Visual C# .Net using framework 4.5

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Lecture 06

Events

An event in C# is a way for a class (Sender) to provide notifications to clients (Listener) of that class when some interesting thing happens to an object. The most familiar use for events is in graphical user interfaces

The ideal case that we have 2 classes:

1)Sender, which must contains the events. The event itself didn't know what function will be executed, he knows what is the Signature of the function to be executed and its return type (delegate). In the event declaration, it must specify the delegate. Also, the Sender Class must contains the code that fire the event.

2)Listener, contains the relation of the events with the method that will be executed when the event fire. This is done through the delegate. It also contains the implementation of the methods to be executed when the event fire.

Example:

Write a program that read a number from the user, this number is between 1 and 100. If the number is Less than 1, it print a message on the screen "Less than 1" and if it is greater than 100, it prints "Out of Range"

Events

1) The Sender

```
public delegate void ValueHandler(string msg);
public class Sender
{
        public int I;
        //The Sender class can send these 2 events
        public event ValueHandler Low;
        public event ValueHandler High;
        public void ReadData()
        {
                I = int.Parse(Console.ReadLine());
                If(I < 1)
                {
                        if(Low != null)
                        {
                                Low("Out of Range, Number is too small");
                        }
                }
```

Events

1) The Sender

```
                else
                {
                        if(I > 100)
                        {
                                if(High !=null)
                                {
                                        High("Out of Range, Number is too large");
                                }
                        }
                }
        }//End Read Data
}//End Sender Class
```

Events

2) The Listening to the incoming Event

```
public class EventApp
{       public static int Main()
        {       Sender s = new Sender();
                //Hooks into events
                s.Low  += new ValueHandler(OnLow);
                s.High += new ValueHandler(OnHigh);
                //Call the Read Data
                s.ReadData();
        }
        public void OnLow(string str)
        {
                Console.WriteLine(”{0}”, str);
        }
        public void OnHigh(string str)
        {
                Console.WriteLine(”{0}”, str);
        }
}
```

Generics

With the release of .NET 2.0, the C# programming language has been enhanced to support a new feature of the CTS termed generics. Simply, generics provide a way for programmers to define “placeholders” (formally termed type parameters) for method arguments and type definitions, which are specified at the time of invoking the generic method or creating the generic type

Generic methods: enable you to specify, with a single method declaration, a set of related methods.

Generic classes: enable you to specify, with a single class declaration, a set of related classes.

Generics

```
class Point<M>
{
        M x;
        M y;
        public Point(M a, M b)
        {
                x = a;
                y = b;
        }
        public override string ToString()
        {
                return ("X = " + x.ToString() + " , Y = " + y.ToString());
        }
}
```

Generics

Here, we have made a class Calculate contains a static method used to swap any 2 data from the same data type, it is also Generics

```
class Calculate<T>
{
        public static void Swap(ref T a, ref T b)
        {
                T temp;
                temp = a;
                a = b;
                b = temp;
        }
}
```

Generics

```
class Program
{
        static void Main(string[] args)
        {
                int x = 3;
                int y = 4;
                Calculate<int>.Swap(ref x, ref y);
                Console.WriteLine("X = {0}", x);
                Console.WriteLine("Y = {0}", y);
                Point<float> pt1 = new Point<float>(5.6f, 7.9f);
                Point<float> pt2 = new Point<float>(20.5f, 50.7f);
                Calculate<Point<float>>.Swap(ref pt1, ref pt2);
                Console.WriteLine("PT1 = {0}", pt1.ToString());
                Console.WriteLine("PT2 = {0}", pt2.ToString());
        }
}
```

Partial class

It is possible to split the definition of a class, struct or interface over two or more source files.

Each source file contains a section of the class definition, and all parts are combined when the application is compiled.

We use partial class for:

- When working on large projects, spreading a class over separate files allows multiple programmers to work on it simultaneously.
- When working automatic generated source, code can be added to the class without having to recreate the source file. Visual Studio uses this approach when creating Windows Forms

Use the **partial** keyword modifier to split class definition.

Partial class

```
public partial class Employee
{
        public void Test1()
        {
        }
}

public partial class Employee
{
        public void Test2()
        {
        }
}
```

Partial class

Notes:

- All class part must be defined within the same namesapace.
- All parts must use partial keyword.
- All parts must be available at compile time to form the final type.
- All parts must have the same accessibility (public, private, …).
- If any part is declared abstract, then the entire class is abstract.
- If any part is declared sealed, then the entire class is sealed.
- If any part declare a base type, then the entire type inherits that class.
- The partial keyword appears immediately before the keyword class, struct or interface.

