



**Department of Economic Informatics and Cybernetics**  
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# Windows Applications Programming

Windows Forms



Few words about me...



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## Further Reading / Watching

- Courses on Microsoft Virtual Academy - [mva.microsoft.com](https://mva.microsoft.com)
  - Free
- Courses on PluralSight - [www.pluralsight.com](https://www.pluralsight.com)
  - Free trial
  - Free access (limited period) through [Microsoft DreamSpark](#)

# API reference and Source code

- API reference:
  - <https://msdn.microsoft.com/en-us/library/>
- .NET Framework source code:
  - <http://referencesource.microsoft.com/#mscorlib/system/string.cs,8281103e6f23cb5c>

# Windows Forms

# .NET Graphical User Interface

- Windows Forms (2001)
- Windows Presentation Foundation
- Universal Windows Platform

# Startup and Shutdown

- Startup

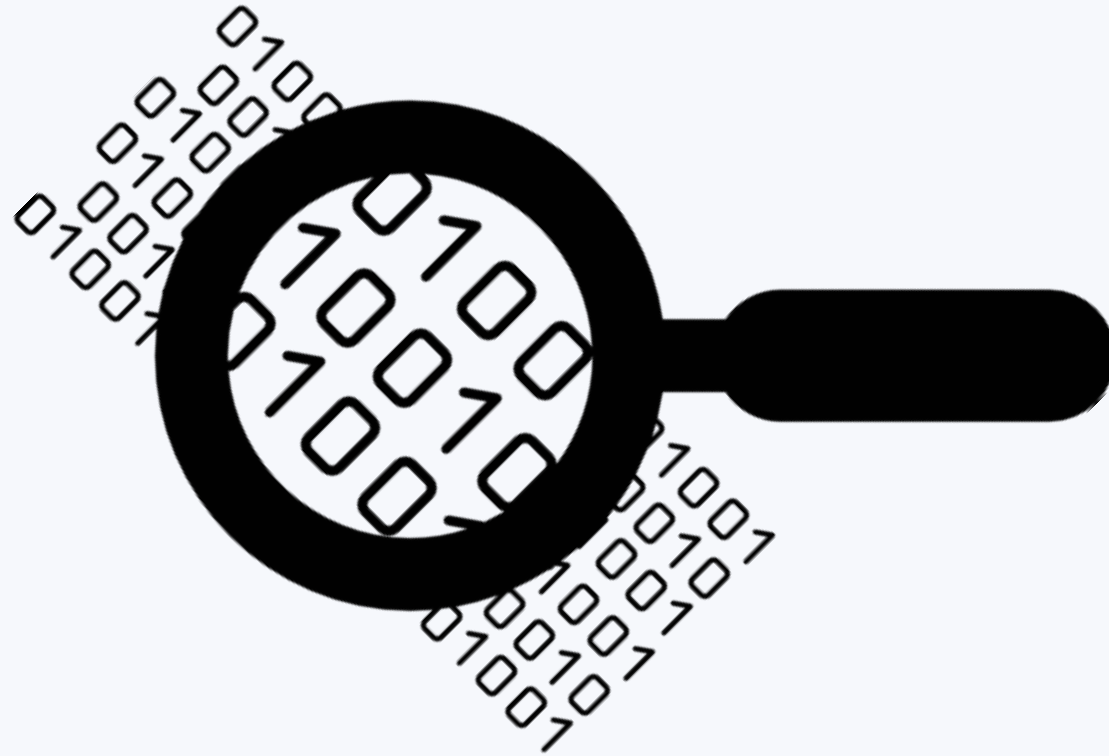
```
[STAThread]
static void Main( )
{
    Application.Run(new Form1( ));
}
```

# Application Class

- The Application Class
  - Run
  - Exit
  - ThreadException



# Demo



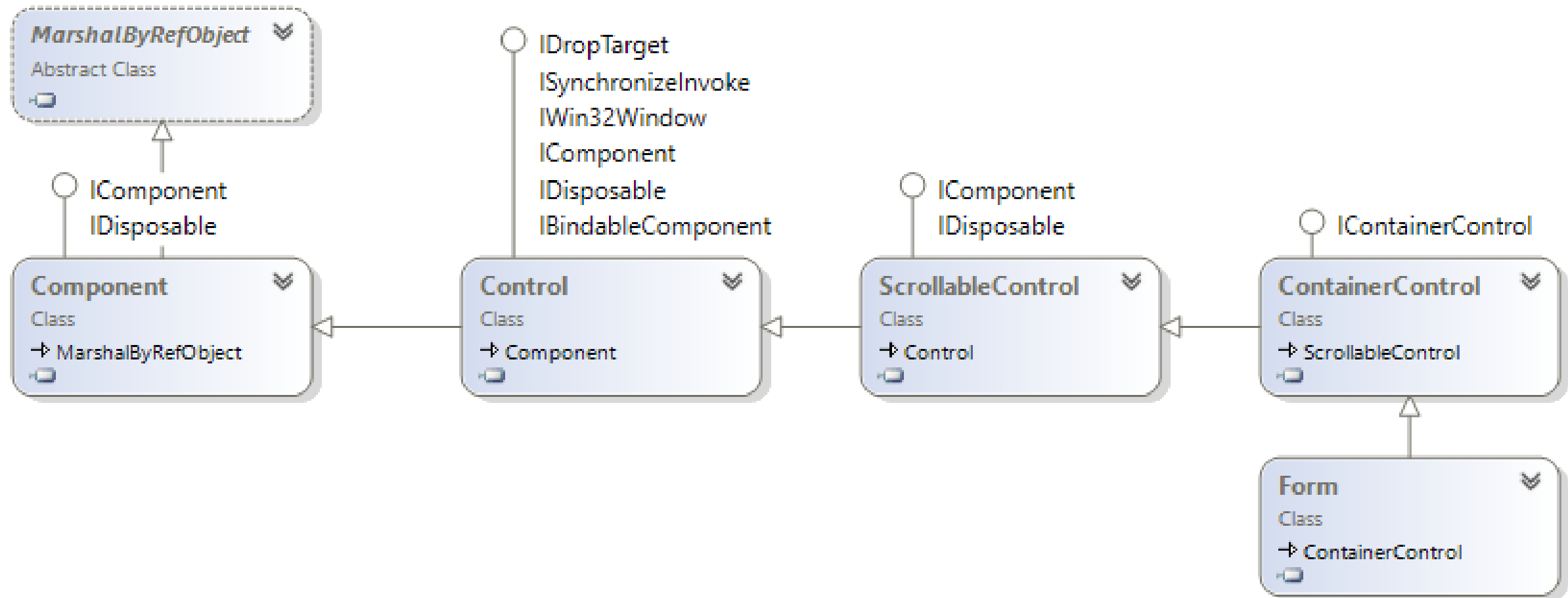
# Form Class

# Form Class

- All windows in a Windows Forms application are represented by objects of some type deriving from the Form class.

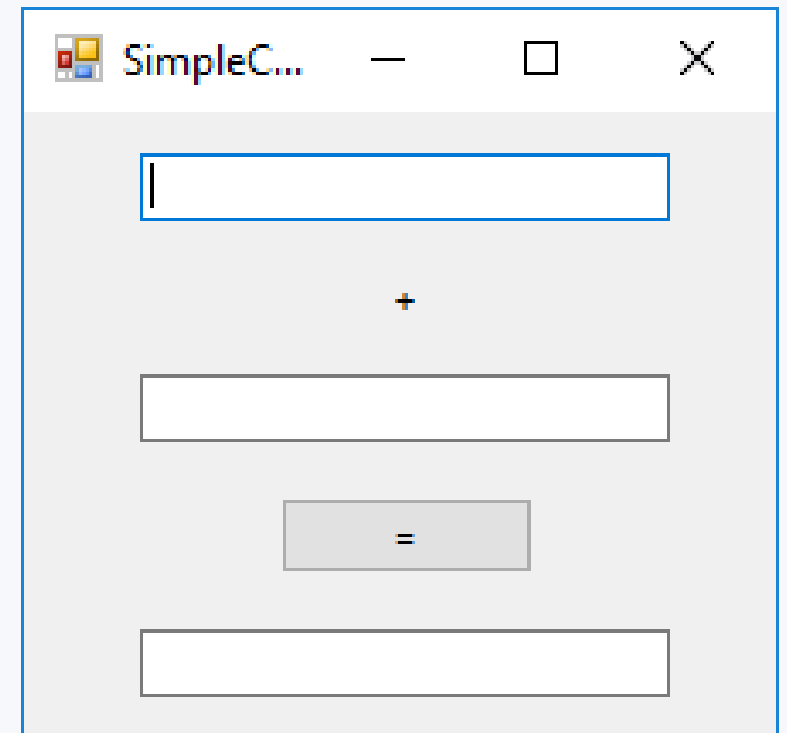
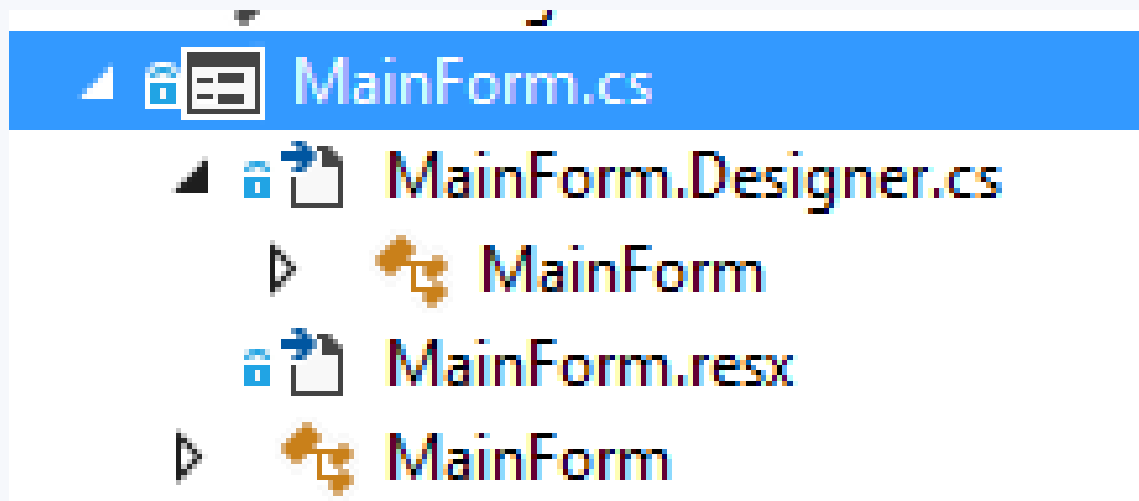
```
public partial class MainForm : Form
{
    // Constructor
    public MainForm()
    {
        InitializeComponent();
    }
}
```

# Inheritance



# The Forms Designer

- visual designer that auto-generates code.
- Uses partial classes.



