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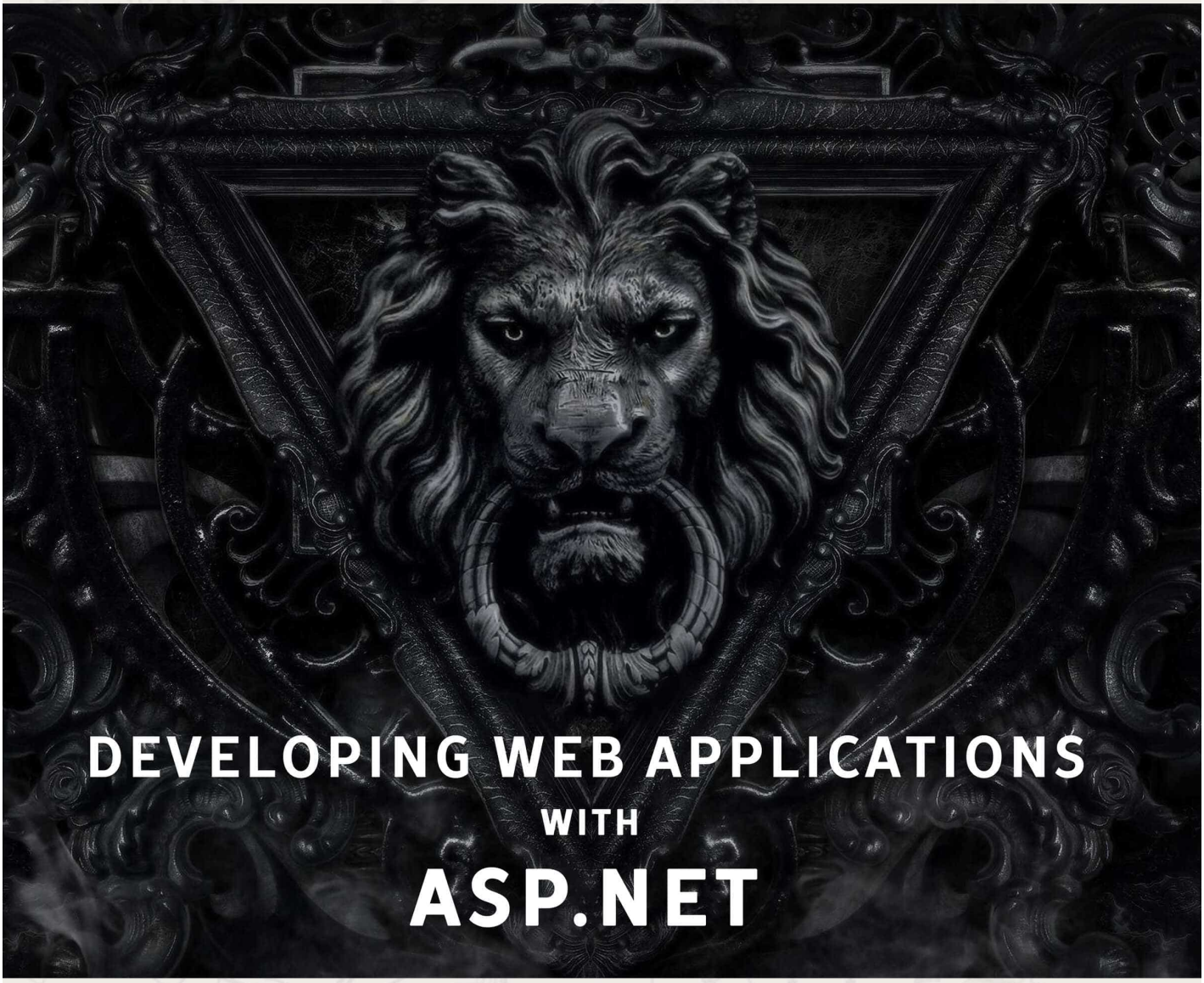

# DEVELOPING WEB APPLICATIONS WITH ASP.NET

Jump2Learn - The Online Learning Place

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# Unit - 1

# Introduction to ASP.NET

## 1.1 What is ASP.NET:

ASP.NET means **"Active Server Pages"** which is frontend language & it is established & supported by Microsoft.

