**ASP.NET**

ASP.NET is an Open-Source Web Framework, created by Microsoft, for building Modern Web Apps and Services with .NET using C# or VB.NET or F# languages. ASP.NET extends the .NET platform with tools and libraries specifically for building Web Apps.

.NET is Platform Independent i.e., applications that are developed by using .NET can run on multiple Platform’s and to run .NET Applications on a machine that machine should be 1st installed with a software i.e., .NET Runtime. Microsoft provided us 3 different .NET Runtimes that came over a period, like:

* .NET Framework Runtime
* .NET Core Runtime
* .NET Runtime

.NET Framework Runtime was launched in the year 2002 and this is available only for Windows Platforms. The first version of this Runtime is 1.0 and the last version is 4.8.

.NET Core Runtime was launched in the year 2016 and this is available for multiple platforms like Windows, Linux, and Mac. The first version of this Runtime is 1.0 and the last version is 3.1.

.NET Runtime is also same as .NET Core Runtime which was launched in the year 2020 and this is also available for multiple platforms like Windows, Linux, and Mac. This is a combination of .NET Framework and .NET Core and evolved as “One .NET”. The first version of .NET Runtime started with 5.0 and we call this as .NET 5 and the latest is .NET 6.

In .NET Framework we have been provided with ASP.NET Framework for building Web Applications and under this we have different options like:

* ASP.NET Web Forms
* ASP.NET MVC
* ASP.NET Web API

In .NET CORE, .NET 5, and .NET 6 we have been provided with ASP.NET Core Framework for building Web Applications and under this also we have different options again, like:

* ASP.NET Core Web App (Razor Pages)
* ASP.NET Core Web App (Model-View-Controller)
* ASP.NET Core Web API

**Note:** ASP.NET Core is the open-source version of ASP.NET, that can be developed and run-on Windows, Linux, macOS, and Docker. This was first released in 2016 and is a re-design of earlier Windows-Only versions of ASP.NET. Performance is a key focus of ASP.NET Core which is faster than other popular web frameworks as per independent [TechEmpower benchmarks](https://www.techempower.com/benchmarks/#hw=ph&test=plaintext). Like the rest of .NET, ASP.NET is also open source on GitHub which has over 100,000 contributions and 3,700 companies have already contributed.

**Applications what we use day to day are divided into different categories like:**

* Desktop Applications
* Web Applications
* Mobile Applications

**Desktop Applications** means, these applications must be installed on our computer first to consume them.

**Example:** MS Office, Skype Messenger, Zoom, Browsers, etc.

**Web Applications** means, we install these applications on a centralized machine known as Web Server and then clients can access the application by connecting to the Web Server using a Browser thru Internet.

**Example:** Facebook, Gmail, Amazon, Flipkart, etc.

**Mobile Applications** are also like Desktop Applications only i.e., we need to install them on our Mobiles or Tablets to consume, but they work with the help of Internet like a Web Application.

**Example:** WhatsApp, Swiggy, Zomato, Uber, Ola, etc.

**Desktop Applications Vs Web Applications:**

* Web Applications need to be installed only once that to on 1 Computer only whereas Desktop App’s must be installed separately on each computer.
* When we need to update a Web App’s it needs to be done only on the single computer where it is installed, whereas in case of Desktop App’s it needs to be done on every computer.
* Desktop App’s are confined to a particular location, and they have usability constraints, whereas Web App’s are convenient for the users to access them from any location using internet.
* Web Application’s relies significantly on internet connectivity and speed, so absence of internet or poor connectivity can cause performance issues whereas Desktop App’s are standalone in nature and hence do not face any hindrances resulting from Internet connectivity.
* Web Application is completely internet dependent, so they consume more bandwidth whereas Desktop App’s are partially internet dependent, so they consume less bandwidth.
* To build Desktop Application with .NET Languages we are provided with technologies like Console App’s, Windows App’s, WPF (Windows Presentation Foundation) App’s and same as that to build Web Applications we are provided with technologies like ASP.NET and ASP.NET Core.

**What is Internet?**

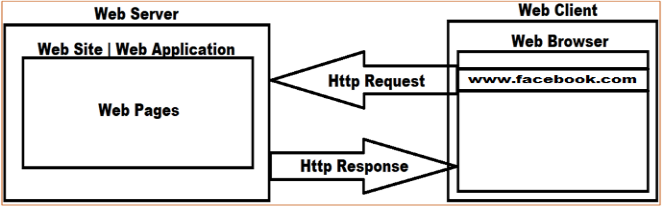
**Ans: Internet** is a global system of interconnected computer networks that use the standard Internet protocol suite (TCP/IP) to link several billion devices worldwide. It is a *network of networks* that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless, and optical networking technologies. Internet carries an extensive range of information, resources, and services, such as the inter-linked hypertext documents and applications of the World Wide Web (WWW), the infrastructure to support email, and peer-to-peer networks for file sharing and telephony.

**What is World Wide Web (WWW)?**

* The Web is a network of computers all over the world.
* All the computers in the web can communicate with each other.
* All the computers use a communication protocol called Http(s).

**How does WWW work?**

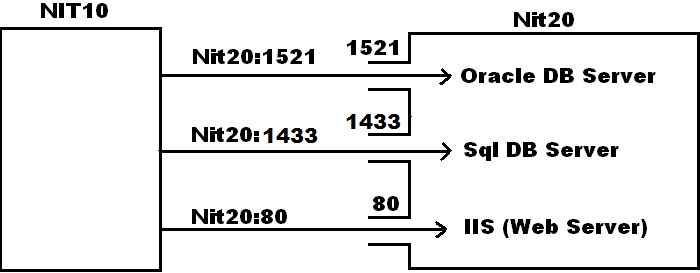
* Web information is stored in files called Web Pages.
* Collection of Web Pages is known as Web Site or Web Application.
* Web Site or Web Application is hosted on computers called Web Servers.
* Devices reading the Web Pages are called Web Clients.
* Web Clients views the Web Pages with a program called as Web Browser.



**How does a Web Browser fetch a Web Page?**

* A browser fetches a Web Page from a Web Server by a request and this request is a standard “HTTP Request” containing a page address known as URL (Uniform Resource Locator).
* An address or URL may look like this: **http(s)://www.google.com:80/default.html**

**Format of URL:** **<Protocol>://<Domain Name>:<Port>/<Request Page>**



**How does a Browser Display a Web Page?**

* All Web Pages contain instructions for display and the Web Browser displays the page by reading those instructions.
* The most common display instructions are called HTML.

**What is a Web Server?**

* The collection of Web Pages is called as a Web Site or Web Application.
* To let others, view your Web Pages, you must publish your Web Site or Web Application.
* To publish your Site or Application, you must copy it to a Web Server.
* Your own PC can act as a Web Server if it is connected to a network, but the most common practice is to use a Hosting Internet Service Provider (ISP).

**What is an Internet Service Provider?**

* An ISP provides Internet Services.
* A common Internet service is Web Hosting.
* Web Hosting means storing your Web Site or Web Application on a Public Server.
* Web Hosting normally includes Email Services also.
* Web Hosting often includes Domain Name Registration also.

**Summary:**

* If you want other people to view your Web Site or Application, you must copy your Site to a Public Server.
* Even if you can use your own PC as a Web Server but it is very common to let an ISP host your Site.
* Included in Web Hosting solution you can also expect Domain Name Registration and standard Email Services.
* Hosting your Site or Application on your own Server is always an option and here are some points to consider:

1. **Hardware Expenses:**To run a “real” Web Site or Web Application, you will have to buy some powerful Server hardware. Don’t expect that a low-cost PC will do the job. You will also need a permanent (24 hours a day) high-speed internet connection.
2. **Software Expenses:** Remember that Server-Licenses often are higher than Client-Licenses. Also note that Server-Licenses might have limit on number of users.
3. **Labour Expenses:** Don’t expect low labour expenses. You must install your own hardware and software. You also must deal with bugs and viruses and keep your server constantly running.

**Benefits of using an Internet Service Provider (Public Server):** renting a Web Server from an ISP is a very common option and most small companies store their Web Site or Web Application on a Server provided by an ISP only. Here are some advantages:

1. **Connection Speed:** Most ISPs have very fast connections to the Internet.
2. **Security and Stability:** ISPs are specialists on Web Hosting. Expect their Servers to have more than 99% up time, the latest software patches, and the best Virus Protection.
3. **Powerful Hardware:** ISPs often have powerful Web Servers that can be shared by several companies. You can also expect them to have an effective Load Balancing, and necessary Backup Servers.

**Things to Consider with an ISP:**

1. **24-hour support:** Make sure your ISP offers 24-hours support. Don’t put yourself in a situation where you cannot fix critical problems without having to wait until the next working day. Toll-free phone could be vital if you don’t want to pay for long distance calls.
2. **Daily Backup:** Make sure your ISP runs a daily backup routine; otherwise, you may lose valuable data.
3. **Traffic Volume:** Study the ISP’s traffic volume restrictions. Make sure that you don’t have to pay a fortune for unexpected high traffic if your Site becomes popular.
4. **Content Restrictions:** Study the ISP’s content restrictions if you plan to publish pictures or broadcast video or sound and make sure that you can do it.
5. **E-mail Capabilities:** Make sure your ISP supports the Email capabilities you need.
6. **Database Access:** If you plan to use data from Databases in your Site, make sure your ISP supports the Database access you need.

**What is TCP/IP?**

**Ans:** TCP/IP stands for Transmission Control Protocol / Internet Protocol, is a family of protocols for communication between computers. It defines how electronic devices should be connected over the network, and how data should be transmitted between them.

* **TCP:** is responsible for breaking down data into small packets before they can be sent over a network, and for assembling the packets again when they arrive.
* **IP**: takes care of the communication between computers. It is responsible for addressing, sending, and receiving the data packets over the Internet.

**TCP/IP Protocols for the Web:** web browsers and servers use TCP/IP protocols to connect to the Internet. Common TCP/IP protocols are:

1. **HTTP:** Hyper Text Transfer Protocol takes care of the communication between a Web Server and a Web Browser. HTTP is used for sending requests from a Web Client (Browser) to a Web Server, returning Web Content (Web Pages) from the Server back to the Client.
2. **HTTPS:** Secure HTTP, takes care of secure communication between a Web Server and a Web Browser. HTTPS typically handles Credit Card transactions and other sensitive data.
3. **FTP:** File Transfer Protocol, takes care of transmission of files between Computers.
4. **SMTP:** Simple Mail Transfer Protocol, used to send or receive Emails between Senders and Receivers.

**IP is Connection-Less:**

* IP is a “connection-less” communication protocol.
* IP does not occupy the communication line between two computers. This reduces the need for network lines. Each line can be used for communication between many different computers at the same time.
* With IP, messages are broken up into small independent “packets” and sent between computers via the Internet. IP is responsible for “routing” each packet to the correct destination.

**IP Routers:**

* When an IP Packet is sent from a computer, it arrives at an IP Router.
* IP Router is now responsible for “routing” the packet to the correct destination, directly or via another Router.
* Communicating via IP is like sending a long letter as many small postcards, each finding its own way to the receiver.

**IP Addresses:**

* This is a unique identification for every device in the network.
* IP uses 32 bits or four bytes numeric value where each number should be ranging between 0 to 255.
* IP addresses are normally written as four numbers separated by a period, like this: 31.13.65.36.
* Each device must have a unique IP address before it can connect to the Internet.
* Each IP packet must have an address before it can be sent to another computer.
* This is an IP address: 31.13.65.36. This might be the same address: [www.facebook.com](http://www.facebook.com/)

**Domain Names:**

* A name is much easier to remember than a 12-digit number.
* Names used for IP addresses are called Domain Names; for example, “www.facebook.com” is a domain name.
* When you address a web site, like “www.facebook.com”, the name is translated to a number by a Domain Name Server (DNS).
* All over the world, DNS Servers are connected to the Internet. DNS servers are responsible for translating domain names into IP Addresses.
* When a new domain name is registered together with an IP Address, DNS servers all over the world are updated with this information.

**What is a Domain Name?**

* A domain name is a unique name for a Web Site, like google.com, facebook.com.
* Choosing a hosting solution should include domain name registration also.
* Domain names must be registered. When domain names are registered, they are added to a large domain name register. In addition, information about the Web Site, including the IP Address is stored on a DNS Server.
* DNS stands for Domain Name System. A DNS Server is responsible for informing all other computers on the Internet about the domain name and the Web Site address.

**Registering a Domain:**

* Domains can be registered from domain name registration companies.
* These companies provide an interface to search for available domain names, and they offer a variety of domain name extensions that can be registered at the same time.

**Choosing a Domain Name:**

* Choosing a domain name is a major step for any individual or organization.
* New domain name extensions and creative thinking offer thousands of excellent domain names!
* When choosing a name, it is important to consider the purpose of a domain name, which is to provide an easy way to reach your web site.
* The best domains have the following characteristics: Short, Meaningful, Clear and Exposure:

1. **Short** - People don’t like to type! A short domain name is easier to type, read, and remember.
2. **Meaningful** - A short domain is nothing without meaning, “34i4nh.com” is not easy to enter or to remember. Select a domain that relates to your site in a way that people will understand about you or your site.
3. **Clear** - Clarity is important when selecting a domain name. Avoid a name that is difficult to spell or pronounce.
4. **Exposure** - Names that are short and easy to remember are an asset. In addition to visitors, also consider search engines. Search engines index your site and rank it for relevance against terms people search for your sites, consider including a relevant search term in your domain.

**What is web hosting?**

**Ans:** Web hosting is a service provided by companies (the web host) that sell or lease space on a server where you can store the files that make your website accessible on the internet. This typically requires that you own a domain, and these companies may help you in purchase one.

**What is shared hosting?**

**Ans:** Shared hosting is a popular hosting option where a provider hosts multiple websites on one physical web server. Typically, most websites don't use many server resources, so shared hosting lets providers offer stable service at a low cost. Shared hosting allows you to share hosting space and costs with others, while benefitting from the speed and space you need for your small business website.

**Domain Name Servers (DNS):** it is the Internet’s equivalent of a phone book. They maintain a directory of domain names and translate them to IP Addresses. This is necessary because, although domain names are easy for people to remember, computers or machines, access websites based on IP Addresses only. Information from all the domain name servers across the Internet are gathered and housed at the Central Registry. Host companies and Internet Service Providers interact with the Central Registry on a regular schedule to get updated DNS information.

**The Internet Assigned Numbers Authority (IANA):** manages IP address space allocations globally and delegates five Regional Internet Registries (RIRs) to allocate IP address blocks to local Internet Registries like ISP’s and other entities. A Regional Internet Registry (RIR) is an organization that manages the allocation and registration of Internet number resources within a particular region of the world. The Regional Internet Registry system eventually dividing the world into 5 RIR’s:

* African Network Information Center (AFRINIC) for Africa.
* American Registry for Internet Numbers (ARIN) for the United States, Canada, several parts of the Caribbean region, and Antarctica.
* Asia-Pacific Network Information Centre (APNIC) for Asia, Australia, New Zealand, and neighboring countries.
* Latin America and Caribbean Network Information Centre (LACNIC) for Latin America and parts of the Caribbean region.
* Réseaux IP European’s Network Coordination Centre (RIPE NCC) for Europe, Russia, Middle East, and Central Asia.

**Till now you might have created some Web Pages by using HTML, Java Script, and CSS, and are able to access those pages from your local machines by using their physical path or address in the browser; but how can we access those Web Pages from remote machines within a network?**

**Ans:** If we want to provide access to the Web Pages, we have developed to remote machines we need to take the help of a Server Software known as “Web Server”.

**What is a Server?**

**Ans:** It is software which works on 2 principles like request and response. There are so many Servers software’s in the industry, like Server Operation Systems (Windows Servers, Linux, Solaris, etc.) Database Servers (Oracle, SQL Server, and My SQL etc.), Application Servers, Web Servers, etc., and for us what we need is a Web Server to provide access to our Web Pages to Remote Clients.

**What is the need of a Web Server?**

**Ans:** this software is used for taking request (HTTP Request) from clients in the form of a “URL (Uniform Resource Locator)” and then sends Web Pages as response (HTTP Response).

**What Web Server software’s are available for us to consume?**

**Ans:** There are so many Webservers software’s that are available in the market like Apache Web Server from Apache, Nginx Web Server from NGINX, IIS Web Server from Microsoft, GWS Web Server from Google, LiteSpeed Web Server from LiteSpeed Technologies, but the most compatible Web Server for ASP.NET Applications is IIS Web Server from Microsoft.

**Working with IIS Web Server:**

* IIS stands for Internet Information Services which is formerly known as Internet Information Server.
* IIS Web Server is a product of Microsoft and more compatible for our ASP.NET and ASP.NET Core Applications.
* IIS is a part of Windows OS which is generally installed on our machines along with the Operating System, and to verify whether it is installed on your machine or not, open any Web Browser and type in the below URL:

[http://localhost](http://localhost/)

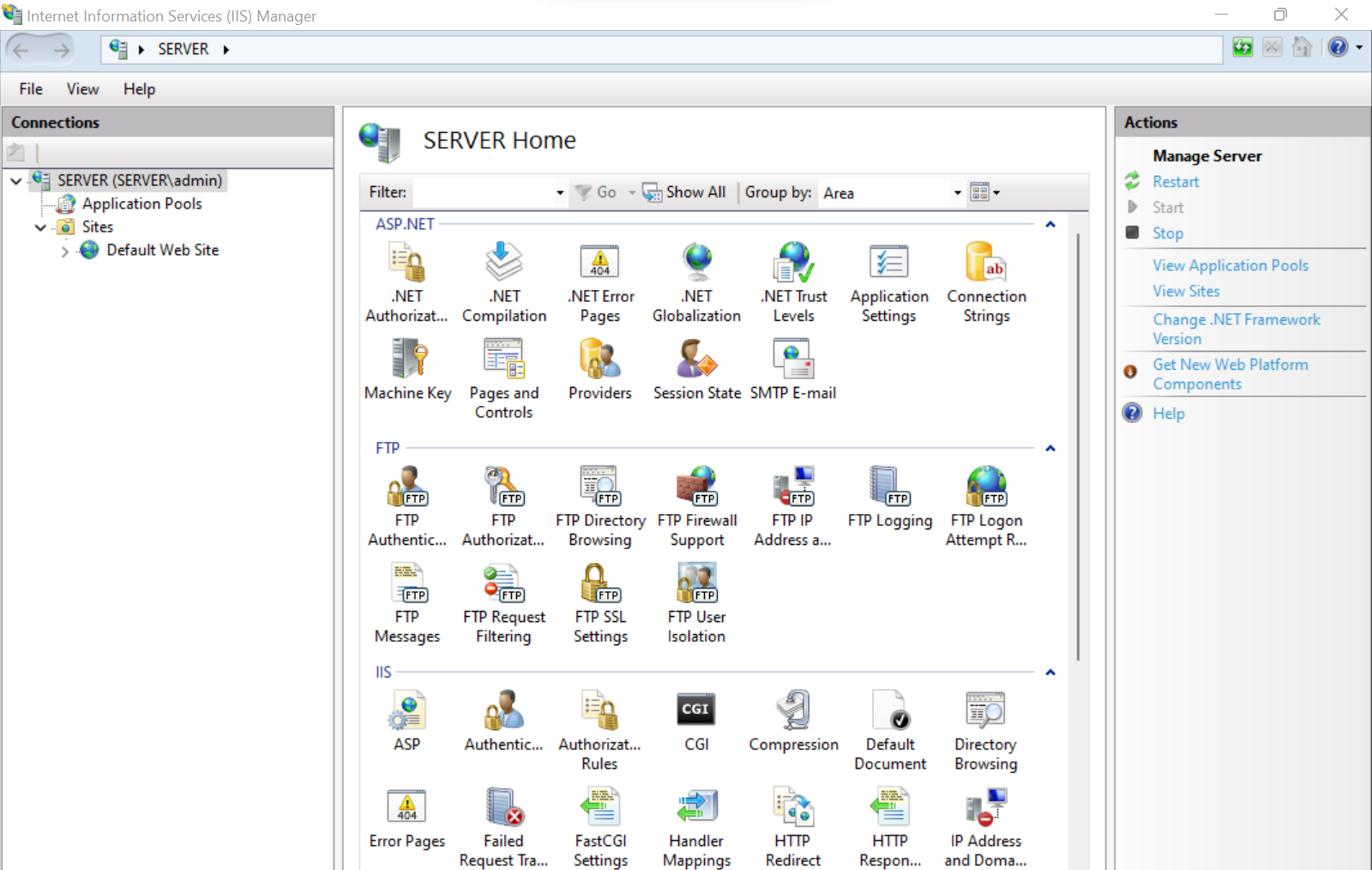
**Note:** If IIS is not installed on your machine, we get the below error:

“HTTP Error 404. The requested resource is not found.”

**Installing IIS on our machine if not installed already:** Go to Control Panel => click on Programs and Features => In the window opened, click on “Turn Windows features on or off”, which opens another window called “Windows Features” => in the new window opened select the CheckBox “Internet Information Services” and also select each and every Sub-Item (Checkbox’s) under it and click on the Ok button which will install IIS on your machine, then restart your machine. Once IIS is installed on your machine re-verify whether it is working or not by using the above URL.

**How to access a Web Page using IIS?**

**Ans:** When we install IIS Web Server on our machine it will provide us an admin console for managing IIS and we call it as “IIS Manager”, which can be launched by searching for “inetmgr” in the window search. Once IIS Manager is opened, in LHS of the window we find “Connections Panel” and in that Panel we find our Computer Name as Server Name (Server is the name of my Web Server because the name of my computer is Server) and when we expand it, we find a node called as “Sites” and under that we find a website with the name “Default Web Site” which is created when IIS is installed on our machines.

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**What is a Web Site?**

**Ans:** Web Site is a collection of Web Pages, and a Web Server is a collection of Web Sites, i.e., a Web Server can contain 1 or more Web Sites under it and by default when IIS is installed on a machine there will be 1 Website already created, with the name as “Default Web Site”.

**To access Web Pages thru IIS Web Server, do the following:**

**Step 1:** Create a folder on your PC in any drive naming it as “MVC7”.

**Step 2:** Create an HTML Page with the name “Login.html” with the below code and save it into “MVC7” folder.

<!DOCTYPE html>

<html>

<head><title>Login Form</title></head>

<body>

<form>

<table align="center">

<caption>Login Form</caption>

<tr>

<td>User Name:</td>

<td><input type="text" id="txtName" name="txtName" /></td>

</tr>

<tr>

<td>Password:</td>

<td><input type="password" id="txtPwd" name="txtPwd" /></td>

</tr>

<tr>

<td align="center" colspan=2>

<input type="submit" value="Login" id="btnLogin" name="btnLogin" />

<input type="reset" />

</td>

</tr>

</table>

</form>

</body>

</html>

**If we want to access Web Pages thru Web Server, we are provided with 3 different options:**

**Option 1:** Accessing thru “Default Web Site”, because this Website is already created under IIS Web Server we can access our Web Pages thru the Site and to do that we need to copy our Web Pages to a folder that is linked with this Website i.e., “<OS Drive>:\inetpub\wwwroot” and if we copy our Web Pages into this folder we can access them thru IIS using their “Virtual Path” either from a local or a remote machine also. To test this let’s copy our “Login.html” file into this folder and then access it thru the Virtual Path of the file as following:

**Local Machine** => <http://localhost/Login.html> or [http://Server/Login.html](http://server/Login.html)

**Remote Machine** => [http://Server/Login.html](http://server/Login.html)

**Note:** for every Web Site that is created on IIS, there will be 1 associated folder on the Hard Disk and all the Web Pages of that Site should be placed into that folder, right now “Default Web Site” is mapped with the “wwwroot” folder and that is the reason why we placed our “Login.html” Page into that folder. To view the mapping folder of “Default Web Site”, right click on the “Default Web Site” in “IIS Manager” Window => select “Manage Website” and under that select “Advanced Settings” which opens a window and in that we find “Physical Path” property and beside that we find the folder that is mapped to this Web Site.

**Option 2:** Accessing them thru an application or virtual directory created under Default Web Site, in this case without copying all the Web Pages into “inetpub/wwwroot” folder as we did in the previous case, we can create an “Application or Virtual Directory” under “Default Web Site” and map them to our physical folder where we have saved our Web Pages i.e., “MVC7” Folder.

**Note:** An Application or Virtual Directory is a Sub-Item under the Default Web Site mapped with a physical folder.

To create an application or virtual directory, Right Click on “Default Web Site” in “IIS Manager”, select the option “Add Application” or “Add Virtual Directory” which opens a Window and in that, in “Alias” TextBox enter a name of your choice and under “Physical Path” TextBox enter the physical path of your folder i.e., "<drive>:\MVC7".

Now following the above process, create 1 Application with the name “Site1” and create 1 Virtual Directory with the name “Site2” and map both to our physical folder i.e., “MVC7”. From now we can access the page of this folder in any of the following ways:

**Local Machine:** <http://localhost/Site1/Login.html> Or [http://Server/Site1/Login.html](http://server/Site1/Login.html)

**Local Machine:** <http://localhost/Site2/Login.html> Or [http://Server/Site2/Login.html](http://server/Site2/Login.html)

**Remote Machine:** [http://Server/Site1/Login.html](http://server/Site1/Login.html)

**Remote Machine:** [http://Server/Site2/Login.html](http://server/Site2/Login.html)

**Option 3:** Accessing the Web Pages by creating a Site. In this case we create a new Site under IIS just like the existing site i.e., Default Web Site and map it to a physical folder, but the difference is; in this case we can give our own Host Name or Domain Name just like “localhost” which is the Host Name or Domain Name for “Default Web Site” or we can use the same Host Name i.e., “localhost” and change the Port No.

**Creating a new Site by changing Port No:** right click on “Sites” node in “Connections” panel and select the option “Add Website”, which opens a new window and in that window under “Site name” Textbox specify a name to the site for example: “NITSite1” and under “Physical path” TextBox specify location of our folder i.e., “<drive>:\MVC7”, now under “Port” Textbox the default Port will be shown as “80”, change to any new value like “90” and click on the “Ok” button which will create the new site under IIS. Now we can access the Web Pages in our folder using the below URL:

**Local Machine:** <http://localhost:90/Login.html> Or [http://Server:90/Login.html](http://server:90/Login.html)

**Remote Machine:** [http://Server:90/Login.html](http://server:90/Login.html)

**Creating a new Site by changing Host or Domain Name:** right click on “Sites” node in “Connections” panel and select the option “Add Website”, which opens a new window and in that window under “Site name” Textbox specify a name to the site for example: “NitSite2” and under “Physical path” TextBox specify location of our folder i.e., “<drive>:\MVC7”, now under “Host Name” TextBox specify a Host Name or Domain Name, for example “nitsite.com” and click on the “Ok” button, which will create a new Site under Sites.

**Note:** To use the Web Site we need to specify the Host Name under a file “hosts” which is in the following folder: “C:\Windows\System32\drivers\etc”. To do that open “hosts” file and in the last line write the below code:

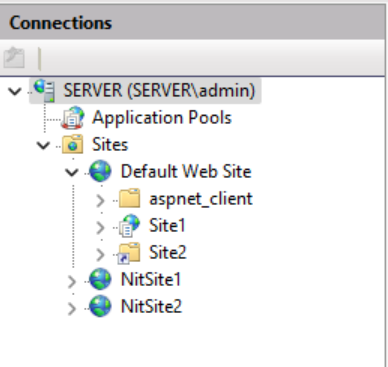
**127.0.0.1 nitsite.com**

**Now we can access the Web Pages in our folder using the following URL:**

**Local Machine** => <http://nitsite.com/Login.html>

**Remote Machine** => <http://nitsite.com/Login.html>

**Note:** till now we have created 1 Application and 1 Virtual Directory under “Default Web Site” and 2 Sites under the Server with the name “MySite1” and “MySite2” so all these 4 will be present under “IIS Manager” under Connections panel as below:



**Design Patterns**

Design patterns represent the best practices used by experienced object-oriented software developers. Design patterns are solutions to general problems that software developers faced during software development. These solutions were obtained by trial and error by numerous software developers over quite a substantial period.

Design patterns have been evolved over a long period of time and they provide best solutions to certain problems faced during software development. Learning these patterns helps un-experienced developers to learn software design in an easy and faster way. Design patterns are solutions to software design problems you find again and again in real-world application development.

**What is Gang of Four (GOF)?**

In 1994, four authors Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides published a book titled “Design Patterns - Elements of Reusable Object-Oriented Software” which initiated the concept of Design Pattern in Software development. These authors are collectively known as Gang of Four (GOF). The book is divided into 2 parts, first part explaining about the “Pros and Cons” of Object-Oriented Programming and in the second explaining the evolution of 23 software design patterns.

**Types of Design Patterns:**

As per the design pattern reference book “Design Patterns - Elements of Reusable Object-Oriented Software”, there are 23 design patterns which can be classified in to three categories: Creational, Structural and Behavioral patterns.

**Creational Patterns**: These design patterns provide a way to create objects while hiding the creation logic, rather than instantiating objects directly using new operator. This gives program more flexibility in deciding which objects need to be created for a given use case.

**Structural Patterns:** These design patterns concern class and object composition. Concept of inheritance is used to compose interfaces and define ways to compose objects to obtain new functionalities.

**Behavioral Patterns:** These design patterns are specifically concerned with communication between objects.

**Creational Patterns:**

* Abstract Factory Creates an instance of several families of classes.
* Builder Separates object construction from its representation.
* Factory Method Creates an instance of several derived classes.
* Prototype A fully initialized instance to be copied or cloned.
* Singleton A class of which only a single instance can exist.

**Structural Patterns:**

* Adapter Match interfaces of different classes.
* Bridge Separates an object’s interface from its implementation.
* Composite A tree structure of simple and composite objects.
* Decorator Add responsibilities to objects dynamically.
* Facade A single class that represents an entire subsystem.
* Flyweight A fine-grained instance used for efficient sharing.
* Proxy An object representing another object.

**Behavioral Patterns:**

* Chain of Responsibility A way of passing a request between a chain of objects
* Command Encapsulate a command request as an object
* Interpreter A way to include language elements in a program
* Iterator Sequentially accessing the elements of a collection
* Mediator Defines simplified communication between classes
* Memento Capture and restore an object's internal state
* Observer A way of notifying change to several classes
* State Alter an object's behavior when its state changes
* Strategy Encapsulates an algorithm inside a class
* Template Method Defer the exact steps of an algorithm to a subclass
* Visitor Defines a new operation to a class without change

**Architectural Patterns**

An architectural pattern is a general, reusable solution to a commonly occurring problem in software architecture within a given context. These are like software design pattern only but have a broader scope.

Software application architecture is the process of defining a structured solution that meets all the technical and operational requirements, while optimizing common quality attributes such as performance, security, and manageability.

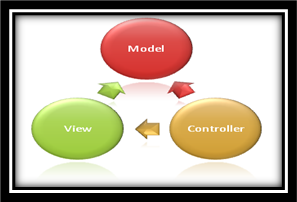
It involves a series of decisions based on a wide range of factors, and each of these decisions can have considerable impact on the quality, performance, maintainability, and overall success of the application. The architectural patterns address various issues in software engineering, such as computer hardware performance limitations, high availability and minimization of a business risk and cost.

**List of Architectural Patterns:**

* Blackboard system
* Broker pattern
* Event - driven architecture
* Implicit invocation
* Layers
* Microservices
* Model - View - Controller (MVC)
* Presentation - abstraction - control
* Model - View - Presenter (MVP)
* Model - View - View Model (MVVM)
* Entity - component - system
* Multitier architecture (often three-tier or n-tier)
* Naked objects
* Operational data store (ODS)
* Peer - to - peer
* Pipe and filter architecture
* Service - oriented architecture
* Space - based architecture

**What is MVC?**

**Ans:** The Model-View-Controller (MVC) is an architectural pattern which separates an application into three main groups of components: Models, Views, and Controllers. This pattern helps to achieve separation of concerns. Using this pattern, user requests are routed to a Controller which is responsible for working with the Model to perform user actions and/or retrieve results of queries. The Controller chooses the View to display to the user and provides it with any Model data it requires. The following diagram shows the three main components and which ones reference the others:



**MODEL:** The Model in an MVC application represents the state of the application and any business logic or operations that should be performed by it. Business logic should be encapsulated in the model, along with any implementation logic for persisting the state of the application.