# Demo



# Partial Class

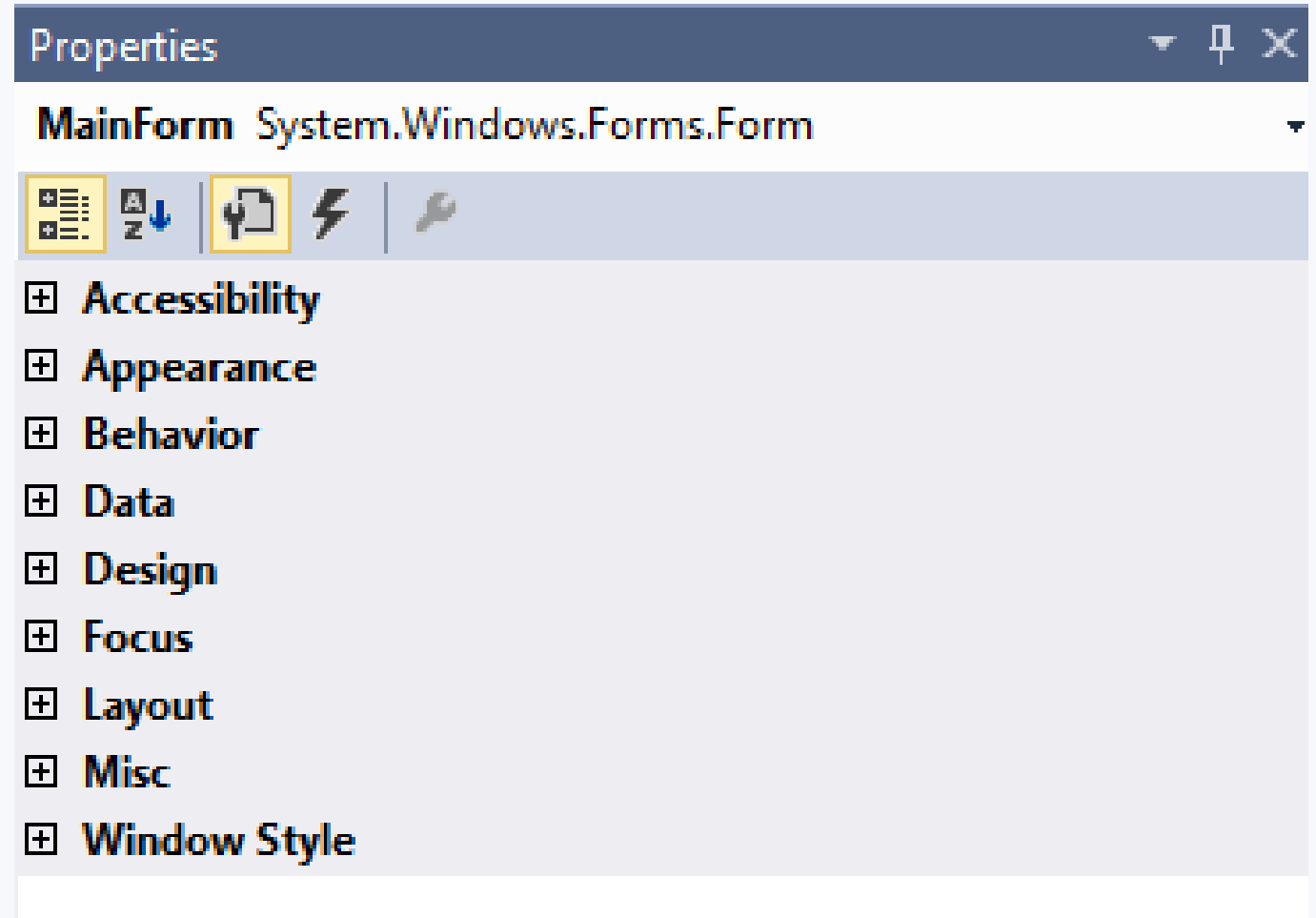
- It is possible to split the definition of a class or a struct, an interface or a method over two or more source files. Each source file contains a section of the type or method definition, and all parts are combined when the application is compiled.

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

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

# Properties

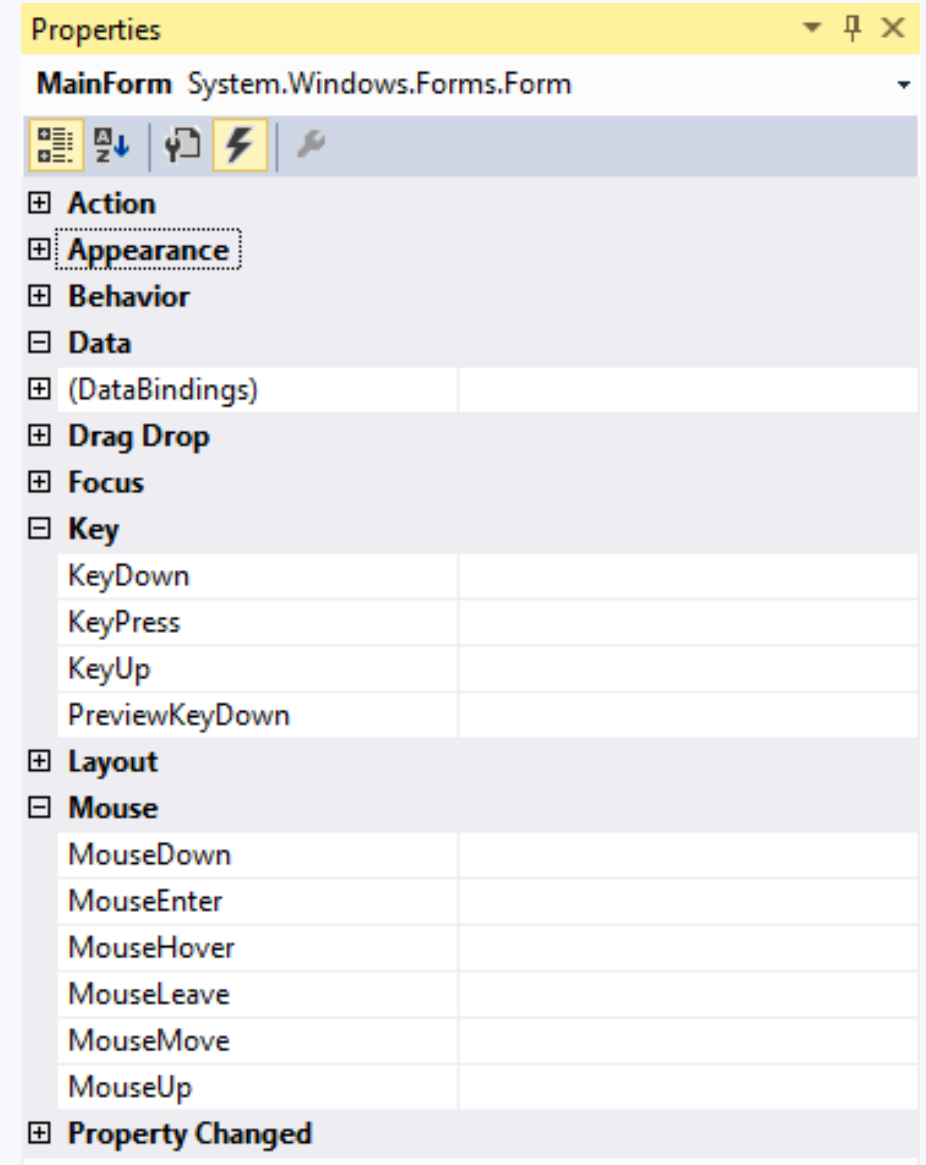
- Appearance
  - BackColor
  - Font
  - ForeColor
  - Text
- Design
  - Name





# Events

- Key
  - KeyDown
  - KeyPress
  - KeyUp
- Mouse
  - MouseDown
  - MouseUp
  - Click



# Keyboard Events

# Keyboard Events

- Key events occur in the order specified below.

Event	Event data	Description
KeyDown	KeyEventArgs	Raised when a key is pressed. The KeyDown event occurs prior to the KeyPress event.
KeyPress	KeyPressEventArgs	Raised when a character generating key is pressed. The KeyPress event occurs after the KeyDown event and before the KeyUp event.
KeyUp	KeyEventArgs	Raised when a key is released.

# KeyPress

- Occurs when a character is pressed on the keyboard, and again each time the character is repeated while it continues to be pressed.
- The KeyPress event is not raised by non-character keys other than space and backspace; however, the non-character keys do raise the KeyDown and KeyUp events.
- Use the KeyChar property to sample keystrokes at run time and to consume or modify a subset of common keystrokes.

# KeyPressEventArgs

Property	Description
Handled	Boolean value indicating if the event was handled. false until set otherwise. When true, the keystroke is not displayed.
KeyChar	Read-only value of type char containing the composed ASCII character.

## KeyDown andKeyUp

- **KeyDown** - Occurs when a key on the keyboard is pressed down.
- **KeyUp** - Occurs when a key on the keyboard is released.
- The **KeyDown** and **KeyUp** events are useful to fine-tune an application's behavior as keyboard keys are pressed and released, and for handling noncharacter keys such as the function or arrow keys.
- Handlers for these events receive an instance of the `KeyEventArgs` class as their event parameter.

# KeyEventArgs properties

Property	Data type	Description
Alt	Boolean	Read-only value indicating if the Alt key was pressed. true if pressed, false otherwise.
Control	Boolean	Read-only value indicating if the Ctrl key was pressed. true if pressed, false otherwise.
Shift	Boolean	Read-only value indicating if the Shift key was pressed. true if pressed, false otherwise.
Modifiers	Keys	Read-only flags indicating the combination of modifier keys (Alt, Ctrl, Shift) pressed. Modifier keys can be combined using the bitwise OR operator.
Handled	Boolean	Value indicating if the event was handled. false until set otherwise.
KeyCode	Keys	Read-only value containing the key code for the key pressed. Typical values include the A key, Alt, and BACK (backspace).
KeyData	Keys	Read-only value containing the key code for the key pressed, combined with modifier flags to indicate combination of modifier keys (Alt, Ctrl, Shift).
KeyValue	integer	Key code property expressed as a read-only integer.

# Mouse Events



# Mouse Events

Event	Event argument	Description
Click	EventArgs	Raised when the control is clicked.
DoubleClick	EventArgs	Raised when the control is double-clicked.
MouseEnter	EventArgs	Raised when the mouse cursor enters the control.
MouseHover	EventArgs	Raised when the mouse cursor hovers over the control.
MouseLeave	EventArgs	Raised when the mouse cursor leaves the control.
MouseDown	MouseEventArgs	Raised when the mouse cursor is over the control and a mouse button is pressed.
MouseMove	MouseEventArgs	Raised when the mouse cursor is moved over the control.
MouseWheel	MouseEventArgs	Raised when the control has focus and the mouse wheel is rotated.
MouseUp	MouseEventArgs	Raised when the mouse cursor is over the control and a mouse button is released.

# Click and MouseClick

Depressing a mouse button when the cursor is over a control typically raises the following series of events from the control:

- MouseDown event.
- Click event.
- MouseClick event.
- MouseUp event.

Click events are logically higher-level events of a control. They are often raised by other actions, such as pressing the ENTER key when the control has focus.

MouseClick contains specific mouse information (button, number of clicks, wheel rotation, or location),

# MouseEventArgs properties

Property	Description
Button	Returns the pressed mouse button. Must be one of the members of the MouseButton enumeration
Clicks	Returns the integer number of times the mouse button was pressed and released. Resets after two clicks.
Delta	Returns the signed integer number of detents the mouse wheel was rotated. A positive value indicates that the wheel was rotated forward, i.e., away from the user, and a negative value indicates the wheel was rotated backward, i.e., toward the user.
X	The X coordinate, in pixels, of the mouse cursor's hot spot when the button was clicked, relative to the top-left corner of the control.
Y	The Y coordinate, in pixels, of the mouse cursor's hot spot when the button was clicked, relative to the top-left corner of the control.

