C# - POLYMORPHISM

http://www.tutorialspoint.com/csharp/csharp_polymorphism.htm

The word **polymorphism** means having many forms. In object-oriented programming paradigm, polymorphism is often expressed as 'one interface, multiple functions'.

Polymorphism can be static or dynamic. In **static polymorphism**, the response to a function is determined at the compile time. In **dynamic polymorphism**, it is decided at run-time.

Static Polymorphism

The mechanism of linking a function with an object during compile time is called early binding. It is also called static binding. C# provides two techniques to implement static polymorphism. They are:

- Function overloading
- Operator overloading

We discuss operator overloading in next chapter.

Function Overloading

You can have multiple definitions for the same function name in the same scope. The definition of the function must differ from each other by the types and/or the number of arguments in the argument list. You cannot overload function declarations that differ only by return type.

The following example shows using function **print** to print different data types:

```
using System;
namespace PolymorphismApplication
{
   class Printdata
   {
      void print(int i)
      {
         Console.WriteLine("Printing int: {0}", i );
      }

      void print(double f)
      {
         Console.WriteLine("Printing float: {0}" , f);
      }

      void print(string s)
      {
         Console.WriteLine("Printing string: {0}", s);
      }
      static void Main(string[] args)
      {
         Printdata p = new Printdata();

         // Call print to print integer
         p.print(5);

         // Call print to print float
         p.print(500.263);

         // Call print to print string
         p.print("Hello C++");
         Console.ReadKey();
      }
   }
}
```

When the above code is compiled and executed, it produces the following result:

```
Printing int: 5
Printing float: 500.263
Printing string: Hello C++
```

Dynamic Polymorphism

C# allows you to create abstract classes that are used to provide partial class implementation of an interface. Implementation is completed when a derived class inherits from it. **Abstract** classes contain abstract methods, which are implemented by the derived class. The derived classes have more specialized functionality.

Here are the rules about abstract classes:

- You cannot create an instance of an abstract class
- You cannot declare an abstract method outside an abstract class
- When a class is declared **sealed**, it cannot be inherited, abstract classes cannot be declared sealed.

The following program demonstrates an abstract class:

```
using System;
namespace PolymorphismApplication
{
   abstract class Shape
   {
      public abstract int area();
   }
   class Rectangle:  Shape
   {
      private int length;
      private int width;
      public Rectangle( int a=0, int b=0)
      {
         length = a;
         width = b;
      }
      public override int area ()
      {
         Console.WriteLine("Rectangle class area :");
         return (width * length);
      }
   }

   class RectangleTester
   {
      static void Main(string[] args)
      {
         Rectangle r = new Rectangle(10, 7);
         double a = r.area();
         Console.WriteLine("Area: {0}",a);
         Console.ReadKey();
      }
   }
}
```

When the above code is compiled and executed, it produces the following result:

```
Rectangle class area :
Area: 70
```

When you have a function defined in a class that you want to be implemented in an inherited classes, you use **virtual** functions. The virtual functions could be implemented differently in different inherited class and the call to these functions will be decided at runtime.

Dynamic polymorphism is implemented by **abstract classes** and **virtual functions**.

The following program demonstrates this:

```
using System;
namespace PolymorphismApplication
{
   class Shape
   {
      protected int width, height;
      public Shape( int a=0, int b=0)
      {
         width = a;
         height = b;
      }
      public virtual int area()
      {
         Console.WriteLine("Parent class area :");
         return 0;
      }
   }
   class Rectangle: Shape
   {
      public Rectangle( int a=0, int b=0): base(a, b)
      {

      }
      public override int area ()
      {
         Console.WriteLine("Rectangle class area :");
         return (width * height);
      }
   }
   class Triangle: Shape
   {
      public Triangle(int a = 0, int b = 0): base(a, b)
      {

      }
      public override int area()
      {
         Console.WriteLine("Triangle class area :");
         return (width * height / 2);
      }
   }
   class Caller
   {
      public void CallArea(Shape sh)
      {
         int a;
         a = sh.area();
         Console.WriteLine("Area: {0}", a);
      }
   }
   class Tester
   {

      static void Main(string[] args)
      {
         Caller c = new Caller();
         Rectangle r = new Rectangle(10, 7);
         Triangle t = new Triangle(10, 5);
         c.CallArea(r);
         c.CallArea(t);
         Console.ReadKey();
      }
   }
}
```

When the above code is compiled and executed, it produces the following result:

```
Rectangle class area:
Area: 70
Triangle class area:
Area: 25
```