**VIEW:** Views are responsible for presenting content through the user interface. There should be minimal logic within views, and any logic in them should relate to presenting content.

**Controller:** Controllers are the components that handle user interaction, work with the model, and ultimately select a view to render. In an MVC application, the view only displays information; the controller handles and responds to user input and interaction. In the MVC pattern, the controller is the initial entry point, and is responsible for selecting which model types to work with and which view to render (hence its name - it controls how the application responds to a given request).

**History of MVC:** MVC traditionally used for Desktop Graphical User Interfaces (GUIs) and later this architecture has become popular for designing Web Applications and even Mobile and other Clients. Popular programming languages like Java, .NET, Ruby, PHP, Python, Java Script, and others have their own MVC Frameworks that are currently being used in Web Application development.

| **Language** | **MVC Framework** |
| --- | --- |
| Java | Spring, Structs |
| PHP | Cake PHP, Code Igniter, Zend Framework, Laravel |
| Perl | Catalyst, Dancer |
| Python | Django, Flask, Grok |
| Ruby | Ruby on Rails, Nitro |
| Java Script | Angular, Spine |
| .NET | ASP.Net MVC, ASP.Net Core MVC |

Trygve Reenskaug introduced MVC into Smalltalk-76 while visiting the Xerox Palo Alto Research Center in the 70’s. In the 1980’s, Jim Althoff and others implemented a version of MVC for the Smalltalk-80 class library.

MVC pattern has subsequently evolved giving rise to variants such as hierarchical model -view - controller (HMVC), model - view - adapter (MVA), model - view - presenter (MVP), model - view - view model (MVVM), and others that adapted MVC for different contexts.

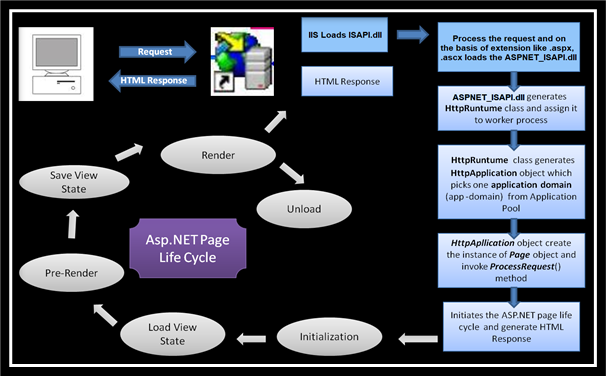
Although originally developed for desktop computing, MVC has been widely adopted as architecture for web applications in major programming languages. Several MVC Web Frameworks have been designed that enforce the MVC pattern that are listed above.

**Differences between ASP.NET WebForms and ASP.NET MVC**

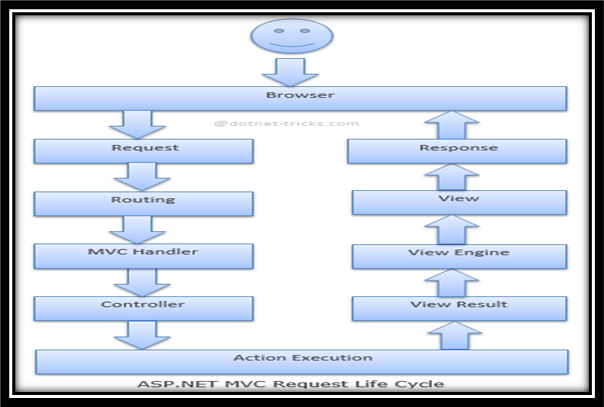
*“First of all, lets’ be clear that ASP.NET MVC is not a replacement for ASP.NET Web Forms. Both these development models exist and can be used to develop ASP.NET Web App*lications.”

| **ASP.Net Web Forms** | **ASP.Net MVC** |
| --- | --- |
| ASP.NET Web Forms uses page controller pattern approach for rendering layout. In this approach, every page has its own controller i.e., code-behind file that processes the request. | ASP.NET MVC uses Front Controller approach. That approach means, a common controller for all pages, processing the requests. |
| Lots of server-side interactions and post backs. | Very minimum post backs and interactions. |
| Asp.Net Web Form has file-based URLs means file name exist in the URLs which must have its physically existence. | Asp.Net MVC has route-based URLs means URLs are divided into controllers and actions and moreover it is based on a controller but not on physical file. |
| No separation of concerns. As we discussed that every page (.aspx) has its own controller i.e., code behind “aspx.cs” file, so both are tightly coupled. | Very clean separation of concerns. View, Model and Controller are neatly separated. |
| Because of this coupled behavior, automated testing is difficult. | Testability is key feature in ASP.NET MVC. Test driven development is quite simple using this approach. |
| To achieve stateful behavior, ViewState is used. Purpose was to give developers, the same experience of a typical Win Forms application. | ASP.NET MVC approach is stateless as that of the web. So here no concept of ViewState. |
| Statefulness has lot of problems for web environment i.e., excessively large ViewState. Large ViewState means increase in page size. | As controller and view are not dependent and no ViewState concept in ASP.NET MVC, so output is very simple and clean. |
| ASP.NET Web Form follows Web Forms Syntax. | ASP.NET MVC follows customizable syntax both Web Forms as well as Razor (default). |
| ASP.NET Web Forms model follows a complex Page Life Cycle. | No Page Life cycle like Web Forms. Request cycle is simple in ASP.NET MVC model. |
| In Web Forms we have Server Controls; so minimal knowledge of HTML and CSS is required. | In MVC we have html helpers, so detailed knowledge of HTML and CSS is required. |
| Provides limited control over HTML, Java Script and CSS which is necessary in many cases. | Full control over HTML, Java Script, and CSS. |
| With lots of control libraries availability and limited knowledge of other related technologies, ASP.NET Web Forms is RAD (Rapid Application Development) approach. | It’s a step back. For developers decreasing in the productivity. |
| It’s good for small scale applications with limited team size. | It’s better as well as recommended approach for large-scale applications where different teams are working together. |
| Response type can be HTML only and if we want any other response type; we need to write some complex code. | Response type can either be HTML, XML, JSON, etc. |

**ASP.NET Web Forms Request Life Cycle (Page Life Cycle):**



**ASP.NET MVC Request Life Cycle:**



**Routing:** ASP.NET Routing is the first step in MVC request cycle. Basically, it is a pattern matching system that matches the request’s URL against the registered URL patterns in the Route Table. When a matching pattern found in the Route Table, the Routing engine forwards the request to the corresponding “IRouteHandler” for that request and the default one calls the “MvcHandler”. The routing engine returns a 404 HTTP status code against that request if the patterns are not found in the Route Table. When application starts at first time, it registers one or more patterns to the Route Table to tell the routing system what to do with any requests that match these patterns. An application has only one Route Table and this is setup in the “Global.asax” file of the application.

**MvcHandler:** The “MvcHandler” is responsible for initiating the real processing inside ASP.NET MVC. “MvcHandler” implements “IHttpHandler” interface and further process the request by using “ProcessRequest” method.

**Controller:** “MvcHandler” uses the “IControllerFactory” instance and tries to get an “IController” instance. If successful, then it calls the Execute method.

**Action Execution:** Once the controller has been instantiated, Controller’s “ActionInvoker” determines which specific action to invoke on the controller. Action to be executed is chosen based on attributes “ActionNameSelectorAttribute” (by default method which have the same name as the action is chosen) and “ActionMethodSelectorAttribute” (If more than one method found, the correct one is chosen with the help of this attribute).

**View Result:** The action method receives user input, prepares the appropriate response data, and then executes the result by returning a result type. The result type can be “ViewResult”, “RedirectToRouteResult”, “PartialViewResult”, “RedirectResult”, “ContentResult”, “JsonResult”, “FileResult”, and “EmptyResult”.

**View Engine:** The first step in the execution of the View Result involves the selection of the appropriate View Engine to render the View Result. It is handled by “IViewEngine” interface of the view engine. By default, ASP.NET MVC uses “Web Forms” and “Razor” view engines. You can also register your own custom view engine to your MVC application.

**View:** Action method may return a text string, a binary file or a JSon formatted data. The most important Action Result is the View Result, which renders and returns an HTML page to the browser by using the current view engine.

**ASP.NET** MVC Versions:

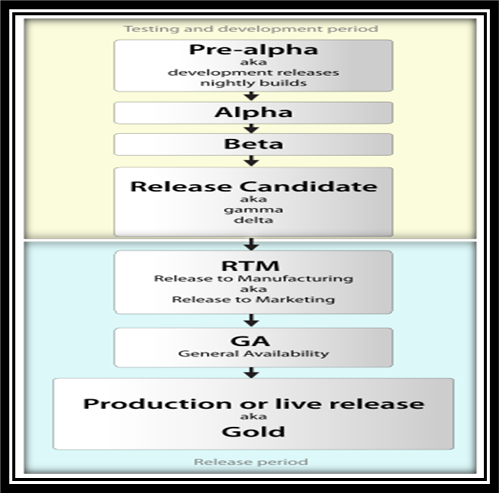
| **ASP.NET MVC - Release history** | |
| --- | --- |
| **Date** | **Version** |
| 10 December 2007 | ASP.NET MVC CTP |
| 13 March 2009 | ASP.NET MVC 1.0 |
| 16 December 2009 | ASP.NET MVC 2 RC |
| 4 February 2010 | ASP.NET MVC 2 RC 2 |
| 10 March 2010 | ASP.NET MVC 2 |
| 6 October 2010 | ASP.NET MVC 3 Beta |
| 9 November 2010 | ASP.NET MVC 3 RC |
| 10 December 2010 | ASP.NET MVC 3 RC 2 |
| 13 January 2011 | ASP.NET MVC 3 |
| 20 September 2011 | ASP.NET MVC 4 Developer Preview |
| 15 February 2012 | ASP.NET MVC 4 Beta |
| 31 May 2012 | ASP.NET MVC 4 RC |
| 15 August 2012 | ASP.NET MVC 4 |
| 30 May 2013 | ASP.NET MVC 4 4.0.30506.0 |
| 26 June 2013 | ASP.NET MVC 5 Preview |
| 23 August 2013 | ASP.NET MVC 5 RC 1 |
| 17 October 2013 | ASP.NET MVC 5 |
| 17 January 2014 | ASP.NET MVC 5.1 |
| 10 February 2014 | ASP.NET MVC 5.1.1 |
| 4 April 2014 | ASP.NET MVC 5.1.2 |
| 22 June 2014 | ASP.NET MVC 5.1.3 |
| 1 July 2014 | ASP.NET MVC 5.2.0 |
| 28 August 2014 | ASP.NET MVC 5.2.2 |
| 9 February 2015 | ASP.NET MVC 5.2.3 |
| 12 February 2018 | ASP.NET MVC 5.2.4 |
| 2 May 2018 | ASP.NET MVC 5.2.5 |
| 11 May 2018 | ASP.NET MVC 5.2.6 |
| 29 November 2018 | ASP.NET MVC 5.2.7 |

**ASP.Net Core MVC** Versions:

| **ASP.NET Core MVC - Release history** | |
| --- | --- |
| **Date** | **Version** |
| 17 May 2016 | ASP.NET Core MVC 1.0.0-rc2 |
| 12 August 2016 | ASP.NET Core MVC 1.0.0 |
| 17 August 2016 | ASP.NET Core MVC 1.0.1 |
| 17 November 2016 | ASP.NET Core MVC 1.0.2 |
| 6 March 2017 | ASP.NET Core MVC 1.0.3 |
| 9 May 2017 | ASP.NET Core MVC 1.0.4 |
| 20 September 2017 | ASP.NET Core MVC 1.0.5 |
| 14 November 2016 | ASP.NET Core MVC 1.0.6 |
| 16 November 2016 | ASP.NET Core MVC 1.1.0 |
| 27 January 2017 | ASP.NET Core MVC 1.1.1 |
| 6 March 2017 | ASP.NET Core MVC 1.1.2 |
| 9 May 2017 | ASP.NET Core MVC 1.1.3 |
| 20 September 2017 | ASP.NET Core MVC 1.1.4 |
| 14 November 2017 | ASP.NET Core MVC 1.1.5 |
| 12 December 2017 | ASP.NET Core MVC 1.1.6 |
| 13 March 2018 | ASP.NET Core MVC 1.1.7 |
| 11 August 2017 | ASP.NET Core MVC 2.0.0 |
| 14 November 2017 | ASP.NET Core MVC 2.0.1 |
| 9 January 2018 | ASP.NET Core MVC 2.0.2 |
| 13 March 2018 | ASP.NET Core MVC 2.0.3 |
| 30 May 2018 | ASP.NET Core MVC 2.1.0 |
| 18 June 2018 | ASP.NET Core MVC 2.1.1 |
| 4 December 2018 | ASP.NET Core MVC 2.2.0 |
| 29 September 2019 | ASP.NET Core MVC 3.0.0 |
| 3 December 2019 | ASP.NET Core MVC 3.1.0 |
| 14 January 2020 | ASP.NET Core MVC 3.1.1 |
| 14 July 2020 | ASP.NET Core MVC 3.1.6 |
| 10 November 2020 | ASP.NET Core MVC 5.0 |
| 10 November 2021 | ASP.NET Core MVC 6.0 |
| 8 November 2022 | ASP.NET Core MVC 7.0 |

**Note:** There is no separate versioning for ASP.NET Core. It is the same as .NET Core versions.

**Software Version Release Life Cycle:**



**ASP.NET MVC 5**

**Developing an ASP.NET MVC 5 Application:** This is the last version of MVC from .NET Framework and the next version is first named as MVC 6 but later changed to ASP.NET Core MVC and ported to .NET Core. So, first let’s learn working with ASP.NET MVC 5.

**Step 1:** Download and install the latest version of Visual Studio Community Edition i.e., VS 2022 (Version 17), from <https://visualstudio.microsoft.com/downloads> and in the downloader select the below **workloads**:

* ASP.NET and web development
* Azure development
* Data storage and processing
* Visual Studio extension development

**Now select individual components tab on the top and make sure all the below are selected:**

* .NET 7.0 Runtime
* .NET 6.0 Runtime (Long Term Support)
* .NET 5.0 Runtime (Out of support)
* .NET Core 2.1 Runtime
* .NET Core 3.1 Runtime
* Select all .NET Framework versions Checkbox's leaving other out of support Checkbox’s and ML.NET

**Step 2:** Creating an MVC Project and to do this, open Visual Studio 2022 => Click on “Create a new project” on RHS of the window, now in the new window opened, under “All Languages” Dropdown select “C#”, under “All Platforms” Dropdown select “Windows”, under “All Project Types” Dropdown select “Web”, now in the below list select “ASP.NET Web Application (.NET Framework)” and click on “Next” button, now in the new Window opened, under “Project Name” TextBox enter “MVCTestProject1” as name of our project, under “Location” TextBox enter “<drive>:\MVC7”, under “Framework” Dropdown List, choose the latest version of “.NET Framework” i.e., “.NET Framework 4.8” and click on “Create” button which will launch a new Window with the name “Create a new ASP.NET Web Application” and under this select the following options: choose “Empty” project template, in the RHS select “MVC” CheckBox under “Add folders & core references”, uncheck all the other Checkbox’s over there and click on the “Create” button which will create the project.

**Note:** Same as the above create another new project naming the project as “MVCTestProject2”, but now under “Create a new ASP.NET Web Application” Choose “MVC” project template, uncheck all the other Checkbox’s over there and click on the “Create” button to create the project.

**MVC Project Structure:** when we create a new project either by choosing “Empty Project Template and select MVC CheckBox” or “MVC Project Template”, a set of files and folders are added in the project as following:

**1. Connected Services:** This is used for integrating Microsoft Azure Service into Visual Studio, so that we can easily host and manage our application to Azure Portal from Visual Studio it-self.

**2. App\_Data:** this folder contains local Data Source files like “.mdf” files, “.xml” files, “Excel” files, etc.

**3. App\_Start:** this folder contains a set of files which contains classes, and these classes get executed when the application starts execution. App\_Start folder can contain following files in it:

BundleConfig.cs => Contains BundleConfig Class

FilterConfig.cs => Contains FilterConfig Class

IdentityConfig.cs => Contains IdentityConfig Class

RouteConfig.cs => Contains RouteConfig Class

Startup.Auth.cs => Contains Startup Class

**Note:** if we opened an “Empty Project Template” then “App\_Start” folder contains only “RouteConfig.cs” file, whereas if we opened an “MVC Project Template” then “App\_Start” folder contains “BundleConfig.cs”, “FilterConfig.cs” and “RouteConfig.cs” files.

**4. Content:** this folder contains static files like “.css” files, “image” files, etc.

**Note:** if we open an “Empty Project Template” then Content folder will not be existing, whereas if we open an “MVC Project Template” then this folder exists with a set of “.css” (Bootstrap) files in it.

**5. Controllers:** this folder contains Controller classes where each Controller should be defined in a separate file.

**Note:** if we open an “Empty Project Template” then Controllers folder is empty, whereas if we open an “MVC Project Template” then this folder will contain 1 default Controller with the name “HomeController” under the file “HomeController.cs”.

**6. Fonts:** this folder contains any custom fonts that are being used in the application.

**Note:** if we open an “Empty Project Template” then Font’s folder will not exist, whereas if we open an “MVC Project Template” then this folder will exist with a set of fonts in it.

**7. Models:** this folder contains Model classes i.e., classes representing the Entities and Properties representing the Attributes of Entities as well as all the Methods to manipulate the data.

**Note:** if we open an “Empty Project Template” or “MVC Project Template” also this folder will exist but will be empty only.

**8. Scripts:** this folder contains Java Script or jQuery files that are used for development of the application.

**Note:** if we open an “Empty Project Template” then Scripts folder will not exist, whereas if we open an “MVC Project Template” then this folder will exist with a set of “.js” (jQuery) files in it.

**9. Views:** this folder contains all the View files (UI) that are required for this application and the extension of these files will be “.cshtml” in case we are working with “C#” Language or else if we are working with “VB” Language then extension of the files will be “.vbhtml” and these files contains both “C# / VB” and Html code in them, and we call these files as “Razor Pages”.

**Note:** if we open an “Empty Project Template” then Views folder comes with a file in it i.e., “Web.config”, whereas if we open an “MVC Project Template” then this folder will contain 2 sub folder in it with the names “Home” and “Shared” and these folders will contain a set of “.cshtml” files, and apart from that “Views” folder also contain “\_ViewStart.cshtml” and “Web.config” files.

Under the Views folder, for every Controller it will create a folder to store all the Views that are associated with that Controller, for example if there is a Controller with the name “HomeController” then there will be a “Home” folder created under Views folder to store all the Views associated with the “HomeController” class.

Under the Views folder, we can also have Shared folder containing all the Views that are common for all the Controllers in the application, for example Layout View, Error View, etc.

**10. Global.asax:** this is a file that contains a Global Configuration class, and, in this class, we define a set of methods: “Application\_Start”, “Application\_End”, “Application\_Error” that executes for application-level actions and other methods like: “Session\_Start” and “Session\_End” that executes for session level actions.

**11. Packages.config:** this contains information of packages that are used under this project, so that anyone can easily understand if there are any 3rd party packages consumed for the development of this application.

**12. Web.config:** this is a configuration file for the whole application which contains configuration settings like “App Settings”, “Connection Strings”, “Network Settings”, “Compiler Settings”, etc.

**Controller**

It is a class that handles user requests i.e., this class is responsible for taking all the incoming requests for an MVC Application.

The parent class for all Controllers we define should be the class “Controller” which is in turn a child of class “ControllerBase” and both the classes are defined in “System.Web.MVC” namespace. Every Controller class should suffix the word “Controller” to it, for example if we want to define a controller with the name “Home” then it should be named as “HomeController”.

To test working with Controllers, create a new ASP.Net Web Application Project, naming it as “MVCTestProject3”, select Empty Project Template, check the MVC CheckBox, un-check all the other Checkbox’s and click on the Create button.

**Adding a Controller to our MVC Project:** We can add a controller to an MVC Project in 2 different ways:

Manually defining Controller class.

Using scaffolding to define Controller class.

**Option 1: Manually defining a Controller class.**

Open Solution Explorer => right click on the Controllers folder => select Add => New Item or Class => now in the “Add New Item” window select Class, name it as “TestController.cs” and click on the “Add” button. Now in the class do the following:

**Step 1:** Import the namespace “System.Web.Mvc”.

**Step 2:** Inherit our TestController class with Controller class which should now look as below:

public class TestController : Controller

**Note:** Every Controller class contains methods in it known known as Action methods and there should be minimum 1 Action method in a Controller class.

**Step 3:** Define 2 action methods in the class as below:

public string Index()

{

return "Hello from Test Controller - Index Action Method.";

}

public string Show()

{

return "Hello from Test Controller - Show Action Method.";

}

**Step 4:** Press F5 to run the project, which will launch the Browser and by default it displays “http://localhost:port” in the address bar, add “/Test/Index” to it, to run the Index Action method or “/Test/Show” to run Show Action method, which should look as below:

http://localhost:port/Test/Index

http://localhost:port/Test/Show

In the above URL => “Test” is the name of Controller class, and “Index or Show” are names of the Action methods we want to invoke.

**How an MVC Applications runs under Visual Studio?**

**Ans:** Every Web Application requires a Web Server to run, and the job of this Web Server is to take the request from end users and send back a response, so a Web Server is mandatory to run a Web Application. To run Web Applications at the time of development, Visual Studio provides a built-in Web Server, using which we can run and test our applications in development environment i.e., “IIS Express”. IIS Express Web Server will start when we start our Web Application in Visual Studio, and we can see that in our computer “Status Tray”.

IIS Express, for unique identification of every Web Application will assign a numeric logical address to the application and we call it as “Port”, which is going to be different from Project to Project and Machine to Machine. Ports are logical i.e.; they don’t have any physical existence and we use them for unique identification of an application. By default, every machine will be having 65,536 ports ranging between 0 - 65535 and IIS Express will allocate any port of its choice randomly.

**Note:** IIS Express is a development Web Server, which the whole industry uses in development environment, and in staging and production environments we don’t run Web Applications on IIS Express i.e., we will be running them using “IIS Web Server” because IIS Express can provide access to the application only from local computer and that to IIS Express will start only when we run the project whereas when we use IIS, applications can be accessed from other computers in the network also, and it will be running independent of it-self directly under the OS, 24/7.

We can host or publish our web applications into “IIS” from Visual Studio provided “IIS” is installed on our computers. To test “IIS” is installed on our computer or not, go to Windows Search and search for “inetmgr” which will show “Internet Information Services (IIS) Manager”, click on it to open.

**Installing IIS on our machine if not installed:** to install IIS on our computer, go to Control Panel => Click on Programs and Features => In the window opened click on “Turn Windows features on or off”, which opens another window called “Windows Features” => In the window opened select the CheckBox “Internet Information Services” and also select each and every Sub-CheckBox under it, and click on Ok button which installs IIS on your machine.

**Hosting a Web Application in IIS from Visual Studio:** to do this Open Solution Explorer, right click on the Project and select Properties which will open the “Project Property Window”. In the LHS select Web and then in the RHS we find the option “Servers and in that we will find a DropDownList showing the value "IIS Express" selected, change the selection to “Local IIS” in the DropDownList which will change the “Project URL” in the TextBox below and now the value will be: <http://localhost/MVCTestProject3> and beside the TextBox we will find a button with the caption “Create Virtual Directory” click on it which will host or deploy the application in IIS, click on the Save button is “Standard Tool Bar” and close “Project Property Window”. Now hit F5 to run the project which will display <http://localhost/MVCTestProject3> in the address bar add, “/Test/Index” to it, to run the Index Action method or “/Test/Show” to run Show Action method, which should now look as below:

<http://localhost/MVCTestProject3/Test/Index>

<http://localhost/MVCTestProject3/Test/Show>

**We can even execute the Index Action Method using the below URL also:**

**IIS Express:** http://localhost:port/Test

**Local IIS:** <http://localhost/MVCTestProject3/Test>

**Note:** in the above case even if Action method name is not specified in the URL still it will launch “Index” Action Method because the default Action Method for all controllers is Index. Same as that the default Controller for the project is “HomeController” and to test that add a new class in the Project naming it as “HomeController” and write the following code under the class by importing “System.Web.MVC” namespace and inherit the class from Controller:

public string Index()

{

return "Hello from Home Controller - Index Action Method.";

}

public string Show()

{

return "Hello from Home Controller - Show Action Method.";

}

Now when we run the project it will execute the Home Controller’s Index Action method and the URL in the address bar will be as below:

**IIS Express:** http://localhost:port

**Local IIS:** <http://localhost/MVCTestProject3>

**The below URL’s when used will give you the following results:**

**IIS Express:**

http://localhost:port //Invokes Home Controller’s Index

http://localhost:port/Home //Invokes Home Controller’s Index

http://localhost:port/Home/Index //Invokes Home Controller’s Index

http://localhost:port/Home/Show //Invokes Home Controller’s Show

http://localhost:port/Test //Invokes Test Controller’s Index

http://localhost:port/Test/Index //Invokes Test Controller’s Index

http://localhost:port/Test/Show //Invokes Test Controller’s Show

**Local IIS:**

<http://localhost/MVCTestProject3> //Invokes Home Controller’s Index

<http://localhost/MVCTestProject3/Home> //Invokes Home Controller’s Index

<http://localhost/MVCTestProject3/Home/Index> //Invokes Home Controller’s Index

<http://localhost/MVCTestProject3/Home/Show> //Invokes Home Controller’s Show

<http://localhost/MVCTestProject3/Test> //Invokes Test Controller’s Index

<http://localhost/MVCTestProject3/Test/Index> //Invokes Test Controller’s Index

<http://localhost/MVCTestProject3/Test/Show> //Invokes Test Controller’s Show

**Option 2:** Using Scaffolding to define Controller class.

ASP.NET Scaffolding is a code generation framework for ASP.NET Web Applications. From VS 2013 Microsoft included code generators for MVC and Web API Projects. We use this scaffolding in our project when we want to quickly add code that interacts with Data Models. Using scaffolding will reduce the amount of time to develop standard operations in our project.

To add a controller using scaffolding open Solution Explorer => right click on Controllers folder => select Add => Controller => now in the “Add New Scaffolded Item” window select “MVC 5 Controller – Empty” template and click on the “Add” button which will then open a window asking for a name, enter the name as “DemoController” and click on “Add” button which adds the Controller class as following:

public class DemoController : Controller

{

// GET: Product

public ActionResult Index()

{

return View();

}

}

When we use Scaffolding to add a Controller, by default the class will inherit from “Controller” class and this will also import “System.Web.Mvc” namespace. Now delete all the existing code in class and write the below code over there:

public string Index()

{

return "Hello from Demo Controller - Index Action Method.";

}

public string Show()

{

return "Hello from Demo Controller - Show Action Method.";

}

**IIS Express:**

http://localhost:port/Demo //Invokes Demo Controller's Index

http://localhost:port/Demo/Index //Invokes Demo Controller's Index

http://localhost:port/Demo/Show //Invokes Demo Controller's Show

**Local IIS:**

<http://localhost/MVCTestProject3/Demo> //Invokes Demo Controller's Index

http://localhost/MVCTestProject3/Demo/Index //Invokes Demo Controller's Index

<http://localhost/MVCTestProject3/Demo/Show> //Invokes Demo Controller's Show

**Where is the information of default controller “Home” and default action method “Index” were specified?**

**Ans:** Those details are present in “RouteConfig.cs” file which is present in “App\_Start” folder. To verify that open “RouteConfig.cs” file and there we find a class with the name “RouteConfig” and code in the class will be as following:

public class RouteConfig

{

public static void RegisterRoutes(RouteCollection routes)=

{

routes.IgnoreRoute("{resource}.axd/{\*pathInfo}");

routes.MapRoute(

name: "Default",

url: "{controller}/{action}/{id}",

defaults: new { controller = "Home", action = "Index", id = UrlParameter.Optional }

);

}

}

**What is Routing?**

**Ans:** Routing enables you to use URL’s that do not have to map to specific files in a Web Site. Because URL does not have to map to a file, you can use URL’s that are descriptive of the user’s action and therefore easily understood by the users. In an ASP.NET Web Forms application that does not use routing, an incoming request for a URL typically maps to a physical file that handles the request, such as an “.aspx” file. For example, a request for http://localhost:port/Products.aspx?id=4 maps to a file that is named “Products.aspx” that contains the code and markup for rendering a response to the browser. The Web Page uses the query string value “id=4” to determine what type of content to display.

By using routing, we can define URL patterns that map to request-handler files, but that do not necessarily include the names of those files in URL. In addition, we can also include placeholders in a URL pattern so that variable data can be passed to the request handler without requiring a query string. For example, in this URL: http://localhost:port/Products/Show/4, routing parser can pass the values Products, Show, and 4 to the page handler if the route is defined by using the URL pattern “{controller}/{action}/{id}”. The page handler would receive a dictionary collection in which the value associated with the key controller is Products, the value for the key action is Show, and the value for the id is 4. In a request that is not managed by URL routing, the “/Products/Show/4” fragments would be interpreted as the path of a file in the application.

**Routes:** A route is a URL pattern that is mapped to a handler. A handler can be a class that processes the request, such as a controller in an MVC App. To define a route, you create an instance of the Route class by specifying the URL pattern, the handler, and optionally a name for the route. You add the route to the application by adding the Route object to the static Routes property of the RouteTable class. The Routes property is a RouteCollection object that stores all the routes for the application.

We typically do not have to write code to add routes in an MVC application. Visual Studio project templates for MVC include pre-configured URL routes. These are defined in RouteConfig class, which is defined in “RouteConfig.cs” file and then registered in “Application\_Start” method of “MVCApplication” class defined under “Global.asax” file by calling “RouteConfig.RegisterRoutes”.

**URL Patterns:** This can contain literal values and variable placeholders (referred to as URL Parameter’s). The literals and placeholders are in segments of the URL which are delimited by the slash (/) character. When a request is made, the URL is parsed into segments and placeholders, and the variable values are provided to the request handler. This process is like the way the data in query strings is parsed and passed to the request handler. In both cases variable information is included in the URL and passed to the handler in the form of “key-value” pairs. For query strings both the keys and the values are in the URL. For routes, the keys are the placeholder names defined in the URL pattern, and only the values are in the URL.

In an URL pattern, you define placeholders by enclosing them under curly braces {}. You can define more than one placeholder in a segment, but they must be separated by a literal value. For example, {language}-{country}/{action} is a valid route pattern. However, {language}{country}/{action} is not a valid pattern, because there is no literal value or delimiter between the placeholders. Therefore, routing cannot determine where to separate the value for language placeholder from the value for the country placeholder.

**Can we define multiple routes in RouteConfig class?**

**Ans:** Yes, we can define multiple routes in the RouteConfig class, so that MVC Framework evaluates each route in sequence. It starts with the first configured route, and if the incoming URL doesn’t satisfy the URL pattern of the route, then it will evaluate the second route and so on. To understand this open “RouteConfig.cs” file and add the below code above “default” route:

routes.MapRoute(

name: "Student",

url: "NIT/Students",

defaults: new { controller = "Student", action = "Index" }

);

Now we have added a new route with the name Student, so MVC Framework will first evaluate this route to check if the incoming request satisfy the URL pattern or not, and if not satisfied then it will go to “default” route which is existing.

Now add a new Controller to the Controllers folder using “Scaffolding”, name it as “StudentController” and re-write the existing Index action method in the class as following:

public string Index()

{

return "Hello from Student Controller - Index Action method.";

}

**URL to action the above action method should be as following:**

**IIS Express:** http://localhost:port/NIT/Students

**Local IIS:** http://localhost: MVCTestProject3/NIT/Students

**Note:** while defining multiple routes it’s better to define the “default” route in the last otherwise all incoming requests will be handled by “default” route only and to understand that change the sequence of the routes we defined in “RouteConfig” class and try to access the Student Controller with the above URL will give you “Not Found – 404” error.

**Passing parameters to Controller’s Action methods:** we can pass parameters to Action methods of Controllers in different ways like using Route Parameters and Query Strings.