# Click

```
this.btnCalculate.Click += new System.EventHandler(this.btnCalculate_Click);
```

```
private void btnCalculate_Click(object sender, EventArgs e)
{
    var value1 = int.Parse(tbValue1.Text);
    var value2 = int.Parse(tbValue2.Text);

    var sum = value1 + value2;
    tbSum.Text = sum.ToString();
}
```

# Alt Shortcuts

# Alt Shortcuts

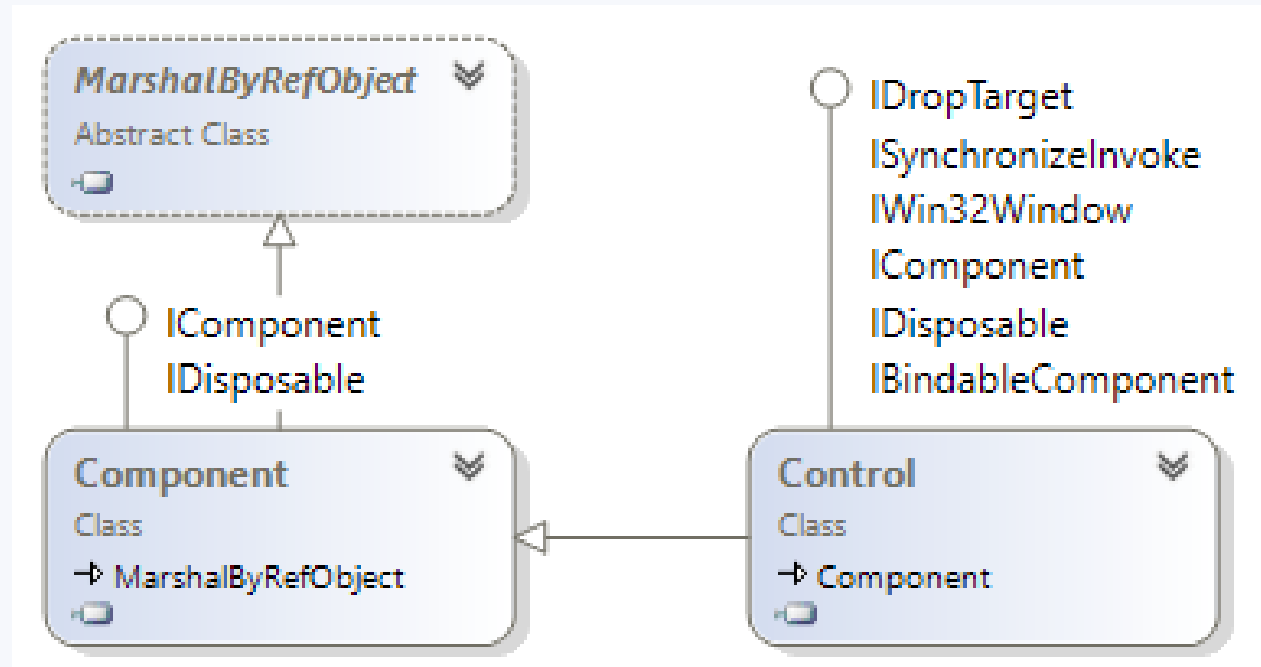
- An **access key** is an underlined character in the text of a menu, menu item, or the label of a control such as a button. It allows the user to "click" a button by pressing the ALT key in combination with the predefined access key.

```
// C#  
// Set the letter "P" as an access key.  
button1.Text = "&Print";
```

Controls

# Control Class

- The Control class forms the basis for all windows controls in .NET, and provides many properties, methods, and events.

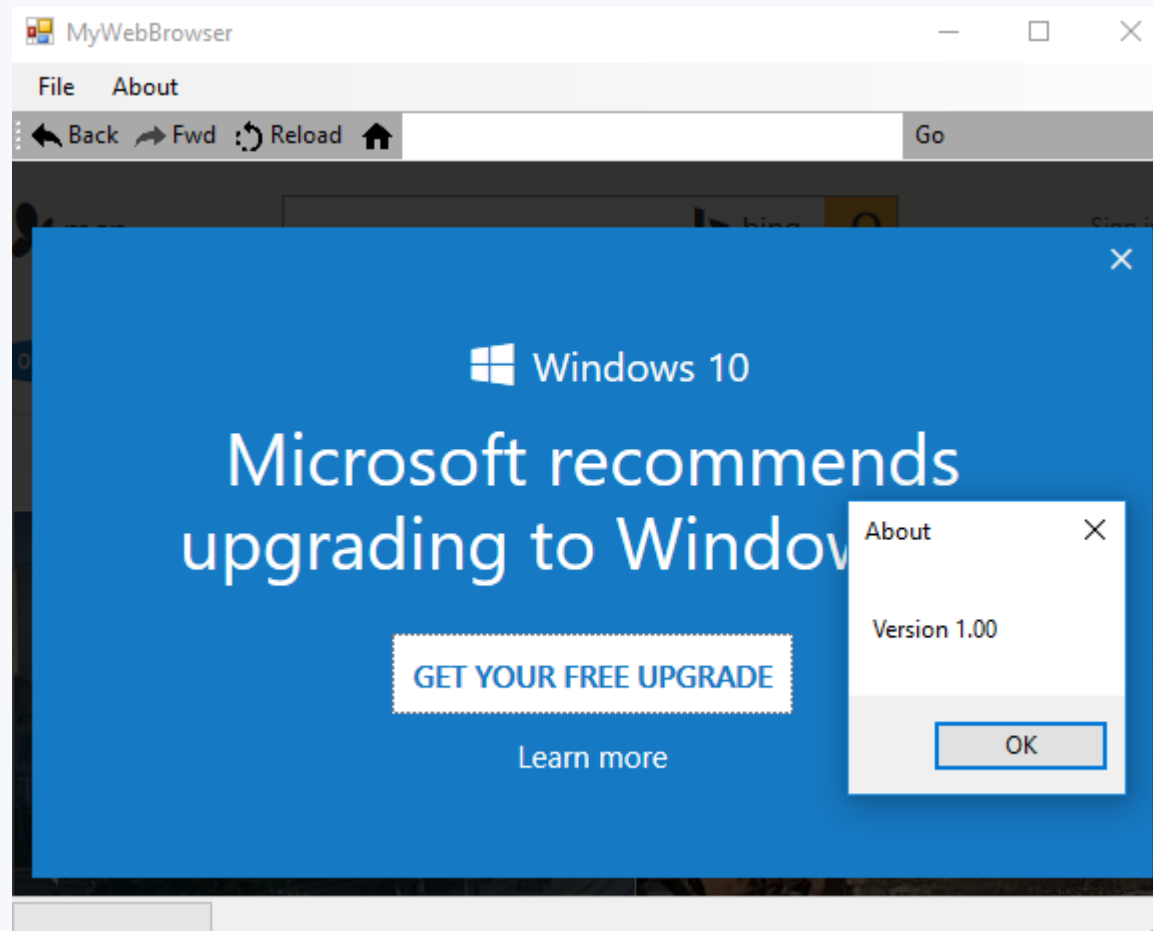


- Further reading: [link](#)



# Common controls

- Recommended Controls and Components by Function:  
<https://msdn.microsoft.com/en-us/library/xfak08ea%28v=vs.110%29.aspx>



# Common controls

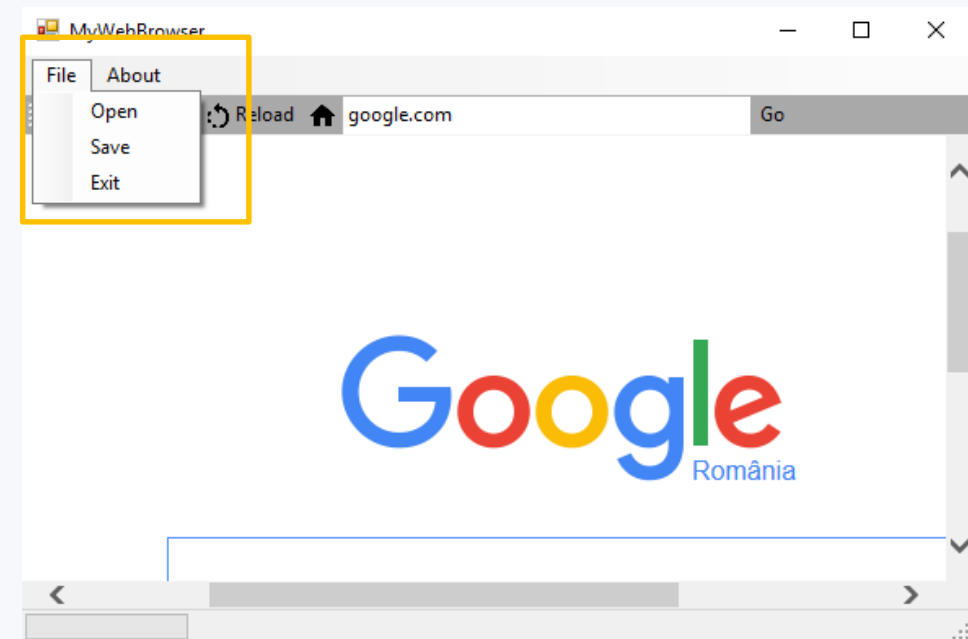
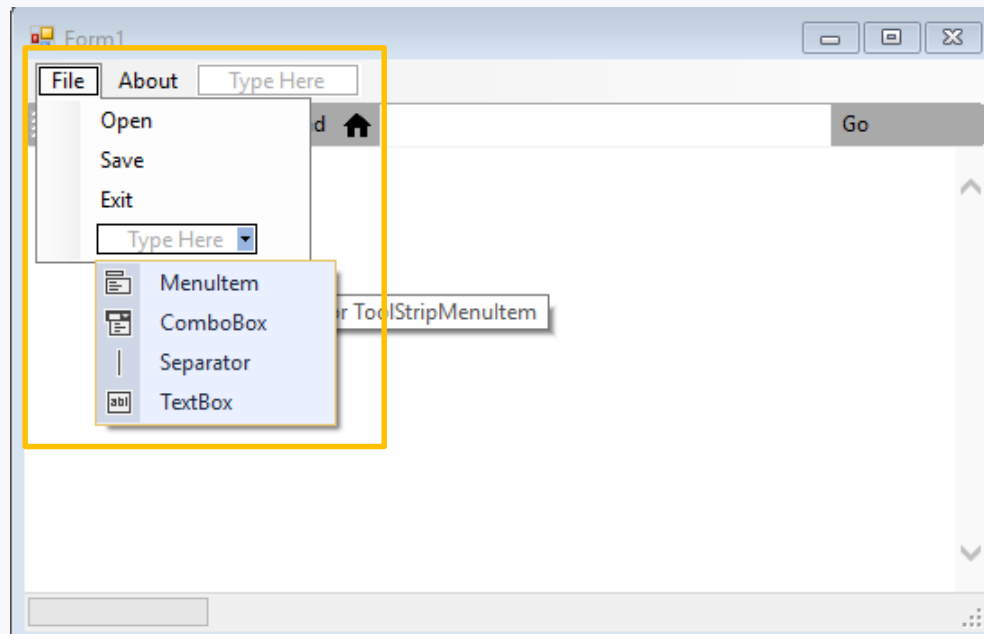
- Alphabetic list of controls and components: <https://msdn.microsoft.com/en-us/library/3xdhey7w%28v=vs.110%29.aspx>

