Accessibilities options
 - `public` – Accessible to all
 - `private` – Accessible to containing class
 - `protected` – Accessible to containing or derived classes
 - `internal` – Accessible to code in same assembly
 - `protected internal` – means `protected` or `internal`
- Classes can be marked as `public` or `internal`
 - By default they are `private`
 - Accessible only to code in the same source module

Type Members in C#

- Fields

- The state of an object or type

- Methods

- Constructors
- Functions
- Properties (smart fields)

- Members come in two basic forms

- Instance – per object data and methods
 - Default
- Static – per type data and methods
 - Use the `static` keyword

Methods

- Declared inline with type definition

```
class MyType{  
    public Int32 SomeMethod(){  
        return x;  
    }  
  
    public static void StaticMethod(){  
        // Do something  
    }  
}
```

- No inline keyword, methods are inlined when appropriate by the JIT compiler

Properties

- Methods that look like fields (smart fields)

```
class Point{
    Int32 x;
    Int32 y;
    public Int32 x{
        get{return x;}
        set{x = value;}
    }
    public Int32 y{
        get{return y;}
        set{y = value;}
    }
}
```

- Can have read-only or write-only properties



Demo Classes and Properties

Instance Constructors

- Constructors are used to initialize fields
- You can implement simpler constructors in terms of more complex ones with the `this` keyword (suggested)

```
class Point{
    Int32 x;
    Int32 y;

    public Point():this(0, 0){}

    public Point(Int32 x, Int32 y){
        this.x = x;
        this.y = y;
    }
}
```

- You can indicate which base constructor to call
 - Use the `base` keyword

Type (static) Constructors

- Type constructors are used to initialize `static` fields for a type
- Only one static constructor per type
 - Called by the Common Language Runtime
 - Guaranteed to be called before any reference to the type or an instance of the type
 - Must have no parameters
- Use the `static` keyword to indicate a type constructor

Derivation and Object

- All types in the system are derived from `Object`
- You can specify a base class
 - Without a base class the compiler assumes `Object`
- Object reference variables are used as generic references
 - Collection classes in the Framework Class Library
- Object implements useful methods like
 - `ToString()`, `GetType()`
 - `ReferenceEquals()`

Polymorphism and Virtual Functions

- Use the `virtual` keyword to make a method virtual
- In derived class, override method is marked with the `override` keyword
- Example

- `Tostring()` method in Object class

```
public virtual string ToString();
```

- Example derived class overriding `Tostring()`

```
class SomeClass:Object{  
    public override String ToString(){  
        return "Some String Representing State";  
    }  
}
```

C# and Events

- C# has built in support for events
- Great for dealing with objects in an event-driven operating system
- Improved performance and flexibility over an all-virtual-function solution
- More than one type can register interest in a single event
- A single type can register interest in any number of events

Handling an Event

EventHand.cs

```
using System;
using System.Windows.Forms;
class MyForm:Form{
    MyForm(){
        Button button = new Button();
        button.Text = "Button";
        button.Click += new EventHandler(HandleClick);
        Controls.Add(button);
    }
    void HandleClick(Object sender, EventArgs e){
        MessageBox.Show("The Click event fired!");
    }
    public static void Main(){
        Application.Run(new MyForm());
    }
}
```



Demo EventHandler.cs

Defining an Event

- Based on a callback mechanism called a **delegate**

```
class EventInt{
    Int32 val;
    public Int32 value{
        get{return val;}
        set{
            if(Changed != null)
                Changed(value, val);
            val = value;
        }
    }
    public event Callback Changed;
    public delegate
        void Callback(Int32 newVal, Int32 oldval);
}
```


Callback Methods (Delegates)

Delegates.cs

```
using System;
delegate void MyDelegate(String message);
class App{
    public static void Main(){
        MyDelegate call = new MyDelegate(FirstMethod);
        call += new MyDelegate(SecondMethod);
        call("Message A");
        call("Message B");
    }
    static void FirstMethod(String str){
        Console.WriteLine("1st method: "+str);
    }
    static void SecondMethod(String str){
        Console.WriteLine("2nd method: "+str);
    }
}
```

Interfaces

- C# supports interfaces
 - Your types can implement interfaces
 - Must implement all methods in the interface
 - You can define custom interfaces
- Interfaces can contain methods but no fields
 - Properties and events included
 - Constructors are not supported in interfaces
- Use the **interface** keyword

```
interface Name{  
    // Members  
}
```

Operator Overloading and Type Conversion

- C# allows you to write operator overload methods
- Called when a custom type is used in an expression with operators
 - Can overload: `+`, `-`, `*`, `|`, etc.
- Can create custom cast methods
 - Implicitly or explicitly convert your type to another type

C# and OOP

- C# and the .NET Framework promote component development
 - Can use binary or pre-compiled objects
 - More applications will use more components
 - Creates a market for third-party component vendors
 - Strong security story allows for internet deployment of objects
- C# has a great set of tools for the object oriented programmer