**Using Route Parameters:** by default, we can pass 1 parameter to any action method i.e., “id” because it was defined in “default route” under the class “RouteConfig” and to check that, open “RouteConfig.cs” file and watch the value of “URL” which will be as following:

**url: "{controller}/{action}/{id}"**

**Note:** by default, this “id” is optional, and we can find that under “defaults” in the next line.

**defaults: new { controller = "Home", action = "Index", id = UrlParameter.Optional }**

If required we can send this “id” value to the Action method and that value can be used inside the method and to use it, Action method should have “id” as parameter.

To test this, let’s add a new controller under our current project i.e., “MVCTestProject3” with the name “ParamsController”, delete the existing Index action method and write the below methods under the class:

//Passing value to id is mandatory

public string Index1(int id)

{

return "The value of id is: " + id;

}

//Passing value to id is optional and if not passed value will be "0"

public string Index2(int id = 0)

{

return "The value of id is: " + id;

}

//Passing value to id is optional and if not passed value will be "null"

public string Index3(int? id)

{

return "The value of id is: " + id;

}

**Execute the above methods as following:**

**IIS Express:**

http://localhost:port/Params/Index1 //Invalid

http://localhost:port/Params/Index1/100 //Valid

http://localhost:port/Params/Index2 //Valid, but value of id is 0

http://localhost:port/Params/Index2/200 //Valid

http://localhost:port/Params/Index3 //Valid, but value of id is null

http://localhost:port/Params/Index3/300 //Valid

**Local IIS:**

<http://localhost/MVCTestProject3/Params/Index1> //Invalid

http://localhost/MVCTestProject3/Params/Index1/100 //Valid

http://localhost/MVCTestProject3/Params/Index2 //Valid, but value of id is 0

http://localhost/MVCTestProject3/Params/Index2/200 //Valid

http://localhost/MVCTestProject3/Params/Index3 //Valid, but value of id is null

http://localhost/MVCTestProject3/Params/Index3/300 //Valid

**Note:** the parameter name in all the 3 Index action methods should be “id” only (not case sensitive and can be of any type) because it is the same name we have in “RouteConfig.cs” file, so we can’t change it in our action methods and if we try to use a different name to the parameter other than “id” then the value we passed thru the route will not be taken by the action method and to test that define 2 new action methods in the “ParamsController” class as below:

//Passing value to x is mandatory and if passed also it will not take it because of parameter name

public string Index4(int x)

{

return "The value of id is: " + x;

}

//Passing value to x is optional and if passed also it will not take it because of parameter name

public string Index5(int? x)

{

return "The value of id is: " + x;

}

**Execute the above methods as following:**

**IIS Express:**

http://localhost:port/Params/Index4 //Invalid because there is no value for x

http://localhost:port/Params/Index4/400 //Invalid because the value is not taken to x

http://localhost:port/Params/Index5 //Valid and the value for x is null

http://localhost:port/Params/Index5/500 //Valid, but now also the value for x is null only

**Local IIS:**

http://localhost/MVCTestProject3/Params/Index4 //Invalid because there is no value for x

http://localhost/MVCTestProject3/Params/Index4/400 //Invalid because the value is not taken to x

http://localhost/MVCTestProject3/Params/Index5 //Valid and the value for x is null

http://localhost/MVCTestProject3/Params/Index5/500 //Valid, but now also the value for x is null only

The name “Id” which is defined in “RouteConfig” under the default route is not specified to be of a particular type so while using it in our action method we can specify any type to it and to test that define a new Action method in the “ParamsController” class as following:

//Passing value to Id is option because it is defined as type string & strings are by default Nullable (reference types)

public string Index6(string Id) {

return "The value of id is: " + Id;

}

**Execute the above method as following:**

**IIS Express:**

http://localhost:port/Params/Index6 //Valid and value of Id is null

http://localhost:port/Params/Index6/Hello //Valid and value of Id is Hello

http://localhost:port/Params/Index6/600 //Valid and value of Id is 600

http://localhost:port/Params/Index6/true //Valid and value of Id is true

http://localhost:port/Params/Index6/34.56 //Invalid, because of the special character decimal

**Local IIS:**

http://localhost/MVCTestProject3/Params/Index6 //Valid and value of Id is null

http://localhost/MVCTestProject3/Params/Index6/Hello //Valid and value of Id is Hello

http://localhost/MVCTestProject3/Params/Index6/600 //Valid and value of Id is 600

http://localhost/MVCTestProject3/Params/Index6/true //Valid and value of Id is true

<http://localhost/MVCTestProject3/Params/Index6/34.56> //Invalid, because of the special character decimal

**Passing multiple parameters to Action method:** If we want to pass multiple parameters to Action methods, we can change the default route “URL” in RouteConfig class, for example if we want to have 2 parameters to our action methods re-write the “URL” as following :

url: "{controller}/{action}/{id}/{name}"

**Now in the below, change the defaults as following:**

defaults: new { controller = "Home", action = "Index", id = UrlParameter.Optional, name = UrlParameter.Optional }

Now we can define action methods to accept 2 parameters with the names “id” & “name” and to test that add 2 new Action methods under our “ParamsController” class as following:

//Passing value to Id is mandatory and Name is optional

public string Index7(int Id, string Name)

{

return $"Value of Id is: {Id} and value of Name is: {Name}";

}

//Passing values to Id and Name are optional

public string Index8(int? Id, string Name)

{

return $"Value of Id is: {Id} and value of Name is: {Name}";

}

**Execute the above methods as following:**

**IIS Express:**

http://localhost:port/params/Index7 //Invalid because Id is mandatory parameter

http://localhost:port/params/Index7/700 //Valid, in this case Name will be null value

http://localhost:port/params/Index7/700/Raju //Valid

http://localhost:port/Params/Index7/Raju/700 //Invalid because parameter values not in order

http://localhost:port/Params/Index7?Id=700&Name=Raju //Valid, as we are passing values by specifying names

http://localhost:port/Params/Index7?Name=Raju&Id=700 //Valid, as we are passing values by specifying names

**Local IIS:**

<http://localhost/MVCTestProject3/params/Index7> //Invalid because Id is mandatory parameter

<http://localhost/MVCTestProject3/params/Index7/700> //Valid, in this case Name will be null value

<http://localhost/MVCTestProject3/params/Index7/700/Raju> //Valid

[http://localhost/MVCTestProject3/Params/Index7/Raju/700](http://localhost:58243/Params/Index7/Raju/700) //Invalid because parameter values not in order

http://localhost/MVCTestProject3/Params/Index7?Id=700&Name=Raju //Valid

http://localhost/MVCTestProject3/Params/Index7?Name=Raju&Id=700 //Valid

**IIS Express:**

http://localhost:port/params/Index8 //Valid, in this case Id & Name will be null value

http://localhost:port/params/Index8/800 //Valid, in this case Name will be null value

http://localhost:port/params/Index8/800/Raju //Valid

http://localhost:port/Params/Index8/Raju/800 //Invalid because parameter values not in order

http://localhost:port/Params/Index8?Name=Raju //Valid, in this case id will be null value

http://localhost:port/Params/Index8?Id=800&Name=Raju //Valid, as we are passing values by specifying names

http://localhost:port/Params/Index8?Name=Raju&Id=800 //Valid, as we are passing values by specifying names

**Local IIS:**

http://localhost/MVCTestProject3/params/Index8 //Valid

http://localhost/MVCTestProject3/params/Index8/800 //Valid

http://localhost/MVCTestProject3/params/Index8/800/Raju //Valid

http://localhost/MVCTestProject3/Params/Index8/Raju/800 //Invalid

http://localhost/MVCTestProject3/Params/Index8?Name=Raju //Valid

<http://localhost/MVCTestProject3t/Params/Index8?Id=800&Name=Raju> //Valid

<http://localhost/MVCTestProject3/Params/Index8?Name=Raju&Id=800> //Valid

**Using Query String:** by using Query String’s also we can pass values to Action methods and to test that add a new Action method into the “ParamsController” class as following:

public string Index9(int Pid, string Pname, double Price)

{

return $"Pid: {Pid}; Pname: {Pname}; Price: {Price}";

}

**Now run the application by using the following URL:**

**IIS Express:**

http://localhost:port/Params/Index9/101/Shoes/3500 //Invalid

http://localhost:port/Params/Index9?Pid=101&Pname=Shoes&Price=3500 //Valid

http://localhost:port/Params/Index9?Pname=Shoes&Price=3500&Pid=101 //Valid

http://localhost:port/Params/Index9?Price=3500&Pid=101&Pname=Shoes //Valid

**Local IIS:**

http://localhost/MVCTestProject3/Params/Index9/101/Shoes/3500 //Invalid

http://localhost/MVCTestProject3/Params/Index9?Pid=101&Pname=Shoes&Price=3500 //Valid

http://localhost/MVCTestProject3/Params/Index9?Pname=Shoes&Price=3500&Pid=101 //Valid

http://localhost/MVCTestProject3/Params/Index9?Price=3500&Pid=101&Pname=Shoes //Valid

**Note:** Without defining any parameters to the Action method also we can read Query String values in our code, to test that add a new Action method into the “ParamsController” class as following:

public string Index10()

{

int Pid = int.Parse(Request.QueryString["Pid"]);

string Pname = Request.QueryString["Pname"];

double Price = double.Parse(Request.QueryString["Price"]);

return $"Pid: {Pid}; Pname: {Pname}; Price: {Price}";

}

**Now run the application by using the following URL:**

**IIS Express:**

http://localhost:port/Params/Index10/101/Shoes/3500 //Invalid

http://localhost:port/Params/Index10?Pid=101&Pname=Shoes&Price=3500 //Valid

http://localhost:port/Params/Index10?Pname=Shoes&Price=3500&Pid=101 //Valid

http://localhost:port/Params/Index10?Price=3500&Pid=101&Pname=Shoes //Valid

**Local IIS:**

<http://localhost/MVCTestProject3/Params/Index10/101/Shoes/3500> //Invalid

<http://localhost/MVCTestProject3/Params/Index10?Pid=101&Pname=Shoes&Price=3500> //Valid

<http://localhost/MVCTestProject3/Params/Index10?Pname=Shoes&Price=3500&Pid=101> //Valid

<http://localhost/MVCTestProject3/Params/Index10?Price=3500&Pid=101&Pname=Shoes> //Valid

**Note:** In this case “id” and “name” parameters in RouteConfig class will not have any impact because both are optional.

Now let’s write another 2 methods to understand about Query String’s, 1 with-out parameters and 1 with parameters.

public string Validate1()

{

string Name = Request["Name"];

string Pwd = Request["Pwd"];

if (Name == "Raju" && Pwd == "Admin")

return "Valid User";

else

return "Invalid User";

}

public string Validate2(string Name, string Pwd)

{

if (Name == "Raju" && Pwd == "Admin")

return "Valid User";

else

return "Invalid User";

}

**We can execute the above methods following:**

**IIS Express:**

http://localhost:port/Params/Validate1?Name=Raju&Pwd=Admin

http://localhost:port/Params/Validate1?Pwd=Admin&Name=Raju

http://localhost:port/Params/Validate2?Name=Raju&Pwd=Admin

http://localhost:port/Params/Validate2?Pwd=Admin&Name=Raju

**Local IIS:**

http://localhost/MVCTestProject3/Params/Validate1?Name=Raju&Pwd=Admin

http://localhost/MVCTestProject3/Params/Validate1?Pwd=Admin&Name=Raju

http://localhost/MVCTestProject3/Params/Validate2?Name=Raju&Pwd=Admin

<http://localhost/MVCTestProject3/Params/Validate2?Pwd=Admin&Name=Raju>

**Action Methods:** The methods that we defined under the Controller class for performing user interactions are known as Action methods i.e., users will directly call these methods for performing actions.

**To define Action Methods, we need to follow a set of rules:**

Action methods must be public, so every public method in a Controller class is an Action method only.

Action methods cannot be static because behind the screen instance of the Controller class is used for calling the Action methods.

It is not suggested to overload Action methods but if required we can still do that by decorating the method with “ActionName” attribute.

[ActionName("SayHello1")]

public string SayHello()

{

return "Hello how are you?";

}

[ActionName("SayHello2")]

public string SayHello(string Name)

{

return "Hello " + Name + " how are you?";

}

**Note:** in the above case we need to call the method with the “ActionName” we have defined by but not with the original method name, to test this define the above methods inside of “ParamsController” class and then we need to call them as following:

**We can execute the above methods following:**

**IIS Express:**

http://localhost:port/Params/SayHello1

http://localhost:port/Params/SayHello2?Name=Raju

**Local IIS:**

<http://localhost/MVCTestProject3/Params/SayHello1>

<http://localhost/MVCTestProject3/Params/SayHello2?Name=Raju>

If we want to define any non-action methods in a controller class, make sure they are not public or else decorate them with “NonAction” attribute and in this case when we try to access those methods from browser we get “404 Not Found” error.

< private or internal or protected or private protected or protected internal > string Display()

{

return "Non-Action Method";

}

Or

[NonAction]

public string Display()

{

return "Non-Action Method";

}

Action methods are generally value returning and very importantly in an MVC Application - Action Methods return type is an “ActionResult”, where “ActionResult” is a class and under this class there are a set of child classes and we call all those class as ActionResult only, and we can use any of those child classes as a return type of our Action method.

**List of ActionResult child classes are:**

ActionResult

FileResult

FilePathResult

FileStreamResult

FileContentResult

JsonResult

ViewResult

EmptyResult

ContentResult

RedirectResult

JavaScriptResult

PartialViewResult

HttpStatusCodeResult

RedirectToRouteResult

**General signature of an Action method will be as following:**

public <ActionResult> <Name>( [<Parameter List>] )

{

-Implement required logic here

-return an ActionResult

}

The most important ActionResult of an Action method is “ViewResult”, and a View in an MVC Application is the UI (User Interface) which contains all the presentation logic in it.

An Action method to return an “ActionResult”, we are provided with a set of methods known as “Helper Methods” and these helper methods are defined under Controller class, which is the parent or base class for all the controllers we define.

| **Helper Methods** | **Action Results** |
| --- | --- |
| File | FileResult |
| Json | JsonResult |
| View | ViewResult |
| --- | EmptyResult |
| Content | ContentResult |
| Redirect | RedirectResult |
| JavaScript | JavaScriptResult |
| PartialView | PartialViewResult |
| HttpNotFound | HttpStatusCodeResult |
| RedirectToRoute | RedirectToRouteResult |
| RedirectToAction | RedirectToRouteResult |

**Note:** all the above helper methods are defined under the class “Controller” and to see them go to “ParamsController.cs” file and in that file, right click on the “Controller” class and select the option “Go to Definition” which will take you to the pre-defined Controller class and display’s the metadata of that class.

**Views**

View is the second important component in an MVC Application which acts as a UI (User Interface) for presenting the data or results to end users as well as for accepting data from users. Views are stored under “Views” folder and under this folder a separate folder is maintained for storing the Views associated with each Controller i.e., if we have an “EmployeeController” then under the Views folder we will have “Employee” folder for storing all the Views that are associated with “EmployeeController” and so on.

**Note:** if a Controller is added by using Scaffolding, then automatically it will also add an associated folder for storing its Views, under the Views folder, whereas this will not happen if we define a Controller with manual coding and in that case, it is our responsibility to do that. Under the Views folder we can also maintain a folder with the name “Shared” for storing the Views that are common for multiple Controllers.

**What does a View contain in it?**

**Ans:** A View contains code for presentation or presentation logic which is a combination of “C# or VB” and HTML (CSS and Java Script also). When a request is sent for a View by the client, the logic implemented in the View gets processed and finally everything gets converted into Text (HTML) and we call this process as “Rendering”.

**What is rendering?**

**Ans:** Unfortunately, Internet still has bandwidth limitations and not every person is running on the same OS, same Web Browser or same Device, and these issues make it necessary to stick with HTML (Text Format) as our mark-up language of choice. So, in all the Server-Side technologies including ASP.NET; Web Server will process all the logic implemented by us using any language and converts the result into Text (HTML) which we call it as “**Rendering”** and then that HTML will be sent to clients as response. Views are processed by “View Engines” to render the results and MVC by default supports 2 different View Engines, those are:

Web Forms Engine

Razor Engine

**Web Forms Engine:** this is the default View Engine that is introduced along with MVC in 2008 and the coding style will exactly be like ASP.NET Web Forms, and the extension of View Pages here is “.aspx”.

**Razor Engine:** this is introduced in MVC 3.0 and in this case, View Pages will be having an extension of “.cshtml” or “.vbhtml” based on the language we use for developing the Views.

**Note:** Razor Engine is the most advanced View Engine and the most recommended also. Pages that are created for Razor Engine are known as Razor Pages and these Pages can contain either “HTML and C# or VB” code in them with an easy syntax.

**Sample Web Form page with a for loop:**

<%

for(int i=1;i<=10;i++)

{

%>

<h3>Hello World</h3>

<%

}

%>

**Sample Razor page with a for loop:**

@{

for(int i=1;i<=10;i++)

{

<h3>Hello World</h3>

}

}

**Note:** apart from the above 2 View Engines, ASP.NET MVC also supports many other third-party View Engines also like “NHaml”, “Brail”, “NDjango”, “Spark”, “Hasic”, etc.

**Creating Action methods returning ViewResult:** create a new ASP.NET Web Application project naming it as “MVCActionResults”; choose “Empty Project Template”, check “MVC” CheckBox and click on the Create Button.

Now add a Controller in to the Controllers folder of the project naming it as “HomeController” and by default the class contains a method with the name “Index” and it’s return type will be “ActionResult”, change it as “ViewResult” (not mandatory) or leave the same and add 2 more Action methods in the class as following:

public ViewResult Register()

{

return View();

}

public ViewResult Login()

{

return View();

}

**Adding Views for Action Methods:** we place Views under Views folder of the project and whenever a Controller is added to the project using Scaffolding, automatically a new folder gets added to the Views folder with the name of that Controller, so under the Views folder we will now find a folder with the name “Home” as we added a controller with the name “Home” and all Views that are associated with this Controller are generally placed into the Home folder.

Now let’s add 3 Views i.e., 1 for each Action method and to do that right click on the Home folder, select Add => “View”, this will open a new window with the name “Add New Scaffolded Item”, in that select “MVC 5 View” and click “Add” which opens a new window “Add View”, in that window under “View Name” TextBox specify the view name as “Index” (will by default show the name as “View”), leave the “Template” TextBox with its existing value i.e., “Empty (without model)”, un-check all other Checkbox’s on the screen and click on “Add” button which will add the View with some HTML Code in it.

**Now in the view file write the below code under the “<div>” tag:**

<h1 style="text-align:center;color:red;text-decoration:underline">Naresh I Technologies</h1>

<h2>Click on the links below to navigate:</h2>

<h3>

<a href="/Home/Register">Register</a> <br />

<a href="/Home/Login">Login</a> <br />

<a href="/Home/ForgotPassword">Forgot Password</a><br />

<a href="/Home/ResetPassword">Reset Password</a><br />

<a href="/Home/Contact">Contact Us</a><br />

<a href="/Home/Mission">Mission</a><br />

<a href="/Home/About">About Us</a><br />

</h3>

**Add another view same as the above with the name Register and write the below code in its <div> tag:**

<h1 style="text-align:center;color:red;text-decoration:underline">Naresh I Technologies</h1>

<h3 style="text-align:center;text-decoration:underline">Registration Page</h3>

<table align="center">

<tr><td>Name:</td><td><input type="text" id="txtName" name="txtName" /></td></tr>

<tr><td>User Id:</td><td><input type="text" id="txtUid" name="txtUid" /></td></tr>

<tr><td>Password:</td><td><input type="password" id="txtPwd" name="txtPwd" /></td></tr>

<tr><td>Confirm Password:</td><td><input type="password" id="txtCPwd" name="txtCPwd" /></td></tr>

<tr><td>Mobile:</td><td><input type="tel" id="txtMobile" name="txtMobile" /></td></tr>

<tr><td>Email Id:</td><td><input type="email" id="txtEmail" name="txtEmail" /></td></tr>

<tr>

<td colspan="2" align="center">

<input type="submit" id="btnRegister" value="Register" />

<input type="reset" id="btnReset" value="Reset" />

</td>

</tr>

</table>

<h4 style="text-align:center;color:red">

Click here to go to <a href="/Home/Index">Home Page.</a>

</h4>

**Now add another view same as the above with the name Login and write the below code in its <div> tag:**

<h1 style="text-align:center;color:red;text-decoration:underline">Naresh I Technologies</h1>

<h3 style="text-align:center;text-decoration:underline">Login Page</h3>

<table align="center">

<tr><td>User Id:</td><td><input type="text" id="txtUid" name="txtUid" /></td></tr>

<tr><td>Password:</td><td><input type="password" id="txtPwd" name="txtPwd" /></td></tr>

<tr>

<td colspan="2" align="center">

<input type="submit" id="btnLogin" value="Login" />

<input type="reset" id="btnReset" value="Reset" />

</td>

</tr>

</table>

<h4 style="text-align:center;color:red">

Click here to go to <a href="/Home/Index">Home Page.</a>

</h4>

Now run the project which will launch the “Index” view first because we are already aware that, default Controller is Home and default Action method is Index (listed in RouteConfig class). Index View will provide Links for launching Login and Register views, click on them to launch the corresponding Views.

**Note:** while launching a View we don’t require to specify the View Name in the Helper method => “View()” because View names matches with the Action method names.

**Can the Action method name and View name be different?**

**Ans:** Yes, Action method name and View name can be different, and if they are different, we need to explicitly pass View name or path of that View as a parameter to the Helper method. To test this, add 2 new Views naming them as “ForgotPwd” and “ResetPwd”.

**Write the below code under “<div>” tag of “ForgotPwd.cshtml” file:**

<h1 style="text-align:center;color:red;text-decoration:underline">Naresh I Technologies</h1>

<div style="text-align:center;background-color:cyan">

Forgot your password? Enter your registered Email Id, to receive a reset password link.

<br />

Email Id: <input type="email" id="txtEmail" name="txtEmail" />

<input type="submit" id="btnSubmit" value="Submit" />

</div>

<h4 style="text-align:center;color:red">

Click here to go to <a href="/Home/Index">Home Page.</a>

</h4>

**Write the below code under “<div>” tag of “ResetPwd.cshtml” file:**

<h1 style="text-align:center;color:red;text-decoration:underline">Naresh I Technologies</h1>

<div style="text-align:center;background-color:cyan">

<h4>Reset Password</h4>

<table align="center">

<tr><td>New Password:</td><td><input type="password" id="txtPwd" name="txtPwd" /></td></tr>

<tr><td>Confirm Password:</td><td><input type="password" id="txtCPwd" name="txtCPwd" /></td></tr>

<tr>

<td colspan="2" align="center">

<input type="submit" id="btnSubmit" value="Submit" />

<input type="reset" id="btnReset" value="Reset" />

</td>

</tr>

</table>

</div>

<h4 style="text-align:center;color:red">Click here to go to <a href="/Home/Index">Home Page.</a></h4>

**Now go to “HomeController” class and add 2 new Action Methods in the class as following:**

public ViewResult ForgotPassword()

{

return View("ForgotPwd");

}

public ViewResult ResetPassword()

{

return View("~/Views/Home/ResetPwd.cshtml");

}

**Note:** in the above case Action method names are not matching with View names so we are explicitly passing View name as parameter to the Action method and that can be done in any of the above 2 ways.

**Is it mandatory to place the View exactly under the folder representing the Controller?**

**Ans:** No, it is not mandatory i.e., we can place them in “Shared” folder also which will be present inside of the Views folder. To test this, add a new folder under Views folder naming it as “Shared” and add a View into the folder naming it as “Contact.cshtml” and write the below code under its “<div>” tag:

<h1 style="text-align:center;color:red;text-decoration:underline">Naresh I Technologies</h1>

<div style="background-color:cyan">

<fieldset style="border: 5px solid coral">

<legend>Contact Us:</legend>

&nbsp;&nbsp;Phone: 2374 6666 <br />

&nbsp;&nbsp;Whatsapp: 81791 91999 <br />

&nbsp;&nbsp;Email: info@nareshit.com <br />

&nbsp;&nbsp;Website: www.nareshit.com <br />

&nbsp;&nbsp;Address: 2nd Floor, Durga Bhavani Plaza, Satyam Theatre Road, Ameerpet, Hyderabad - 500016

</fieldset>

</div>

<h4 style="text-align:center;color:red">Click here to go to <a href="/Home/Index">Home Page.</a></h4>

**Now go to “HomeController” class and add a new Action Methods in the class as following:**

public ViewResult Contact()

{

return View();

}

**Note:** in the above case the View gets launched even if it is not present inside of the Home folder because View Engine will first search in the Home folder and if not found, then it will search in the Shared folder to find the View. Apart from the Shared folder we can also place it in any other folders also but if we do so, we need to explicitly specify path of the View to the Helper method, and to test this add another new folder in Views folder with the name as “Test”, and under the new folder add a View naming it as “Mission.cshtml” and write the below code under its “<div>” tag:

<h1 style="text-align:center;color:red;text-decoration:underline">Naresh I Technologies</h1>

<div style="background-color:burlywood">

<h3 style="text-align: center;color:chartreuse">Our Mission</h3>

<p style="text-align: justify; font-size:16px; text-indent:50px; color:brown">To enrich the knowledge & skill sets of young software engineers by providing value added training in the areas of Software Development & Testing. To serve the industries by providing trained human resources in the above areas. To provide quality Software Training and Consulting Services in the areas of J2EE, .NET, ERP, Database Administration, Testing, Content Management with Live Projects.

</p>

</div>

<h4 style="text-align:center;color:red">Click here to go to <a href="/Home/Index">Home Page.</a></h4>

**Now go to “HomeController” class and add a new Action method in the class as following:**

public ViewResult Mission()

{

return View("~/Views/Test/Mission.cshtml");

}

**What is the default View Engine in an MVC5 Application?**

**Ans:** The default View Engine in an MVC5 Application is “Web Form Engine”, so if a View page is existing with both “.aspx” as well as “.cshtml” extensions the first preference goes to “.aspx” only.

To test this, add 2 new Views into the Home folder of Views folder with the name “About.aspx” and “About.cshtml”.

**Note:** From MVC5 the support for adding “Web Form Views” is removed, so we should explicitly add an “ASP.NET Web Form” and make the necessary changes to it to make it a “Web Form View Page” and to do that, right click on the Home folder under Views Folder, select Add => New Item and in the New Item Window select “Web Form”, name it as “About.aspx” and click on “Add” button to add a “Web Form” and then write the below code in “About.aspx” file under its “<div>” tag:

<h1 style="text-align: center; color: red; text-decoration: underline">Naresh I Technologies</h1>

<div style="background-color: cyan">

<h3 style="text-align: center">About page created using Web Form View Engine.</h3>

<p style="text-align: justify; font-size: 16px; text-indent: 50px; color: coral">Naresh I Technologies (Pronounced: NareshIT) is a leading software training institute providing Software Training, Project Guidance, IT Consulting and Technology Workshops. Using our enhanced global software training delivery methodology, innovative software training approach and industry expertise, we provide high-value corporate training services that enable our clients to enhance business performance, accelerate time-to-market, increase productivity, and improve customer service. We serve Global 100 companies and the leading software vendors in Banking & Financial Services, Insurance, Telecommunications, Technology and Media, Information & Education industries. We design and mentor human resources for our clients who create competitive advantage. Founded in 2004 and headquartered in Hyderabad, India, we have offices and training institutes throughout India.

</p>

</div>

<h4 style="text-align: center; color: red">Click here to go to <a href="/Home/Index">Home Page.</a></h4>

Now go to “About.aspx.cs” and to do that right click on “About.aspx” and select the option “View Code” which will take us to “About.aspx.cs” and there if we will find a class “About” inheriting from “System.Web.UI.Page”, change that as “System.Web.Mvc.ViewPage”.

Now add another view in home folder naming it as “About.cshtml” and write same code as above View in the “<div>” tag but change the “Inner Html” of “<h3>” tag in the top as: **About page created using Razor View Engine**.

**Now go to HomeController class and add a new Action Methods in the class as following:**

public ViewResult About()

{

return View();

}

Now launch Index View and click on the “About Page” hyper link and this will launch “About.aspx” page because by default it will search for “.aspx” pages first, whereas if we want “About.cshtml” page to be launched we need to pass the address of “About.cshtml” file as parameter to Helper method and to test that re-write code in “About” Action method as following:

return View("~/Views/Home/About.cshtml");

Without passing the address of View Page to Helper Method also, we can launch the “.cshtml” View and to do that we need to either clear all the “View Engines” and then freshly add “Razor View Engine” or Remove the “Web Form View Engine” to make “Razor View Engine” as default View Engine. To do that go to “Global.asax” file and write the below code in top of “Application\_Start” method:

ViewEngines.Engines.Clear();

ViewEngines.Engines.Add(new RazorViewEngine());

Or

ViewEngines.Engines.Remove(ViewEngines.Engines.OfType<WebFormViewEngine>().FirstOrDefault());

**Note:** Now even if the code under “About” Action method is “return View();” also, it will launch “About.cshtml” only and in this case if we try to launch “About.aspx” View Page by specifying the explicit path also, we get an error because “WebFormViewEngine” support has been removed by us.

**Can an Action method return different views based on a condition?**

**Ans:** Yes, it is possible to return different views by an Action method based on a condition. To test this, add 2 new Views under Home folder of Views with the names “Show1.cshtml” and “Show2.cshtml”, and write the below code under their “<div>” tags:

**Show1.cshtml:**

<h1 style="text-align:center;color:red;text-decoration:underline">Naresh I Technologies</h1>

<div style="background-color: cyan"><h3 style="text-align: center">This is Show1 View Page</h3></div>

<h4>Click here to go to <a href="/Home/Index">Home Page.</a></h4>

**Show2.cshtml:**

<h1 style="text-align: center; color: red">Naresh I Technologies</h1>

<div style="background-color: cyan"><h3 style="text-align: center">This is Show2 View Page</h3></div>

<h4>Click here to go to <a href="/Home/Index">Home Page.</a></h4>

**Now under “HomeController” class add a new Action method as following:**

public ViewResult Show(int id)

{

if (id == 1)

{

return View("Show1");

}

else

{

return View("Show2");

}

}

**Now go to “Index.cshtml” and add the below links over there:**

<a href="/Home/Show/1">Show1 View</a><br />

<a href="/Home/Show/2">Show2 View</a>

**Can we overload Action methods?**

**Ans:** It is not recommended to overload Action methods but still this is possible by decorating the Action method with “ActionName” attribute, and remember while calling the method, in the URL we can’t use the Action method name, but we need to use the “ActionName” only and to test this, add 2 new Action methods into the “HomeController” class as following:

[ActionName("Display1")]

public ViewResult Display()

{

return View();

}

[ActionName("Display2")]

public ViewResult Display(int? id)

{

return View();

}

Now add 2 new Views with the names “Display1.cshtml” and “Display2.cshtml”, and write the below code under their “<div>” tag:

**Display1.cshtml:**

<h1 style="text-align:center;color:red;text-decoration:underline">Naresh I Technologies</h1>

<div style="background-color: cyan"><h3 style="text-align: center">This is Display1 View Page</h3></div>

<h4>Click here to go to <a href="/Home/Index">Home Page.</a></h4>

**Display2.cshtml:**

<h1 style="text-align:center;color:red;text-decoration:underline">Naresh I Technologies</h1>

<div style="background-color: cyan"><h3 style="text-align: center">This is Display2 View Page</h3></div>

<h4>Click here to go to <a href="/Home/Index">Home Page.</a></h4>

**Now go to “Index.cshtml” and add links for launching the above 2 Views also as following:**

<br /><a href="/Home/Display1">Display1 View</a>

<br /><a href="/Home/Display2">Display2 View</a>

**MVC Action Selectors:** these are attributes that can be applied on an Action method, and they help the view engine to select the correct action method to handle the request.

**We have 3 Action Selectors and those are:**

**ActionName**

**NonAction**

**ActionVerbs**

**ActionName:** this attribute is used to specify a different name to any Action method than its actual name. We use this attribute when we want an Action method to be called with a different name instead of the actual name of the method. Generally used in-case we want to overload Action methods.

**Non-Action:** this attribute indicates a public method of the Controller is not an Action method i.e., when we use this attribute, then the public method in the Controller class will not be treated as an Action method and we can't call this method from browsers using a URL.