Menus

# Menus

- MenuStrip
- ToolStrip
- ContextMenuStrip
- StatusStrip

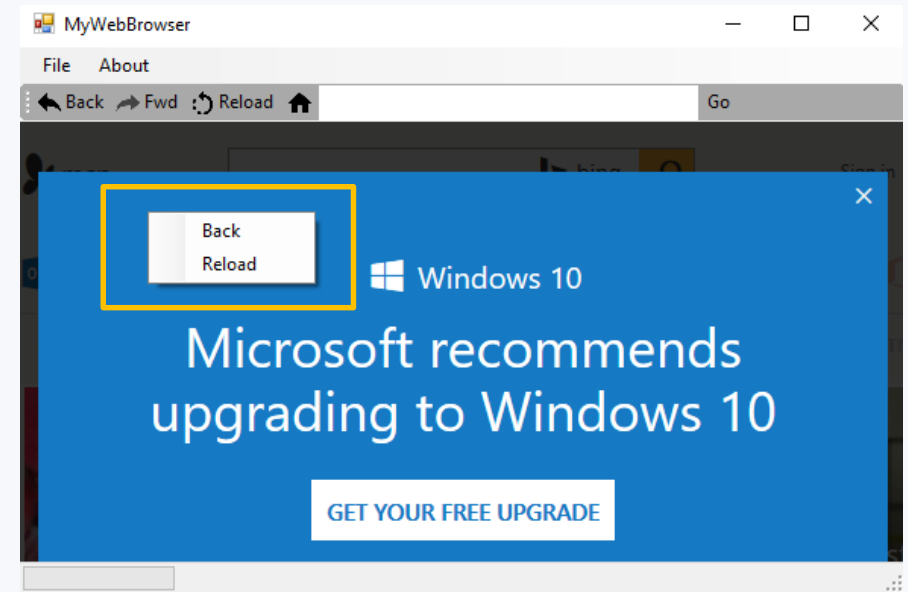
# MenuStrip



# MenuStrip

- `System.Windows.Forms.MenuStrip`
- The MenuStrip control represents the container for the menu structure of a form. You can add [ToolStripMenuItem](#) objects to the MenuStrip that represent the individual menu commands in the menu structure.
- Each [ToolStripMenuItem](#) can be a command for your application or a parent menu for other submenu items.
- Further reading: [link](#)

# ContextMenuStrip

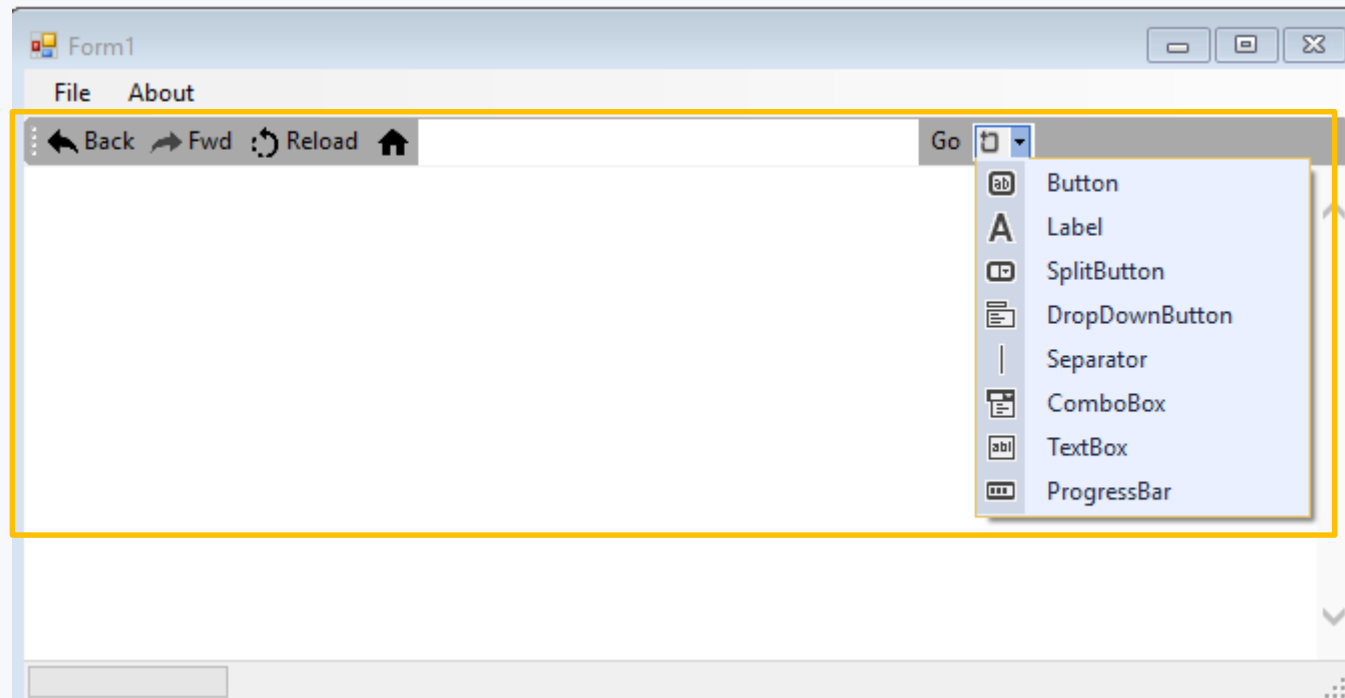


## ContextMenuStrip

- `System.Windows.Forms.ContextMenuStrip`
- Shortcut menus, also called context menus, appear at the mouse position when the user clicks the right mouse button. Shortcut *menus* provide options for the client area or the control at the mouse pointer location.
- Further reading: [link](#)



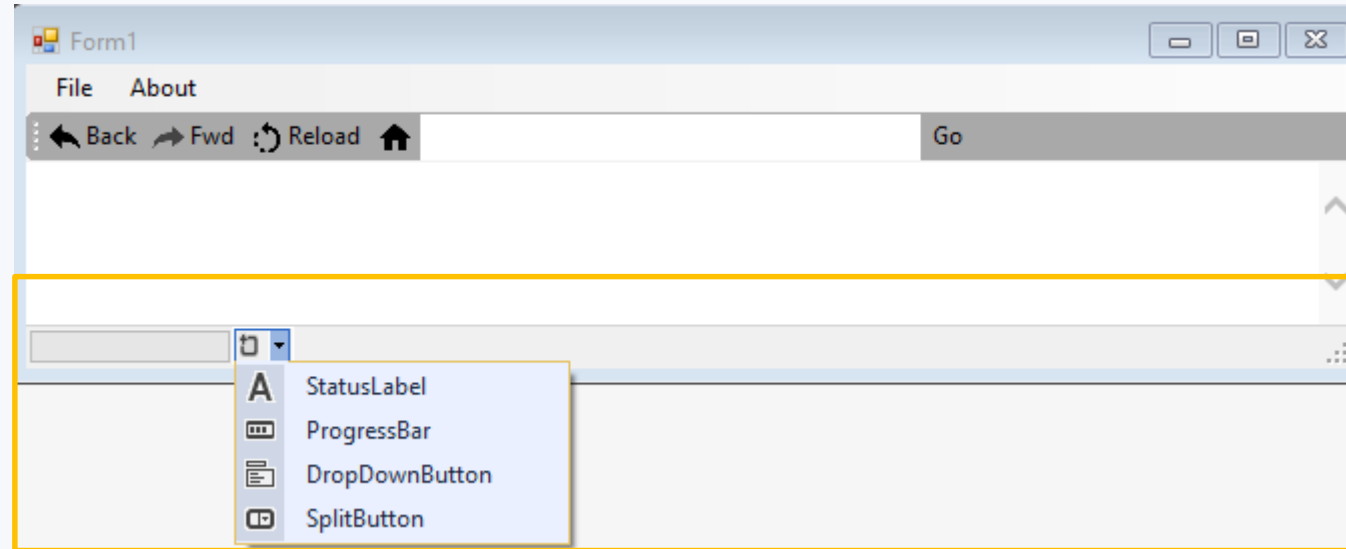
# ToolStrip



# ToolStrip

- `System.Windows.Forms.ToolStrip`
- The Windows Forms ToolStrip control and its associated classes provide a common framework for combining user interface elements into toolbars, status bars, and menus. ToolStrip controls offer a rich design-time experience that includes in-place activation and editing, custom layout, and rafting, which is the ability of toolbars to share horizontal or vertical space.
- Further reading: [link](#)

# StatusStrip



# StatusStrip

- `Windows.Forms.StatusStrip`
- A `StatusStrip` control displays information about an object being viewed on a Form, the object's components, or contextual information that relates to that object's operation within your application.
- Typically, a `StatusStrip` control consists of `ToolStripStatusLabel` objects, each of which displays text, an icon, or both. The `StatusStrip` can also contain `ToolStripDropDownButton`, `ToolStripSplitButton`, and `ToolStripProgressBar` controls.
- Further reading: [link](#)

# Data Validation

# Using **Validating** and **Validated** Events

The screenshot shows a Windows application window titled "WinAppProgramming Run". Inside the window is a form titled "New Participant". The form contains several input fields: "Last Name", "First Name", "Birth Date", "Gender" (with radio buttons for "Male" and "Female"), and "SSN". The "Last Name" field is currently empty and has a red error icon next to it. A tooltip message "The Last Name should not be empty!" is displayed over the "Last Name" field. The "Birth Date" field shows "Thursday . April 07, 2016" with a calendar icon. There is an "Add Participant" button on the right side of the form. Below the form is a large empty rectangular area.

## Control.Validating Event

- Occurs when the control is validating.
- If the CausesValidation property is set to **false**, the Validating and Validated events are suppressed.

```
private void tbLastName_Validating(object sender, CancelEventArgs e)
{
    string lastName = ((TextBox) sender).Text.Trim();

    if (string.IsNullOrEmpty(lastName))
    {
        e.Cancel = true;

        epLastName.SetError((Control) sender, "Last Name is empty!");
    }
}
```

## Control.Validating Event

- Events:
  1. Enter
  2. GotFocus
  3. Leave
  4. Validating
  5. Validated
  6. LostFocus
  
- If the Cancel property of the CancelEventArgs is set to **true** in the Validating event delegate, all events that would usually occur after the Validating event are suppressed.



## Control.Validated Event

- Occurs when the control is finished validating.

```
private void tbLastName_Validated(object sender, EventArgs e)
{
    epLastName.Clear();
}
```

# Validating the entire form

```
private void btnAdd_Click(object sender, EventArgs e) {
    string firstName = tbFirstName.Text.Trim();
    string lastName = tbLastName.Text.Trim();

    bool formContainsErrors = false;

    if (string.IsNullOrEmpty(lastName)) {
        epLastName.SetError(tbFirstName, "Last Name is empty!");
        formContainsErrors = true;
    }

    if (string.IsNullOrEmpty(firstName)) { ... }

    if (formContainsErrors) {
        MessageBox.Show("The form contains errors!", "Error",
            MessageBoxButtons.OK, MessageBoxIcon.Error);
    }
}
```

# Validating the entire form

The screenshot shows a Windows application window titled "WinAppProgramming Run". Inside the window is a form titled "New Participant". The form contains the following fields and controls:

- Last Name:** A text box containing "gfhfg".
- First Name:** An empty text box with a red error icon to its right.
- Birth Date:** A date picker showing "Thursday , April 07, 2016".
- Gender:** Radio buttons for "Male" (selected) and "Female".
- SSN:** A text box containing "222222".
- Add Participant:** A button at the bottom right of the form.

An "Error" dialog box is overlaid on the form, displaying a red "X" icon and the message "The form contains errors!". The dialog box has an "OK" button at the bottom right.

# Complex Visualization Controls

# ListView

- System.Windows.Forms. ListView
- Represents a Windows list view control, which displays a collection of items that can be displayed using one of four different views.