Windows Programming
GUI (Graphical User Interface)

Windows Forms

Microsoft Windows is a graphical interface.

Users interact with applications through windows, which are graphical representation of application data and options.

.NET framework provides a wide array of graphical controls and methods that allow you to create fully visual applications

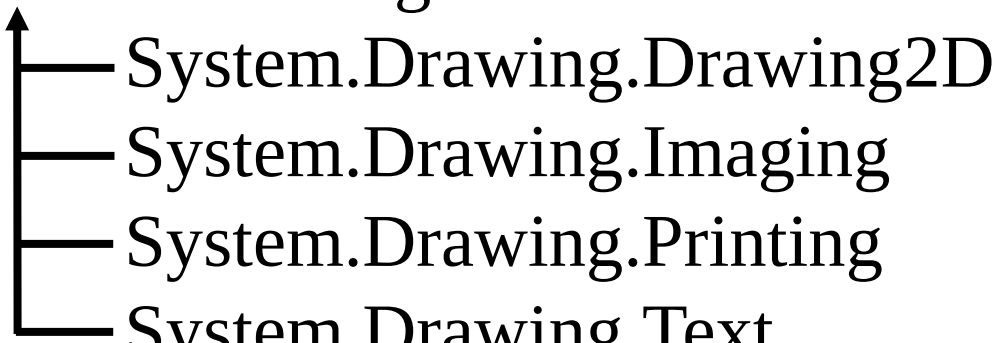
You might want to render your own graphic content in your application or create a custom appearance for a control, you must learn to use the Graphic Device Interface (GDI).

.Net provides a lot of useful classes grouped in 2 major namespaces :

1. System.Windows.Forms
2. System.Drawing

Core GDI+

All windows forms applications inherit from System.Windows.Forms.Form
All graphical function provided by Microsoft.Net framework are available in the System.Drawing namespace (which can be found in the System.Drawing.dll)



Core GDI+

System.Drawing

It is the core GDI+ namespace, which defines numerous types for basic rendering as well as the almighty Graphics type.

System.Drawing.Drawing2D

It contains classes and enumerations that provide advanced 2-D and vector graphics functionality.

System.Drawing.Imaging

Define types that allow you to directly manipulate graphical images

System.Drawing.Printing

It define types that allow you to render images to the printed page, interact with the printer itself and format the appearance of a given print job.

System.Drawing.Text

This namespace allows you to manipulate collections of fonts

The Graphics object

The Graphics object is the principal object used in rendering graphics
It represents the drawing surface of a visual element, such as form, a control or an image object.
A form has an associated Graphics object that can be used to draw inside the form, and the same for the control and the image.
You can’t directly instantiate one with the call of constructor.
Instead, you must create a Graphics object directly from the visual element.
You can use CreateGraphics method that allow you to get a reference to the Graphics object associated with that control

Ex:
```
System.Drawing.Graphics myGraphics;
myGraphics = myForm.CreateGraphics();
```

Coordinates and Shapes

Many of drawing methods defined by the Graphics object require you to specify the coordinate in which you wish to render a given item.

System.Drawing namespace contains a variety of structure that can be used to describe the location or the region within this coordinate system.

By default, the origin of the coordinate system for each control is the Upper Left corner, which has coordinates of (0,0)

Point :

Represents an ordered pair of integer x- and y-coordinates that defines a point in a two-dimensional plane

```
public Point(int dw);
public Point(Size sz);
public Point(int x, int y);
```

Coordinates and Shapes

PointF :

Represents an ordered pair of floating point x- and y-coordinates that defines a point in a two-dimensional plane.

```
public PointF(float dw);
public PointF(SizeF sz);
public PointF(float x, float y);
```

Size :

Stores an ordered pair of integers, typically the width and height of a rectangle.

```
public Size(Point pt);
public Size(int width, int height);
```

Coordinates and Shapes

SizeF :

Stores an ordered pair of float, typically the width and height of a rectangle.

```
public SizeF(PointF pt);
public SizeF(float width, float height);
```

Rectangle :

Stores a set of four integers that represent the location and size of a rectangle.

```
public Rectangle(Point location, Size size);
public Rectangle(int x, int y, int width, int height);
```

RectangleF :