**ActionVerbs:** this attribute is used on an Action method when we want to handle different type of HTTP requests. MVC framework provides various action verbs like: “HttpGet”, “HttpPost”, “HttpPut”, “HttpDelete”, “HttpOptions” and “HttpPatch”. You can apply one or more action verbs on an action method to handle different HTTP requests. If we don’t apply any action verb on an action method, then by default it handles “HttpGet” requests.

In our application if we have defined 2 Login Action methods and those methods are decorated with [HttpGet] and [HttpPost] ActionVerbs, then whenever we send the first request (get request) to “Login” Action method then it will invoke the method which is decorated with [HttpGet] Action Verb and launches the corresponding View. When we fill in the credentials and click on the “Login” button it will send a “Post” or “Postback” request and will then invoke “Login” Action method which is decorated with [HttpPost] Action Verb.

**Razor Programming**

From MVC 3.0 Microsoft introduced Razor Engine for creating View Pages without using Web Form Pages. View Pages that are created targeting Razor Engine are saved with “.cshtml” extension whereas View Pages that are created targeting Web Form Engine are saved with “.aspx” extension.

Web Form Pages are provided with Design View, Source View and Code View, where we will be using Design View for design the UI with a “drag & drop” feature and Source View for implementing HTML, Java Script and CSS, and Code View for implementing C# Logic whereas Razor Pages is provided only with Source View and here only we can implement HTML, Java Script, CSS and C# Logic also, and this is the reason why these pages are saved with “.cshtml” extension.

Razor View Pages are light weight when compared to Web Form View Pages because we don’t use any ASP.NET Server Controls but will use only Html Controls so doesn’t require maintaining of View State.

Razor View Pages uses “@{ ... }” sign to implement C# code, whereas in Web Form Pages if we want to write any C# code it should be under “<% ... %>” tags.

**Code in Razor View Page can be written in 3 different ways:**

Single Line Statements.

In-Line Statements.

Multi Line Statements.

**Single Line Statements:** these are generally for declarations and Initializations.

**Syntax:**

@{ <Stmt>; }

**Examples:**

@{ int Count = 0; }

@{ Count += 100; }

@{ Object obj = new Object(); }

**In-Line Statements:** these statements are generally used for accessing values of Members, just by pre-fixing “@” character before the Member.

<h3>Value of count is: @Count</h3>

<h3>obj is of type: @obj.GetType() </h3>

**Multi Line Statements:** we use this for writing multiple lines of code.

**Syntax:**

@{

<Stmt's>

}

**Example:**

@{

string Date = DateTime.Now.ToShortDateString();

string Time = DateTime.Now.ToShortTimeString();

<h3>Today's Date is: @Date</h3>

<h3>Current Time is: @Time</h3>

}

**Note:** in multiline statement block we can write HTML Code directly without enclosing them in double quotes, whereas if we want to use any static text, we need to either prefix it with “@:” or put it under “<text></text>” tags.

@{

string Date = DateTime.Now.ToShortDateString();

string Time = DateTime.Now.ToShortTimeString();

@:Today's Date is: @Date

<text>Current Time is:</text> @Time

}

Comments in razor programming should be under “@\* Comment Text \*@” and in a multiline statement block we can also use our CSharp style of single line commenting i.e., “//”.

To test the above add, a new Controller in our current project i.e., “MVCActionResults”, name the Controller as “RazorController”, add a View to the default “Index” Action method, and write the below code in its “<div>” tag:

@\* Single Line Statements \*@

@{ int Count = 0; }

@{ Count += 100; }

@{ string str = "Hello World"; }

@{ Object Obj = new Object(); }

@\* In Line Statements \*@

Value of count is: @Count

<br>

Value of str is: @str

<br>

Obj is of type: @Obj.GetType()

<hr>

@\* Multi Line Statements \*@

@{

string Date = DateTime.Now.ToShortDateString();

string Time = DateTime.Now.ToShortTimeString();

<span>Today's Date is: @Date</span>

<br>

@:Current Time is: @Time

<br>

<text>Current Time is: @Time</text>

}

<hr>

@\* If condition in Razor programming \*@

@{

int x = 131;

if (x % 2 == 0)

{

<span>@x is an even number.</span>

}

else

{

<span>@x is an odd number.</span>

}

}

<hr>

@{ string[] Colors = { "Red", "Blue", "Green", "Yellow", "Magenta" }; }

@\* Loops in Razor programming - For Loop \*@

@{

<h4>List of colors printed using for loop:</h4>

<ol>

@for (int i = 0; i < Colors.Length; i++)

{

<li>@Colors[i]</li>

}

</ol>

}

<hr>

<h4>List of colors printed using for loop:</h4>

<ol>

@for (int i = 0; i < Colors.Length; i++)

{

<li>@Colors[i]</li>

}

</ol>

<hr>

<h4>List of colors printed using for loop:</h4>

<ol>

@{

for (int i = 0; i < Colors.Length; i++)

{

<li>@Colors[i]</li>

}

}

</ol>

<hr>

@\* Loops in Razor programming - ForEach Loop \*@

@{

<h4>List of colors printed using foreach loop:</h4>

<ul>

@foreach (string color in Colors)

{

<li>@color</li>

}

</ul>

}

<hr>

<h4>List of colors printed using foreach loop:</h4>

<ul>

@foreach (string color in Colors)

{

<li>@color</li>

}

</ul>

<hr>

<h4>List of colors printed using foreach loop:</h4>

<ol>

@{

foreach (string color in Colors)

{

<li>@color</li>

}

}

</ol>

**Passing values from Controller Action Methods to Views in an MVC Application:** we are already aware that in an MVC Application all requests are handled by a Controller and these Controllers only will receive the information either from the End User or Model and these values should be sent to the View for displaying. To pass values from a Controller’s Action method to a View we are provided with various options like:

* ViewData
* ViewBag
* TempData
* Cookies
* Session
* Application
* Anonymous Types
* Model Objects

To test all the above options, create a new “ASP.Net Web Application” project naming it as “MVCDataTransfer”, choose “Empty Project Template”, select “MVC Checkbox” and click on the Create button.

**Now go to “RouteConfig.cs” file and modify the “url” value as following:**

url: "{controller}/{action}/{id}/{name}/{price}"

**Now change the defaults also as following:**

defaults: new

{

controller = "Home",

action = "Index",

id = UrlParameter.Optional,

name = UrlParameter.Optional,

price = UrlParameter.Optional

}

**ViewData:** this is a property defined under the class “ControllerBase” which is a grandparent for all our Controllers, so we can directly consume “ViewData” property in our Controller classes. **ViewData** is of type “ViewDataDictionary” which will internally store the data in the form of “Key-Value” or “Name-Value” combinations, so values that are stored in this “ViewData” will internally be stored in “ViewDataDictionary”.

**Storing values into ViewData:**

**Syntax:** ViewData[string Key] = Value (object)

**Example:** ViewData["Name"] = "Raju";

**Accessing values from ViewData:**

**Syntax:** Object obj = ViewData[string Key]

**Example:** Object obj = ViewData["Name"];

string Name = obj.ToString();

Or

string Name = ViewData["Name"].ToString();

Add a new Controller in it project naming it as “HomeController”, delete the existing “Index” action method in the class and write the below code in the class:

public ViewResult Index1(int? id, string name, double? price)

{

ViewData["Id"] = id;

ViewData["Name"] = name;

ViewData["Price"] = price;

return View();

}

Now add a View to the “Index1” Action method (with-out choosing any layout) and write the following code inside of the “<div>” tag:

<table border="1" align="center" width="15%">

<caption>Product Details</caption>

<tr>

<td>Id:</td><td>@ViewData["Id"]</td>

</tr>

<tr>

<td>Name:</td><td>@ViewData["Name"]</td>

</tr>

<tr>

<td>Price:</td>

<td>

@{

double Price = Convert.ToDouble(ViewData["Price"]);

Price = Price + (Price \* 10 / 100);

@Price

}

</td>

</tr>

</table>

Execute the “Index1” Action method as following: http://localhost:port/Home/Index1/101/Shoes/3500, and in the case all the values that are sent to the Action method thru URL will be captured in Action method and stored into “ViewData” so that those values can be accessed under the corresponding View of Index1’s action method.

**Drawbacks of ViewData:**

* ViewData can transfer data from a Controllers Action method to its corresponding View only.
* ViewData life lasts only during the current HTTP request i.e., ViewData values will be cleared if redirection occurs.
* ViewData is resolved dynamically at runtime, as a result, it doesn’t give any compile-time error checking as well as we do not get support of Intellisense. For example, if we miss-spell the “Key Names” then we will not get any compile-time or runtime error also, whereas we come to know about the problem at the runtime because the value is not displayed.
* ViewData values must be converted into an appropriate type (un-boxing) before using them because they are present in object format, as we have performed in-case of Price value to calculate 10% Tax.

**Note:** we can store scalar as well as complex types also in ViewData but while accessing them we need to explicitly convert them into its original type again. To test this, add a new Action method in “HomeController” class as below:

public ViewResult Display1()

{

List<string> Colors = new List<string>() { "Red", "Blue", "Pink", "Black", "White", "Green", "Brown", "Purple" };

ViewData["Colors"] = Colors;

return View();

}

Now add a View to the “Display1” Action method (with-out choosing any layout) and write the following code inside of the “<div>” tag:

<h3>List of colors: </h3>

<ol>

@foreach (string color in (List<String>)ViewData["Colors"])

{

<li>@color</li>

}

</ol>

**Execute “Display1” Action Method as following:** http://localhost:port/Home/Display1

**ViewBag:** this is also a property defined in the class “ControllerBase”, but this of type “dynamic”. Dynamic is a new type introduced in C# 4.0, capable of storing any type of value and this is type safe because it represents the value in its exact type in runtime. ViewBag was introduced in MVC 3.0 which was just a wrapper around the ViewData but was type safe, so it doesn’t require any type conversion while consuming.

**Storing a value into ViewBag:**

**Syntax:** ViewBag.PropertyName = Value;

**Example:** ViewBag.Name = "Raju";

**Accessing a value from ViewBag:**

**Syntax:** <type> var = ViewBag.PropertyName;

**Example:** string Name = ViewBag.Name;

**To test working with ViewBag add 2 new Action methods in the class Home Controller as below:**

public ViewResult Index2(int? id, string name, double? price)

{

ViewBag.Id = id;

ViewBag.Name = name;

ViewBag.Price = price;

return View();

}

public ViewResult Display2()

{

List<string> Colors = new List<string>() { "Red", "Blue", "Pink", "Black", "White", "Green", "Purple", "Yellow" };

ViewBag.Colors = Colors;

return View();

}

**Now add a View to each action method and write the below code in them by deleting all the existing content:**

**Index2.cshtml:**

<table border="1" align="center" width="15%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@ViewBag.Id</td></tr>

<tr><td>Name:</td><td>@ViewBag.Name</td></tr>

<tr>

<td>Price:</td>

<td>

@{

double Price = ViewBag.Price;

Price = Price + (Price \* 10 / 100);

@Price

}

</td>

</tr>

</table>

**Display2.cshtml:**

<h3>List of colors: </h3>

<ol>

@foreach (string color in ViewBag.Colors)

{

<li>@color</li>

}

</ol>

**Execute Index2 Action Method as following:** http://localhost:port/Home/Index2/105/Shoes/3500

**Execute Display2 Action Method as following:** http://localhost:port/Home/Display2

As discussed above “ViewBag” is a wrapper around “ViewData” i.e., data that is stored in the “ViewBag” will be internally stored in “ViewDataDictionary” only, so values that are stored in a “ViewBag” can also be accessed thru “ViewData” and vice-versa. To test this, go to “Index2.cshtml” and change the statement @ViewBag.Id to @ViewData["Id"] and execute Index2 action method and still we get the same output as before.

**Note:** ViewBag is “Type Safe”, i.e., it doesn't require any type conversions while accessing the data because we get the values back in their original types only, whereas ViewData requires type conversion as the values come back as object. ViewData and ViewBag are accessible only within the request that is in the corresponding Views associated with the Action Methods. In both the cases if the “Key Names” are misspelled then we don’t get a compile-time or a runtime error.

**TempData:** this is also a property under the class “ControllerBase”, but this is of type “TempDataDictionary”. Both “ViewDataDictionary” and “TempDataDictionary” are child classes of “IDictionary” interface which is designed for storing data in [key-value] or [name-value] combination.

The difference between TempData and ViewData is TempData can maintain the state of values between multiple requests i.e., it can pass values from 1 action method to another action method which are present in the same controller or another controller also.

**To test this, add 2 new action methods in “HomeController” class as below:**

public RedirectToRouteResult Index3(int? id, string name, double? price)

{

ViewData["Id"] = id;

ViewBag.Name = name;

TempData["Price"] = price;

return RedirectToAction("Index4");

}

public ViewResult Index4()

{

return View();

}

In the above case request will first come to “Index3” action method with a set of values and that method stores those values into “ViewData”, “ViewBag” and “TempData” respectively, and then redirects to “Index4” action method which is performed by using “RedirectToAction” helper method and in this case return type of “Index3” action method should be “RedirectToRouteResult” but not “ViewResult”.

**Now add a View to Index4 action method and write the below code in its “<div>” tag:**

<table border="1" align="center" width="15%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@ViewData["Id"]</td></tr>

<tr><td>Name:</td><td>@ViewBag.Name</td></tr>

<tr>

<td>Price:</td>

<td>

@{

double Price = Convert.ToDouble(TempData["Price"]);

Price = Price + (Price \* 10 / 100);

@Price

}

</td>

</tr>

</table>

**Execute Index3 Action Method as following:** http://localhost:port/Home/Index3/105/Shoes/3500

When the request is sent to “Index3” action method, it will redirect to “Index4” action method by calling “RedirectToAction()”, so this method will send a re-direction response (302) to the browser, so that browser will send a new request to “Index4” action method and then “Index4” view gets launched and we can watch that in the browser’s address bar which will be shown as following: http://localhost:port/Home/Index4. If we watch the output in the browser, it will not display the values of “Id” and “Name” but will display the value of “Price” because “ViewData” and “ViewBag” can’t maintain the state of values between multiple requests, but “TempData” can maintain.

If we want to resolve the above problem, go to “Index3” action method and change “ViewData” and “ViewBag” to “TempData” and change the code in “Index4.cshtml” file and watch the difference.

In the above example by using “RedirectToAction” helper method we are able to transfer the control from 1 action method to another action method that is present in the same controller, whereas we can also transfer to an action method that is present in another controller also, and to test it add a new action method in the “HomeController” class as below:

public RedirectToRouteResult Index5(int? id, string name, double? price)

{

TempData["Id"] = id;

TempData["Name"] = name;

TempData["Price"] = price;

return RedirectToAction("Index1", "Test");

}

In the above code under “RedirectToAction” helper method, “Test” is the controller’s name and “Index1” is the action method name where it must redirect. RedirectToAction helper method is an overloaded method that is pre-defined as following:

**RedirectToAction(string actionName)**

**RedirectToAction(string actionName, string controllerName)**

Now add a new Controller in the project naming it as “TestController”, change the default Action method name i.e., “Index” to “Index1”, add a View to the method and write the below code in the View under “<div>” tag:

<table border="1" align="center" width="15%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@TempData["Id"]</td></tr>

<tr><td>Name:</td><td>@TempData["Name"]</td></tr>

<tr>

<td>Price:</td>

<td>

@{

double Price = Convert.ToDouble(TempData["Price"]);

Price = Price + (Price \* 10 / 100);

@Price

}

</td>

</tr>

</table>

**Execute Index5 Action Method of Home Controller as following:**

http://localhost:port/Home/Index5/105/Shoes/3500

**After execution of Index5 Action method, the URL in address bar will be as following because it is re-directed:**

http://localhost:port/Test/Index1

**Flow of control:** Request sent to => Index5 action method of HomeController => Redirected to => Index1 action method of TestController.

**Note:** “TempData” is also not type safe like “ViewData” so here also we need to perform type conversion while working with data and the only difference between “ViewData” and “TempData” is “TempData” can maintain the state of values between multiple requests.

If we access values once from “TempData” immediately all those values get deleted and can’t be accessed in next requests, to test this add a hyper link after the table in “Index1.cshtml” file of “TestController” as following:

<center>Click to launch new <a href="/Test/Display1">Page</a>.</center>

So, if we click on the hyper link it must call “Display1” action method of “TestController” class, so add a new action method in “TestController” class as following:

public ViewResult Display1()

{

return View();

}

**Add a View to Display1 action method and write the below code in its “<div>” tag:**

<table border="1" align="center" width="15%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@TempData["Id"]</td></tr>

<tr><td>Name:</td><td>@TempData["Name"]</td></tr>

<tr>

<td>Price:</td>

<td>

@{

double Price = Convert.ToDouble(TempData["Price"]);

Price = Price + (Price \* 10 / 100);

@Price

}

</td>

</tr>

</table>

**Execute Index5 Action Method of HomeController as following:**

http://localhost:port/Home/Index5/105/Shoes/3500

This will launch “Index1” view of “TestController” displaying the values and now click on the hyper link we added to launch “Display1” view of “TestController”, but “Display1” view will not display the values because we accessed values in “Index1” view and immediately those values got deleted, so can’t be accessed in “Display1” view again.

**Flow of control:** Request sent to => Index5 action method of HomeController => Redirected to => Index1 action method of TestController => when the link is clicked redirects to => Display1 Action method of TestController.

To overcome the above problem and access the values in next requests, we need to use the “Peek” method of “TempData” while accessing values, so that the values will be persisting even after accessing them and can be accessed again. To do that, change the code of accessing data in “Index1” view as following:

@TempData["Id"] => @TempData.Peek("Id")

@TempData["Name"] => @TempData.Peek("Name")

@TempData["Price"] => @TempData.Peek("Price")

**Note:** In this case if we want to transfer data from “Display1” view to any other views there also we must change the code as above.

To retain the values of “TempData” after accessing, we can also call “Keep” method in place of “Peek”, but the difference is when we use “Keep” it will retain all the values of “TempData” and can be consumed in the next request, where “Peek” method is used for retaining specific values only. So, without calling the Peek method 3 times we can simply call the Keep method and to try this write the below code, above the “<table>” tag in “Display1.cshtml” file:

@{ TempData.Keep(); }

**Note:** Call Keep for retaining all the values of TempData and call Peek to retain specific values of TempData.

**Cookies:** A Cookie is a small piece of text that is used to store user-specific information and that information can be read by the Web Application whenever user visits the site. When a user requests for a Web Page, Web Server sends not just a page, but also a cookie containing the date and time. Cookies are stored in browser memory or a folder on the user’s hard disk and when the user requests for the Web Page again, browser looks for the Cookies associated with the Web Page and sends them to the Server. Browser stores cookies separately for each different site we visit.

**Writing Cookies on client machine:** To write a Cookie on Client Machine first we need to create the instance of HttpCookie class; store values into it treating it like an array and then write that Cookie to Client Machine by using Response object.

HttpCookie cookie = new HttpCookie("LoginCookie");

cookie["User"] = "Raju"; cookie["Pwd"] = "admin";

Response.Cookies.Add(cookie);

**Reading Cookies back on our WebPages:** we can read Cookies Present on the Client Machine from a View or Action Method using Request object.

HttpCookie cookie = Request.Cookies["LoginCookie"];

string User = cookie["User"];

string Pwd = cookie["Pwd"];

**Cookies are or 2 types:**

1. In-Memory Cookies
2. Persistent Cookies

In-Memory cookies are stored in browser's memory so once the browser is closed, immediately all the cookies that are associated with that browser window will be destroyed, and by default every cookie is In-Memory only. Persistent Cookies are stored on Hard Disk of the client machines, so even after closing the browser window also they will be persisting and can be accessed next time we visit the site. To make a cookie as persistent we need to set “Expires” property of Cookie with a “DateTime” value.

**Setting expires property of Cookie:**

**cookie.Expires = <DateTime>;**

To test working with Cookies, add 2 new Action methods in “HomeController” for creating a Cookie with a set of values and then launching the View to display those values as below:

public ViewResult Index6(int? Id, string Name, double? Price)

{

HttpCookie cookie = new HttpCookie("ProductCookie");

cookie["Id"] = Id.ToString();

cookie["Name"] = Name;

cookie["Price"] = Price.ToString();

cookie.Expires = DateTime.Now.AddDays(3);

Response.Cookies.Add(cookie);

return View();

}

public ViewResult Index7()

{

return View();

}

**Now add a View to “Index6” Action method and write the below code under its “<div>” tag:**

@{

HttpCookie cookie = Request.Cookies["ProductCookie"];

int Id = int.Parse(cookie["Id"]);

string Name = cookie["Name"];

double Price = double.Parse(cookie["Price"]);

}

<table border="1" align="center" width="20%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@Id</td></tr>

<tr><td>Name:</td><td>@Name</td></tr>

<tr>

<td>Price:</td>

<td>

@{

Price = Price + Price \* 10 / 100;

@Price

}

</td>

</tr>

</table>

<center>Click to launch new <a href="/Home/Index7">Page</a>.</center>

**Execute Index6 Action Method of Home Controller as following:**

http://localhost:port/Home/Index6/105/Shoes/3500

In the above case when we call Index6 action method, will launch the associated view and displays the values that are stored in the cookie and when we click on the Link in the bottom will call Index7 action method of the same controller which will also display the values that stored in the cookie and to test that add a View for Index7 action method and write the below code in it under the “<div>” tag:

@{

HttpCookie cookie = Request.Cookies["ProductCookie"];

int Id = int.Parse(cookie["Id"]);

string Name = cookie["Name"];

double Price = double.Parse(cookie["Price"]);

}

<table border="1" align="center" width="20%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@Id</td></tr>

<tr><td>Name:</td><td>@Name</td></tr>

<tr>

<td>Price:</td>

<td>

@{

Price = Price + Price \* 10 / 100;

@Price

}

</td>

</tr>

</table>

<center>Click to launch new <a href="/Test/Index2">Page</a>.</center>

When we click on the Link in above View will launch Index2 action method of TestController and here also it displays the values that are stored in Cookie and to test it add a new action method in TestController class as below:

public ViewResult Index2()

{

return View();

}

**Add a View to the above Index2 action method and write the below code under it’s “<div>” tag:**

@{

HttpCookie cookie = Request.Cookies["ProductCookie"];

int Id = int.Parse(cookie["Id"]);

string Name = cookie["Name"];

double Price = double.Parse(cookie["Price"]);

}

<table border="1" align="center" width="20%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@Id</td></tr>

<tr><td>Name:</td><td>@Name</td></tr>

<tr>

<td>Price:</td>

<td>

@{

Price = Price + Price \* 10 / 100;

@Price

}

</td>

</tr>

</table>

**Flow of control:** Request sent to => “Index6” Action method of “HomeController” => When the hyper link is clicked on page, it is redirect to => “Index7” Action method of “HomeController” => When the hyper link is clicked on page, it is redirect to => “Index2” Action method of “TestController”

**Drawbacks of Cookies:**

1. We can create only 50 cookies for each website, so every new cookie from the site will override the old cookie once after reaching the limit.
2. A cookie can store only 4 K.B. of data that too of type string only.
3. Cookies are not secured because they are stored on client machines.
4. Because cookies are stored on client machines there is a problem like clients can either delete the cookies or even disable cookies.

**Location of Cookies:**

**Microsoft Edge:** C:\Users\<User>\AppData\Local\Microsoft\Edge\User Data\Default

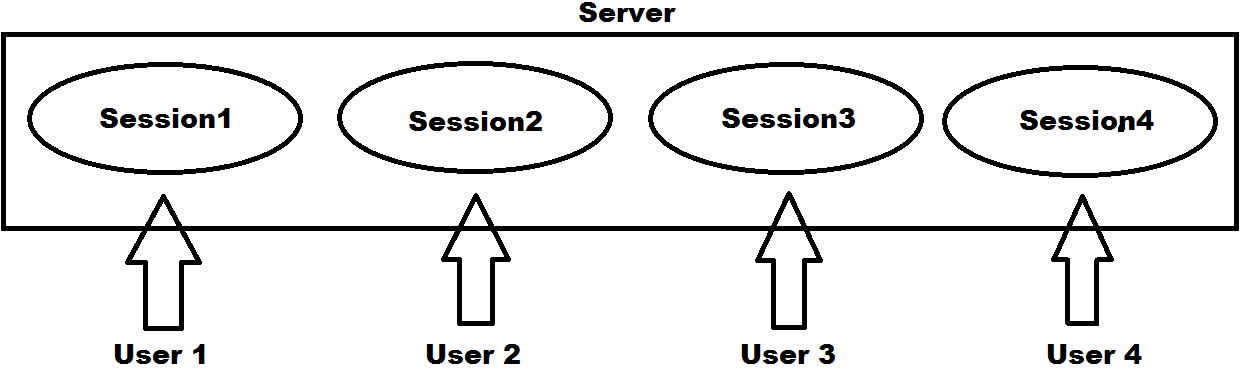
**Google Chrome:** C:\Users\<User>\AppData\Local\Google\Chrome\User Data\Default

**Disabling cookies on Brower:** Click on “…” option beside the Address bar in browser => select settings and in the window opened, on the LHS select “Cookies and site permissions” and then on the RHS click on “Manage and delete cookies and site data” option and under that switch off the toggle button => “Allow sites to save and read cookie data (recommended)”.

**Delete Cookies on Browser:** To delete cookies on our browser use the command Ctrl + Shift + Delete which will open “Clear browsing data” window, in that select “Cookies and other site data” Checkbox and click “Clear now”.

**Session:** this is also a property but defined under “Controller” class and this is of type “HttpSessionStateBase”, and these are same as Sessions in “ASP.NET Web Forms”. Values that are stored in a Session are accessible from anywhere to anywhere for a particular user in the Session Life-time i.e., Action to Action in same Controller or other Controller, Controller to View, View to Controller, View to View etc.

Whenever a user connects to the Web Server, server will create a Session and gives it to the user for storing any values that are associated with him which are accessible only to him in every page he visits in the site. This happens for every user connecting to the server. So, each user will be having a Session of his own which will not be shared between other users, in short, a session is a “Single-User Global Data”.



**Storing values into a Session:**

**Syntax:** Session[string key] = value (object)

**Example:** Session["Name"] = "Raju";

**Accessing values from a Session:**

**Syntax:** object value = Session[string key]

**Example:** object value = Session["Name"];

string Name = value.ToString();

Or

string Name = Session["Name"].ToString();

To test Sessions, add 2 new Action methods in “HomeController” as below for transferring session values from Action method to Action method within a controller:

public RedirectToRouteResult Index8(int? id, string name, double? price)

{

Session["Id"] = id;

Session["Name"] = name;

Session["Price"] = price;

return RedirectToAction("Index9");

}

public ViewResult Index9()

{

return View();

}

In the above case we are storing the values into a Session in “Index8” action method and then redirecting to “Index9” action method of same Controller, so the view that is associated with “Index9” can access the values from the Session and display them. Now add a View to “Index9” Action method and write the below code under its “<div>” tag:

<table border="1" align="center" width="15%">

<caption>Product Details</caption>

<tr><td>Id: </td><td>@Session["Id"]</td></tr>

<tr><td>Name: </td> <td>@Session["Name"]</td></tr>

<tr>

<td>Price: </td>

<td>

@{

double Price = Convert.ToDouble(Session["Price"]);

Price = Price + (Price \* 10 / 100);

@Price;

}

</td>

</tr>

</table>

**Execute Index8 Action Method of Home Controller as following:**

http://localhost:port/Home/Index8/105/Shoes/3500

**After execution of Index8 Action Method, the URL in the address bar will be as following because it re-directed:**

http://localhost:port/Home/Index9

**Flow of control:** Request sent to => “Index8” Action method of “HomeController” => Redirected to => “Index9” Action method of “HomeController”.

Values that are stored in a Session are accessible in Action methods or Views which are defined in same or different Controller also and for testing this add a new Action method in “HomeController” as below:

public RedirectToRouteResult Index10(int? id, string name, double? price)

{

Session["Id"] = id;

Session["Name"] = name;

Session["Price"] = price;

return RedirectToAction("Index3", "Test");

}

In the above case “Index10” action method of “HomeController” is storing the values into a Session and then redirecting to “TestController” => “Index3” action method, so the view that is associated with the “Index3” action method can access the values from Session and from there if we further redirect to any other View also, we can access the values from the Session and to test that add 2 new Action methods in “TestController” as below:

public ViewResult Index3()

{

return View();

}

public ViewResult Display2()

{

return View();

}

**Add a View to “Index3” Action method and write the below code under its “<div>” tag:**

<table border="1" align="center" width="15%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@Session["Id"]</td></tr>

<tr><td>Name:</td><td>@Session["Name"]</td></tr>

<tr>

<td>Price:</td>

<td>

@{

double Price = Convert.ToDouble(Session["Price"]);

Price = Price + (Price \* 10 / 100);

@Price

}

</td>

</tr>

</table>

<center>Click to launch new <a href="/Test/Display2">Page</a>.</center>

**Add a View to Display2 Action method and write the below code under its “<div>” tag:**

<table border="1" align="center" width="15%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@Session["Id"]</td></tr>

<tr><td>Name:</td><td>@Session["Name"]</td></tr>

<tr>

<td>Price:</td>

<td>

@{

double Price = Convert.ToDouble(Session["Price"]);

Price = Price + (Price \* 10 / 100);

@Price

}

</td>

</tr>

</table>

**Execute Index10 Action Method of Home Controller as following:**

http://localhost:port/Home/Index10/105/Shoes/3500

**Flow of control:** Request sent to => “Index10” Action method of “HomeController” => Redirected to => “Index3” Action method of “TestController” => when the hyper link is clicked on page, it is again redirected to => “Display2” Action method of “TestController”.

**How is a session identified to which user it belongs to?**

**Ans:** Whenever a Session is created for a user it is given with a Unique Id known as “SessionId” and this “SessionId” is written to client’s browser in the form of a “In-Memory Cookie”, so whenever the client comes back to the server in a next request, server will read the Cookie, picks the “SessionId” and associates user with his exact Session.

**Note:** because SessionId is stored on client’s browser in the form of an “In-Memory Cookie”, other tabs under the browsers instance can also access that session, whereas a new instance of a new browser can’t access the Session.

**What happens to Sessions associated with clients if the client closes the browser?**

**Ans:** Every Session will be having a “time-out” period of “20 Minutes (default)” from the last request (Sliding Expiration), so within 20 Minutes if the Session is not used by the User, Server will destroy that, Session.

**Note:** we can change the default time-out period of “20 Mins” to our required value thru “Web.config” file by setting “timeout” attribute value of “sessionState” element as following:

<sessionState cookieless="AutoDetect" timeout="1" />

**Can we explicitly destroy a Session associated with a User?**

**Ans:** Yes, this can be performed by calling “Abandon()” method on the Session and this is what we generally do under “Sign Out” or “Log Out” options in a Web Site or Web Application.

**E.g.:** Session.Abandon();

**Where will Web Server store Session values?**

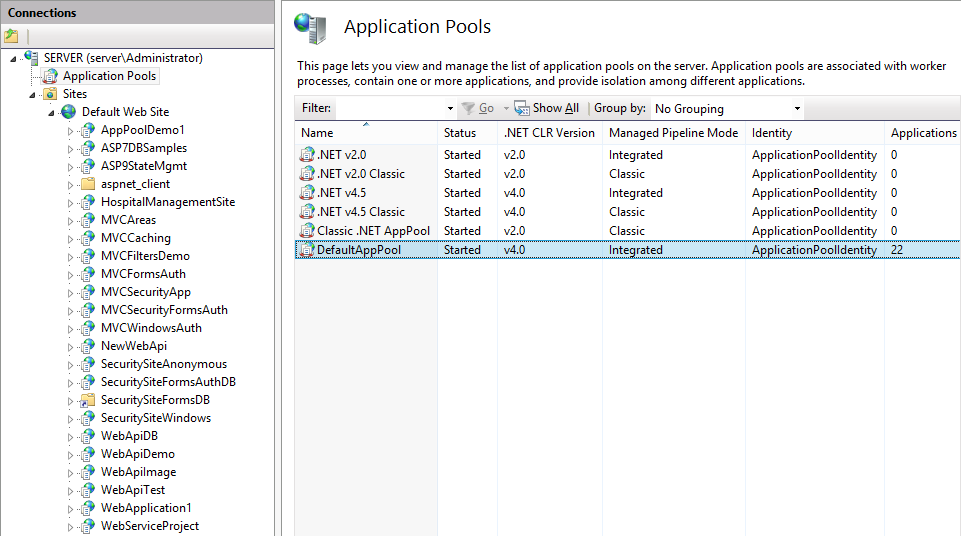
**Ans:** Web Server can store Session values in 3 different locations:

1. In-Proc [d]
2. State Server
3. SQL Server

**In-Proc:** this is the default option used for storing Session values and in this case Session values are stored under the memory of “IIS Worker Process”.