The screenshot shows a Windows application window titled "WinAppProgramming Run". Inside the window, there is a "New Participant" form with three text boxes: "Last Name" (containing "LastName3"), "First Name" (containing "FirstName3"), and "Birth Date" (containing "Tuesday, June 10, 1980"). An "Add Participant" button is located to the right of the "First Name" box. Below the form, there are five tabs: "Details", "List", "LargeIcon", "SmallIcon", and "Tile". The "List" tab is selected, displaying a ListView control. The ListView contains two groups of items: "Children" and "Adults". The "Children" group has three items, each with a child icon, "LastName1", "FirstName1", and "4/8/2016". The "Adults" group has two items, each with an adult icon, "LastName2", "FirstName2", and "6/10/1980", followed by "LastName3", "FirstName3", and "6/10/1980".

Last Name	First Name	Birth Date
<b>Children</b>		
LastName1	FirstName1	4/8/2016
LastName1	FirstName1	4/8/2016
LastName1	FirstName1	4/8/2016
<b>Adults</b>		
LastName2	FirstName2	6/10/1980
LastName3	FirstName3	6/10/1980

## ListView

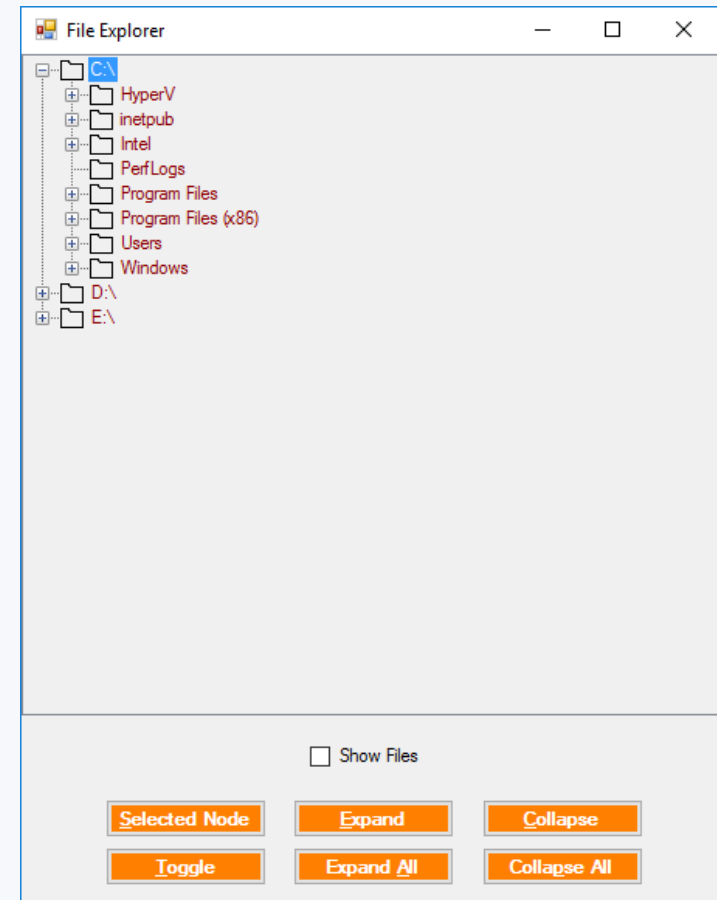
- Important properties:
  - Items
  - Columns
  - Groups
- CheckBoxes
- View: Details, List, Tile, SmallIcon, LargeIcon
- FullRowSelect: True/False
- GridLines: True/False
- SmallImageList / LargeImageList

## ListView

- Important events:
  - SelectedIndexChanged

# TreeView

- `System.Windows.Forms.TreeView`
- Displays a hierarchical collection of labeled items, each represented by a [TreeNode](#).





# TreeView

- Important properties:
  - Nodes
  - SelectedNode
  - Sorted
  - CheckBoxes
  - ImageList

## TreeView

- Important Events:
  - AfterSelect
  - AfterExpand

# Exception Handling

## Try, Catch, Finally

- A **try** statement specifies a code block subject to error-handling or cleanup code. The **try block** must be followed by a **catch block**, a **finally block**, or both.
- The catch block executes when an error occurs in the try block.
- The finally block executes after execution leaves the try block (or if present, the catch block), to perform cleanup code, whether or not an error occurred.

# Try, Catch, Finally

```
try
{
... // exception may get thrown within execution of this block
}
catch (ExceptionA ex)
{
... // handle exception of type ExceptionA
}
catch (ExceptionB ex)
{
... // handle exception of type ExceptionB
}
finally
{
... // cleanup code
}
```

## Common Exception Types

- **System.ArgumentException** - Thrown when a function is called with a bogus argument.
- **System.ArgumentNullException** - Subclass of ArgumentException that's thrown when a function argument is (unexpectedly) null.
- **System.ArgumentOutOfRangeException** - Subclass of ArgumentException that's thrown when a (usually numeric) argument is too big or too small. For example, this is thrown when passing a negative number into a function that accepts only positive values.

## Common Exception Types

- **System.InvalidOperationException** - Thrown when the state of an object is unsuitable for a method to successfully execute, regardless of any particular argument values. Examples include reading an unopened file or getting the next element from an enumerator where the underlying list has been modified partway through the iteration.
- **System.NotSupportedException** - Thrown to indicate that a particular functionality is not supported. A good example is calling the Add method on a collection for which IsReadOnly returns true.
- **System.NotImplementedException** - Thrown to indicate that a function has not yet been implemented.

## Common Exception Types

- A catch block has access to an Exception object that contains information about the error. You use a catch block to either compensate for the error or *rethrow* the exception. You rethrow an exception if you merely want to log the problem, or if you want to rethrow a new, higher-level exception type.
- A finally block adds determinism to your program: the CLR endeavors to always execute it. It's useful for cleanup tasks such as closing network connections.

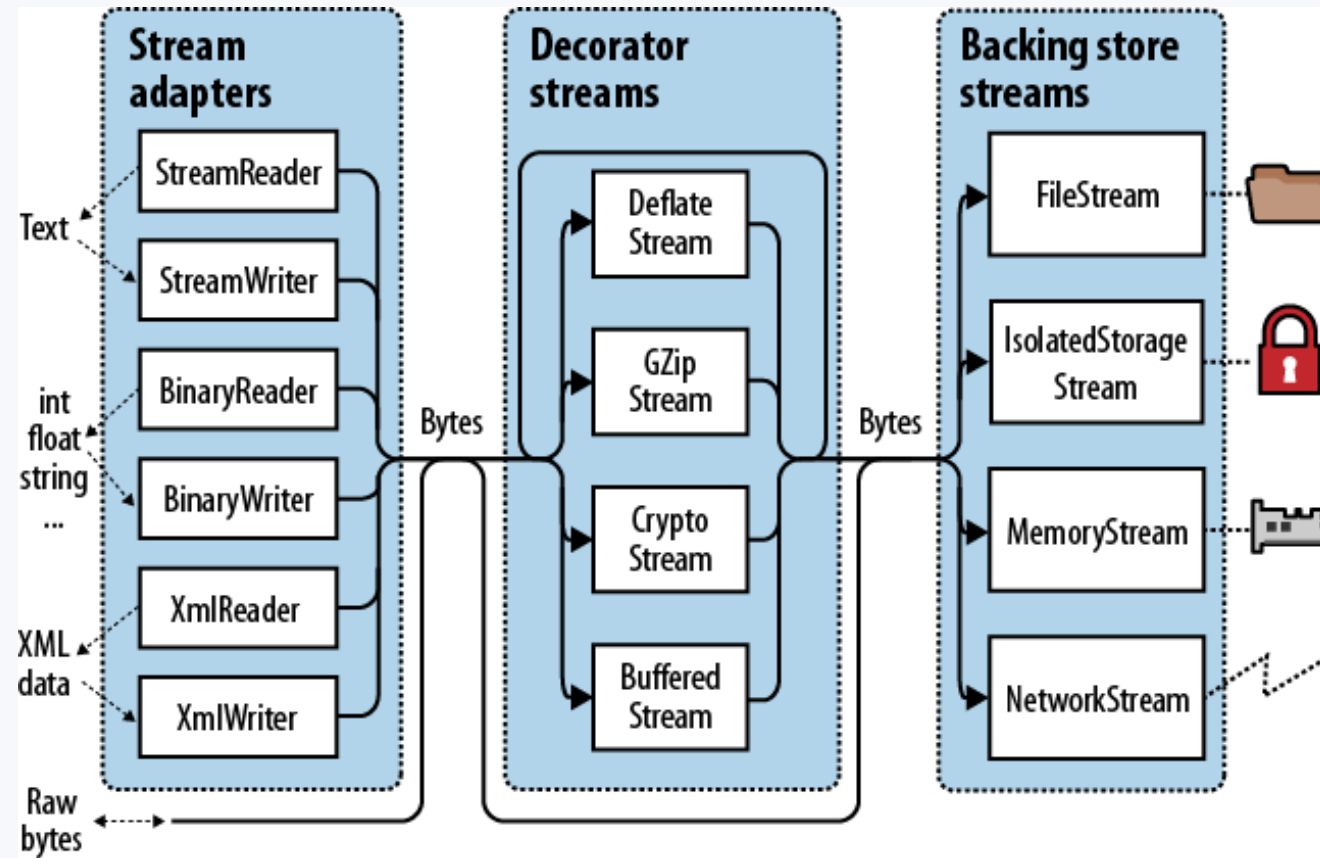


Streams

# Stream Architecture

- A **stream** is an abstraction of a **sequence of bytes**, such as a **file**, an **input/output device**, an inter-process communication pipe, or a **TCP/IP socket**.
- **System.IO.Stream** class and its derived classes provide a generic view of these different types of input and output, and isolate the programmer from the specific details of the operating system and the underlying devices.
- **System.IO.Stream** is the abstract base class of all streams.
- Further reading: [link](#)

# Stream architecture



## Stream Architecture

- Unlike an array, where all the backing data exists in memory at once, a stream deals with data serially—either one byte at a time or in blocks of a manageable size. Hence, a stream can use little memory regardless of the size of its backing store.