Stores a set of four floating-point numbers that represent the location and size of a rectangle.

```
public RectangleF(PointF location, SizeF size);
public RectangleF(float x, float y, float width, float height);
```

Drawing a string

To display a string, use the method DrawString() which is a member of Graphics class. There are 6 overload for DrawString() method

Overload #1

public void DrawString(string s, Font font, Brush brush, PointF point);

s : the string to be displayed
s = “Welcome to C#

font : the font to be used in writing the string
font = new Font(“Times New Roman”, 20);

brush : represent the color used to write
brush = new SolidBrush(Color.Black);

point : the upper left corner of where to start writing
point = new PointF(15, 15);

Drawing a string

Overload #2

public void DrawString(string s, Font font, Brush brush, float x, float y);

s : the string to be displayed
s = “Welcome to C#

font : the font to be used in writing the string
font = new Font(“Times New Roman”, 20);

brush : represent the color used to write
brush = new SolidBrush(Color.Black);

(x, y) : the upper left corner of where to start writing
x = 15;
y = 15;

Drawing a string

Overload #3

public void DrawString(string s, Font font, Brush brush, RectangleF layoutRectangle);

s : the string to be displayed

s = “Welcome to C#

font : the font to be used in writing the string

font = new Font(“Times New Roman”, 20);

brush : represent the color used to write

brush = new SolidBrush(Color.Black);

layoutRectangle : a rectangle where to write the string. If the string is longer than the rectangle width, a part will not appear

layoutRectangle = new RectangleF(10, 10, 60, 30);

Drawing a string

Where to call the DrawString() method?

We need the DrawString() to be called automatically when the form has to be redrawn.

So, we need to override the OnPaint Event handler method, as follow:

```
Protected override void OnPaint(PaintEventArgs e)
{
        Graphics MyGraphics = this.CreateGraphics();
        MyGraphics.DrawString(…);
}
```

Drawing a line

To draw a line, use the method DrawLine() which is a member of Graphics class.

The DrawLine method have 4 overloading:

public void DrawLine(Pen pen, Point pt1, Point pt2);

public void DrawLine(Pen pen, int x1, int y1, int x2, int y2);

pen: is used to determine the line color and style

Pen pen = new Pen(Color.Red)

OR Pen pen = new Pen(Color.Red, 5);

The Pen also has some properties as “DashStyle” which is an enumeration contains the line style

Solid = 0, Dash = 1, Dot = 2, DashDot = 3, DashDotDot = 4

p1, (x1, y1): specify the starting point

p2, (x2, y2): specify the ending point

Drawing a rectangle

There are 2 types of rectangle:

1) Just Frame:

To draw a rectangle use the method DrawRectangle() which is a member of Graphics class.

To draw a rectangle we must know the Pen and the UL corner, the width, and the height

The DrawRectangle method have 3 overloading:

```
public void DrawRectangle(Pen pen, Rectangle rect);
public void DrawRectangle(Pen pen, int x, int y, int width, int height);
public void DrawRectangle(Pen pen, float x, float y, float width,
                                                    float   height);
```

Drawing a rectangle

2) Filled Rectangle:

To draw a filled rectangle, use the method FillRectangle() which is a member of Graphics class.

To draw a filled rectangle, we must know the brush (color, style) and the rectangle to be drawn

```
public void FillRectangle(Brush brush, Rectangle rect);
public void FillRectangle(Brush brush, RectangleF rect);
public void FillRectangle(Brush brush, int x, int y, int width,
                          int height);
public void FillRectangle(Brush brush, float x, float y, float width,
                          float height);
```

Drawing a rectangle

2) Filled Rectangle:

The Brush is used to determine the color and the filled style. This is an abstract base class and cannot be instantiated. To create a brush object, use classes derived from Brush such as SolidBrush, HatchBrush

Working with SolidBrush

public SolidBrush(Color color);

It has only one property which is the color of the rectangle and the filled area.

Ex : Brush mBrush = new SolidBrush(Color.Yellow);

Drawing a rectangle

2) Filled Rectangle:

Working with HatchBrush

```
public HatchBrush(HatchStyle hatchstyle, Color foreColor);
        //default background BLACK
public HatchBrush(HatchStyle hatchstyle, Color foreColor,
                  Color backColor);
```

The HachStyle is an enumeration that define the pattern used to fill the Shape"Rectangle"

Ex of style : BackwardDiagonal //
ForwardDiagonal \\
Vertical ||