ASP.NET is a web application which allows the programmer to build dynamic web sites, Web applications & web services. ASP.NET allows to develop web applications using a full featured programming language such as C#, VB.NET, Jscript or J#.

ASP.NET is a web development platform, which provides the easiest & most accessible way to build, deploy & run distributed web applications which can target for any device as well as browser. In short, ASP.NET is used to produce interactive, data-driven web applications over the internet.

ASP.NET works on top of the HTTP protocol, and uses the HTTP commands and policies to set a browser-to-server two-sided communication and cooperation.

ASP.NET applications are compiled codes, written using the extensible and reusable components or objects present in .Net framework. These codes can use the entire hierarchy of classes in .Net framework.

ASP.NET consist of a large number of controls such as text boxes, buttons, labels & many more for assembling , configuring & manipulating code to create HTML pages.

An ASP.NET web application is made of pages. When a user requests an ASP.NET page, the IIS gives the processing of the page to the ASP.NET runtime system.

The ASP.NET runtime transforms the .aspx page into an instance of a class, which inherits from the base class page of the .Net framework. Therefore, each ASP.NET page is an object and all its components i.e., the server-side controls are also objects.

## 1.2 .NET Framework 2.0:

.NET is Software Platform. It is a language neutral environment for developing applications. It also provides an execution environment and integration with various programming languages for building, deploying and running web-based and standalone enterprise applications. All aspects to manage the program execution like memory allocation for data storage and instructions, granting and denying permission to the application, managing execution of application and reallocation of memory for resources which are not needed is managed easily in ASP.NET. It consists of class libraries and reusable components.

The block diagram of .NET framework is as follows:

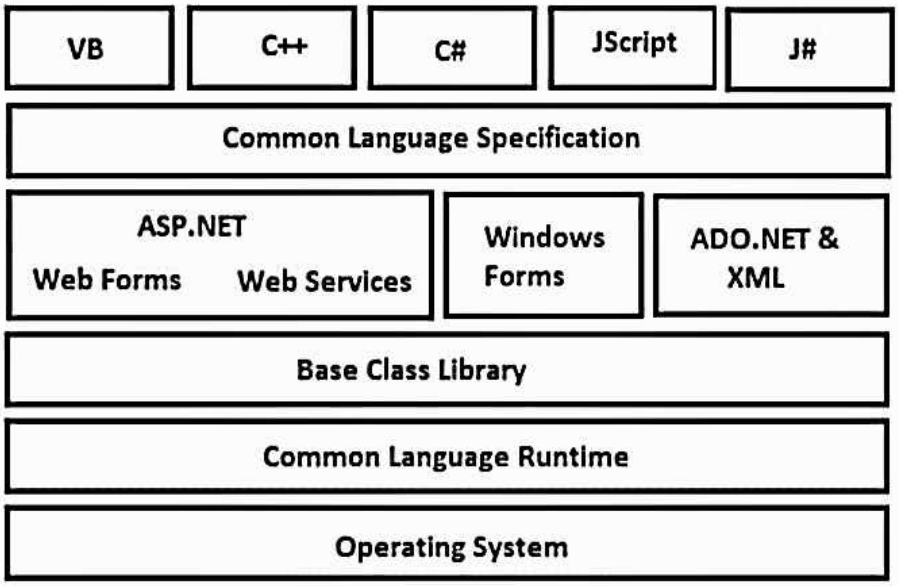


Figure 1: .NET Framework

### 1.2.1 Programing Languages:

.Net framework is designed for cross language compatibility which means it supports various programing languages like Visual Basic (VB), Visual Basic .Net (VB.Net), C#, J# etc. So programmers/developers can choose any favourite programing language to build web application.

### 1.2.2 Common Language Specification (CLS):

CLS is the collection of rules and constraints that every language compatible to .NET must follow. It is one of the core components of the .Net Framework which helps to build communication between different components written in different programming language and reuse the common logics. Microsoft has defined three level of CLS compatibility as follow:

- **Compliant Producer:** The component developed in this type of language can be used by any other language.
- **Consumer:** In this category, the language can use classes produced in any other language.
- **Extender:** In this category, languages cannot use classes as in CONSUMER category but can also extend classes using inheritance.