## System.IO.FileStream

- Can be used to read from, write to, open, and close files on a file system.

```
var fs = new FileStream (  
    "x.bin",  
    FileMode.Open,  
    FileAccess.Read  
))
```

- Further reading: [link](#)

# System.IO.FileMode

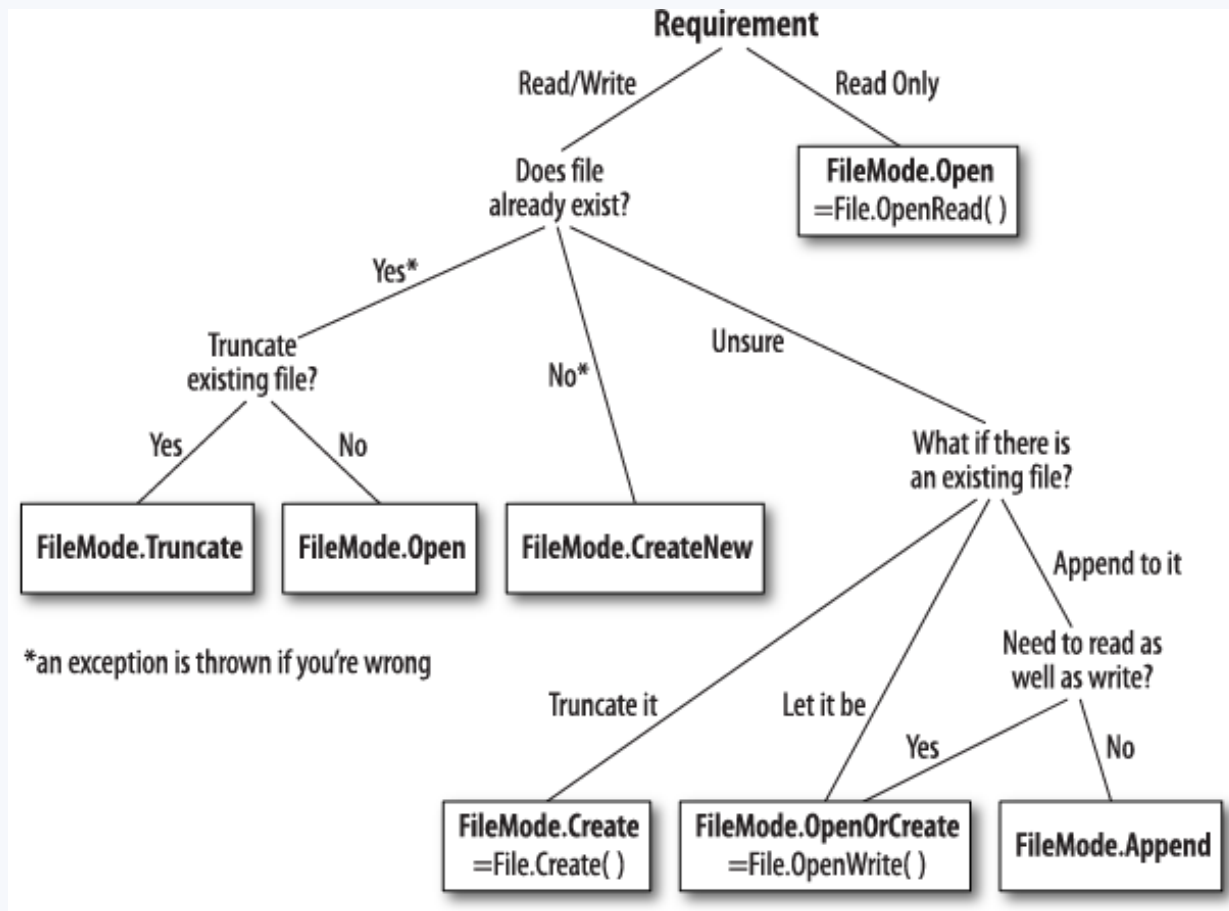
Append	Opens the file if it exists and seeks to the end of the file, or creates a new file. This requires <a href="#">FileIOPermissionAccess.Append</a> permission.
Create	Specifies that the operating system should create a new file. If the file already exists, it will be overwritten. This requires <a href="#">FileIOPermissionAccess.Write</a> permission.
CreateNew	Specifies that the operating system should create a new file. This requires <a href="#">FileIOPermissionAccess.Write</a> permission.
Open	Specifies that the operating system should open an existing file. The ability to open the file is dependent on the value specified by the <a href="#">FileAccess</a> enumeration.

# System.IO.FileMode

OpenOrCreate	Specifies that the operating system should open a file if it exists; otherwise, a new file should be created. If the file is opened with FileAccess.Read, <a href="#">FileIOPermissionAccess.Read</a> permission is required. If the file access is FileAccess.Write, <a href="#">FileIOPermissionAccess.Write</a> permission is required. If the file is opened with FileAccess.ReadWrite, both <a href="#">FileIOPermissionAccess.Read</a> and <a href="#">FileIOPermissionAccess.Write</a> permissions are required.
Truncate	Specifies that the operating system should open an existing file. When the file is opened, it should be truncated so that its size is zero bytes. This requires <a href="#">FileIOPermissionAccess.Write</a> permission.

- Further reading: [link](#)

# System.IO.FileMode





## System.IO.FileAccess

Read	Read access to the file. Data can be read from the file. Combine with Write for read/write access.
ReadWrite	Read and write access to the file. Data can be written to and read from the file.
Write	Write access to the file. Data can be written to the file. Combine with Read for read/write access.

- Further reading: [link](#)

## Writing Text Files

- `System.IO.StreamWriter` - Implements a [TextWriter](#) for writing characters to a stream in a particular encoding.
- Useful Methods:
  - Write
  - WriteLine
- Further reading: [link](#)

```
static void Main(string[] args){
    // Get the directories currently on the C drive.
    DirectoryInfo[] cDirs = new DirectoryInfo(@"c:\").GetDirectories();

    // Write each directory name to a file.
    using (StreamWriter sw = new StreamWriter("CDriveDirs.txt")) {
        foreach (DirectoryInfo dir in cDirs){
            sw.WriteLine(dir.Name);
        }
    }

    // Read and show each line from the file.
    string line = "";
    using (StreamReader sr = new StreamReader("CDriveDirs.txt")) {
        while ((line = sr.ReadLine()) != null) {
            Console.WriteLine(line);
        }
    }
}
```

# Writing Text Files

WinAppProgramming Run

Serialization **TextFile** Export

New Participant

Last Name  Birth Date

First Name

**Add Participant**

Last Name	First Name	Birth Date	
sdffds	fdfd	4/15/2016	
sdffds	fdfd	4/15/2016	
sdffds	fdfd	4/15/2016	
sdffds	fdfd	4/15/2016	



# File and Directory Operations

- The System.IO namespace provides a set of types for performing “utility” file and directory operations, such as copying and moving, creating directories, and setting file attributes and permissions.
- *Static classes:*
  - File and Directory
- *Instance method classes (constructed with a file or directory name)*
  - FileInfo and DirectoryInfo
- *Additional class:*
  - Path

# Special Folders

```
string myDocPath =  
    Environment.GetFolderPath(Environment.SpecialFolder.MyDocuments);
```

**Examples:** Desktop, ProgramFiles, ProgramFilesX86, Favorites, MyMusic, MyVideos

All special folders: [link](#)

## System.IO.File

- Important methods:

```
bool Exists (string path); // Returns true if the file is present
```

```
void Delete (string path);
```

```
void Copy (string sourceFileName, string destFileName);
```

```
void Move (string sourceFileName, string destFileName);
```

```
void Replace (string sourceFileName, string destinationFileName,  
string destinationBackupFileName);
```

```
FileAttributes GetAttributes (string path);
```

```
void SetAttributes (string path, FileAttributes fileAttributes);
```



## System.IO.Directory

- Important methods:

```
void SetCurrentDirectory (string path);  
DirectoryInfo CreateDirectory (string path);  
DirectoryInfo GetParent (string path);  
string GetDirectoryRoot (string path);  
string[] GetLogicalDrives();  
// The following methods all return full paths:  
string[] GetFiles (string path);  
string[] GetDirectories (string path);  
string[] GetFileSystemEntries (string path);  
IEnumerable<string> EnumerateFiles (string path);  
IEnumerable<string> EnumerateDirectories (string path);
```

## System.IO.FileInfo

- Provides additional properties such as:
  - Extension,
  - Length,
  - IsReadOnly,
  - Directory.
- Further reading: [link](#)

## Other classes

- DirectoryInfo
  - Further reading: [link](#)
- Path
  - Further reading: [link](#)

# Serialization

# Serialization and Deserialization

- *Serialization* is the act of taking an in-memory object or *object graph* (set of objects that reference each other) and flattening it into a stream of bytes or XML nodes that can be stored or transmitted. *Deserialization* works in reverse, taking a data stream and reconstituting it into an in-memory object or object graph.
- Serialization and deserialization are typically used to:
  - Transmit objects across a network or application boundary.
  - Store representations of objects within a file or database.

# Serialization Engines

- There are four serialization mechanisms in the .NET Framework:
  - The data contract serializer
  - **The binary serializer**
  - The (attribute-based) XML serializer (XmlSerializer)
  - The IXmlSerializable interface

## Binary Serializer

```
[Serializable]
public sealed class Person
{
    public string Name;
    public int Age;
}
```

- The **[Serializable]** attribute instructs the serializer to include all fields in the type. This includes both private and public fields (but not properties). Every field must itself be serializable; otherwise, an exception is thrown.
- Primitive .NET types such as string and int support serialization (as do many other .NET types).

## Binary Serializer

```
private void btnSerialize_Click(object sender, EventArgs e){
    IFormatter formatter = new BinaryFormatter();
    using (FileStream s = File.Create("serialized.bin"))
        formatter.Serialize(s, _participants);
}

private void btnDeserialize_Click(object sender, EventArgs e){
    IFormatter formatter = new BinaryFormatter();
    using (FileStream s = File.OpenRead("serialized.bin")) {
        _participants = (List<Participant>)formatter.Deserialize(s);
        DisplayParticipants();
    }
}
```



## Binary Serialization Attributes

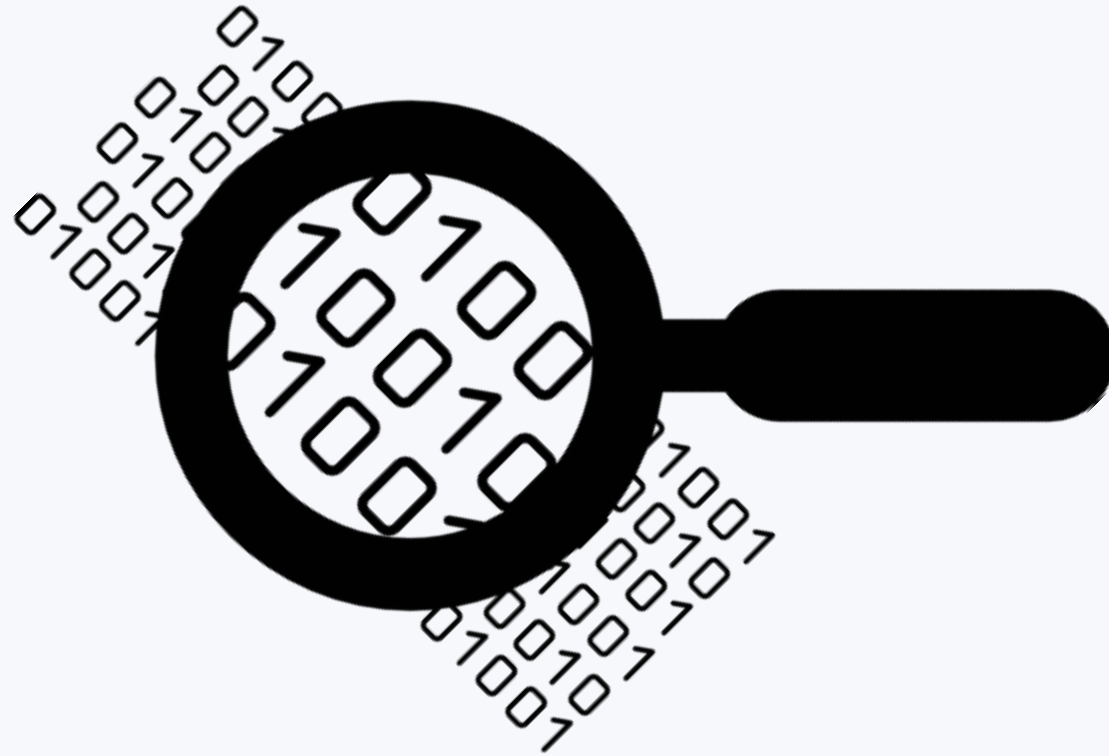
- [NonSerialized]
  - Fields that should not be serialized, such as those used for temporary calculations, or for storing file or window handles, must be marked explicitly with the [NonSerialized] attribute

```
public sealed class Person
{
    public string Name;
    public DateTime DateOfBirth;
    [NonSerialized] public int Age;
    [NonSerialized] public bool Valid = true;
    public Person() { Valid = true; }
}
```

Graphics

# Graphics

- The Graphics class provides methods for drawing objects to the display device. A Graphics is associated with a specific device context.
- You can obtain a Graphics object (the class does not include a public constructor):
  - by calling the Control.CreateGraphics method on an object that inherits from System.Windows.Forms.Control;
  - by handling a control's Control.Paint event and accessing the Graphics property of the System.Windows.Forms.PaintEventArgs class;
  - from an image by using the Graphics.FromImage method.