**What is IIS Worker Process?**

**Ans:** Under IIS, Web Application run’s inside of a container known as Application Pool and an Application Pool is a container of Web Applications that will execute under a single or multiple Worker Process. Application Pool is the Heart of a Web Application and by default under IIS all Web Applications runs under the same Application Pool which is created when IIS is installed i.e., “Default App Pool”. To check that open “IIS Manager” and in the LHS under “Connections Panel” we will find “Applications Pools” and “Sites” options, select “Application Pools” which displays “DefaultAppPool” on the RHS.

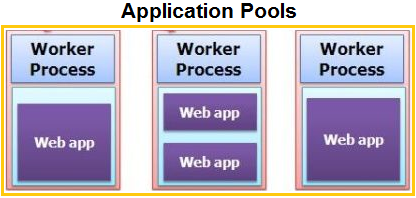


If you notice the above there are 22 applications on the server running under “DefaultAppPool” and it is still possible to run each Web Application under a separate Application Pool which enables us to isolate our Web Application for better Security, Reliability and Availability; therefore, problems in one application pool do not affect Web Sites or Applications in other Application Pools.

**Note:** whenever a new Site is created under IIS, it will also create an Application Pool under which the Site runs, and name of that Application Pool will be the same name of Site.

We can also create our own Application Pools under IIS and to do that right click on Application Pools node under Connection Panel and select “Add Application Pool” which opens a window asking for a name, enter name as “MyPool” and click “Ok”. Currently the new Application Pool i.e., “MyPool” doesn't have any applications running under it and if we want our application to run under “MyPool”, then right click on our application under “Default Web Site” and choose Manage Applications => Advanced Settings, which opens a window and in that select “Application Pool” and Click on the button beside it which opens another window listing all the Pools that are available in a DropDownList, select “MyPool” and Click Ok and Ok again.

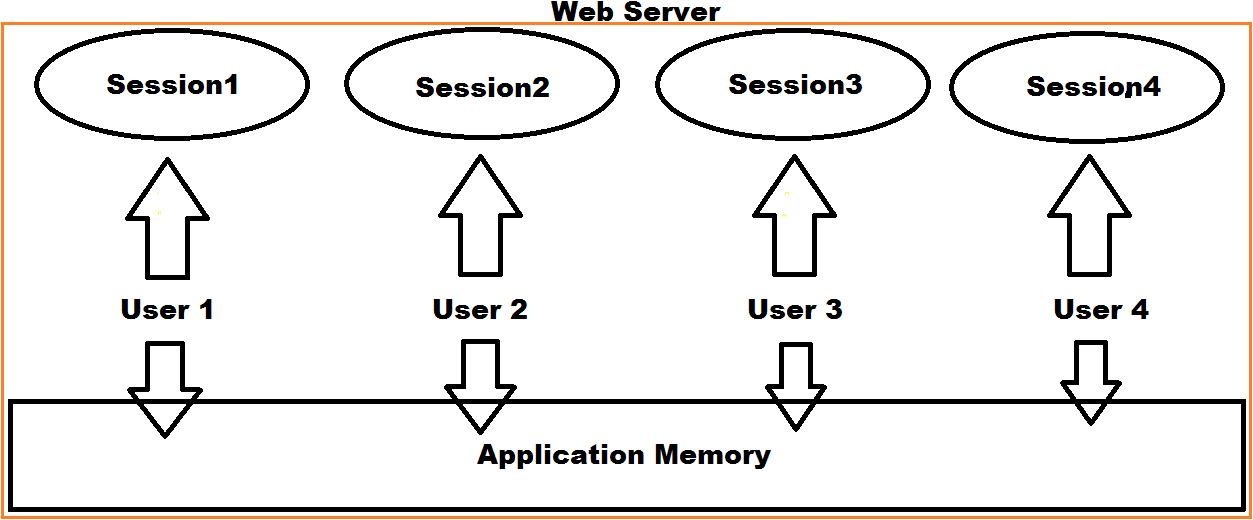
The IIS Worker Process is a Windows Process (w3wp.exe) which runs Web applications and is responsible for handling requests sent to a Web Server for a specific Application Pool. Each application pool creates at least one instance of w3wp.exe and that is what processes requests in your application, responsible for processing Asp.net application request and sending back response to the client. All ASP.NET functionalities run within the scope of this Worker Process.



We can view the “IIS Worker Process” that is associated with each Application Pool under “Task Manager” which displays a separate “IIS Worker Process” for each Application Pool. To get the exact details go to “Details Section” in the Task Manager and there we find “w3wp.exe” and beside that it will display the Application Pool to which the Worker Process is associated.

**Note:** in In-Proc session mode Session Values are stored under the Memory that is associated with IIS Worker Process, who runs our Web Application. So, in this case if we recycle the IIS Worker Process all the Session Values that are stored under this will be destroyed and to test this, open “Task Manager” identify the “IIS Worker Process” under which our Web Application is running, select it and click on “End Task” button which will destroy all the session values associated with that application.

**Application:** this is a global storage mechanism that is used to store data on the server which is shared between all users i.e., data stored in Application is accessible to all users and anywhere in the application (Multi-User Global Data). Application-State is stored in the memory of the Web Server and is faster than storing and retrieving information from a Database. Application is used in the same way as Session, but Session is specific for a single user, whereas Application is common for all users of the application.



Application does not have any default expiration period like Session, so when we recycle the Worker Process or restart the Web Server only the data in application will be lost. Data is stored into Application in the form of name/value pairs only like we store in Session, ViewData or TempData. We store data into Application by using “Application” property of “HttpContext” class that is defined in “System.Web”.

**Note:** Application Memory is not Thread-Safe, so to overcome the problem whenever we are dealing with Application-State data we need to call Lock() and UnLock() methods on Application object.

**Storing values into Application:**

**Syntax:** System.Web.HttpContext.Current.Application[string key] = value (object)

**Example:** System.Web.HttpContext.Current.Application["Name"] = "Raju";

**Accessing values from Application:**

**Syntax:** object value = System.Web.HttpContext.Current.Application[string key]

**Example:** object value = System.Web.HttpContext.Current.Application["Name"];

string Name = value.ToString();

Or

string Name = System.Web.HttpContext.Current.Application["Name"].ToString();

public ViewResult Index11(int? Id, string Name, double? Price)

{

System.Web.HttpContext.Current.Application.Lock();

System.Web.HttpContext.Current.Application["Id"] = Id;

System.Web.HttpContext.Current.Application["Name"] = Name;

System.Web.HttpContext.Current.Application["Price"] = Price;

System.Web.HttpContext.Current.Application.UnLock();

return View();

}

public ViewResult Index12()

{

return View();

}

**Now add a View to “Index11” Action method and write the below code under its “<div>” tag:**

<table border="1" align="center" width="20%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@HttpContext.Current.Application["Id"]</td></tr>

<tr><td>Name:</td><td>@HttpContext.Current.Application["Name"]</td></tr>

<tr>

<td>Price:</td>

<td>

@{

double Price = Convert.ToDouble(HttpContext.Current.Application["Price"]);

Price = Price + Price \* 10 / 100;

@Price

}

</td>

</tr>

</table>

<center>Click to launch new <a href="/Home/Index12">Page</a>.</center>

**Execute Index11 Action Method of Home Controller as following:**

http://localhost:port/Home/Index11/105/Shoes/3500

In the above case when we call Index11 action method, will launch the associated View and displays the values that are stored in the Application Memory and when we click on the Link in the bottom will call Index12 action method of the same controller which will also display the values that stored in Application Memory and to test that add a View for Index12 action method and write the below code in it under the “<div>” tag:

<table border="1" align="center" width="20%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@HttpContext.Current.Application["Id"]</td></tr>

<tr><td>Name:</td><td>@HttpContext.Current.Application["Name"]</td></tr>

<tr>

<td>Price:</td>

<td>

@{

double Price = Convert.ToDouble(HttpContext.Current.Application["Price"]);

Price = Price + Price \* 10 / 100;

@Price

}

</td>

</tr>

</table>

<center>Click to launch new <a href="/Test/Index4">Page</a>.</center>

When we click on the Link in above View will launch Index4 action method of TestController and here also it displays the values that are stored in Cookie and to test it add a new action method in TestController class as below:

public ViewResult Index4()

{

return View();

}

**Add a View to the above Index4 action method and write the below code under it’s “<div>” tag:**

<table border="1" align="center" width="20%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@HttpContext.Current.Application["Id"]</td></tr>

<tr><td>Name:</td><td>@HttpContext.Current.Application["Name"]</td></tr>

<tr>

<td>Price:</td>

<td>

@{

double Price = Convert.ToDouble(HttpContext.Current.Application["Price"]);

Price = Price + Price \* 10 / 100;

@Price

}

</td>

</tr>

</table>

**Flow of control:** Request sent to => “Index11” Action method of “HomeController” => When the hyper link is clicked on page, it is redirect to => “Index12” Action method of “HomeController” => When the hyper link is clicked on page, it is redirect to => “Index4” Action method of “TestController”

**Anonymous Types:** This is another mechanism using which we can transfer values from Action method to View or Action method to Action method within the same Controller or another Controller also, without using ViewData, ViewBag, TempData and Session. An anonymous type is a type (class) without a name that contains a set of read only properties, for which we can directly create the instance by using “new” keyword.

**For example if we define a class as below:**

public class Employee

{

public int Id { get; set; }

public string Name { get; set; }

public string Job { get; set; }

public double Salary { get; set; }

public bool Status { get; set; }

}

**We can create instance of the above class as following:**

Employee Emp = new Employee { Id = 1001, Name = "Raju", Job = "Manager", Salary = 50000.00, Status = true };

In the above case we are creating the instance of “Employee” class which is defined first and then initializing the attributes (Id, Name, Job, Salary and Status) that are associated with it, so now the instance “Emp” contains all attribute values in it. Without explicitly defining a class/type also, we can create an instance for a type and initialize it as following:

var Emp = new { Id = 1001, Name = "Raju", Job = "Manager", Salary = 50000.00, Status = true };

In the above case also instance “Emp” is an instance containing all the attribute values in it same as in the first scenario, but the difference is in the first case we defined the class first and then created the instance whereas in the second case we created the instance without defining the type and we call this “Anonymous Type”.

Anonymous type (introduced in C# 3.0), as the name suggests, is a type that doesn’t have any name. C# allows you to create an instance with the new keyword without defining a class. The implicitly typed variable - “var” or “dynamic” is used to hold the reference of anonymous types. In the above example, “Emp” is an instance of the anonymous type which is created by using the new keyword and object initializer syntax. It includes 5 properties of different data types. An anonymous type is a temporary type that is inferred based on the data that you include in an object initializer. Properties of anonymous types will be read-only properties so you cannot change their values.

Notice that the compiler applies the appropriate type to each property based on the value assigned. For example, Id is of integer type, Name and Job are of string type, Salary is of double type and Status is of boolean type. Internally, the compiler automatically generates the new type for anonymous types. You can check that by calling GetType() method on an anonymous type of instance which will return the following value:

**<>f\_\_AnonymousType0`5[System.Int32,System.String,System.String,System.Double,System.Boolean]**

By using these anonymous types also, we can transfer values from an Action method to its corresponding View or an Action method to another Action method that is present in the same Controller or other Controller.

**Define a new Action method in Home Controller as below:**

public ViewResult Index13(int? Id, string Name, double? Price)

{

var Product = new { Id = Id, Name = Name, Price = Price };

return View(Product);

}

**Add a View to the above Action method and write the below code under its “<div>” tag:**

@{

int? Id = Convert.ToInt32(ViewData.Eval("Id"));

string Name = ViewData.Eval("Name").ToString();

double? Price = ViewData.Eval("Price") as double?;

}

<table border="1" align="center" width="15%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@Id</td></tr>

<tr><td>Name:</td><td>@Name</td></tr>

<tr>

<td>Price:</td>

<td>

@{

Price = Price + (Price \* 10 / 100);

@Price

}

</td>

</tr>

</table>

In the above case while accessing values from an anonymous type in the View, we need to first capture those values from ViewData i.e., even if we did not explicitly store the values in ViewData, they are implicitly stored into ViewData and accessible under the View.

While accessing the values from ViewData we require calling “Eval” method on ViewData, because the values are stored in the form of an “instance or object (Complex type)” and under that instance or object we have all the 3 values which should be separated first and then consumed.

**Execute Index13 Action Method of Home Controller as following:**

http://localhost:port/Home/Index13/105/Shoes/3500

**Now define another new Action method in Home Controller as below:**

public RedirectToRouteResult Index14(int? id, string name, double? price)

{

var product = new { Id = id, Name = name, Price = price };

return RedirectToAction("Index5", "Test", product);

}

**Define a new Action method in “TestController” as below:**

public ViewResult Index5(int? id, string name, double? price)

{

var product = new { Id = id, Name = name, Price = price };

return View(product);

}

**Add a View to Index5 Action method and write the below code in its “<div>” tag:**

@{

int? Id = Convert.ToInt32(ViewData.Eval("Id"));

string Name = ViewData.Eval("Name").ToString();

double? Price = ViewData.Eval("Price") as double?;

}

<table border="1" align="center" width="15%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@Id</td></tr>

<tr><td>Name:</td><td>@Name</td></tr>

<tr>

<td>Price:</td>

<td>

@{

Price = Price + (Price \* 10 / 100);

@Price

}

</td>

</tr>

</table>

**Execute Index14 Action Method of Home Controller as following:**

http://localhost:port/Home/Index14/105/Shoes/3500

**Flow of control:** Request sent to => Index14 action method of HomeController => Redirected to => Index5 action method of TestController.

**Model Object:** this is another way how we can transfer data from Controller to the View, which provides “type safety” and “intellisense” in Views, so by using this also we can transfer values from Action method to corresponding View or Action method to Action method of same Controller or other Controller. To test this, first add a class in the project under “Models” folder naming the class as “Product” and write the below code in it:

public class Product

{

public int? Id { get; set; }

public string Name { get; set; }

public double? Price { get; set; }

}

Now import the namespace “MVCDataTransfer.Models” In “HomeController” class and define a new action method as below:

public ViewResult Index15(int? id, string name, double? price)

{

Product product = new Product { Id = id, Name = name, Price = price };

return View(product);

}

**In the above action method, we can write code in any of these ways:**

Product product = new Product { Id = id, Name = name, Price = price };

return View(product);

Or

var product = new Product { Id = id, Name = name, Price = price };

return View(product);

Or

dynamic product = new Product { Id = id, Name = name, Price = price };

return View(product);

Or

return View(new Product { Id = id, Name = name, Price = price });

**Add a View to “Index15” Action method and write the below code:**

@\*Write the below statement at top of the View \*@

@model MVCDataTransfer.Models.Product

@\*Write this code under the <div> tag:\*@

<table border="1" align="center" width="15%">

<caption>Product Details</caption>

<tr><td>Id:</td><td>@Model.Id</td></tr>

<tr><td>Name:</td><td>@Model.Name</td></tr>

<tr>

<td>Price:</td>

<td>

@{

double? Price = Model.Price + (Model.Price \* 10 / 100);

@Price

}

</td>

</tr>

</table>

**Note:** in this case on top of the View we need to first import the model object by using “@model” directive, so that we can access the member of the Product class by using “@Model” Property.

**Execute “Index15” Action Method as following:**

http://localhost:port/Home/Index15/105/Shoes/3500

In the above “Index15” action method without reading each parameter value individually we can directly read it thru the Model class, by using the class as method parameter.

**To test that let’s now add another Action method in “HomeController” class as following:**

public RedirectToRouteResult Index16(Product product)

{

return RedirectToAction("Index6", "Test", product);

}

**Add a new Action method in “Test Controller” class as following:**

public ViewResult Index6(Product product)

{

return View(product);

}

**Note:** now add a View to Index6 Action method of Test Controller and write code same as we written in Index15 Action method of Home Controller.

**Execute Index16 Action Method as following:**

http://localhost:port/Home/Index16/105/Shoes/3500

**Flow of control:** Request sent to => Index16 action method of HomeController => Redirected to => Index6 action method of TestController.

**State Management:** Web Applications are stateless i.e., we can never access the values of 1 request, in the next request of the same page or other pages also. But sometimes we need the values of 1 request, in the next request to same page or other pages and to overcome this problem and maintain the state of values between multiple requests to the same page or between different pages we are provided with the concept called as State Management. In ASP.NET to maintain the state of values we are provided with various techniques like:

* Query String
* Hidden Field
* TempData
* Cookie
* Session
* Application

**UI Designing**

We design user interfaces in any application for taking input from end users or displaying the results. Designing of a user interface in Web Applications is performed with HTML, which provides with a set of controls. Whereas in ASP.NET MVC we call user interface as View, and we can design them by using any of the below options:

1. Using Html Controls
2. Using Html Helpers
3. Using Strongly Typed Html Helpers

To test these, create a new “ASP.Net Web Application” project naming it as “MVCUIDesigning”, choose “Empty Project Template”, check the “MVC” Checkbox and click on “Create” button to create the project.

**Designing a View (UI) by using HTML Controls:** Add a Controller into the Controllers folder naming it as “EmpController”, delete all the existing code in the class and write the below code:

[HttpGet]

public ViewResult AddEmp()

{

return View();

}

[HttpPost]

public ViewResult AddEmp(int? id, string name, string job, double? salary)

{

ViewData["Id"] = id;

ViewData["Name"] = name;

ViewData["Job"] = job;

ViewData["Salary"] = salary;

return View("DisplayEmp1");

}

**Add a view to “AddEmp” action method and write the below code in its “<div>” tag:**

<form id="f1" method="post">

Enter Employee Id: <br />

<input type="text" name="Id" id="Id" /> <br />

Enter Employee Name: <br />

<input type="text" name="Name" id="Name" /> <br />

Enter Employee Job: <br />

<input type="text" name="Job" id="Job" /> <br />

Enter Employee Salary: <br />

<input type="text" name="Salary" id="Salary" /> <br /><br />

<input type="submit" value="Save" />

<input type="reset" value="Reset" />

</form>

**Flow of Control** => Call AddEmp => Get Action method of EmpController which will launch AddEmp => View => on click of “Save” button it will invoke AddEmp => Post Action method and launches DisplayEmp1 => View.

Add another view in “Emp” folder of “Views” folder with the name “DisplayEmp1” and write the below code in its “<div>” tag:

<table border="1" align="center">

<caption>Employee Details</caption>

<tr><td>Employee Id:</td><td>@ViewBag.Id</td></tr>

<tr><td>Employee Name:</td><td>@ViewBag.Name</td></tr>

<tr><td>Employee Job:</td><td>@ViewBag.Job</td></tr>

<tr><td>Employee Salary:</td><td>@ViewBag.Salary</td></tr>

<tr>

<td colspan="2" align="center"><a href="/Emp/AddEmp">Add a new Employee</a></td>

</tr>

</table>

**Execute “AddEmp” Action method of “EmpController” as following:**

http://localhost:port/Emp/AddEmp

**Note:** in this example, Action method “Parameter Names” are exactly matching with “Control Names” of the View, so that values entered in the Controls will directly come into those Parameters. But the drawback in this approach is when there are multiple Controls on the View, there should also be multiple Parameters defined to the action method to read all those Control Values, so the Parameter List will be lengthy and code gets complex, to overcome this problem of reading each Control Value thru an individual Parameter we can use “Form Collection” class as action method parameter, and read values of each Control present on the form.

**To test this, rewrite the “AddEmp” Post Action method as below:**

[HttpPost]

public ViewResult AddEmp(FormCollection fc)

{

ViewData["Id"] = fc["id"];

ViewData["Name"] = fc["name"];

ViewData["Job"] = fc["job"];

ViewData["Salary"] = fc["salary"];

return View("DisplayEmp1");

}

**Execute “AddEmp” Action method of “EmpController” as following:**

https://localhost:port/Emp/AddEmp

**Note:** without reading each controls value thru “FormCollection” we can use “Model Binding” and capture all the values at a time in the View and pass them to another View for displaying which provides type safety and intellisense support.

**To test this, add a new class under the Models folder with the name “Employee” and write the below code in it:**

public class Employee

{

public int? Id { get; set; }

public string Name { get; set; }

public string Job { get; set; }

public double? Salary { get; set; }

}

Now go to “EmpController” class and rewrite the “AddEmp – Post Action” method as following by importing “MVCUIDesigning.Models” namespace.

[HttpPost]

public ViewResult AddEmp(Employee Emp)

{

return View("DisplayEmp2", Emp);

}

**Add another view with the name “DisplayEmp2” and write the below code in it:**

@\*Write the below statement at top of the View \*@

@model MVCUIDesigning.Models.Employee

@\*Write this code under the <div> tag:\*@

<table border="1" align="center">

<caption>Employee Details</caption>

<tr><td>Employee Id:</td><td>@Model.Id</td></tr>

<tr><td>Employee Name:</td><td>@Model.Name</td></tr>

<tr><td>Employee Job:</td><td>@Model.Job</td></tr>

<tr><td>Employee Salary:</td><td>@Model.Salary</td></tr>

<tr><td colspan="2" align="center"><a href="/Emp/AddEmp">Add a new Employee</a></td></tr>

</table>

**Run “AddEmp” Action method of “EmpController” with the following URL:**

https://localhost:port/Emp/AddEmp

**Flow of Control** => Call AddEmp => Get Action method of EmpController which will launch AddEmp => View => on click of “Save” button it will invoke AddEmp => Post Action method and launches DisplayEmp2 => View.

**Designing a View (UI) by using HTML Helpers:** we are all aware that in Web Applications we design User Interfaces with the help of HTML Controls and to simplify UI designing process, MVC provides us “HTML Helper Methods” and these methods will generate or render required “HTML Code” i.e., the return type of these methods is a string and that produces required HTML. These helper methods are equivalent to “ASP.NET Server Controls” that we used in “ASP.NET Web Forms”.

**Working with Html Helper Methods:**

**Syntax:** @Html.TextBox(string name) => string (Return Type)

**Example:** @Html.TextBox("Id") => <input type="text" id="Id" name="Id" />

In the above case “@Html” is an instance of the class “System.Web.Mvc.HtmlHelper” and this class will generate the required HTML and returns it in the form of a string when we call methods of the class, and these methods are called as “HTML Helper Methods” and all of them are “Extension Methods”.

**Methods of the “HtmlHelper” class:**

* BeginForm
* EndForm
* ActionLink
* CheckBox
* DropDownList
* Hidden
* ListBox
* Password
* RadioButton
* Label
* TextBox
* TextArea
* Display
* Editor

**Creating a “Form” using Html Helper Methods:**

BeginForm()

BeginForm(string actionname, string controllername)

BeginForm(string actionname, string controllername, object routevalues)

BeginForm(string actionname, string controllername, FormMethod method)

BeginForm(string actionname, string controllername, object routevalues, FormMethod method)

@{

Html.BeginForm();

-Place all controls here

Html.EndForm();

}

Or

@using(Html.BeginForm())

{

-Place all controls here

}

**Creating a Label:**

@Html.Label(string value)

@Html.Label(string name, string value)

@Html.Label(string name, string value, object HtmlAttributes)

**Creating a TextBox:**

@Html.TextBox(string name)

@Html.TextBox(string name, object default)

@Html.TextBox(string name, object default, object HtmlAttributes)

**Creating a Password:**

@Html.Password(string name)

@Html.Password(string name, string default)

@Html.Password(string name, string default, object HtmlAttributes)

To work with “Html Helpers” add a new Controller under “MVCUIDesigning” project naming it as “AccountController”, delete the existing code in the class and write the below code over there:

public ViewResult Login()

{

return View();

}

public ViewResult Validate()

{

string Name = Request["txtName"];

string Password = Request["txtPwd"];

if (Name == "Admin" && Password == "Admin@123")

{

Session["Name"] = Name;

return View("Success");

}

else

{

ViewBag.Name = Name;

return View("Failure");

}

}

Add 3 Views under “Account” folder which is present under “Views” folder naming them as “Login.cshtml”, “Success.cshtml” and “Failure.cshtml” and write code under them.

**Note:** if we want to use Bootstrap for styling of HTML in Views, we need to install Bootstrap in our projects, and this can be done in 2 different ways i.e., either by using “NuGet Package Manager” or by using “Library Manager”.

**What is NuGet?**

**Ans:** NuGet can be used to find and install packages, i.e., software libraries, assemblies, and any other things that you want to use in your project. NuGet is not a tool that is specific to “ASP.NET MVC” projects. This is a tool that you can use inside of “Visual Studio” for “Console Applications”, “Windows Applications”, “WPF Applications” and any other type of Application. NuGet is a Package Manager, and is responsible for downloading, installing, updating, and configuring software in your project. From the term software we don’t mean end users software like Microsoft Word or Notepad, etc. but any pieces of software, which you want to use in our project i.e., “Assembly” references.

**NuGet Package Manager:** this is an option which provides an interface to search for the libraries that can be used in our project, which also helps in installing those libraries in our projects and consume. To use this, go to Tools Menu => Select the Menu Item, “NuGet Package Manager” and under that select the Sub Menu Item, “Manage NuGet Packages for Solution” and this will launch a new window, choose “Browse” option on the top and search for “Bootstrap”, which displays various “Bootstrap” libraries that are available, select “bootstrap”, “by The Bootstrap Authors, Twitter Inc.,” and then in the RHS select the “Checkbox” that displays our “Project Name” and then the “Install” button is enabled, click on it, which will install the required “Bootstrap” files into our application by creating a new folder under the project with the name “Content”.

**Library Manager:** this option was newly added from “Visual Studio 2017” for managing all the client-side libraries and to use this open Solution Explorer, right-click on the Project and choose Add => “Client-Side Library” which will launch “Add Client-Side Library” dialog and in that fill the below details:

* Provider: cdnjs (default)
* Library: twitter-bootstrap@5.1.0
* Select Include all library files radio button.
* Target Location: Content/Bootstrap

Click “Install” button and this will install “Bootstrap” in our project under the specified folder, and this action will add a file in the project with a name “libman.json” and under this file the details of all the libraries installed will be present as following:

{

"version": "1.0",

"defaultProvider": "cdnjs",

"libraries": [

{

"library": "twitter-bootstrap@5.2.0",

"destination": "Content/Bootstrap"

}

]

}

**Note:** same as the above we can also install any other libraries like jQuery, Ajax, etc. into our projects by using the above 2 tools.

To use bootstrap in “Login.cshtml”, drag and drop “bootstrap.min.css” file from “Content” folder in to the “<head>” section and then write the below code under the “<div>” tag:

@using (Html.BeginForm("Validate", "Account"))

{

@Html.Label("User Name:", new { @class = "text-info" });<br />

@Html.TextBox("txtName", "", new { placeholder = "Enter Name" });<br /><br />

@Html.Label("Password:", new { @class = "text-info" });<br />

@Html.Password("txtPwd", "", new { placeholder = "Enter Password" });<br /><br />

<input type="submit" value="Login" class="btn btn-success" />

<input type="reset" value="Reset" class="btn btn-success" />

}

**Success.cshtml:** write the below code under its “<div>” tag.

<h4>Hello @Session["User"], welcome to the site.</h4>

**Failure.cshtml:** write the below code under its “<div>” tag.

<h4>Hello @ViewData["User"], your given credentials are invalid.</h4>

**Execute Login Action method of “HomeController” using the below URL:**

https://localhost:port/Account/Login

This will launch “Login.cshtml” View to enter user credentials and when we fill the credentials and click on “Login” button it will launch “Success.cshtml” View if the credentials are valid or else “Failure.cshtml” View if the credentials are invalid.

**Designing Views using “Html Helpers” and reading Form values using Models:**

**Step 1:** Add a new class in Models folder of “MVCUIDesigning” project, naming it as “Student” and write the below code in it:

public class Student

{

public int Sid { get; set; }

public string Name { get; set; }

public int Class { get; set; }

public string Gender { get; set; }

public double Fees { get; set; }

public string Address { get; set; }

}

**Step 2:** Add a new Controller in the Controllers folder naming it as “StudentController”, delete all the existing content of the class and write the below code over there by importing “MVCUIDesigning.Models” namespace for working with “Student” class:

[HttpGet]

public ViewResult AddStudent()

{

return View();

}

[HttpPost]

public ViewResult AddStudent(Student student)

{

return View("DisplayStudent", student);

}

**Step 3:** Add a View for “AddStudent” action method and write the below code in it:

@\*Write the below statement at top of the View \*@

@model MVCUIDesigning.Models.Student

@\*Write this code under the <div> tag:\*@

@using (Html.BeginForm())

{

@Html.Label("Student Id: "); <br />

@Html.TextBox("Sid"); <br />

@Html.Label("Name: "); <br />

@Html.TextBox("Name"); <br />

@Html.Label("Class: ");

List<int> li = new List<int>() { 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 };

SelectList items = new SelectList(li);

@Html.DropDownList("Class", items, "-Select Class-"); <br />

@Html.Label("Gender: ");

@Html.RadioButton("Gender", "Male"); @:Male

@Html.RadioButton("Gender", "Female"); @:Female <br />

@Html.Label("Fees: "); <br />

@Html.TextBox("Fees"); <br />

@Html.Label("Address: "); <br />

@Html.TextArea("Address", "", 3, 21, new { });

<br /><br />

<input type="submit" value="Save" />

<input type="reset" value="Reset" />

}

**Step 4:** Add a new View with the name “DisplayStudent” under “Student” folder of “Views” folder and write the below code in it:

@\*Write the below statement at top of the View \*@

@model MVCUIDesigning.Models.Student

@\*Write this code under the <div> tag:\*@

<h4>Student Details</h4>

<ul>

<li>Student Id: @Model.Sid</li>

<li>Student Name: @Model.Name</li>

<li>Student Class: @Model.Class</li>

<li>Student Gender: @Model.Gender</li>

<li>Student Fees: @Model.Fees</li>

<li>Student Address: @Model.Address</li>

</ul>

**Execute “AddStudent” Action method of “StudentController” using the below URL:**

https://localhost:port/Student/AddStudent

This will launch “AddStudent” view to enter details for a new “Student” and when we fill the Form and click on the “Save” button, will launch “DisplayStudent.cshtml” view to display the details which the user has entered in the Form.