### 1.2.3 Web Forms:

In ASP.NET, web forms are called web pages which help to develop web applications. It is consist of two parts:

1. Template which contains HTML based layout information for all GUI controls.
2. Component which contains the logic behind the controls.

### 1.2.4 Web Services:

A web service is a web-based functionality that runs on Web Server. It is accessed using the protocols of the web to be used by the web applications. They are the small unit of code which is design to handle limited set of task. They are independent of operating system and programming language.

### 1.2.5 Window Forms:

Windows Forms contain the graphical representation of any window displayed in the application. It also provides integrated and unified way of developing Graphical User Interface. It has rich variety of windows controls and user interface support like Text Box, Button, Check Box, etc.

We can design the GUI by dragging the control directly on a form which made it possible to design the win forms easily and quickly as Visual Studio .NET uses the 'System.Winform' namespace to draw the Graphical User Interface.

### 1.2.6 ADO.NET & XML:

It is the technology used for working with data and databases which is also known as Data Access Layer. It provides access to data sources like SQL server, OLE DB, XML etc. The ADO.NET allows connection to data sources for retrieving, manipulating, and updating data.

### 1.2.7 Base Class Library (BCL):

.Net framework consists of classes, interfaces and value types that help in speeding up the development process and provide access to the system functionality. The class library is a collection of methods & functions that can be reusable types meant to be used by managed code.

It is an object –oriented library that is used in component –based application. The Class library is made up of a hierarchy of namespaces that expose classes, structure, interfaces, enumerations and delegates. The namespaces are logically defined by their functionality. Most of the methods are split into either System.* or Microsoft.* namespaces. For

example, The System.Data namespace contains the functionality available for accessing database.

### 1.2.8 Common Language Runtime (CLR):

It is the runtime environments which do both compile and run the application. So it is also known as the heart of .NET framework. MSIL (Microsoft Intermediate Language) which is language independent code, so CLR uses this code for the execution of the application. The MSIL code is translated by JIT (Just-in Time) compiler.

### 1.2.9 Microsoft Intermediate Language (MSIL) :

It is also known as Intermediate Language (IL) or Common Intermediate Language (CIL). A.NET programming language does not compile the code into executable code; instead it compiles the code into an intermediate code called Microsoft Intermediate Language (MSIL) or Intermediate Language (IL) or Common Intermediate Language (CIL).

This IL or MSIL or CIL code is machine independent code which is then send to CLR which converts this machine independent code into native code with the help of JIT (Just-in Time Compiler) available in CLR.

### 1.3 Compile Code:

To serve the user request, ASP.NET must first compile the code. ASP.NET code can be written in any language supported by .NET framework. When code is compiled, it is first converted into Microsoft Independent Language (MSIL). Then this independent language is further converted into Machine Specific instructions.

### Benefits of Compiled Code:

1. At code compilation time, it is checking for syntax error, type safety etc. Due to which many errors can be eliminated and that is how it gives stability in code from the later stage.
2. Compile code is much faster than scripting languages. As they are similar to machine code which makes the performance of the execution.
3. Compiled code is difficult to read. So that no one can convert compiled code to source code again and that is how code becomes secure.
4. AS MSIL supports any .NET language, we are able to use assemblies which are written in different language. For example, if you are writing an ASP.NET Web page in C#, you can add a reference to a .dll file that was written in Visual Basic. Such interoperability functionality is also used.

ASP.NET 2.0 provides two paths for structuring the cod of ASP.NET pages: Code Behind and Code Inline

### 1.3.1 Code Behind

In this way, code is separated from content completely and stored in a separate file. The idea of using the code behind is to separate the business logic to be stored in .aspx page and presentation logic to be stored in separate class file either .aspx.vb or .aspx.cs. By doing this, it makes easy to work with pages. As if you are working in team environment where visual designers work in the UI if the page and coders work on the business logic. This relationship between your class and the web page is established by a Page directive at the top of the .aspx file:

< %@ Page inherits="Default" % >

The inherits attribute identifies the class created in the code-behind file from which this .aspx file will derive.