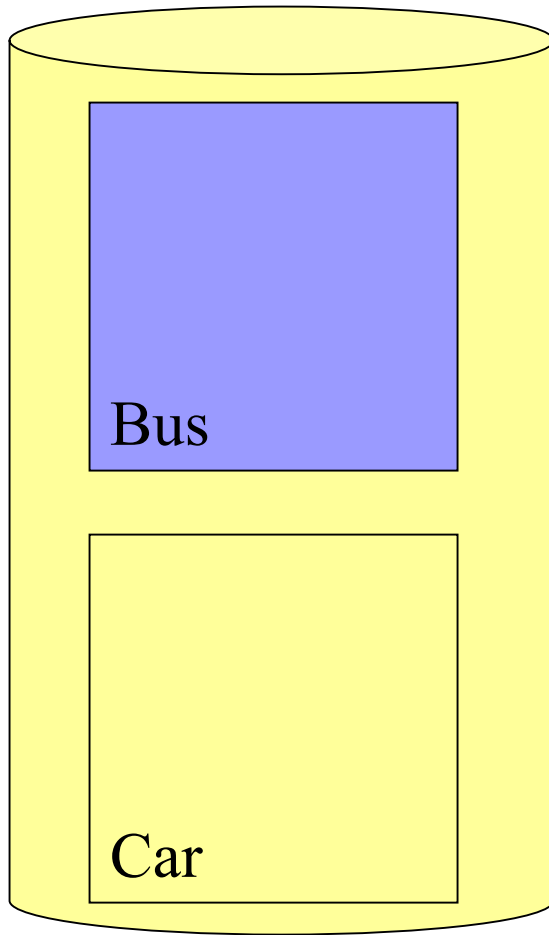


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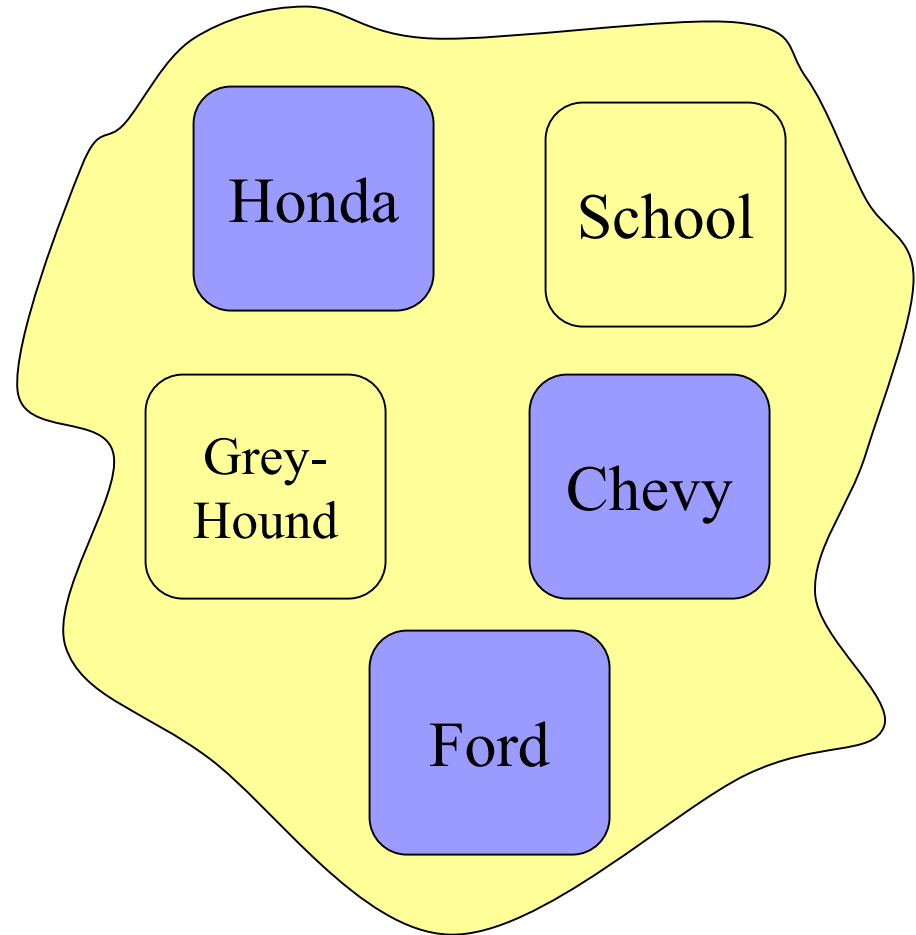
Hidden Slides are Originals for Art in Tutorial .DOC file

Types



Types include methods and description of fields for objects. **Stored in Exe.**

Instances (objects)



Instances are **in-memory data**. Includes data for fields and refers to type information.

A type defines a number of fields and methods. A derived type inherits the base type's fields and methods, and adds a few of its own, to become a new type-extension of an existing type.

Fields and Methods

```
String Description;  
FuelType Fuel;  
Double EfficiencyQuotient
```

Machine

Fields and Methods

```
String Make;  
String Model;
```

Automobile