**Strongly Typed Html Helpers:** In the above program when we are reading the form values by using Model Object in “Post” action method we have a problem, i.e., Control Name should exactly be same as the Property Name of Model class. For example, if the Property Name is “Sid” in Model Class then Control Name also should be “Sid” only and if we give this as wrong, we don’t get any compile time or run-time errors, but that controls value will not be read into the Model’s Property. To overcome this problem, in “MVC 2.0” we are provided with “Strongly Typed Html Helper” and these Helpers purely depends on Model Classes, so while designing the UI’s we don’t require to give any name to Control’s. Strongly Typed Html Helpers are also same as Html Helpers we have used till now, but the only difference is, here every Helper method is suffixed with “For”, for example:

| **Html Helpers** | **Strongly Typed Html Helpers** |
| --- | --- |
| Label | LabelFor |
| Hidden | HiddenFor |
| ListBox | ListBoxFor |
| TextBox | TextBoxFor |
| TextArea | TextAreaFor |
| Password | PasswordFor |
| CheckBox | CheckBoxFor |
| RadioButton | RadioButtonFor |
| DropDownList | DropDownListFor |
| Editor | EditorFor |
| Display | DisplayFor |
| DisplayName | DisplayNameFor |

**To work with Strongly Typed Html Helpers add 2 new action methods in the “StudentController” as following:**

[HttpGet]

public ViewResult AddStudentST()

{

return View(new Student());

}

[HttpPost]

public ViewResult AddStudentST(Student student)

{

return View("DisplayStudentST", student);

}

**Add a View to “AddStudentST” Action method and write the below code in its “<div>” tag:**

@\*Write the below statement at top of the View \*@

@model MVCUIDesigning.Models.Student

@\*Write this code under the <div> tag:\*@

@using (Html.BeginForm())

{

@Html.LabelFor(S => S.Sid); <br />

@Html.TextBoxFor(S => S.Sid); <br />

@Html.LabelFor(S => S.Name); <br />

@Html.TextBoxFor(S => S.Name); <br />

@Html.LabelFor(S => S.Class);

List<int> li = new List<int>() { 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 };

SelectList items = new SelectList(li);

@Html.DropDownListFor(S => S.Class, items, "-Select Class-"); <br />

@Html.LabelFor(S => S.Gender);

@Html.RadioButtonFor(S => S.Gender, "Male")@:Male

@Html.RadioButtonFor(S => S.Gender, "Female")@:Female <br />

@Html.LabelFor(S => S.Fees); <br />

@Html.TextBoxFor(S => S.Fees); <br />

@Html.LabelFor(S => S.Address); <br />

@Html.TextAreaFor(S => S.Address, 3, 21, new { });

<br /><br />

<input type="submit" value="Save" />

<input type="reset" value="Reset" />

}

Add a new View with the name “DisplayStudentST” under “Student” folder of “Views” folder and write the below code in it:

@\*Write the below statement at top of the View \*@

@model MVCUIDesigning.Models.Student

@\*Write this code under the <div> tag:\*@

<h4>Student Details</h4>

<ul>

<li>@Html.DisplayNameFor(S => S.Sid): @Html.DisplayFor(S => S.Sid)</li>

<li>@Html.DisplayNameFor(S => S.Name): @Html.DisplayFor(S => S.Name)</li>

<li>@Html.DisplayNameFor(S => S.Class): @Html.DisplayFor(S => S.Class)</li>

<li>@Html.DisplayNameFor(S => S.Gender): @Html.DisplayFor(S => S.Gender)</li>

<li>@Html.DisplayNameFor(S => S.Fees): @Html.DisplayFor(S => S.Fees)</li>

<li>@Html.DisplayNameFor(S => S.Address): @Html.DisplayFor(S => S.Address)</li>

</ul>

**Execute “AddStudentST” Action method of “StudentController” using the below URL:**

https://localhost:port/Student/AddStudentST

This will launch “AddStudentST” view to enter details for a new “Student” when we fill the Form and click on “Save” button will launch “DisplayStudentST.cshtml” view to display the details which the user has entered in the Form.

**Note:** DisplayNameFor method will get the Property-Name over there and DisplayFor method will get the Property-Value over there.

**Partial Views**

Just like we have “User Controls” in ASP.NET Web Forms we have “Partial Views” in ASP.NET MVC. A Partial View is also a View, but this can be used in other Views, i.e., they provide re-usability.

Creating a Partial View is also just like creating a normal View and the extension of the Partial View also will be “.cshtml” only, but in a Partial View we don’t have any HTML tag’s like “<head>” and “<body>” by default. Partial Views are generally stored in the “Shared” folder of “Views” folder because they are consumed by multiple Views in the application, and it is suggested (optional) to prefix Partial View names with “underscore (\_)” to differentiate them from other Views.

To work with Partial Views in our existing project i.e., “MVCUIDesigning” add a new folder with the name “Shared” in the “Views” folder and add another folder under the project with the name “Images”, copy an image into that folder and rename it as “Header”.

Now right click on the Shared folder select “Add” => “View”, name it as “\_Header” and check the “Create as a Partial View” Checkbox which will disable all the other Checkbox’s on the window, and then Click on “Add” button. This action will create a blank “.cshtml” file, write the below code in it:

<div style="color:darksalmon;text-align:center;height:150px;background-color:azure;border-style:dotted;

border-color:slateblue;border-width:thick; box-shadow: 0px 0px 50px inset">

<img id="imgNaresh" alt="www.nareshit.com" src="~/Images/Header.png" width="96%" height="80%" />

<marquee style="font-size:x-large;color:crimson;" behavior="alternate">

.NET, Java, Python, Hadoop, Data Science, DevOps, etc.

</marquee>

</div>

**Consuming a Partial View:** after creating the Partial View, we can consume it in any of our Views by calling the below 3 methods of “HtmlHelper” class:

* @Html.Partial(string PartialViewName) => MvcHtmlString
* @ { Html.RenderPartial(string PartialViewName); } => void
* @ { Html.RenderAction(string ActionMethodName); } => void

The first option of calling the method “Partial” returns an “MVCHtmlString” and we can call this method in any of our View Pages. Because this method returns a string back there is a chance to manipulate the content of the Partial View in the future within our View Pages.

The second option of calling the method “RenderPartial” is also done in our View Pages, and this is a preferred option because its return type is void and there is no chance to manipulate the Partial View i.e., it can be used as is only.

Third option is also non-modifiable but to use this we again need to define a new Action method under any Controller class because in this case we call the Action method in our View Page but not Partial View.

**Html.Partial:** to test this, open “AddStudent.cshtml” View of “StudentController” and write the below code in its “<body>” section just above the “<div>” tag:

@Html.Partial("\_Header")

**Note:** as said above we can manipulate the content of the Partial View in this case and to test that, go to “DisplayStudent.cshtml” view of “StudentController” and write the below code in its “<body>” section just above the “<div>” tag:

@{

String str = Html.Partial("\_Header").ToString();

str = str.Replace("150", "200");

MvcHtmlString htmlString = new MvcHtmlString(str);

@htmlString

}

In the above case the width of “<div>” is increased from 150 pixels to 200 pixels and in the same way we can manipulate anything with-in the Partial View.

**Html.RenderPartial:** to test this, open “AddStudentST.cshtml” View of “StudentController” and write the below code in its “<body>” section just above the “<div>” tag:

@{

Html.RenderPartial("\_Header");

}

**Html.RenderAction:** in this case we can’t directly call the “PartialView”, but what we need to call is an Action method, which will in-turn, call the “PartialView”. To test this, go to “StudentController” and define a new Action method in it as below:

public PartialViewResult Header()

{

return PartialView("\_Header");

}

Now go to “DisplayStudentST.cshtml” view of “StudentController” and write the below code in the “<body>” section just above the “<div>” tag:

@{

Html.RenderAction("Header");

}

**Creating a Partial View that loads data from Model:**

**Step 1:** add a new class in Models folder of the project naming it as Customer and write the below code in it:

public class Customer

{

public int Custid { get; set; }

public string Name { get; set; }

public string Account { get; set; }

public double Balance { get; set; }

public string City { get; set; }

public bool Status { get; set; }

public string Photo { get; set; }

}

**Step 2:** under the Images folder of the project add 6 images corresponding to 6 Customers naming them as “Image1”, “Image2”, “Image3”, “Image4”, “Image5” and “Image6”.

**Step 3:** add a new Controller under the Controllers folder with the name as “CustomerController”, delete existing code in the class and write the below code over there, by importing the namespace “MVCUIDesigning.Models”:

public ViewResult DisplayCustomers()

{

Customer c1 = new Customer { Custid = 1001, Name = "Peter", Account = "Savings", Balance = 50000.00,

City = "Delhi", Status = true, Photo = "/Images/Image1.jpg" };

Customer c2 = new Customer { Custid = 1002, Name = "Kevin", Account = "Current", Balance = 50000.00,

City = "Kolkata", Status = true, Photo = "/Images/Image2.jpg" };

Customer c3 = new Customer { Custid = 1003, Name = "Sandra", Account = "Demat", Balance = 50000.00,

City = "Mumabi", Status = true, Photo = "/Images/Image3.jpg" };

Customer c4 = new Customer { Custid = 1004, Name = "Williams", Account = "Savings", Balance = 50000.00,

City = "Chennai", Status = true, Photo = "/Images/Image4.jpg" };

Customer c5 = new Customer { Custid = 1005, Name = "John", Account = "Demat", Balance = 50000.00,

City = "Bengaluru", Status = true, Photo = "/Images/Image5.jpg" };

Customer c6 = new Customer { Custid = 1006, Name = "Bill", Account = "Current", Balance = 50000.00,

City = "Hyderabad", Status = true, Photo = "/Images/Image6.jpg" };

List<Customer> customers = new List<Customer> { c1, c2, c3, c4, c5, c6 };

return View(customers);

}

In the above case Display action method is creating instance of 6 Customers, adding them into a List and then sending that List to its corresponding View to display. To display each Customer’s data in a table format lets create a Partial View first.

**Step 4:** add a Partial View in the Shared folder of the Views folder naming it as “\_CustomerView”, select the “Create as a Partial View” CheckBox, click Add button and write the below code in it:

@model MVCUIDesigning.Models.Customer

<table border="1" width="350">

<tr>

<td rowspan="6" style="width:200px;height:200px">

<img style="width:100%;height:100%" src="@Url.Content(Model.Photo)" />

</td>

<td>Custid: @Model.Custid</td>

</tr>

<tr><td>Name: @Model.Name</td></tr>

<tr><td>Account: @Model.Account</td></tr>

<tr><td>Balance: @Model.Balance</td></tr>

<tr><td>City: @Model.City</td></tr>

<tr><td>Status: @Html.CheckBoxFor(C => C.Status)</td></tr>

</table>

**Step 5:** add a View to “DisplayCustomers” action method of “CustomerController” and write the below code in it.

@\*Write the below statement at top of the View \*@

@model List<MVCUIDesigning.Models.Customer>

@\*Write this code under the <div> tag:\*@

<h2>Customer Details</h2>

@foreach (MVCUIDesigning.Models.Customer customer in Model) or @foreach (var customer in Model)

{

Html.RenderPartial("\_CustomerView", customer);

}

When we send a request to “DisplayCustomers” action method of “CustomerController”, the method creates a List of Customers and transfers it to “DisplayCustomers.cshtml” View, and this View will in turn call the “Partial View” i.e., “\_CustomerView” for displaying each Customer data in a table format.

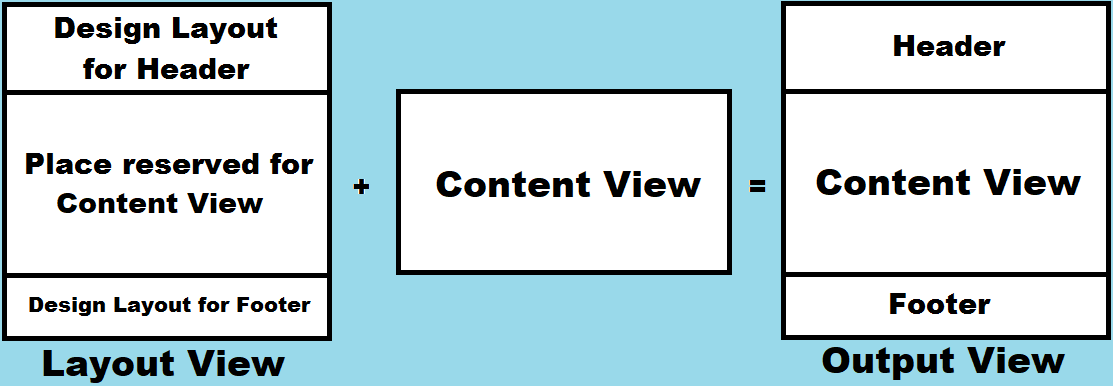
**Layout Views**

These are like “Master Pages” in “ASP.NET Web Forms” and by using these we can design a Layout for the whole application. Generally, every application will have a common Layout like the Header, Footer, Menu Bar, and Navigation Bar etc. So, in such scenario without re-designing them for multiple times in each View Page, we will design it as a Layout View and then use it in the whole Application.

In “ASP.NET Web Forms” the extension of a “Master Page” is “.master” whereas in “ASP.NET MVC” the extension of “Layout View” is also “.cshtml” only.

|  | **ASP.Net Web Forms** | **ASP.NET MVC** |
| --- | --- | --- |
| Page or View | .aspx | .cshtml |
| User Control or Partial View | .ascx | .cshtml |
| Master Page or Layout View | .master | .cshtml |

**Note:** Layout Views are also known as Master Pages and our View Pages are known as Content Pages or Content View so these Content Pages will merge with the Master Page to display the final output.

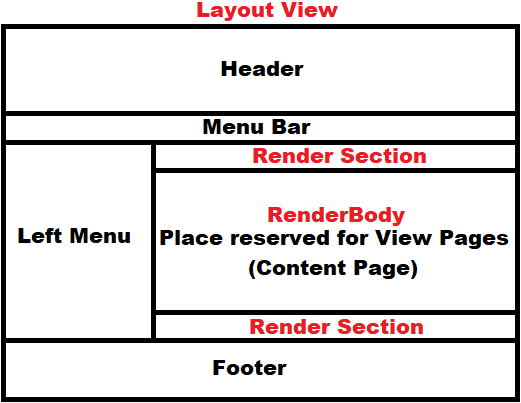


To include a Content View into a particular location of a Layout View we need to call a method i.e., “RenderBody” so that the Content View will come and sit in that location. A Layout View can contain 1 and only 1 “RenderBody” method call.

To include a “piece of text” into any location of a Layout View we need to call the method “RenderSection”, so that “text” can be sent into the Layout View from Content View and sending that “text” is not mandatory i.e., while calling the “RenderSection” method we can specify a name to the section and a “boolean” value to indicate, sending a value to that section is mandatory or optional.

RenderSection(string name, bool required)

**Note:** A Layout View can have any no. of “RenderSection” method calls in it, and in this process for every “RenderSection” we need to give a unique name for identification.



**Designing a Layout View:**

**Step 1:** Create a new “ASP.NET Web Application” project naming it as “MVCLayoutViews” choose “Empty Project Template”, check “MVC” Checkbox and click on the Create button to create the project.

**Step 2:** Install Bootstrap into the project either by using “NuGet Package Manager” or “Library Manager”, which installs all the required files by creating required folders under the project.

**Step 3:** Add a new folder under Views folder naming it as “Shared” because “Partial Views” and “Layout Views” are generally stored in Shared folder only and the name of these 2 Views will be prefixed with “\_ (underscore)” character.

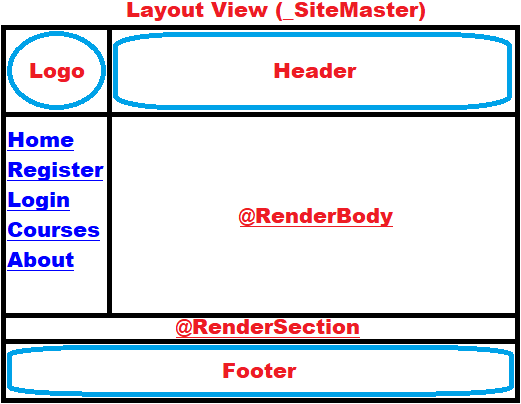
**Step 4:** add a View into the Shared folder naming it as “\_SiteMaster.cshtml”, uncheck the CheckBox “Use a layout page” and click on the Add button. This action will add a new View and if we observe the code in this View, we find a statement on the top of the file as following to specify a Layout for this View:

@{

Layout = null;

}

* Right now, what we are designing is a “Layout View” only and we don’t want to apply another layout to the current View, so delete it.
* Now under the <title> section of the page we find “\_SiteMaster”, delete it and write the following there: “@ViewBag.Title – NIT” so that we can send any value to this “Title” from the “Content View”.
* Now drag and drop “bootstrap.min.css” file from the content folder into the “<head>” section.
* Add a new folder under the Project with the name Images and add 3 Images into that folder: “Header.png”, “Footer.png” and “Logo.jpg”.
* Now let’s design a Layout View as below:



**Write the below code under the “<div>” tag to create the above “Layout View”:**

<table style="width:100%">

<tr>

<td align="center" style="background-color:aquamarine">

<img src="~/Images/Logo.jpg" style="height:100px;width:100px" class="rounded-circle" />

</td>

<td>

<img src="~/Images/Header.png" style="height:100px;width:100%" class="rounded" />

</td>

</tr>

<tr>

<td style="vertical-align:top;background-color:burlywood">

<nav class="navbar-dark bg-primary">

<font size="4">

@Html.ActionLink("Home Page", "Home", "NareshIt", new { @class = "navbar-brand" }) <br />

@Html.ActionLink("Registration Page", "Register", "NareshIt", new { @class = "navbar-brand" }) <br />

@Html.ActionLink("Login Page", "Login", "NareshIt", new { @class = "navbar-brand" }) <br />

@Html.ActionLink("Courses Offered", "Courses", "NareshIt", new { @class = "navbar-brand" }) <br />

@Html.ActionLink("About Us", "About", "NareshIt", new { @class = "navbar-brand" }) <br />

</font>

</nav>

</td>

<td>

@RenderBody()

</td>

</tr>

<tr>

<td colspan="2" style="background-color:coral;text-align:center">

@RenderSection("S1", false)

</td>

</tr>

<tr>

<td colspan="2" style="width:100%">

<img src="~/Images/Footer.png" style="width:100%;height:50px" class="rounded" />

</td>

</tr>

</table>

**How is a Layout applied to a View (Content View)?**

**Ans:** if we want to apply any Layout to a View, we can do that in 2 different ways.

**1. Page Level Binding:** we can do this by writing the below code on the top of View Pages:

@{

Layout = "~/Views/Shared/\_SiteMaster.cshtml";

}

**Note:** while adding a new View we can select the “Layout View” for the View by selecting the CheckBox, with the caption “Use a layout page” and when we select the CheckBox, a TextBox and Button with the caption “…” will enable, and by clicking on that Button we can select our “Layout View” so that it will write the above code automatically. The drawback in this approach is we need to use this statement on every “View Page” where we want to apply the Layout.

**2. Application-Level Binding:** we do this by writing code in “\_ViewStart.cshtml” file because this View will execute before execution of any other View and this is called implicitly by MVC Framework. This file should be in the root folder of “Views” i.e., directly under the “Views” folder. Let’s add this file in the Views folder and to do that right click on Views folder and select the option => Add => View, name the View as “\_ViewStart.cshtml”, choose “Empty (Without model)” template and make sure all the Checkboxes are un-checked and click on the Add Button. Delete all the content present in the file and write the below code over there:

@{

Layout = "~/Views/Shared/\_SiteMaster.cshtml";

}

**Note:** if the “\_ViewStart.cshtml” file is not added by us and when adding a new View if we check the CheckBox “Use a layout page”, but did not select any “Layout View” then “MVC Scaffolding” will add a “Layout View” in to the project with the name “\_Layout.cshtml” and also it adds “\_ViewStart.cshtml” file under the Views folder with the below code in it:

@{

Layout = "~/Views/Shared/\_Layout.cshtml";

}

Whereas when we add “\_ViewStart.cshtml” explicitly and specified the layout as “\_SiteMaster.cshtml”, then when adding a new View if we check the CheckBox “Use a layout page” but did not select a “Layout View” then automatically the Layout we specified in “\_ViewStart.cshtml” will be applied i.e., “\_SiteMaster.cshtml”.

**Note:** if the “\_ViewStart.cshtml” file is present under the Views folder, then all the Views will apply this layout whereas if it is present under the Views folder corresponding to a Controller then it applies only to the Views in that folder and if we have file present in both the places then first preference goes to local.

**Step 5:** Add a new Controller in Controllers folder naming it as “NareshITController”, delete the existing Action method in it and write the below code over there:

public ViewResult Home()

{

return View();

}

public ViewResult Register()

{

return View();

}

public ViewResult Login()

{

return View();

}

public ViewResult Courses()

{

return View();

}

public ViewResult About()

{

return View();

}

**Step 6:** Add Views to all the Action methods and while adding them check the CheckBox “Use a layout page”.

**Note:** as said above, when we perform application level binding of a “Layout View” by entering the details of the “Layout View” under “\_ViewStart.cshtml” file then while adding a View if we select the CheckBox “Use a layout page” then it will automatically make use of the “Layout View” that is specified in “\_ViewStart.cshtml”, whereas if we have multiple “Layout Views”, we need to click on “…” Button and select the “Layout View” explicitly which will then perform Page Level Binding.

**Code under “Home.cshtml” file:**

@{

ViewBag.Title = "Home Page";

}

<p style="text-align: justify; color: palevioletred; font-family: Arial; text-indent: 50px">We have set the pace with online learning. Learn what you want, when you want, and practice with the instructor-led training sessions, on-demand video tutorials which you can watch and listen.</p>

<ol style="color:blueviolet; background-color: darkseagreen">

<li>150+ Online Courses</li>

<li>UNLIMITED ACCESS</li>

<li>EXPERT TRAINERS</li>

<li>ON-THE-GO-LEARNING</li>

<li>PASSIONATE TEAM</li>

<li>TRAINING INSTITUTE OF CHOICE</li>

</ol>

<p style="text-align: justify; color: palevioletred; font-family: Arial; text-indent: 50px">Naresh I Technologies is renowned around the world for classroom training where every aspirant is encouraged to attend technical sessions discussing every facet of the subject with excruciating detail on varied technologies. Every aspirant in the training program will be provided with the hands-on experience through a number of Lab assignments and case studies there by making them more employable.</p>

@section S1 {

<font size="3" color="blue">Excellence in IT Training since 2003.</font>

}

**Code under “Register.cshtml” file:**

@{

ViewBag.Title = "Registration Page";

}

<h3 style="text-align:center;text-decoration:underline">Registration Page</h3>

<table align="center" class="table-bordered">

<tr><td>Name:</td><td><input type="text" id="txtName" /></td></tr>

<tr><td>User Id:</td><td><input type="text" id="txtUid" /></td></tr>

<tr><td>Password:</td><td><input type="password" id="txtPwd" /></td></tr>

<tr><td>Confirm Password:</td><td><input type="password" id="txtCPwd" /></td></tr>

<tr><td>Mobile:</td><td><input type="tel" id="txtMobile" /></td></tr>

<tr><td>Email Id:</td><td><input type="email" id="txtEmail" /></td></tr>

<tr>

<td colspan="2" align="center">

<input type="submit" id="btnRegister" value="Register" />

<input type="reset" id="btnReset" value="Reset" />

</td>

</tr>

</table>

@section S1 {

<font size="3" color="blue">Join us for best IT Training.</font>

}

**Code under “Login.cshtml” file:**

@{

ViewBag.Title = "Login Page";

}

<h3 style="text-align:center;text-decoration:underline">Login Page</h3>

<table class="table-bordered" align="center">

<tr><td>User Id:</td><td><input type="text" id="txtUid" /></td></tr>

<tr><td>Password:</td><td><input type="password" id="txtPwd" /></td></tr>

<tr>

<td colspan="2" align="center">

<input type="submit" id="btnLogin" value="Login" />

<input type="reset" id="btnReset" value="Reset" />

</td>

</tr>

</table>

@section S1 {

<font size="3" color="blue">Trained over 10,00,000 IT Professionals.</font>

}

**Code under “Courses.cshtml” file:**

@{

ViewBag.Title = "Courses Page";

}

<h2>Courses Offered:</h2>

<ul type="square">

<li>.NET</li>

<li>Java</li>

<li>Python</li>

<li>Hadoop</li>

<li>DevOps</li>

<li>Selenium</li>

<li>Cloud Technologies</li>

<li>Data Science</li>

<li>Automation</li>

<li>Software Testing</li>

<li>Mobile Technologies</li>

<li>Digital Marketing</li>

<li>Spring Boot & Microservices</li>

</ul>

@section S1 {

<font size="3" color="blue">Experienced faculties with excellent training skills.</font>

}

**Code under “About.cshtml” file:**

@{

ViewBag.Title = "About Page";

}

<p style="text-align: justify; color: green; font-family: 'Agency FB'; text-transform: capitalize; text-indent: 50px;font-size:15px">NareshIT (Naresh I Technologies) is a leading Software Training Institute and provides Job Guarantee Program through Nacre in Hyderabad, Chennai, Bangalore, Vijayawada and across the world with Online Training services. Managed and Lead by IT Professionals with more than a decade experience in leading MNC companies. We are most popular for our training approach that enables students to gain real-time exposure on cutting-edge technologies. Naresh I Technologies started satisfying the students who are at remote locations with Online Training program, with an intention to provide services for all those aspirants who want to be part of the software industry. The aspirants who due to various reasons cannot travel physically to our location can just keep themselves registered for this program along with their needs with just a single phone call or a mail provided in our contact’s page. The Online Training program is conducted over the internet using the latest state of the art software tools and via the video and desktop sharing facility. The training program is conducted by well experienced training faculty who are mentored in conducting such sessions as per the convenience of the participant. The Online Training program is provided with required material for reference and on hands exercises and Lab sessions for practical exposure. The students are monitored for any clarifications and doubts by the faculty all through the course either by phone or mail as per the convenience of the participants. Our sole maxim in introducing Online Technical Training Sessions is to cater to the training requirements of the aspirants who due to various reasons cannot travel physically to our location. In the online training program, the training sessions are conducted over the internet using the latest state of the art software tools and the hands-on experience also will be provided at the convenience of the participant. </p>

**Action Results in MVC**

Action Methods in an “MVC Application” can return different types of results and we call them as Action Results. In MVC, “ActionResult” is a class, and this class has various child classes under it and an Action method can return any of those classes as a result i.e., either parent class “ActionResult” or its child classes. Controller class (the parent class of all the Controllers we define) provides different helper methods to return a Result, where each helper method returns a different “ActionResult”, for example:

| **Helper Methods** | **Action Results** |
| --- | --- |
| File | FileResult |
| Json | JsonResult |
| View | ViewResult |
| --- | EmptyResult |
| Content | ContentResult |
| Redirect | RedirectResult |
| JavaScript | JavaScriptResult |
| PartialView | PartialViewResult |
| HttpNotFound | HttpNotFoundResult |
| HttpStatusCodeResult | HttpUnauthorizedResult |
| RedirectToRoute | RedirectToRouteResult |
| RedirectToAction | RedirectToRouteResult |

* **ViewResult:** sends a view as response.
* **PartialViewResult:** sends a partial view as response002E
* **RedirectToRouteResult:** represents a result that performs a redirection to an action method by using the specified route values dictionary.
* **JsonResult:** represents a class that is used to send JSON-Formatted content as response.
* **FileResult:** represents a class that is used to send binary file content as response.
* **RedirectResult:** controls the processing of application’s action method by redirecting to a specified URI.
* **ContentResult:** represents a user-defined content type, which is sent as a response.
* **JavaScriptResult:** sends JavaScript content as a response (currently this is not supported by the modern browsers and removed in MVC Core).
* **EmptyResult:** represents a result that does nothing, such as controller action method which returns void.
* **HttpStatusCodeResult:** provides a way to return an action result with a specific HTTP Status Code and Description.

In the previous programs we have already used “ViewResult”, “PartialViewResult” and “RedirectToRouteResult” and to test the other Action Results lets create a new “ASP.NET Web Application” project naming it as “ActionResultsInMVC”, choose “MVC Project Template”, un-check all the other Checkboxes and click on Create button to create the project.

**Note:** if we open a project by choosing “MVC Project Template” then, we will find a “Content” folder with “Bootstrap” installed and we will find a “Scripts” folder with “JQuery” installed and also a “fonts” folder with few “Fonts” installed in it. In the “Controllers” folder we find a Controller with the name “HomeController” with 3 Action methods in it with the name: Index, About and Contact; and these methods will also have associated Views in the “Home” folder of “Views” folder. We will also have “Shared” folder with a “Layout View (\_Layout.cshtml)” and “\_ViewStart.cshtml” in which the Layout is applied.

**Now do the following under the Project:**

**Step 1:** Add a new folder in the project, naming it as “Downloads”, and add 1 “.pdf” and 1 “.doc” file into the folder.

**Step 2:** Add a new class in Models folder of the project naming it as “Employee” and write the below code in it:

public class Employee

{

public int Id { get; set; }

public string Name { get; set; }

public string Job { get; set; }

public double Salary { get; set; }

public bool Status { get; set; }

}

**Step 3:** Add a Controller naming it as “ResultsController” and define the below “Action Methods” in the class.

using System.Text;

using ActionResultsInMVC.Models;

#region JsonResult

public JsonResult GetEmployees()

{

Employee e1 = new Employee { Id = 101, Name = "Scott", Job = "CEO", Salary = 25000, Status = true };

Employee e2 = new Employee { Id = 102, Name = "Smith", Job = "President", Salary = 22000, Status = true };

Employee e3 = new Employee { Id = 103, Name = "Parker", Job = "Manager", Salary = 18000, Status = true };

Employee e4 = new Employee { Id = 104, Name = "John", Job = "Salesman", Salary = 10000, Status = true };

Employee e5 = new Employee { Id = 105, Name = "David", Job = "Clerk", Salary = 5000, Status = true };

Employee e6 = new Employee { Id = 106, Name = "Maria", Job = "Analyst", Salary = 12000, Status = true };

List<Employee> Emps = new List<Employee> { e1, e2, e3, e4, e5, e6 };

return Json(Emps, JsonRequestBehavior.AllowGet);

}

#endregion

#region FileResult

public FileResult DownloadPdf()

{

return File("~/Downloads/Test.pdf", "application/pdf");

}

public FileResult DownloadWord()

{

return File("~/Downloads/Test.doc", "application/msword");

}

#endregion

#region RedirectResult

public RedirectResult OpenFaceBook()

{

return Redirect("https://facebook.com");

}

public RedirectResult OpenTwitter()

{

return Redirect("https://twitter.com");

}

#endregion

#region ContentResult

public ContentResult SendDate1()

{

return Content("Current Date: " + DateTime.Now.ToString());

}

public string SendDate2()

{

return "Current Date: " + DateTime.Now.ToString();

}

public string SayHello1()

{

return "नमस्ते आप कैसे हैं?";

}

public ContentResult SayHello2()

{

return Content("नमस्ते आप कैसे हैं?", "text/plain", Encoding.Unicode);

}

#endregion

#region JavaScriptResult

public JavaScriptResult AlertUser()

{

return JavaScript("alert('Hello, how are you.');");

}

#endregion

#region EmptyResult

public EmptyResult ReturnEmpty1()

{

EmptyResult obj = new EmptyResult();

return obj;

}

public void ReturnEmpty2()

{

string str = "Hello World";

str = str.ToUpper();

}

#endregion

**Add a “View” to “Index Action Method” without choosing a Layout and write the below code in its “<div>” tag:**

<h2>MVC Action Results</h2>

<ol>

<li>@Html.ActionLink("Json Result", "GetEmployees")</li>

<li>@Html.ActionLink("Download Pdf", "DownloadPdf")</li>

<li>@Html.ActionLink("Download Word", "DownloadWord")</li>

<li>@Html.ActionLink("Facebook", "OpenFaceBook", null, new { target = "\_blank" })</li>

<li>@Html.ActionLink("Twitter", "OpenTwitter", null, new { target = "\_blank" })</li>

<li>@Html.ActionLink("Today’s date returned as ContentResult", "SendDate1")</li>

<li>@Html.ActionLink("Today’s date returned as String", "SendDate2")</li>

<li>@Html.ActionLink("नमस्ते बोलो returned as String", "SayHello1")</li>

<li>@Html.ActionLink("नमस्ते बोलो returned as ContentResult", "SayHello2")</li>

<li>@Html.ActionLink("Javascript Alert", "AlertUser")</li>

<li>@Html.ActionLink("Empty Result", "ReturnEmpty1")</li>

<li>@Html.ActionLink("Void Result", "ReturnEmpty2")</li>

</ol>

Run the “Index” action method of “ResultsController” which provides links to execute the other action methods defined in the class.

**Minification and Bundling**

These are two techniques we use in Web Applications to improve request load time. Bundling and Minification improves load time by reducing the size of requested assets and reducing the number of requests to the server for the assets (such as CSS and Java Script.)

**Note:** most of the current major browsers limit the number of simultaneous connections per each host to 6. That means while 6 requests are being processed, additional requests for assets on a host will be queued by the browser.

**Minification:** this performs a variety of different code optimizations to CSS and Scripts such as removing unnecessary white spaces, removing comments, and shortening variable names to one character. For example, consider the below JavaScript function:

function SayHello(name) {

//This function wishes the user with his given name

var msg = "Hello " + name;

alert(msg);

}

**After Minification, the function is reduced as below:**

function SayHello(n){var m="Hello "+n;alert(m);}

In the above case “name” parameter is shortened as “n” and “msg” variable is shorted as “m”, removed comments, line breaks and unnecessary white spaces.