**For Example:**


Figure 2: Code behind Presentation Logic

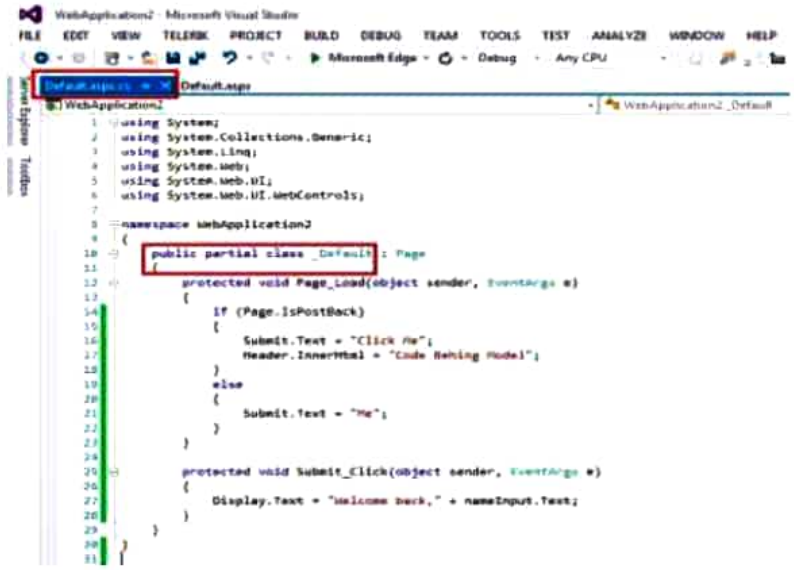


Figure 3: Code behind Business Logic

### 1.3.2 Inline Coding

Inline Code is embedded directly within the ASP.NET page that has an extension of .aspx. It permits the code to be composed along with the HTML source code using a < Script > tag. That means the business logic and the presentation logic are contained within the same file. When the page is deployed, the source code is deployed along with the Web Forms page, because it is physically in the .aspx file. However, you do not see the code, only the results are rendered when the page runs.

**For Example:**


Figure 4: Inline Code

## 1.4 The Common Language Runtime (CLR):

It is the core component of .NET Framework. It is also known as an execution Environment.

It is used to compile the IL or MSIL code to native code.

Following diagram shows the working process of CLR.

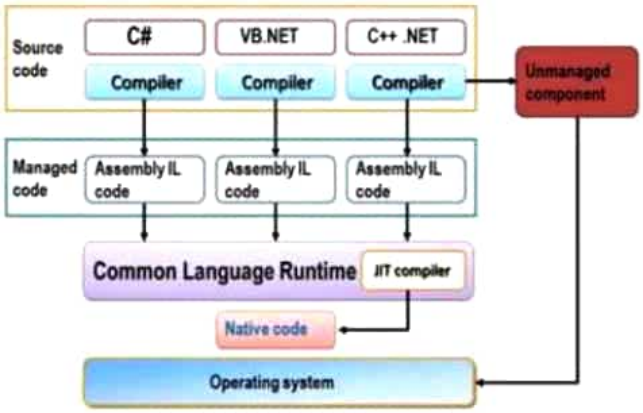


Figure 5: CLR Execution Model

The main function of CLR is to convert the MSIL code to native code and then execute the program. The managed code – a code that is developed with a language compiler that targets the CLR is compiled only when it is needed, that means it converts the appropriate instructions when each functin is called. The unmanaged code – a code thaat is developed without considering the conventions and requirements of CLR, is executed with minimal service of CLR. The CLR's JIT (Just-in Time) compilation converts MSIL to native code on demant at application run.

During the execution of the program, the CLR provides functionaloty such as memory, Debugging, Exception Handling, Security and versioning support to any languages that target it.

In short, When .NET programs are executed, the CLR activates the JIT compiler. The JIT Compiler converts MSIL into native code on demand basis. Thus the program executes as a native code to run the program fast. That is how .NET framework achieves the portability.

### Component of CLR:

**1. Class Loader:** It loads the classes into the system memory as and when needed.

**2. Code Manager:** The code manager in CLR manages the code developed in the .NET framework. The managed code is converted to intermediate language by a language-specific

compiler and then the intermediate language (IL) is converted into the machine code by the Just-In-Time (JIT) compiler.