Dialogs

## Modal & Modeless

- Forms can exhibit either **modal** or **modeless** behavior
- A **modal form** is one that demands the user's immediate attention, and blocks input to any other windows the application may have open.
- Good UI design suggests that you should use **modal** dialogs **only** when absolutely necessary. Typical examples: error messages

# Modal & Modeless

```
//modal
```

```
Form frm = new Form( );  
frm.ShowDialog( );
```

```
//modeless
```

```
Form frm = new Form( );  
frm.Show ( );
```

# Transferring data between forms

The screenshot shows a Windows application window titled "WinAppProgramming Run". Inside, there are two forms: "New Participant" and "Edit Participant".

The "New Participant" form has input fields for "Last Name" (containing "dsfds") and "First Name" (containing "dsfdsdfd"), and a "Birth Date" field (containing "Tuesday , April 19, 2016"). An orange "Add Participant" button is located to the right of the "First Name" field.

The "Edit Participant" form is a modal dialog box that is currently open. It contains the same input fields as the "New Participant" form, with the "Last Name" field selected. It has "Ok" and "Cancel" buttons at the bottom.

Below the "New Participant" form, there is a table with two columns: "Last Name" and "First Name". The table contains four rows of data, all with the same values: "dsfds" and "dsfdsdfd".

At the bottom right of the main window, there are "Edit" and "Delete" buttons.



## Transferring data between forms

```
EditForm editForm = new EditForm((Participant)lvParticipants.SelectedItems[0].Tag);  
if (editForm.ShowDialog() == DialogResult.OK)  
    DisplayParticipants();
```

```
public partial class EditForm : Form  
{  
    private readonly Participant _participant;  
  
    public EditForm(Participant participant) {  
        _participant = participant;  
  
        InitializeComponent();  
    }  
}
```

# Transferring data between forms



# Databases

# Data Access

- ADO.NET - Active Data Objects
- NHibernate
- Entity Framework (recommended)

# ADO.NET - Active Data Objects

- Approaches:
  - **Connection Oriented Data Access Architecture** - the application makes a connection to the Data Source and then interacts with it through SQL requests using the same connection. In these cases the application stays connected to the database system even when it is not using any Database Operations
  - **Disconnected Data Access Architecture** – the application can manipulate a set of DataTable objects (contained within a DataSet) that functions as a client-side copy of the external data. The connection is automatically opened and closed on when needed.
- Further reading: [link](#)

# ADO.NET Data Providers

Type of Object	
Connection	Provides the ability to connect to and disconnect from the data store. Connection objects also provide access to a related transaction object.
Command	Represents a SQL query or a stored procedure. Command objects also provide access to the provider's data reader object.
DataReader	Provides forward-only, read-only access to data using a server-side cursor.
DataAdapter	Transfers DataSets between the caller and the data store. Data adapters contain a connection and a set of four internal command objects used to select, insert, update, and delete information from the data store.
Parameter	Represents a named parameter within a parameterized query.
Transaction	Encapsulates a database transaction.

# ADO.NET Data Providers

- ADO.NET supports multiple *data providers*, each of which is optimized to interact with a specific DBMS
- Connection:
  - `SqlConnection;`
  - `OracleConnection;`
  - `OdbcConnection;`
  - `MySqlConnection;`
  - `SQLiteConnection.`

# Connection

- The connection tells the rest of the ADO.NET code which database it is talking to.
- SQLiteConnection

```
SQLiteConnection conn = new SQLiteConnection("Data Source=database.db");
```

- SqlConnection

```
SqlConnection conn = new SqlConnection("Data Source=DatabaseServer;  
Initial Catalog=Northwind;User ID=YourUserID;Password=YourPassword");
```



# Command

- The **Command** object specifies the type of interaction that will be performed on a database. For example, you can do **select**, **insert**, **update**, and **delete** commands on rows of data in a database table.

```
SQLiteCommand command = new SQLiteCommand("SELECT * FROM Participant",  
_dbConnection);
```

# Command

- `ExecuteScalar()`
  - Executes the query and returns the first column of the first row in the result set returned by the query. All other columns and rows are ignored.
  - If the value in the database is **null**, the query returns **DBNull.Value**.

```
// 1. Instantiate a new command
```

```
SqlCommand cmd = new SqlCommand("select count(*) from Participant", conn);
```

```
// 2. Call ExecuteScalar to send command
```

```
int count = (int)cmd.ExecuteScalar();
```

# Command

- `ExecuteNonQuery()`
  - Can be used to change the data in a database by executing UPDATE, INSERT, or DELETE statements.

# Command

```
const string stringSql = "DELETE FROM Participant WHERE Id=@id";
try{
    //Remove from the database
    _dbConnection.Open();
    SQLiteCommand sqlCommand = new SQLiteCommand(stringSql, _dbConnection);
    var idParameter = new SQLiteParameter("@id");
    idParameter.Value = participant.Id;
    sqlCommand.Parameters.Add(idParameter);

    sqlCommand.ExecuteNonQuery();
}
finally{
    if (_dbConnection.State != ConnectionState.Closed) _dbConnection.Close();
}
}
```

## DataReader

- The ADO.NET DataReader can be used to retrieve a read-only, forward-only stream of data from a database. Results are returned as the query executes, and are stored in the network buffer on the client until you request them using the Read method of the DataReader.

# DataReader

```
SQLiteDataReader sqlReader = sqlCommand.ExecuteReader();
try {
    while (sqlReader.Read())
    {
        _participants.Add(new Participant(
            (long) sqlReader["Id"], (string) sqlReader["LastName"],
            (string) sqlReader["FirstName"],
            DateTime.Parse((string) sqlReader["BirthDate"]));
    }
}
finally {
    // Always call Close when done reading.
    sqlReader.Close();
}
```

# Transaction

```
try{
    _dbConnection.Open();
    dbCommand.Transaction = _dbConnection.BeginTransaction();

    participant.Id = (long)dbCommand.ExecuteScalar();

    dbCommand.Transaction.Commit();
}
catch (Exception){
    dbCommand.Transaction.Rollback();
    throw;
}
finally{
    if (_dbConnection.State != ConnectionState.Closed) _dbConnection.Close();
}
```

## DataSet and DataAdapter

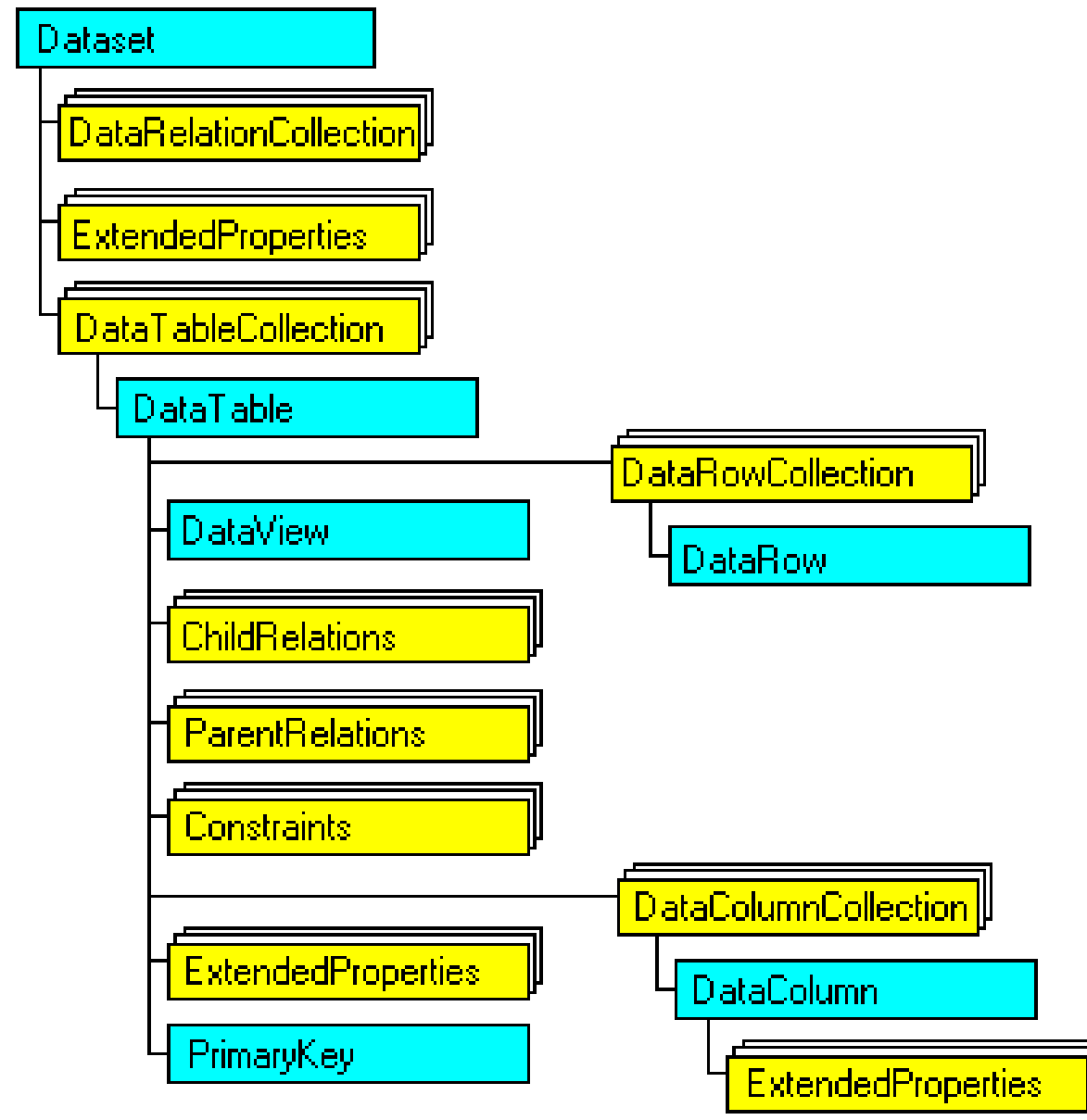
- A **DataSet** is an in-memory data store that can hold numerous tables (**DataTable**). DataSets only hold data and do not interact with a data source.
- It is the **DataAdapter** that manages connections with the data source and gives us disconnected behavior. The DataAdapter opens a connection only when required and closes it as soon as it has performed its task.
- The **DataAdapter** uses **Command** objects to execute SQL commands at the data source to both load the **DataSet** with data and reconcile changes that were made to the data in the **DataSet** back to the data source.



