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

Point-0.cs

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 EventHand.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);
}
```

EventInt.cs

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
}
```

Sortable.cs

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

Overloading.cs TypeConverters.cs

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 venders
  - 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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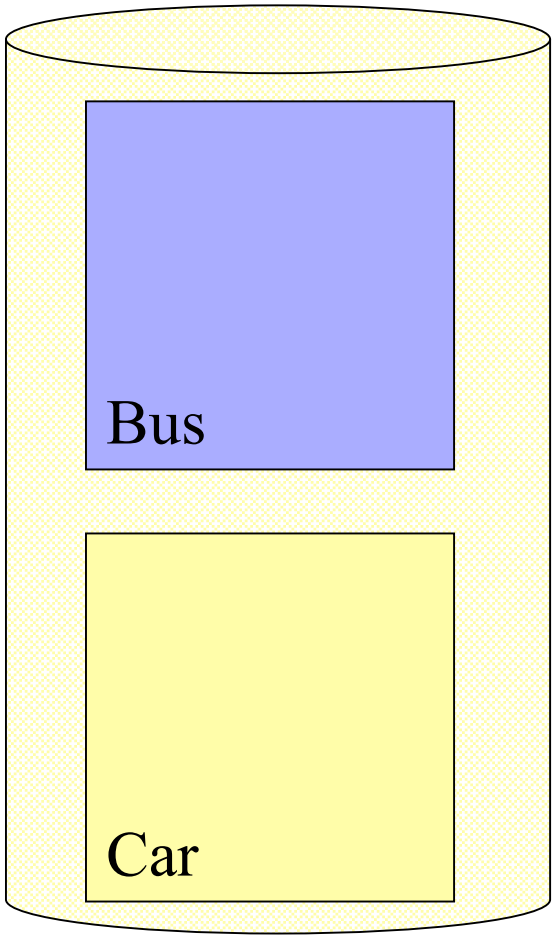
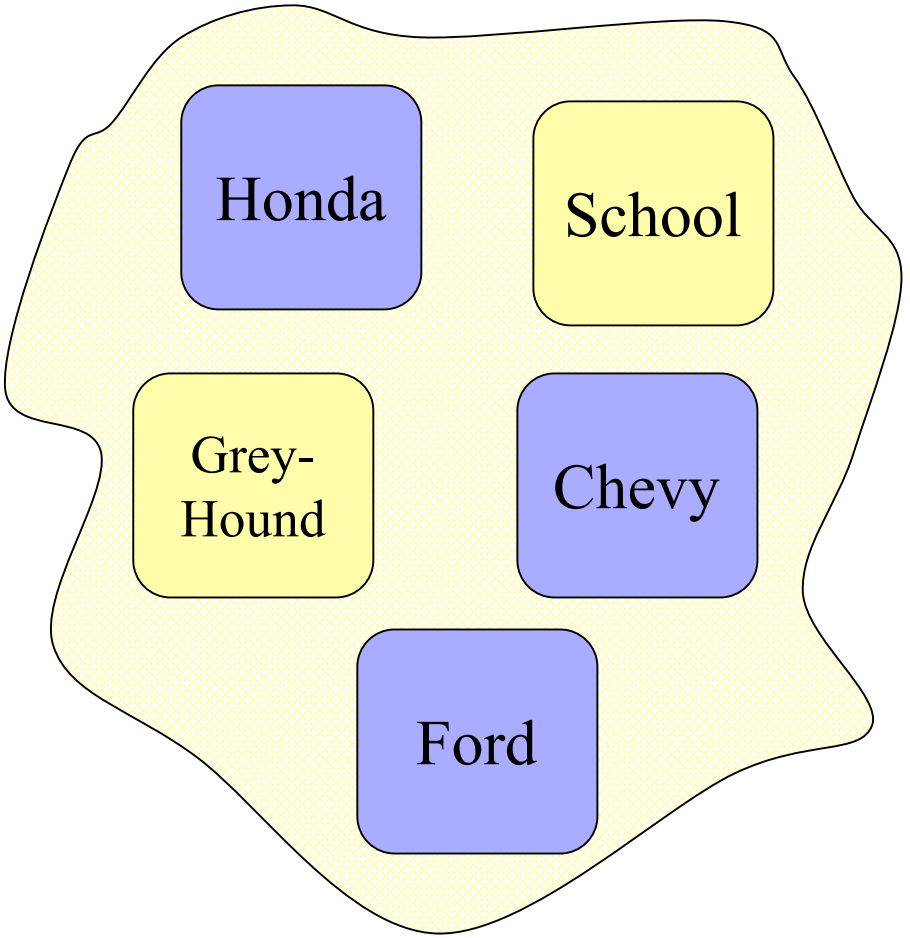
Hidden Slides are Originals for Art in Tutorial .DOC file

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.