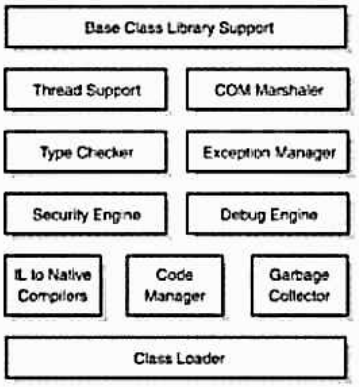


Figure 6: CLR Component

**3. Garbage Collection:** Lifetime of an object is managed by CLR which performs automatic memory management using garbage collector in CLR. An object which is no longer required then such objects are automatically releasing the memory space with help of garbage collector.

i. **MSIL to Native Compilers:** It is used to compile the MSIL code and convert it into native language.

ii. **Debug Engine:** An application can be debugged during the runtime using debug engine.

iii. **Security Engine:** In .NET architecture, security is achieved with the help of the Code Access Security (CAS) mechanism which prevent untrusted code from performing privileged actions. That means, CLR enforces restrictions on managed code through the use of object called permissions. The CLR allows the code to perform only those tasks for which it has permission.

iv. **Exception Manager:** During the execution of the program, if any exception occurs then it is handled by exception manager.

v. **Type Checker:** Objects which are used in application are always accessed in compatible ways, is ensured by this feature of CLR.

vi. **Thread Support:** Support for managing the parallel execution of multiple thread is provided by CLR.

vii. **COM Marshaller:** It allows communication between the application and COM Objects.

viii. **Class Library Support:** It provides Base Class Library classes when application need at execution time.

## 1.5 Object Oriented Concepts:

Object Oriented Programming (OOP) is a programming model where programs are organized around objects, data field and methods which interact to design applications and computer programs.

### 1.5.1 Class:

A class is a user-defined prototype from which objects are created. A class contains fields & methods known as member function into single unit.

**Syntax:**

```
[Access Modifier] <Class name> [:Base Class][:implements interface names]
{
        [Statements]
}
```

Here, access modifiers are Public, Private, Protected and internal.

**For Example:**

```
Public class student
{
        /* fields, variables, methods, properties */
}
```

### 1.5.2 Fields:

Variables declare inside a class are called fields that can be accessed by creating an object of the class and by using the dot syntax (.).

**For Example:**

```
Public Class student
{
Public int roll_no=1;
Public string name="Yash";
static void Main(string[] args)
```

```
{
student myStud = new student();
Console.WriteLine(myStud.roll_no);
Console.WriteLine(myStud.name);
}
}
```

Another way, to declare fields and initialize them while creating objects which is very useful when multiple objects are created.

```
Public Class student
{
Public int roll_no;
Public string name;
static void Main(string[] args)
{
student myStud = new student();
myStud.roll_no=1;
myStud.name="Yash";
Console.WriteLine(myStud.roll_no);
Console.WriteLine(myStud.name);
}
}
```

### 1.5.3 Properties:

Properties are set and retrieved like fields. They are set of descriptive data of an object which are implemented using Get & Set procedures which provide more control on how values are set or returned.

**For Example:**

```
Public Class student
{       // Fields
private int roll_no;
private string name;
//properties
public int RollNo
```

```
{
get
{
return roll_no;
}
Set
 {
roll_no = value;
}
}
public string StudName
{
Get
{
return name;
}
Set
{
name = value;
}
}
static void Main(string[] args)
{
student myStud = new student();
Console.WriteLine(myStud.Roll_No);
Console.WriteLine(myStud.StudName);
}
}
```

### 1.5.4 Methods:

A method is a block of code which only runs when it is called. They are used to perform certain actions, and they are also known as functions of the class.

**For Example:**

```
public Class student
{
public int roll_no=1;
public string name="Yash";
public void display()
{
Console.WriteLine(myStud.roll_no);
Console.WriteLine(myStud.name);
}
static void Main(string[] args)
{
student myStud = new student();
myStud.display();
}
}
```

### 1.5.5 Events:

Events allows objects to perform an actions whenever some specific action takes place. For example, when we click a button, a click event occurs and we can handle that event with event handler.

### 1.5.6 Objects:

It is a basic unit of OOP which represents real time entity. They are called instances of classes which defines the data & behavior of all the instances of that type.

**For Example:**

```
student myStud = new student();
```

### 1.5.7 Constructor:

A constructor is a special method used to initialize objects. Main advantage of a constructor is that it is called when an object of a class is created. Basically, it is used to set the initial values of the fields of the class.