## DataSet and DataAdapter

- For example, the SqlDataAdapter performs the following tasks when filling a DataSet with data:
  - Open connection
  - Retrieve data into DataSet
  - Close connection
- and performs the following actions when updating data source with DataSet changes:
  - Open connection
  - Write changes from DataSet to data source
  - Close connection

# DataSet



# DataAdapter

```
_dbDataAdapter = new SQLiteDataAdapter("SELECT * FROM Participant", _conn);
```

```
//delete
```

```
var deleteCommand = new SQLiteCommand("DELETE FROM Participant WHERE Id = @Id", _conn);  
deleteCommand.Parameters.Add(new SQLiteParameter("@Id"));
```

```
_dbDataAdapter.DeleteCommand = deleteCommand;
```

```
//insert
```

```
var insertCommand = new SQLiteCommand("INSERT INTO Participant (LastName, FirstName, BirthDate)  
VALUES (@LastName, @FirstName, @BirthDate);", _conn);  
insertCommand.Parameters.Add(new SQLiteParameter("@LastName"));  
..... //FirstName, BirthDate
```

```
_dbDataAdapter.InsertCommand = insertCommand;
```

## Choosing a DataReader or a DataSet

- Use a **DataSet** to do the following:
  - Cache data locally in your application so that you can manipulate it. If you only need to read the results of a query, the **DataReader** is the better choice.
  - Interact with data dynamically such as binding to a Windows Forms control or combining and relating data from multiple sources.
  - Perform extensive processing on data without requiring an open connection to the data source, which frees the connection to be used by other clients.
- If you do not require the functionality provided by the **DataSet**, you can improve the performance of your application by using the **DataReader** to return your data in a forward-only, read-only manner.

# Demo



# Data Binding

# Data Binding

- Data binding in Windows Forms gives you the means to display and make changes to information from a data source in controls on the form. You can bind to both traditional data sources as well as almost any structure that contains data.
- Further reading: [link](#)

# Types of Data Binding

Type	Description
Simple data binding	The ability of a control to bind to a single data element, such as a value in a column in a dataset table. This is the type of binding typical for controls such as a <a href="#">TextBox</a> control or <a href="#">Label</a> control, which are controls that typically only displays a single value. In fact, any property on a control can be bound to a field in a database.
Complex data binding	The ability of a control to bind to more than one data element, typically more than one record in a database. Complex binding is also called list-based binding. Examples of controls that support complex binding are the <a href="#">DataGridView</a> , <a href="#">ListBox</a> , and <a href="#">ComboBox</a> controls.



# Simple data binding

```
control.DataBindings.Add(  
    string propertyName,  
    object dataSource,  
    string dataMember,  
    bool formattingEnabled,  
    DataSourceUpdateMode dataSourceUpdateMode  
);
```

```
tbLastName.DataBindings.Add("Text",_viewModel,"LastName",false,DataSourceUpdateMode.OnPropertyChanged);
```

# Complex data binding

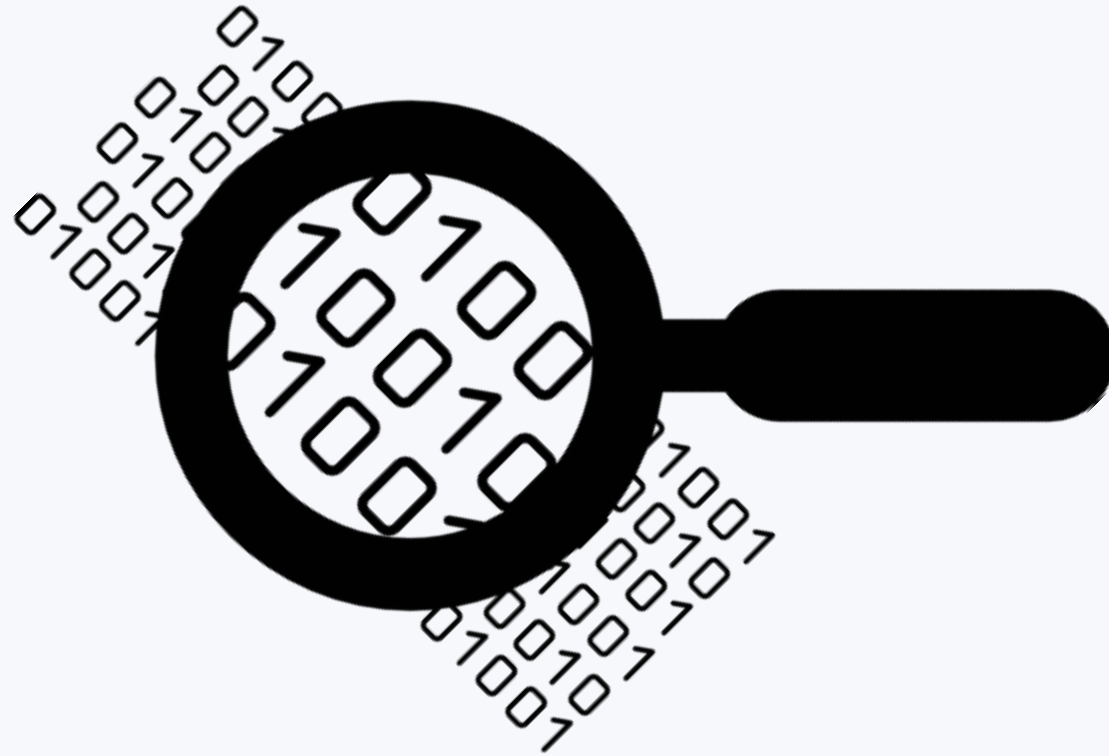
	LastName	FirstName	BirthDate
	dfds	dfdsf	4/22/2016 1:43 ...
▶	sds	sds	4/22/2016
	sds	sds	4/22/2016
	sds	sds	4/22/2016

```
dgvParticipants.DataSource = _viewModel.Participants;
```

## Change notification

- One of the most important concepts of Windows Forms data binding is *change notification*. To ensure that your data source and bound controls always have the most recent data, you must add change notification for data binding.
- Specifically, you want to ensure that bound controls are notified of changes that were made to their data source, and the data source is notified of changes that were made to the bound properties of a control.
- Cases:
  - Simple Binding – [INotifyPropertyChanged](#)
  - Complex data binding – [IBindingList](#)

# Demo



Clipboard

# Clipboard

- Class: `System.Windows.Forms.Clipboard`
- The *clipboard* is a set of functions and messages that enable applications to transfer data. Because all applications have access to the clipboard, data can be easily transferred between applications or within an application.

## Adding data

- Call [SetDataObject](#) to put data on the Clipboard in **one** or **multiple** formats, replacing its current contents.
- For a list of predefined formats to use with the Clipboard class, see the [DataFormats](#) class.

```
DataObject data = new DataObject();
```

```
// Add a Customer object using the type as the format.
```

```
data.SetData(new Customer("Customer as Customer object"));
```

```
// Add a ListViewItem object using a custom format name.
```

```
data.SetData("CustomFormat", new ListViewItem("Customer as ListViewItem"));
```

```
Clipboard.SetDataObject(data);
```

## Adding data

- To add data of a particular format to the Clipboard, replacing the existing data, call the appropriate **SetFormat** method, such as [SetText](#), or call the [SetData](#) method to specify the format.

```
//Copy HTML from web browser onto the clipboard
```

```
Clipboard.SetText(WebBrowser1.DocumentText, TextDataFormat.Html);
```

```
//Copy the picture from the picture box onto the clipboard
```

```
Clipboard.SetImage(PictureBox1.Image);
```

```
//Copy Pixel object onto the clipboard
```

```
Clipboard.SetData("Pixel", _pxl);
```



## Retrieving data

- Call [GetDataObject](#) to retrieve data from the Clipboard. The data is returned as an object that implements the [IDataObject](#) interface.
- To specify the format in these operations, call the [ContainsData](#) and [GetData](#) methods instead.

```
DataObject retrievedData = (DataObject)Clipboard.GetDataObject();

if (retrievedData.GetDataPresent("CustomFormat")){
    ListViewItem item = retrievedData.GetData("CustomFormat") as ListViewItem;
    if (item != null) MessageBox.Show(item.Text);
}

if (retrievedData.GetDataPresent(typeof(Customer))) {
    Customer customer = retrievedData.GetData(typeof(Customer)) as Customer;
    if (customer != null) MessageBox.Show(customer.Name);
}
```

## Retrieving data

- To retrieve data of a particular format from the Clipboard, first call the appropriate **ContainsFormat** method (such as ContainsText) method to determine whether the Clipboard contains data in that format, and then call the appropriate **GetFormat** method (such as GetText) to retrieve the data if the Clipboard contains it.

```
if (Clipboard.ContainsText(TextDataFormat.Html))  
    TextBox2.Text = Clipboard.GetText(TextDataFormat.Html);
```

```
if (Clipboard.ContainsImage())  
    PictureBox2.Image = Clipboard.GetImage();
```

```
if (Clipboard.ContainsData("Pixel")){  
    var tempPixel = (Pixel) Clipboard.GetData("Pixel");  
    LoadPixel(tempPixel, TextBox4);  
}
```

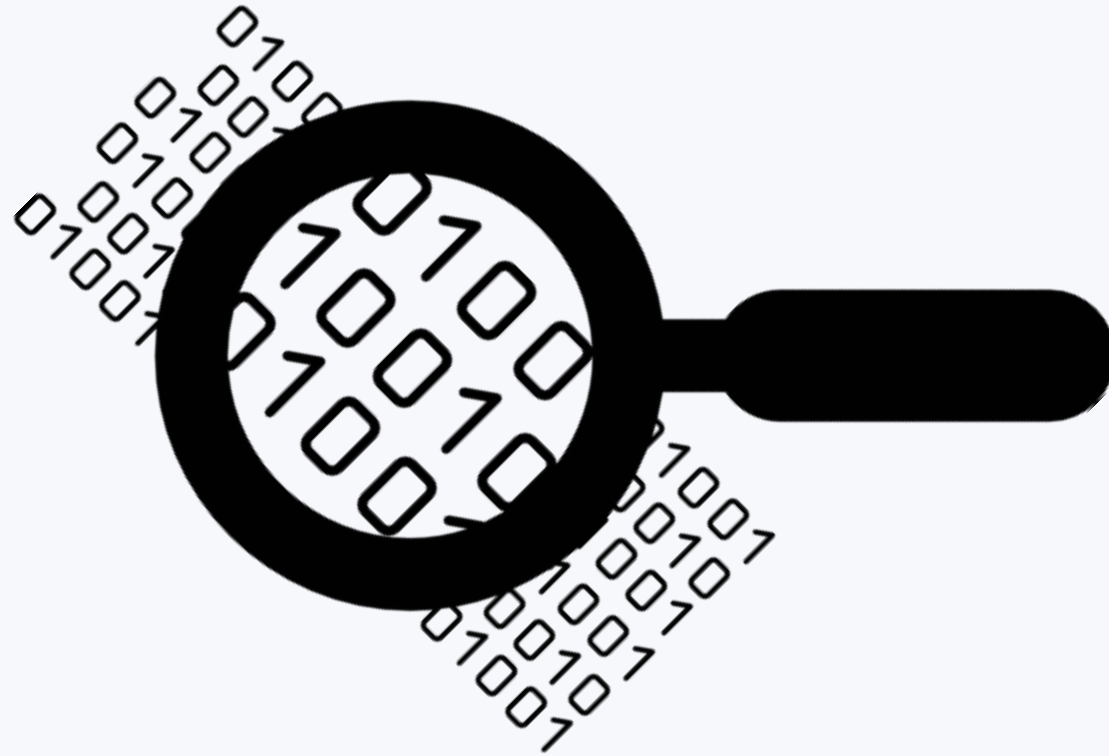
# Clear

- Call the Clear method to remove all data from the Clipboard.

```
//Clear the clipboard  
Clipboard.Clear();
```

Clipboard

Demo



Drag & Drop

Printing



UI Design



# Alignment