**How to perform Minification?**

**Ans:** To perform Minification of assets (CSS and JS files) we need to take the help of some tool and there are various tools available in the industry to do this. In our code we are going to use “Portable Smalify” tool which can be download from this location:

<https://www.softpedia.com/get/PORTABLE-SOFTWARE/System/File-management/Portable-Smalify.shtml>

After downloading, unzip the file into a folder and in that folder, we find “Smalify.exe”. Run it, which will open a User Interface, drag, and drop the folder in which we have placed the “.css” or “.js” files on the UI, which we want to minify and click on the “Minify now” button on the UI.

**Step 1:** Create a new “ASP.NET Web Application” project naming it as “MinificationAndBundling”; choose “Empty Project Template”, check “MVC” checkbox and click on the “Create” button.

Add a folder under the project with the name “Content” and under this folder add 2 “.css” files with the name “Header.css” & “Paragraph.css”, and write the below code in those files:

**Header.css:**

h1 {

color: red;text-align: center;background-color: palegreen;border-style: double;border-bottom-color: bisque;

border-top-color: coral;border-left-color: coral;border-right-color: bisque;text-decoration: underline;

}

**Paragraph.css:**

p {

text-align: justify;text-justify: inter-word;

color: green;font-family: courier;font-size: 160%;

text-transform: capitalize;text-indent: 50px;line-height: 1.8;border: 2px solid #0066FF;

border-top-width: 2px;border-right-width: 2px;border-bottom-width: 2px;border-left-width: 2px;

border-top-style: solid;border-right-style: solid;border-bottom-style: solid;border-left-style: solid;

border-top-color: #0066FF;border-right-color: #0066FF;border-bottom-color: #0066FF;

border-left-color: #0066FF;

}

**Step 2:** Minification of “.css” files and to do that right click on Project in Solution Explorer, select “Open Folder in File Explorer” which will display the list of folders and files under project folder in Windows Explorer. Run “Smalify.exe”, drag and drop the “Content” folder on to the UI of the “Smalify.exe” and click on “Minify now” button, which will generate the minified files “Header.min.css” and “Paragraph.min.css”. To load these files in our project, select “Content” folder in Solution Explorer and choose the option “Show All Files” in the top of Solution Explorer which will show the 2 files under Content folder, right click on them and select the option “Include in Project”, which will load them into the project, and after loading again click on “Show All Files”.

**Step 3:** Add a new Controller with the name “HomeController” and add a View to the existing Index Action Method without selecting “Use a layout page” Check Box. Now drag and drop “Header.min.css” and “Paragraph.min.css” files under the “<head>” tag of the View and write the following code under the “<div>” tag:

<h1>Naresh I Technologies</h1>

<p>Classroom Training schedule is a custom-made training program to suit the aspirants from different educational backgrounds, the training programs are conducted by well-trained faculties in the corresponding specializations in a real-time environment. The classroom training is conducted exclusively in the campus of Naresh i Technologies with well equipped and configured architecture to give students exactly an environment of industrial exposure.</p>

<p>Naresh i Technologies is renowned around the world for classroom training where every aspirant is encouraged to attend technical sessions discussing every facet of the subject with excruciating detail on varied technologies. Every aspirant in the training program will be provided with the hands-on experience through a number of Lab assignments and case studies there by making them more employable.</p>

<p>Digital marketing is an umbrella for an online system. Digital marketing refers to advertising which is delivered through the digital channel. Few digital marketing is like websites, social media, emails and mobile apps. The product is being marketed through digital technology. This Digital marketing online training course will help how to use the Facebook, Twitter, LinkedIn, etc for online advertisement. In simple term, the digital marketing means the promotion of the products or brands via some electronic media.</p>

<p>Corporate Training program is tailor-made to suit the working professionals in the industry who are expected to have a shift in their domain or technology as per their career demand. The corporate training courses are customized to meet the project requirements as expected from the corporate trainees.</p>

<p>The Corporate Training is provided either at the client location or at our Naresh i Technologies campus depending upon the need of the client. In the global markets of competition training and development of the employees to keep up their technical expertise has become the most important composition of any I.T. Organization.</p>

<p>The corporate employees require regular enhancements and update of the up-coming technologies in accordance with the advancements as demanded by the end clients. This requirement of the corporate sector is the key juncture where Naresh iTechnologies started sharing its expertise in reducing the training over-heads of the corporate sector.</p>

<p>The success of Naresh i Technologies lies in customized course content depending on the project requirements of the client and the experience level of the participants thereby enhancing the productivity of the overall industry.</p>

<h1>Excellence In IT Training</h1>

Now run the “Index View” and watch the output, because the page is using 2 CSS Files (Assets) there will be total 3 requests sent from the browser to server to load the assets as following:

* Index.cshtml
* Header.min.css
* Paragraph.min.css

To watch this hit “F12” in the browser which will open a window on the “RHS” called as “Developer Tools”, in that window go to “Network” tab, and click on the refresh button on the browser which will show the no. of requests in the bottom on “Developer Tools” window.

**Note:** To minimize the no. of requests from browser to server, we can take the help of bundling, so that both the CSS files will be loaded in a single request and the no. of requests can be reduced to 2 from 3.

**Bundling:** this is a new feature introduced in “ASP.NET 4.5”. Bundling makes it easy to combine or bundle multiple files into a single unit and by using this we can create CSS, Java Script and other bundles. Fewer files mean fewer HTTP requests and that can improve page load performance.

To perform Bundling we need to take the help of “Web Optimization Framework” library in our project and to use it we need to install it thru “NuGet Package Manager”, and to do that, open “NuGet Package Manager”, go to Browse and search for “Web Optimization Framework” that displays “Microsoft.AspNet.Web.Optimization”, select it and install it.

**Working with Microsoft AspNet Web Optimization Framework:** in this library we are provided with a set of classes under “System.Web.Optimization” namespace:

**StyleBundle:** this represents a collection of Style Sheet files.

**ScriptBundle:** this represents a collection of Script files.

**BundleCollection:** this represents a set of “StyleBundles” and “ScriptBundles”.

**BundleTable:** this is a holder class for the “BundleCollection”.

**Scripts:** this class is used for rendering the Script Bundles in our Web Pages i.e., “.cshtml” files and to do that we need to call a static method under the class i.e., Render to render the script files in ScriptBundles.

**Styles:** this class is used for rendering the Style Bundles in our Web Pages i.e., “.cshtml” files and to do that we need to call a static method under the class i.e., Render to render the style files in StyleBundles.

**Step 4:** To perform bundling, add a “Code File” under “App\_Start” folder with the name “BundleConfig.cs” and write the below code in the file:

using System.Web.Optimization;

namespace MinificationAndBundling

{

public class BundleConfig

{

public static void RegisterBundles(BundleCollection bundles)

{

//Create a StyleBundle and include all the CSS files into it

StyleBundle styleBundle = new StyleBundle("~/Content/NITStyleBundle");

styleBundle.Include("~/Content/Header.min.css", "~/Content/Paragraph.min.css");

bundles.Add(styleBundle);

//Create a ScriptBundle and include all the Scripts files into it (Example Code)

//ScriptBundle scriptBundle = new ScriptBundle("~/Scripts/NITScriptBundle");

//scriptBundle.Include("~/Scripts/Test1.min.js", "~/Scripts/Test2.min.js");

//bundles.Add(scriptBundle); //Example Code

}

}

}

**Step 5:** Now open the “Global.asax” file and call “RegisterBundles” method of “BundleConfig” class inside of “Application\_Start” method by importing “System.Web.Optimization” namespace:

BundleConfig.RegisterBundles(BundleTable.Bundles);

**Step 6:** go to “Index.cshtml” file and do the following:

* Import the namespace “System.Web.Optimization” as following on top of the file:

@using System.Web.Optimization;

* Delete the 2 <link> tag statements in the head section and write the below code over there:

@Styles.Render("~/Content/NITStyleBundle")

* Now run the “Index.cshtml” file again and watch the output, but now also we will have 3 requests only because bundling is performed only in the “Release or Production” mode but not in “Debug or Development” mode. If we want to test bundling at the time of “Application Development” we can achieve that in 2 different ways:
* Open “Web.config” file and there under “<system.web>” tag we find “<compilation>” tag with a boolean attribute “debug” and its value will be “true” by default, change it as “false” and run “Index.cshtml” file again. The code in “Web.config” should now look as following:

<compilation debug="false" targetFramework="4.8" />

* With-out changing the “debug” attribute value as “false” in “Web.config” file also, we can perform bundling i.e., in “Debug or Development” mode bundling can be performed and to do that, change the “false” value as “true” again in “Web.config” file, go to “BundleConfig.cs” and write the below statement in the end of “RegisterBundles” method and run “Index.cshtml” page again.

BundleTable.EnableOptimizations = true;

**Areas**

It is an approach of dividing a large “MVC Applications into smaller logical units, so that organizing of the application becomes much simple and easier. Area in an MVC Application is a collection of “Controllers”, “Views” and “Models” i.e., we can maintain them separately for each module.

For example, in a Hospital Management Application, for better development of the Application the Project Manager divided the Application into different modules like Patient Module, Doctor Module, Staff Module, Insurance Module, Billing Module, Labs Module, Medicine Module and HR Module. Now each Module is given for a different team to develop, so every Module will be having its own Controllers, Views and Models, for example:

Patients => Controllers, Views and Models

Doctors => Controllers, Views and Models

Staff => Controllers, Views and Models

Insurance => Controllers, Views and Models

Billing => Controllers, Views and Models

Labs => Controllers, Views and Models

Medicines => Controllers, Views and Models

HR => Controllers, Views and Models

While integrating all these Modules, for a clear separation and management of the Application we use areas because every area will be having its own Controllers, Views and Models, so under the project we maintain 1 area for each Module as below:

PatientArea => PatientControllers, PatientViews, PatientModels

DoctorArea => DoctorControllers, DoctorViews, DoctorModels

StaffArea => StaffControllers, StaffViews, StaffModels

InsuranceArea => InsuranceControllers, InsuranceViews, InsuranceModels

BillingArea => BillingControllers, BillingViews, BillingModels

LabArea => LabControllers, LabViews, LabModels

MedicinesArea => MedicineControllers, MedicineViews, MedicineModels

HRArea => HRControllers, HRViews, HRModels

To work with areas, create a new “ASP.NET Web Application” project naming it as “MVCAreas”, choose “Empty Project Template”, check the “MVC” CheckBox and click on “Create” button to create the project. To add an Area under the project, right click on the Project and select the option Add => “New Scaffolded Item”, this will open a new window and in that window on the LHS expand the “MVC Node” and select the option “Area” and then on the RHS it will display “MVC 5 Area”, select it and click on “Add” button which will ask for a name to the Area, enter the name as “Patient” and click on the “Add” button which will add “Areas” folder under the Project and under that “Areas” folder it will add another folder with the name “Patient” and under this it will add “Controllers”, “Views” and “Data (Models)” folders and also 1 file with name “PatientAreaRegistration.cs” and under this we find a class “PatientAreaRegistration” inheriting from “AreaRegistration” class and under this class we find a method “RegisterArea” defining the route to accessing the “Action Methods” in this area as following

public override void RegisterArea(AreaRegistrationContext context)

{

context.MapRoute(

"Patient\_default",

"Patient/{controller}/{action}/{id}",

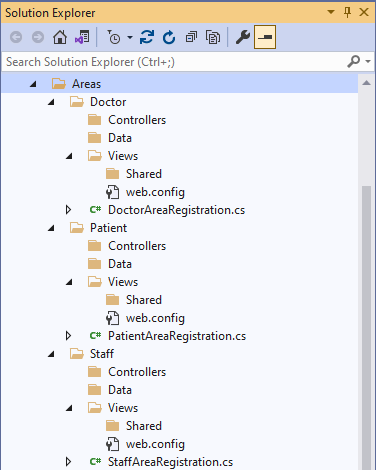
new { action = "Index", id = UrlParameter.Optional }

);

}

**Adding multiple areas in the Project:** to add more “Areas” in the project right click on the “Areas” again and select “Add” => “Area” and in the window opened select “MVC 5 Area” and give a name to it, and by following this process add 2 new Areas with the names “Doctor” and “Staff”.

**Note:** under every Area we have added we will find “Controllers”, “Views” and “Data” folders as well as “AreaRegistration” class as following:



Add a Controller in each Controllers folder with-in the “Areas” naming them as “HomeController” and add a View to each “Index Action Method” by choosing a layout and write the below code in them by deleting the existing code:

**Doctor Home Controller’s - Index.cshtml:**

@{

ViewBag.Title = "Doctors - Index Page";

}

<h2>This is Home Page of Doctor's Area.</h2>

@Html.ActionLink("Back to site home page", "Index", "Home", new { area = "" }, null)

**Patient Home Controller’s - Index.cshtml:**

@{

ViewBag.Title = "Patients - Index Page";

}

<h2>This is Home Page of Patient's Area.</h2>

@Html.ActionLink("Back to site home page", "Index", "Home", new { area = "" }, null)

**Staff Home Controller’s - Index.cshtml:**

@{

ViewBag.Title = "Staff - Index Page";

}

<h2>This is Home Page of Staff Area.</h2>

@Html.ActionLink("Back to site home page", "Index", "Home", new { area = "" }, null)

Add a Controller under the project’s root “Controllers” folder naming it as “HomeController” only, add a View to existing “Index Action Method”, choosing a layout and write the below code in it by deleting existing code:

@{

ViewBag.Title = "Site - Index";

}

<h2>This is the Home Page of Site.</h2>

@Html.ActionLink("Doctor Home Page", "Index", "Home", new { area = "Doctor" }, null)

<br />

@Html.ActionLink("Patient Home Page", "Index", "Home", new { area = "Patient" }, null)

<br />

@Html.ActionLink("Staff Home Page", "Index", "Home", new { area = "Staff" }, null)

Run the project which must launch the above “Index.cshtml” View of the root “Home Controller” but it will not launch because there are multiple “Home Controllers” and “Index Action Methods” under the project, so we get an error. To resolve the problem open “RouteConfig.cs” file present in “App\_Start” folder of the project and specify the namespace of our Root “HomeController” to it in “routes.MapRoute” method, which should now look as below:

routes.MapRoute(

name: "Default",

url: "{controller}/{action}/{id}",

defaults: new { controller = "Home", action = "Index", id = UrlParameter.Optional },

namespaces: new string[] { "MVCAreas.Controllers" }

);

This action should now launch the “Site Home Page” i.e., “Index Page” of root “Home Controller” of the Project and in that “Page” we will find links to launch “Doctor’s Home Page”, “Patient’s Home Page” and “Staff Home Page”, click on them and test it.

**When we enter the below URL in the browser:**

http://localhost:port => launches Site Home Page

**Same as above when we enter below URL’s they should launch their corresponding Home Pages, for example:**

http://localhost:port/Doctor => should launch Doctor home page

http://localhost:port/Patient => should launch Patient home page

http://localhost:port/Staff => should launch Staff home page

But when to try them, we get “Page Not Found” error and to resolve this problem go to each “AreaRegistration.cs” file that are present in each “Areas” folder and there we find the method “RegisterArea”, and in that method with-in the last line specify the default Controller name i.e., “Home”, as following:

**Old Code:** new { action = "Index", id = UrlParameter.Optional }

**New Code:** new { controller = "Home", action = "Index", id = UrlParameter.Optional }

**Data Annotations**

These are nothing but validations that we put in our “Models” to validate the input from the user. These are similar to “Validation Controls” in “ASP.NET Web Forms”. “ASP.NET MVC” provides a unique feature by using which we can validate the models by using the “Data Annotation” attributes importing the namespace “System.ComponentModel.DataAnnotations”. Data Annotations can be used in our View Pages for validating Controls as well as they can also be used in “Entity Framework”. Data Annotations allows us to define all the rules a Model Class and its Properties has to follow, and they are divided into different categories, like:

* Display Attributes
* Validation Attributes
* Modeling Attributes

Every Data Annotation is a class that is defined in the libraries of our language under the namespace “System.ComponentModel.DataAnnotations” and the parent class for all these classes is “Attribute” and the hierarchy of classes is as following:

* Attribute
  + DisplayAttribute
  + DisplayFormatAttribute
  + DisplayColumnAttribute
  + ValidationAttribute
    - RequiredAttribute
    - DataTypeAttribute
    - CompareAttribute
    - RangeAttribute
    - RegularExpressionAttribute
    - RemoteAttribute (This class is defined under “System.Web.MVC” namespace)

**Note:** Data Annotation’s - Validation Attributes, will perform data validations both on Client as well as Server also i.e., first they will validate the data on Client Machine and if at all those validations fail, page will not be submitted to the Server, whereas if the Client disables Java Script on his browser, then data is submitted to Server even if the Validations fail and to overcome this problem validations are re-performed on Server also.

To perform Client-Side Validations, Data Annotations uses JQuery Library, so our View Pages have to use the below JQuery libraries:

* jquery-<version>.min.js
* jquery.validate.min.js
* jquery.validate.unobtrusive.min.js

**Display Attribute:** by using this attribute we can specify a name that has to be displayed by a Label on the view for the Model’s Property.

[Display(Name = "First Name:")]

public string FirstName { get; set; }

**DisplayFormat Attribute:** by using this we can specify how data fields are displayed and formatted and with the help of this we can do the following:

* Display the text as “[Null]” when a data field is empty.
* Display currency data in locale-specific currency format.
* Display date information in any pre-defined or specified format.

**To display numeric data in Currency Format:**

[DisplayFormat(DataFormatString = "{0:c}")]

public double Salary { get; set; }

**To display data in Date Format (MM/dd/yyyy):**

[DisplayFormat(DataFormatString = "{0:d}")]

public DateTime DOB { get; set; }

**To display data in specified Date Format:**

[DisplayFormat(DataFormatString = "{0:dd/MM/yyyy}")]

public DateTime DOB { get; set; }

**To display data in specified Date & Time format (Time in 24 hour format):**

[DisplayFormat(DataFormatString = "{0:dd/MM/yyyy HH:mm:ss}")]

public DateTime DOB { get; set; }

**To display data in specified Date & Time format (Time in 12 hour format with AM/PM):**

[DisplayFormat(DataFormatString = "{0:dd/MM/yyyy hh:mm:ss tt}")]

public DateTime DOB { get; set; }

**To display “Value not specified” when value is null:**

[DisplayFormat(NullDisplayText = "Name not specified.")]

public string Name { get; set; }

**Validation Attributes:**

**Required Attribute:** this attribute is used to specify that the value is mandatory and cannot be skipped.

[Required(ErrorMessage = "Name field can't be left empty.")]

public string Name { get; set; }

**DataType Attribute:** this attribute is used to specify the data type for the model’s property.

[DataType(DataType.Password)]

public string Password { get; set; }

**Compare Attribute:** this attribute is used to compare the value of 1 Model property with other property.

[Compare("Password", ErrorMessage = "Confirm password should match with password.")]

public string ConfirmPassword { get; set; }

**Range Attribute:** this attribute is used to specify a range for the Model properties value.

[Range(18, 60)]

public int Age { get; set; }

**RegularExpression Attribute:** this attribute is used to compare the Model properties value with a “RegularExpression”.

[RegularExpression(@"[6-9]\d{9}")] //Mobile No. should start with 6, 7, 8, and 9 only and can be having a length of 10 digits (Both Max & Min).

public string Mobile { get; set; }

**Remote Attribute:** this attribute class is defined in “System.Web.MVC” namespace which is used to make “AJAX” call to Server and validate data without posting the entire form to the server, whenever a server-side validation is preferable in any particular scenario and in this case the result is sent back from server to client in JSON format.

To test all the above, create a new “ASP.NET Web Application” project naming it as “MVCDataAnnotations”, choose “MVC Project Template” and click on “Create” button to create the project.

**Step 1:** Add a Model class under the Models folder naming it as “User.cs” and write the below code in it by importing “System.ComponentModel.DataAnnotations” namespace:

public class User

{

[Display(Name = "User Name:")]

[Required(ErrorMessage = "User name field can't be left empty.")]

[RegularExpression(@"[A-Za-z\s]{3,}", ErrorMessage = "Name can have alphabets & spaces with min size of 3.")]

public string Name { get; set; }

[DataType(DataType.Password)]

[Required(ErrorMessage = "Password field can't be left empty.")]

[RegularExpression(@"(?=.\*[0-9])(?=.\*[a-z])(?=.\*[A-Z])(?=.\*[@#$\_-])(?=\S+$).{8,16}", ErrorMessage = "Password

Format: <br />-No spaces.<br />-Minimum 1 numeric.<br />-Minimum 1 upper case & lower case alphabet.

<br />-Minimum 1, any of these Special characters: -, \_, @, #, $.<br />-Should be ranging between 8 - 16 chars.")]

public string Password { get; set; }

[Display(Name = "Confirm Password")]

[DataType(DataType.Password)]

[Required(ErrorMessage = "Confirm password field can't be left empty.")]

[Compare("Password", ErrorMessage = "Confirm password should match with password.")]

public string ConfirmPassword { get; set; }

[DataType(DataType.Date)]

[Display(Name = "Date of Birth")]

[Required(ErrorMessage = "Date of birth field can't be left empty.")]

[System.Web.Mvc.Remote("IsValidDate", "User", ErrorMessage = "User should attain 18 years age to register.")]

public DateTime DOB { get; set; }

[Display(Name = "Mobile No")]

[DataType(DataType.PhoneNumber)]

[RegularExpression(@"[6-9]\d{9}", ErrorMessage = "Mobile No. should start with 6, 7, 8, and 9 only and can be

having a length of 10 digits (Both Max & Min).")]

public string Mobile { get; set; }

[Display(Name = "Email Id")]

[DataType(DataType.EmailAddress)]

public string Email { get; set; }

[Display(Name = "Address:")]

[DataType(DataType.MultilineText)]

public string Address { get; set; }

}

**Password rules Regular Expression:**

(?=.\*[0-9]) represents a digit must occur at least once.

(?=.\*[a-z]) represents a lower case alphabet must occur at least once.

(?=.\*[A-Z]) represents an upper case alphabet that must occur at least once.

(?=.\*[@#$\_-]) represents a special character that must occur at least once.

(?=\S+$) white spaces are not allowed in the entire string.

.{8, 16} represents at least 8 characters and at most 16 characters allowed.

**Step 2:** Add a Controller class in Controllers folder of the project naming it as “UserController” delete all the content in the class and write the below code in it by importing “MVCDataAnnotations.Models” namespace:

//Validation code for DOB field which is called using Remote Attribute

public JsonResult IsValidDate(DateTime DOB)

{

bool Status;

if (DOB > DateTime.Now.AddYears(-18))

Status = false;

else

Status = true;

return Json(Status, JsonRequestBehavior.AllowGet);

}

public ViewResult AddUser()

{

return View();

}

public ViewResult DisplayUser(User user)

{

return View(user);

}

**Step 3:** Add a view to “AddUser” action method without choosing any “Layout”, update the version of JQuery (existing is 3.4.1 and latest is 3.6.0) using “Nuget Package Manager” and do the following:

@\* Write the below statement at top of the View. \*@

@model MVCDataAnnotations.Models.User

@\* Drag and Drop the following files from Scripts folder into the "<head>" section. \*@

<script src="~/Scripts/jquery-3.6.0.min.js"></script>

<script src="~/Scripts/jquery.validate.min.js"></script>

<script src="~/Scripts/jquery.validate.unobtrusive.min.js"></script>

@\* Drag and Drop the following file from Content folder into the "<head>" section. \*@

<link href="~/Content/bootstrap.min.css" rel="stylesheet" />

@\* Write the below code under "<div>" tag. \*@

@using (Html.BeginForm("DisplayUser", "User"))

{

<div>

@Html.LabelFor(U => U.Name)<br />

@Html.EditorFor(U => U.Name)

@Html.ValidationMessageFor(U => U.Name)

</div>

<div>

@Html.LabelFor(U => U.Password)<br />

@Html.EditorFor(U => U.Password)

@Html.ValidationMessageFor(U => U.Password)

</div>

<div>

@Html.LabelFor(U => U.ConfirmPassword)<br />

@Html.EditorFor(U => U.ConfirmPassword)

@Html.ValidationMessageFor(U => U.ConfirmPassword)

</div>

<div>

@Html.LabelFor(U => U.DOB)<br />

@Html.EditorFor(U => U.DOB)

@Html.ValidationMessageFor(U => U.DOB)

</div>

<div>

@Html.LabelFor(U => U.Mobile)<br />

@Html.EditorFor(U => U.Mobile)

@Html.ValidationMessageFor(U => U.Mobile)

</div>

<div>

@Html.LabelFor(U => U.Email)<br />

@Html.EditorFor(U => U.Email)

@Html.ValidationMessageFor(U => U.Email)

</div>

<div>

@Html.LabelFor(U => U.Address)<br />

@Html.EditorFor(U => U.Address)

@Html.ValidationMessageFor(U => U.Address)

</div>

<div>

<input type="submit" value="Save User" id="btnSave" />

<input type="reset" value="Reset Data" id="btnReset" />

</div>

}

**Note:** Data Annotations will perform Data Validations when we bind Views with Model Classes using the “Strongly Typed Html Helpers” like LabelFor, TextBoxFor, EditorFor, etc.

Now run the View, fill in the details and click on “Save User” button to launch “DisplayUser” View but in this process if we enter any wrong values into the controls or did not enter values into the controls, Validation Attributes comes into picture, display’s “Error Messages” and will not allow the page to be submit to the server. By default, “Validation Error Messages” are displayed by using the “Span” tag and the text will in black color, whereas if we want to highlight those messages go to “<head>” section of the “AddUser” View and define a style for “<span>” tag as following:

<style>span { color: red;background-color: yellow;font-style: oblique }</style>

Validation Attributes will perform Data Validations on the Client Machine and if at all those validations fail, page will not be submitted to server. Even in case of the “Remote” validation also without submitting the page to Server it will perform an “AJAX” call to the Server and receives the result as “JSON” which will be “true” if the validation is successful and “false” if the validation fails. In case, if Java Script is disabled on client’s browser, then there will be a problem i.e., page gets submitted to Server even if Validations fail, so to overcome the problem, in our “DisplayUser” action method we need to verify with a condition i.e., “ModelState.IsValid” as which is same as ASP.NET Web Forms “Page.IsValid”.

**To test this, re-write code of “DisplayUser” Action method as following:**

if (ModelState.IsValid) {

return View(obj);

}

else {

return View("AddUser", obj);

}

All Validation Attributes will perform Validations on client side only and if at all Java Script is disabled on client’s browser, page will be submitted to the Server, so to overcome this problem, Server will again re-validate all the input, and if the Validations are successful, it will set the Models “IsValid” property as “true”, or “false” if any of the Validations fail which we can use in our Server-Side Logic to perform further actions as we have done above.

Now add a View to “DisplayUser” action method and to do this right click on the “DisplayUser” method in Controller class, select “Add View” and in the window opened choose the option “Details” under “Template DropDownList” and choose “User” under “Model Class DropDownList” which will create View to display data and this is also “Scaffolding”. Run the “AddUser.cshtml”, fill in form with correct values and click on the “Submit” button which will launch “DisplayUser.cshtml” file, by displaying all the values we have entered in “AddUser” View.

If we open “DisplayUser.cshtml” file and watch the code, there we find a “<dl> (Description List)” to display the data and under this “<dt>” tag is used to display “Attribute Name” by calling the helper method “DisplayNameFor” and “<dd>” tag is used to display “Attribute Value” by calling the helper method “DisplayFor”.

**Validation Summary:** This is similar to the “ValidationSummary” we use in “ASP.Net Web Forms” and by using this we can display all the “Error Messages” at 1 place without displaying them beside the controls. To display all our “Error Messages” on top of the form, write the below code in “AddUser” View in the top of “Begin Form” block.

<div>@Html.ValidationSummary("", new { @class = "alert-danger" })</div>

**Note:** After adding this all the “Error Messages” will be displayed by the “Validation Summary” i.e., all at 1 place, but the “Error Messages” will be displayed beside the controls also and to avoid that, change the style code we have defined for “<span>” tag that we have added in “<head>” section as following:

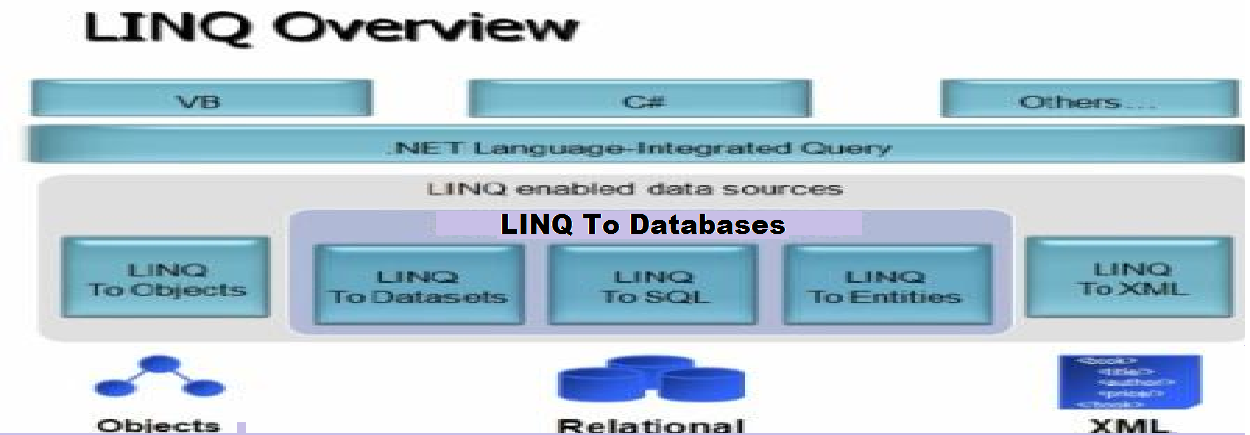
**Old Code:** <style>span { color: red;background-color: yellow;font-style: oblique }</style>

**New Code:** <style>span { display: none }</style>

**Language Integrated Query**

In C# 3.0 .Net has introduced a new language known as “LINQ” much like “SQL (which we use universally with relational databases to perform queries)”. LINQ allows you to write query expressions (like SQL queries) that can retrieve information from a wide variety of Data Sources like Objects, Relational Databases and XML.

**Introduction to LINQ:** LINQ stands for Language Integrated Query. LINQ is a data querying methodology which provides querying capabilities to .NET languages with syntax like a SQL Query. LINQ has a great power of querying from any source of data i.e., the Data Source can be collections of Objects, Relational Databases or XML.

  
**LINQ to Objects:** used to perform queries against the in-memory data like an Array or Collection.

**LINQ to Databases:**

* LINQ to DataSets is used to perform queries against ADO.NET Data Table’s.
* LINQ to SQL is used to perform queries against Microsoft SQL Server Database.
* LINQ to Entities is used to perform queries against any Relation Database like SQL Server, Oracle, etc.

**LINQ to XML (XLinq):** used to perform queries against the XML source.

**Advantages of LINQ:**

* LINQ offers an object-based, language-integrated way to query over data, no matter where that data came from. So, through LINQ we can query Database, XML as well as Collections and Arrays also.
* Compile time syntax checking.
* It allows us to Query Collections, Arrays, & Classes etc. in the native language of our application like VB or C#.

**LINQ to SQL**

Probably the biggest and most exciting addition to the .Net Framework 3.5 is the addition of the .Net Language Integrated Query Framework (LINQ) into C# 3.0. Basically, what LINQ provides is a lightweight façade over programmatic data integration. This is such a big deal because **data is King**. Pretty much every application deal with data in some manner, whether that data comes from memory, databases, XML files, text files, or something else. Many developers find it very difficult to move from the strongly typed object-oriented world of C# to the data tier where objects are second-class citizens. The transition from the one world to the next was a kludge at best and was full of error-prone actions.

In C#, programming with objects means a wonderful strongly typed ability to work with code. You can navigate very easily through the namespaces, work with a debugger in the Visual Studio IDE, and more. However, when you must access data, you will notice that things are dramatically different. You end up in a world that is not strongly typed, where debugging is a pain or even non-existent, and you end up spending most of the time sending strings to the database as commands. As a developer, you also must be aware of the underlying data and how it is.