**For Example:**

```
public class student
```

```
{       //fields
public int roll_no;
public string name;
public student()  // Constructor
{
roll_no=1;
name="Yash";
}
static void Main(string[] args)
{
student myStud = new student(); // This will call the constructor
Console.WriteLine(myStud.roll_no);
Console.WriteLine(myStud.name);
}
}
```

### 1.5.8 Destructor:

It is executed automatically when an object is destroyed. The Destructor is called implicitly by the .NET Framework's Garbage collector so that programmer has no control as when to invoke the destructor.

### 1.5.9 Encapsulation:

Wrapping up of data member & member functions into single unit is called Encapsulation. In other words, Encapsulation is protective shield that prevents the data from being accessed by the code from the outside of that shield.

So, data & members of a class are hidden from any other classes. They can be accessed only through any member function or properties of own class in which they are declared. This concept is called Data Hiding.

**For Example:**

```
public class student
{
private string name;
private int roll_no;
```

```
// using property to get and set the value of studentName
public string StudName
{
get
{
 return name;
}
set
{
name = value;
 }
}
// using property to get and set the value of RollNo
public int R_No
{
get
 {
return roll_no;
}
set
{
roll_no = value;
}
}
}
class Stud_Main
{
static void Main(string[] args)
{
student s=new student();
 // call to set property with respective value to set standard field 'value'
s.R_No=1;
```

```
s.StudName="Yash";
// call to get property value
Console.WriteLine(s.R_No);
Console.WriteLine(s.StudNname);
}
}
```

### 1.5.10 Inheritance:

It is a mechanism by which one class is allowed to inherit the members of another class. That means, Inheritance is the process of forming a new class from an existing class.

The class whose features are inherited is known as Parent class or Super class or Base class. The class who is acquiring the members of Base class is known as Child class or Derived class or Sub class. The subclass can add its own fields and methods in addition to the superclass fields and methods.Inheritance is an important concept of OOP as it helps in reducing the over all code size of the program and support reusability of code. To inherit the class colon ( : ) symbol is used.

**Syntax:**

```
class derived-class : base-class
{
// methods and fields
 .
 .
}
```

**For Example:**

```
public class ParentClass
{
public ParentClass()
{
Console.WriteLine("Parent Constructor.");
}
public void display()
{
Console.WriteLine("I'm a Parent Class.");
```

```
}
}
public class ChildClass: ParentClass
{
public ChildClass()
{
Console.WriteLine("Child Constructor.");
}
public static void Main()
{
ChildClass child = new ChildClass();
child.display();
}
}
```

### 1.5.11 Abstraction:

Data abstraction is the property by which only essential and important information is displayed to user without representing background details which increase the efficiency. It focuses on what the object does instead of how it does it. In other words, abstraction provides a generalized view of classes or objects by providing relevant information.

Abstraction is achieved with the help of either Abstract classes or interfaces. The 'abstract' keyword is used for classes and methods.

#### 1.5.11.1 Abstract Class:

It is such a class which cannot be instantiated. That means, it cannot be used to create an object but it must be inherited from another class. Abstract class can have both regular and abstract methods.

#### 1.5.11.2 Abstract Method:

It can be used only in abstract class and it does not have body. That means methods have only declaration in abstract class and derived class must have their definition. 'Override' keyword is used in derived class while defining the abstract method.

**For Example:**

```
abstract class Shape
{
```

```
public abstract int area();
}
class Square : Shape
{       // private data member
private int side;
public Square(int x = 0)
{
side = x;
}
public override int area()
{
Console.Write("Area of Square: ");
return (side * side);
}
}
class Program
{
static void Main(string[] args)
{
Square s = new Square(4);
double result = s.area();
Console.Write("{0}", result);
}
}
```

### 1.5.12 Interface:

An interface is similar to abstract class which can only contain abstract methods and properties but not fields. They cannot be used to create an object. By default, members of an interface are abstract and public.

Similar to abstract class, all interface methods must be implemented by the class which is implementing it. No override keyword is required while implementing an interface. Just like an inheritance, interfaces can be implemented using symbol colon ( : ).

**For Example:**

```
interface Shape
{
int area(); // interface method (does not have a body)
}
class Square : Shape
{
public int side=4;
public int area()
{
Console.Write("Area of Square: ");
return (side * side);
}
}
class Program
{
static void Main(string[] args)
{
Square s = new Square();
double result = s.area();
Console.Write("{0}", result);
}
}
```

Multiple inheritance is not supported by C#. So it can be achieved using implementing multiple interfaces. To do so, separate them with coma (,).

**For Example:**

```
interface inter1
{
Void method1();
}
interface inter2
{
```

```
Void method2();
}
class DemoClass : interface1, interface2
{
public void method1()
{
Console.WriteLine("First Interface Method");
}
public void method2()
{
Console.WriteLine("Second Interface Method.");
}
}
class Program
{
static void Main(string[] args)
{
DemoClass myObj = new DemoClass();
myObj.method1();
myObj.method2();
}
}
```

### 1.5.13 Polymorphism:

The polymorphism is the process of using an operator or function in different ways for different data input. In other words, it is the ability to redefine methods for derived classes.

There are basically two type of polymorphism:

**1. Compiletime polymorphism:** It is achieved by method or operator overloading. It is also known as static binding or early binding as at compile time only compiler knows that what type of object it is binding to and what are the method it is going to call.

**For Example:**

```
public class Shape
```

```
{
public int Area(int a, int b)
{
return a * b;
}
public double Area(int a, int b, int c)
{
return a * b * c;
}
}
class Program
{
static void Main(string[] args)
{
Shape s = new Shape();
double result = s.Area(4,5);
Console.Write("{0}", result);
result=s.Area(4,5,2);
Console.Write("{0}", result);
}
}
```

**2. Runtime polymorphism:** It is achieved by method overriding. It is also known as dynamic binding or late binding. To override base class methods, 'virtual' keyword is used with base class methods and 'override' keyword is used with each derived class methods to override.

**For Example:**

```
class Shape
{
public virtual void area()
{
Console.write("In Shape class method");
}
```

```
}
class Circle : Shape
{
public override void area()
{
Console.Write("In Circle class method");
}
}
class Triangle : Shape
{
public override void area()
{
Console.Write("In Triagle class method ");
}
}
class Program
{
static void Main(string[] args)
{
Shape sh = new Shape();
sh.area();
Circle c = new Circle();
c.area();
Triangle t = new Triangle();
t.area();
}
}
```

### 1.6 Event Driven Programming:

When something specific has occurred in significance for system hardware or software is call an Event. In other words, Event is a notification that something has occurred and detected by the program. A segment of code that is executed in response to an event is called an event handler.

An event driven programming is a programming approach in which the flow of the program is determined by an event like button clicked, text change etc. That means it enables you to write code that will execute in response to events raised by particular user action.

ASP.NET works like as follow:

1. When first time page is executed, it will create the page and the control objects along with the code initialization is executed and page is provided.
2. Any event can be triggered as some action is performed by the user when the page is served.
3. If any event generates the postback of the form than ASP.NET reponds the page by recreating it.
4. Then it will raises the appropriate event which has triggered the postback.
5. Last, modified page is provided to HTML and served to the client.

### 1.6.1 Page Life Cycle:

Whenever you request an ASP.NET page, a particular set of events is raised in particular sequence. This sequence of events is called the page execution lifecycle.

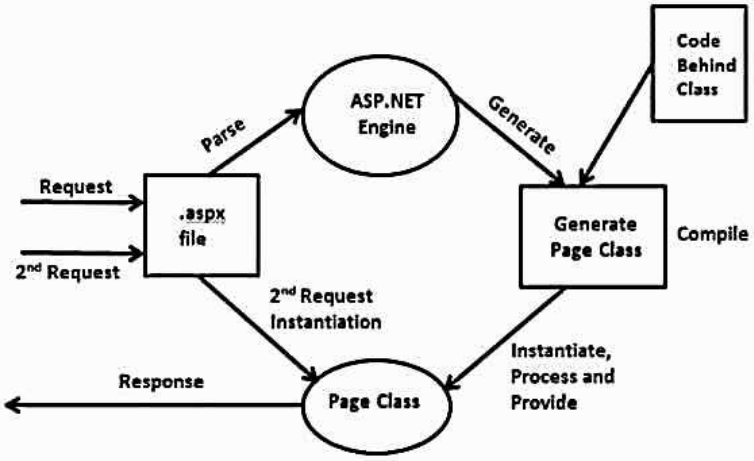


**Figure 7: Page Life Cycle**

When the request comes from the .aspx page, it is given for parsing to asp.net engine. Then a combined page class is generated from that parsed page and the code behind class and then it is compiled. At last, the instance of the class is created and provided to the user.

### 1.6.1.1 Page Life Cycle Stages:

**i. Page Request**

This is when the page is first requested from the server. When the page is requested, the server checks if it is requested for the first time. If so, then it needs to compile the page, parse the response and send it across to the user. If it is not the first time the page is requested, the cache is checked to see if the page output exists. If so, that response is sent to the user.

**ii. Start**

In this phase, 2 objects, known as the Request and Response object are set. If the request is an old request or post back, the IsPostBack property of the page is set to true. The UICulture property of the page is also set.

**iii. Page Initialization**

In this phase, controls on the page are available and each control's UniqueID property is set. A master page and themes are also applied to the page if applicable. If the current request is a postback, the postback data has not been loaded and control property values have not been restored to the values from view state.

**iv. Load**

During this phase, if the current request is a postback, control properties are set to utilize the view state and control state values like if a textbox is supposed to have a default value, that value is loaded during the page load time.

**v. Validation**

In this phase, when the validation controls are present on the page, than on its successful execution, IsValid property of the page is set to true.

**vi. Postback Event Handling**

In this phase, control event handlers are called if the request is a postback. That means this event is triggered if the same page is being loaded again. This happens in response to an earlier event. Sometimes there can be a situation that a user clicks on a submit button on the page. In this case, the same page is displayed again. In such a case, the Postback event handler is called.

**vii. Rendering**

Before this phase, view state is saved for the page and all controls. During this stage, the page calls the Render() method for each control and writes its output to the OutputStream object of the page's Response property.

**viii. Unload**

The unload method takes after the page is fully loaded and is ready to terminate. At this point, rendered page is sent to the client and page properties such as Response and Request are unloaded and clean-up is done.

### 1.6.1.2 Page Events:

Following is the sequence of events raised whenever you request a page:

**i. PreInit**

It is the first event in the page life cycle. It checks the IsPostback property and determines whether the page is a postback. This is the only event where programmatic access to master pages and themes is allowed. You can dynamically set the values of master pages and themes in this event. You can also create controls dynamically in this event.

**ii. Init**

This event fires after each control has been initialized, each control's Unique ID is set. You can use this event to read and initialize value for the controls. This event is fired first for the bottom-most control in the hierarchy, and then fired up the hierarchy until it is fired for the page itself.

**iii. InitComplete**

This event allows tracking of view state. All the controls turn on view-state tracking.

**iv. PreLoad**

The PreLoad event is used for performing the page processing on the page before the control is loaded. We can process any kind of operation that needs to perform before page load.

**v. Load**

This is the first place in the page lifecycle that all values are restored. The Page object calls the OnLoad method and then recursively does the same for each child control until the page and all controls are loaded. The Load event of individual controls occurs after the

Load event of the page. This event is use to set the properties of the controls and it can also be used to establish database connection.

**vi. ControlEvents**

These events are used to handle specific control events, such as a Button control's Click event.

**vii. PreRender**

This event occurs just before the output is provided. By handling this event, pages and controls can perform any updates before the output is provided.

**viii. PreRenderComplete**

As the PreRender event is recursively fired for all child controls, this event ensures the completion of the pre-rendering phase.

**ix. SaveStateComplete**

In this event, state of control on the page is saved. Personalization, control state and view state information is saved.

**x. UnLoad**

This is the last phase of the page life cycle. It raises the UnLoad event for all the controls recursively and for the page itself. It is useful for final cleanup such as closing database connection or any other requested specific tasks.

**Questions:**

**Q-1. Explain .NET Framework 2.0**

**Q-2. What is Compile Code? List out its benefits.**

**Q-3. What is the difference between Code Behind and Inline Coding?**

**Q-4. Explain CLR in detail.**

**Q-5. Explain Object Oriented Concepts.**

**Q.6 Explain ASP.NET Page Life Cycle.**