Microsoft has provided LINQ as a lightweight façade that provides a strongly typed interface to the underlying data stores. LINQ provides the means for developers to stay within the coding environment they are used to and access the underlying data as objects that work with the IDE, Intellisense, and even debugging. With LINQ, the queries that you create now become first-class citizens within the .NET Framework alongside everything else you are used to. When you work with queries for the data store you are working with, you will quickly realize that they now work and behave as if they are types in the system. This means that you can now use any .NET-compliant language and query the underlying data stores as you never have before.

**LINQ to SQL and Visual Studio**: LINQ to SQL in particular is a means to have a strongly typed interface against a SQL Server Database. You will find the approach that LINQ to SQL provides is by far the easiest approach for querying SQL Server available now. It is important to remember that LINQ to SQL is not only about querying data, but you can also perform Insert/Update/Delete operations that you need to perform which are known as CRUD operations (Create/Read/Update/Delete). Visual Studio comes into strong play with LINQ to SQL in that you will find an extensive user interface that allows you to design the LINQ to SQL classes you will work with.

**Adding a LINQ to SQL Class**: To work with LINQ first you need to convert Relational Objects of Database into Object Oriented Types of our language and the process of conversion is known as ORM (Object Relational Mapping) and to perform this we are provided with a tool under Visual Studio i.e., OR Designer (Object-Relational Designer) which does an outstanding job of making it as easy as possible.

To work with LINQ to SQL first create a Database in SQL Server with the name “MVCDB” and then create a table with the name Student using the below SQL Statement:

Create Table Student (Sid Int Primary Key, Name Varchar(50), Class Int, Fees Money, Photo Varchar(100), Status Bit Not Null Default 1)

Now create a new “ASP.NET Web Application” project, naming it as “MVCWithLinq1”, choose “MVC Template” and click on Create button to create the Project. In the project created open Solution Explorer and under the Models folder add the “OR Designer” and to do this open “Add New Item” Window, in the LHS of the Window select “Data” and in the RHS select the option “Linq to SQL Classes” name the item as “MVCDB.dbml” (Database Markup Language). We can give any name to the “.dbml” file but it is always suggested to use our Database name as a name to this, because our database name is “MVCDB” we have named it as “MVCDB.dbml”, now click “Add” button which will do the following:

* Adds a reference to “System.Data.Linq” assembly which is required to work with “LINQ to SQL”.
* Under “Models” folder of Solution Explorer we will find “MVCDB.dbml” and under it we will find 2 sub-items “MVCDB.dbml.layout” and “MVCDB.Designer.cs” and under this file only “OR-Designer” writes all the “ORM” code by converting “Relational Objects” into “Object Oriented Types”.
* The item “MVCDB.dbml” is added to the studio which will appear as a tab within the document window, and this is made up of two parts. The first part on the left is for “Data Classes”, which map to Tables, Views, etc, dragging such items on this surface will give us a visual representation of those objects. The second part on the right is for Methods, which map to the Stored Procedures within the Database.

Let us have a look into the code of “MVCDB.designer.cs” file and there we will find a class “MVCDBDataContext” inheriting from “DataContext” class of “System.Data.Linq” namespace. “DataContext” class works with the “Connection String” and connects to the Database for any required operations when we create instance of the class. “DataContext” class also contains methods in it like “CreateDatabase”, “DeleteDatabase”, “GetTable”, “ExecuteQuery”, “SubmitChanges” etc, using which we can perform action directly on the Database. The “MVCDBDataContext” class which is defined here by default contains 4 parameterized Constructors in it.

**Creating the Student Entity**: For this example, we want to work with the “Student” (Entity) table from the “MVCDB” database, which means that you are going to create a “Student” (Entity) class that will use LINQ to SQL map to Student table. To accomplishing this task simply open the “Server Explorer” within Visual Studio from “View” menu and configure it with our DB i.e., “MVCDB”. To configure the Database under “Server Explorer”, right click on “Data Connections” node and select the option “Add Connection” which open a window “Choose Data Source” and in that select “Microsoft SQL Server” and click on “Ok” button, which opens another window “Add Connection”, in the new window under “Server name:” TextBox enter your “Server Name”, under “Log on to the server” option choose the “Authentication Mode” and provide the “Credentials”, under “Connect to a database” option choose your “Database” from “Select or enter a database name” DropDownList (Database name is “MVCDB” in our case) and click on the “OK” button which adds the Database under “Data Connections” node. Now drag and drop the “Student” table of our “MVCDB” Database onto the design surface of “O/R Designer” in LHS and this action will add a bunch of code in to “MVCDB.designer.cs” file on our behalf with a set of classes in it, and those classes will give you a strongly typed access to the student (Entity) table.

**When we drag & drop the first object (Table or SP) on OR Designer it will perform the following actions:**

* Writes Connection String in to “Web.config” file targeting to the Database we have configured in Server Explorer.
* Defines a new parameter less or default constructor in “MVCDBDataContext” class and we can use this constructor for creating the instance of “MVCDBDataContext” class for connecting to the Database and this constructor will read the Connection String from “Web.config” file.

**When we drag & drop a table on OR Designer the following actions gets performed internally:**

* Defines a class representing the Entity (Table) we have dragged & dropped on the OR Designer where the name of the class will be same as the table name, right now we have dropped “Student” table on OR Designer, so “Student” class gets defined.
* Defines properties under the entity class (Student), where each property represents each attribute of the entity (table). So, in the student class we will find the properties Sid, Name, Class, Fees, Photo and Status.
* Defines a property under “MVCDBDataContext” class referring to the table we are working with, and the type of this property will be “Table<Entity>”, because we are working with “Student Entity” here the name of the property will be “Students” and type of the property will be “Table<Student>”.

**Note:** Table<Entity> is a generic class under “System.Data.Linq” namespace which also contains a set of methods like “DeleteOnSubmit”, “InsertOnSubmit”, “SingleOrDefault” etc. for performing CRUD operations on the Entity.

**Performing CRUD (Create (Insert), Read (Select), Update and Delete) Opertions:** to Perform CRUD operations on SQL Server Database by using Linq to SQL we need to adopt the following process for Insert, Update and Delete:

**Steps for Inserting**:

1. Create an instance of Entity (Student) class, which is defined representing the Student Entity because each instance is a record, and then assign values to the properties because those properties represent attributes.
2. Call InsertOnSubmit method on the table (Students) which adds the record into the table in a pending state.
3. Call SubmitChanges method on DataContext object for saving the changes to Database Server.

**Steps for Updating**:

1. Create reference of Entity (Student) class that has to be updated by calling First or FirstOrDefault or SingleOrDefault or Single method on the table (Students).
2. Re-assign values to properties of the reference so that old values get changed to new values.
3. Call SubmitChanges method on DataContext object for saving the changes to Database server.

**Steps for Deleting**:

1. Create a reference of Entity (Student) class that must be deleted by calling First or FirstOrDefault or SingleOrDefault or Single method on the table (Students).
2. Call DeleteOnSubmit method on the table (Students) that deletes the record from table in a pending state.
3. Call SubmitChanges method on DataContext object for saving the changes to Database server.

**Add a class under Models folder with the name StudentDAL.cs and write the below code in it:**

public class StudentDAL

{

MVCDBDataContext context = new MVCDBDataContext();

public List<Student> GetStudents(bool? Status)

{

List<Student> students;

try

{

if(Status != null)

students = (from s in context.Students where s.Status == Status select s).ToList();

else

students = context.Students.ToList();

return students;

}

catch(Exception ex)

{

throw ex;

}

}

public Student GetStudent(int Sid, bool? Status)

{

Student student;

try

{

if (Status == null)

student = (from s in context.Students where s.Sid == Sid select s).Single();

else

student = (from s in context.Students where s.Sid == Sid && s.Status == Status select s).Single();

return student;

}

catch(Exception ex)

{

throw ex;

}

}

public void AddStudent(Student student)

{

try

{

context.Students.InsertOnSubmit(student);

context.SubmitChanges();

}

catch(Exception ex)

{

throw ex;

}

}

public void UpdateStudent(Student newValues)

{

try

{

Student oldValues = context.Students.Single(S => S.Sid == newValues.Sid);

oldValues.Name = newValues.Name;

oldValues.Class = newValues.Class;

oldValues.Fees = newValues.Fees;

oldValues.Photo = newValues.Photo;

context.SubmitChanges();

}

catch(Exception ex)

{

throw ex;

}

}

public void DeleteStudent(int Sid)

{

try

{

Student oldValues = context.Students.First(S => S.Sid == Sid);

//dc.Students.DeleteOnSubmit(oldValues); //Permenant Deletion

oldValues.Status = false; //Updates the status with-out deleting the record

context.SubmitChanges();

}

catch (Exception ex)

{

throw ex;

}

}

}

**Add a Controller under the Controllers folder with the name StudentController and write the below code in it:**

using System.IO;

using MVCWithLinq1.Models;

public class StudentController : Controller

{

StudentDAL obj = new StudentDAL();

public ViewResult DisplayStudents()

{

return View(obj.GetStudents(true));

}

public ViewResult DisplayStudent(int Sid)

{

return View(obj.GetStudent(Sid, true));

}

[HttpGet]

public ViewResult AddStudent()

{

return View(new Student());

}

[HttpPost]

public RedirectToRouteResult AddStudent(Student student, HttpPostedFileBase selectedFile)

{

if (selectedFile != null)

{

//Checking whether the folder "Uploads" is exists or not and creating it if not exists

string PhysicalPath = Server.MapPath("~/Uploads/");

if(!Directory.Exists(PhysicalPath))

{

Directory.CreateDirectory(PhysicalPath);

}

selectedFile.SaveAs(PhysicalPath + selectedFile.FileName);

student.Photo = selectedFile.FileName;

}

student.Status = true;

obj.AddStudent(student);

return RedirectToAction("DisplayStudents");

}

public ViewResult EditStudent(int Sid)

{

Student student = obj.GetStudent(Sid, true);

TempData["Photo"] = student.Photo;

return View(student);

}

public RedirectToRouteResult UpdateStudent(Student student, HttpPostedFileBase selectedFile)

{

if (selectedFile != null)

{

string PhysicalPath = Server.MapPath("~/Uploads/");

if (!Directory.Exists(PhysicalPath))

{

Directory.CreateDirectory(PhysicalPath);

}

selectedFile.SaveAs(PhysicalPath + selectedFile.FileName);

student.Photo = selectedFile.FileName;

}

else if(TempData["Photo"] != null)

{

student.Photo = TempData["Photo"].ToString();

}

obj.UpdateStudent(student);

return RedirectToAction("DisplayStudents");

}

public RedirectToRouteResult DeleteStudent(int Sid)

{

obj.DeleteStudent(Sid);

return RedirectToAction("DisplayStudents");

}

}

**Add a view with the name DisplayStudents.cshtml, selecting layout Checkbox and write the below code in it:**

@model IEnumerable<MVCWithLinq1.Models.Student>

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Students Details</h2>

<table border="1" align="center" class="table-condensed">

<tr>

<th>@Html.DisplayNameFor(S => S.Sid)</th>

<th>@Html.DisplayNameFor(S => S.Name)</th>

<th>@Html.DisplayNameFor(S => S.Class)</th>

<th>@Html.DisplayNameFor(S => S.Fees)</th>

<th>@Html.DisplayNameFor(S => S.Photo)</th>

<th>Actions</th>

</tr>

@foreach (MVCWithLinq1.Models.Student student in Model)

{

<tr>

<td>@Html.DisplayFor(S => student.Sid)</td>

<td>@Html.DisplayFor(S => student.Name)</td>

<td>@Html.DisplayFor(S => student.Class)</td>

<td>@Html.DisplayFor(S => student.Fees)</td>

<td><img src='/Uploads/@student.Photo' width="40" height="25" alt="No Image" /></td>

<td>

@Html.ActionLink("View", "DisplayStudent", new { Sid = student.Sid })

@Html.ActionLink("Edit", "EditStudent", new { Sid = student.Sid })

@Html.ActionLink("Delete", "DeleteStudent", new { Sid = student.Sid },

new { onclick = "return confirm('Are you sure of deleting the record?')" })

</td>

</tr>

}

<tr><td colspan="6" align="center">@Html.ActionLink("Add New Student", "AddStudent")</td></tr>

</table>

**Add a view with the name DisplayStudent.cshtml, selecting layout Checkbox and write the below code in it:**

@model MVCWithLinq1.Models.Student

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Student Details</h2>

<table border="1" align="center">

<tr>

<td rowspan="4"><img src='~/Uploads/@Model.Photo' width="200" height="200" alt="No Image" /></td>

<td>Sid: @Model.Sid</td>

</tr>

<tr><td>Name: @Model.Name</td></tr>

<tr><td>Class: @Model.Class</td></tr>

<tr><td>Fees: @Model.Fees</td></tr>

<tr>

<td colspan="2" align="center">@Html.ActionLink("Back to Student Details", "DisplayStudents")</td>

</tr>

</table>

**Add a view with the name AddStudent.cshtml, selecting layout Checkbox and write the below code in it:**

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Add New Student</h2>

@using (Html.BeginForm("AddStudent", "Student", FormMethod.Post, new { enctype = "multipart/form-data" }))

{

<div>@Html.LabelFor(S => S.Sid)<br />@Html.TextBoxFor(S => S.Sid)</div>

<div>@Html.LabelFor(S => S.Name)<br />@Html.TextBoxFor(S => S.Name)</div>

<div>@Html.LabelFor(S => S.Class)<br />@Html.TextBoxFor(S => S.Class)</div>

<div>@Html.LabelFor(S => S.Fees)<br />@Html.TextBoxFor(S => S.Fees)</div>

<div>@Html.LabelFor(S => S.Photo)<br /><input type="file" name="selectedFile" /></div>

<div>

<input type="submit" value="Save" />

<input type="reset" value="Reset" />

</div>

}

@Html.ActionLink("Back to Student Details", "DisplayStudents")

**Add a view with the name EditStudent.cshtml, selecting layout Checkbox and write the below code in it:**

@model MVCWithLinq1.Models.Student

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Edit Student</h2>

@using (Html.BeginForm("UpdateStudent","Student",FormMethod.Post,new { enctype = "multipart/form-data" }))

{

<div>@Html.LabelFor(S => S.Sid)<br />@Html.TextBoxFor(S => S.Sid)</div>

<div>@Html.LabelFor(S => S.Name)<br />@Html.TextBoxFor(S => S.Name)</div>

<div>@Html.LabelFor(S => S.Class)<br />@Html.TextBoxFor(S => S.Class)</div>

<div>@Html.LabelFor(S => S.Fees)<br />@Html.TextBoxFor(S => S.Fees)</div>

<div>

@Html.LabelFor(S => S.Photo)<br />

<img src='~/Uploads/@Model.Photo' height="50" width="50" alt="No Image" style="border:dashed 2px red" />

<input type="file" name="selectedFile" />

</div>

<div>

<input type="submit" value="Update" />

@Html.ActionLink("Cancel", "DisplayStudents")

</div>

}

**Calling Stored Procedures using LINQ**

If we want to call Stored Procedures of SQL Server Database by using LINQ we need to first drag & drop those Procedures on to the RHS panel of OR-Designer from Server Explorer, so that they get converted into methods under our “DataContext” class with the same name of Procedures. In this process if the Stored Procedure has any parameters, then those parameters will be defined for Method also, i.e., “input” parameters of Procedure will become “input” parameters of the Method and “output” parameters of the Procedure will become “ref” parameters of the Method.

**For example, if the below SP was dropped on RHS panel of OR-designer:**

Create Procedure Add(@x int, @y int, @z int output)

**A method gets defined under MVCDBDataContext class as following:**

public int Add(int? x, int? y, ref int? z)

If the Procedure is defined to perform any Non-Query operations then return type of the method will be integer, whereas if the Procedure is defined to perform Query operations then return type of the method will be “ISingleResult<T>”, where “T” represents a class that is newly defined when we drag & drop the Query Procedure and the name of the new class will be “SP Name” suffixed with “Result” i.e. for example if the Procedure name is “Student\_Select” then the class name will be “Student\_SelectResult”.

To test calling Stored Procedures, create a new “ASP.NET Web Application” project, naming it as “MVCWithLinq2” choose “MVC Project Template” and click on “Create” button. Now open “Solution Explorer” and under the Models folder add “OR Designer” and to do that open “Add New Item” window, select the option “Linq to SQL Classes”, name it as “MVCDB.dbml” and click on the Add button. Now open “Server Explorer” and configure our “MVCDB” Database under it and create the below 4 Stored Procedure’s in the Database to perform CRUD Operations on “Student” table. To create a Procedure right click on the “Stored Procedures” node under the Database and select the option “Add New Stored Procedure” which opens a window, write the Procedure code over there and after implementing the code write click on the document window and select “Execute” which will create the Procedure in the Database.

CREATE Procedure Student\_Select(@Sid Int=Null, @Status Bit=Null)

As

Begin

If @Sid Is Null And @Status Is Null --Fetches all the records of table

Select Sid, Name, Class, Fees, Photo From Student Order By Sid;

Else If @Sid Is Null And @Status Is Not Null --Fetches records based on Status

Select Sid, Name, Class, Fees, Photo From Student Where Status=@Status Order By Sid;

Else If @Sid Is Not Null And @Status Is Null --Fetches a single record based on Sid

Select Sid, Name, Class, Fees, Photo From Student Where Sid=@Sid;

Else If @Sid Is Not Null And @Status Is Not Null --Fetches a single record based on Sid & Status

Select Sid, Name, Class, Fees, Photo From Student Where Sid=@Sid And Status=@Status;

End;

Create Procedure Student\_Insert(@Sid int, @Name varchar(50), @Class int, @Fees money, @Photo varchar(100)=null)

As

Insert Into Student (Sid, Name, Class, Fees,Photo) Values (@Sid, @Name, @Class, @Fees, @Photo)

Create Procedure Student\_Update(@Sid int, @Name varchar(50), @Class int, @Fees money, @Photo varchar(100)=Null)

As

Update Student Set Name=@Name, Class=@Class, Fees=@Fees, Photo=@Photo Where Sid=@Sid;

Create Procedure Student\_Delete(@Sid Int)

As

Update Student Set Status=0 Where Sid=@Sid;

Now drag and drop the 4 Stored Procedures we have defined above on to the RHS Panel of “OR Designer”, which will generate the required methods in “MVCDBDataContext” class. It also generates a class with the name “Student\_SelectResult” mapping with the results retrieved by “Student\_Select” Stored Procedure.

**Note:** In this case we don’t have “Student (Model)” class generated because we did not drag and drop “Student” table on the “OR-Designer”, so we can use “Student\_SelectResult” class as our Model to perform Model Binding for Views.

**Add a controller in Controllers folder naming it as StudentController.cs and write the below code in it:**

using System.IO;

using MVCWithLinq2.Models;

public class StudentController : Controller

{

MVCDBDataContext dc = new MVCDBDataContext();

public ViewResult DisplayStudents()

{

List<Student\_SelectResult> students = dc.Student\_Select(null, true).ToList();

return View(students);

}

public ViewResult DisplayStudent(int Sid)

{

Student\_SelectResult student = dc.Student\_Select(Sid, true).ToList()[0];

return View(student);

}

[HttpGet]

public ViewResult AddStudent()

{

Student\_SelectResult student = new Student\_SelectResult();

return View(student);

}

[HttpPost]

public RedirectToRouteResult AddStudent(Student\_SelectResult student, HttpPostedFileBase selectedFile)

{

if(selectedFile != null)

{

string folderPath = Server.MapPath("~/Uploads/");

if(!Directory.Exists(folderPath))

{

Directory.CreateDirectory(folderPath);

}

selectedFile.SaveAs(folderPath + selectedFile.FileName);

student.Photo = selectedFile.FileName;

}

dc.Student\_Insert(student.Sid, student.Name, student.Class, student.Fees, student.Photo);

return RedirectToAction("DisplayStudents");

}

public ViewResult EditStudent(int Sid)

{

Student\_SelectResult student = dc.Student\_Select(Sid, true).ToList()[0];

TempData["Photo"] = student.Photo;

return View(student);

}

public RedirectToRouteResult UpdateStudent(Student\_SelectResult student, HttpPostedFileBase selectedFile)

{

if (selectedFile != null)

{

string folderPath = Server.MapPath("~/Uploads/");

if (!Directory.Exists(folderPath))

{

Directory.CreateDirectory(folderPath);

}

selectedFile.SaveAs(folderPath + selectedFile.FileName);

student.Photo = selectedFile.FileName;

}

else if(TempData["Photo"] != null) {

student.Photo = TempData["Photo"].ToString();

}

dc.Student\_Update(student.Sid, student.Name, student.Class, student.Fees, student.Photo);

return RedirectToAction("DisplayStudents");

}

public RedirectToRouteResult DeleteStudent(int Sid)

{

dc.Student\_Delete(Sid);

return RedirectToAction("DisplayStudents");

}

}

**Add a view with the name DisplayStudents.cshtml, selecting layout Checkbox and write the below code in it:**

@model IEnumerable<MVCWithLinq2.Models.Student\_SelectResult>

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Students Details</h2>

<table border="1" align="center" class="table-condensed">

<tr>

<th>@Html.DisplayNameFor(S => S.Sid)</th>

<th>@Html.DisplayNameFor(S => S.Name)</th>

<th>@Html.DisplayNameFor(S => S.Class)</th>

<th>@Html.DisplayNameFor(S => S.Fees)</th>

<th>@Html.DisplayNameFor(S => S.Photo)</th>

<th>Actions</th>

</tr>

@foreach (MVCWithLinq2.Models.Student\_SelectResult student in Model)

{

<tr>

<td>@Html.DisplayFor(S => student.Sid)</td>

<td>@Html.DisplayFor(S => student.Name)</td>

<td>@Html.DisplayFor(S => student.Class)</td>

<td>@Html.DisplayFor(S => student.Fees)</td>

<td><img src='/Uploads/@student.Photo' width="40" height="25" alt="No Image" /></td>

<td>

@Html.ActionLink("View", "DisplayStudent", new { Sid = student.Sid })

@Html.ActionLink("Edit", "EditStudent", new { Sid = student.Sid })

@Html.ActionLink("Delete", "DeleteStudent", new { Sid = student.Sid },

new { onclick = "return confirm('Are you sure of deleting the record?')" })

</td>

</tr>

}

<tr><td colspan="6" align="center">@Html.ActionLink("Add New Student", "AddStudent")</td></tr>

</table>

**Add a view with the name DisplayStudent.cshtml, selecting layout Checkbox and write the below code in it:**

@model MVCWithLinq2.Models.Student\_SelectResult

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Student Details</h2>

<table border="1" align="center">

<tr>

<td rowspan=4><img src='~/Uploads/@Model.Photo' width="200" height="200" alt="No Image" /></td>

<td>Sid: @Model.Sid</td>

</tr>

<tr><td>Name: @Model.Name</td></tr>

<tr><td>Class: @Model.Class</td></tr>

<tr><td>Fees: @Model.Fees</td></tr>

<tr><td colspan="2" align="center">@Html.ActionLink("Back to Student Details", "DisplayStudents")</td></tr>

</table>

**Add a view with the name AddStudent.cshtml, selecting layout Checkbox and write the below code in it:**

@model MVCWithLinq2.Models.Student\_SelectResult

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Add New Student</h2>

@using (Html.BeginForm("AddStudent", "Student", FormMethod.Post, new { enctype = "multipart/form-data" }))

{

<div>@Html.LabelFor(S => S.Sid)<br />@Html.TextBoxFor(S => S.Sid)</div>

<div>@Html.LabelFor(S => S.Name)<br />@Html.TextBoxFor(S => S.Name)</div>

<div>@Html.LabelFor(S => S.Class)<br />@Html.TextBoxFor(S => S.Class)</div>

<div>@Html.LabelFor(S => S.Fees)<br />@Html.TextBoxFor(S => S.Fees)</div>

<div>@Html.LabelFor(S => S.Photo)<br /><input type="file" name="selectedFile" /></div>

<div>

<input type="submit" value="Save" name="btnSave" />

<input type="reset" value="Reset" name="btnReset" />

</div>

}

@Html.ActionLink("Back to Student Details", "DisplayStudents")

**Add a view with the name EditStudent.cshtml, selecting layout Checkbox and write the below code in it:**

@model MVCWithLinq2.Models.Student\_SelectResult

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Edit Student Details</h2>

@using (Html.BeginForm("UpdateStudent","Student", FormMethod.Post, new { enctype="multipart/form-data" }))

{

<div>@Html.LabelFor(S => S.Sid)<br />@Html.TextBoxFor(S => S.Sid, new { @readonly = "true" })</div>

<div>@Html.LabelFor(S => S.Name)<br />@Html.TextBoxFor(S => S.Name)</div>

<div>@Html.LabelFor(S => S.Class)<br />@Html.TextBoxFor(S => S.Class)</div>

<div>@Html.LabelFor(S => S.Fees)<br />@Html.TextBoxFor(S => S.Fees)</div>

<div>

@Html.LabelFor(S => S.Photo)

<br />

<img src='~/Uploads/@Model.Photo' width="50" height="50" alt="No Image" style="border:dashed 2px red" />

<input type="file" name="selectedFile" />

</div>

<div>

<input type="submit" value="Update" name="btnUpdate" />

@Html.ActionLink("Cancel", "DisplayStudents")

</div>

}

**Working with multiple tables using Linq to SQL**

We can work with multiple tables that are present under Database which have a relationship with each other by using LINQ, but to do that we need to define a model class that contains attributes of both the Entities. To test this, create 2 new tables under our “MVCDB” Database with the name “Department” and “Employee”, and insert few records into “Department” table as following:

Create Table Department(Did Int Constraint Did\_PK Primary Key Identity(10, 10), Dname Varchar(50), Location Varchar(50));

Create Table Employee(Eid Int Constraint Eid\_PK Primary Key Identity(1001, 1), Ename Varchar(50), Job Varchar(50), Salary Money, Did Int Constraint Did\_FK References Department(Did), Status Bit Not Null default 1);

Insert Into Department Values ('Marketing ', 'Mumbai ');

Insert Into Department Values ('Sales ', 'Chennai ');

Insert Into Department Values ('Accounting ', 'Hyderabad ');

Insert Into Department Values ('Finance ', 'Delhi ');

To test working with multiple tables, create a new “ASP.NET Web Application” project, naming it as “MVCWithLinq3”, choose “MVC Project Template” and click on the “Create” button. Now under the Models folder add “OR Designer” naming it as “MVCDB.dbml”. Configure our “MVCDB” Database under “Server Explorer” and then drag & drop “Department” and “Employee” Tables on the LHS Panel of OR Designer. Now under Models folder add a Class with the name “EmpDept.cs” and write the below code in it:

using System.Web.Mvc;

public class EmpDept

{

public int Eid { get; set; }

public string Ename { get; set; }

public string Job { get; set; }

public decimal? Salary { get; set; }

public int Did { get; set; }

public string Dname { get; set; }

public string Location { get; set; }

public List<SelectListItem> Departments { get; set; }

}

**Add another class under Models folder with the name EmployeeDAL.cs and write the below code in it:**

using System.Web.Mvc;

public class EmployeeDAL

{

MVCDBDataContext dc = new MVCDBDataContext();

public List<SelectListItem> GetDepartments()

{

List<SelectListItem> Depts = new List<SelectListItem>();

foreach (var Item in dc.Departments)

{

SelectListItem li = new SelectListItem { Text = Item.Dname, Value = Item.Did.ToString() };

Depts.Add(li);

}

return Depts;

}

public EmpDept GetEmployee(int Eid)

{

var Record = (from E in dc.Employees join D in dc.Departments on E.Did equals D.Did where E.Eid == Eid select

new { E.Eid, E.Ename, E.Job, E.Salary, D.Did, D.Dname, D.Location }).Single();

EmpDept Emp = new EmpDept { Eid = Record.Eid, Ename = Record.Ename, Job = Record.Job,

Salary = Record.Salary, Did = Record.Did, Dname = Record.Dname, Location = Record.Location };

return Emp;

}

public List<EmpDept> GetEmployees()

{

var Records = from E in dc.Employees join D in dc.Departments on E.Did equals D.Did where E.Status == true

select new { E.Eid, E.Ename, E.Job, E.Salary, D.Did, D.Dname, D.Location };

List<EmpDept> Emps = new List<EmpDept>();

foreach (var Record in Records)

{

EmpDept Emp = new EmpDept { Eid = Record.Eid, Ename = Record.Ename, Job = Record.Job,

Salary = Record.Salary, Did = Record.Did, Dname = Record.Dname, Location = Record.Location };

Emps.Add(Emp);

}

return Emps;

}

public void Employee\_Insert(EmpDept obj)

{

Employee Emp = new Employee { Ename = obj.Ename, Job = obj.Job, Salary = obj.Salary, Did = obj.Did,

Status = true };

dc.Employees.InsertOnSubmit(Emp);

dc.SubmitChanges();

}

public void Employee\_Update(EmpDept NewValues)

{

Employee OldValues = dc.Employees.Single(E => E.Eid == NewValues.Eid);

OldValues.Ename = NewValues.Ename;

OldValues.Job = NewValues.Job;

OldValues.Salary = NewValues.Salary;

OldValues.Did = NewValues.Did;

dc.SubmitChanges();

}

public void Employee\_Delete(int Eid)

{

Employee OldValues = dc.Employees.Single(E => E.Eid == Eid);

OldValues.Status = false;

dc.SubmitChanges();

}

}

**Add a Controller under Controllers folder with the name EmployeeController.cs and write the below code in it:**

using MVCWithLinq3.Models;

public class EmployeeController : Controller

{

EmployeeDAL obj = new EmployeeDAL();

public ViewResult DisplayEmployees()

{

return View(obj.GetEmployees());

}

public ViewResult DisplayEmployee(int eid)

{

return View(obj.GetEmployee(eid));

}

[HttpGet]

public ViewResult AddEmployee()

{

EmpDept emp = new EmpDept();

emp.Departments = obj.GetDepartments();

return View(emp);

}

[HttpPost]

public RedirectToRouteResult AddEmployee(EmpDept emp)

{

obj.Employee\_Insert(emp);

return RedirectToAction("DisplayEmployees");

}

public ViewResult EditEmployee(int eid)

{

EmpDept Emp = obj.GetEmployee(eid);

Emp.Departments = obj.GetDepartments();

return View(Emp);

}

public RedirectToRouteResult UpdateEmployee(EmpDept emp)

{

obj.Employee\_Update(emp);

return RedirectToAction("DisplayEmployees");

}

public RedirectToRouteResult DeleteEmployee(int eid)

{

obj.Employee\_Delete(eid);

return RedirectToAction("DisplayEmployee");

}

}

**Add a view with the name DisplayEmployees.cshtml, selecting layout Checkbox and write the below code in it:**

@model IEnumerable<MVCWithLinq3.Models.EmpDept>

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Employee Details</h2>

<table border="1" align="center">

<tr>

<th>@Html.DisplayNameFor(E => E.Eid)</th>

<th>@Html.DisplayNameFor(E => E.Ename)</th>

<th>@Html.DisplayNameFor(E => E.Job)</th>

<th>@Html.DisplayNameFor(E => E.Salary)</th>

<th>@Html.DisplayNameFor(E => E.Did)</th>

<th>@Html.DisplayNameFor(E => E.Dname)</th>

<th>@Html.DisplayNameFor(E => E.Location)</th>

<th>Actions</th>

</tr>

@foreach (var Employee in Model)

{

<tr>

<td>@Html.DisplayFor(E => Employee.Eid)</td>

<td>@Html.DisplayFor(E => Employee.Ename)</td>

<td>@Html.DisplayFor(E => Employee.Job)</td>

<td>@Html.DisplayFor(E => Employee.Salary)</td>

<td>@Html.DisplayFor(E => Employee.Did)</td>

<td>@Html.DisplayFor(E => Employee.Dname)</td>

<td>@Html.DisplayFor(E => Employee.Location)</td>

<td>

@Html.ActionLink("View", "DisplayEmployee", new { Eid = Employee.Eid })

@Html.ActionLink("Edit", "EditEmployee", new { Eid = Employee.Eid })

@Html.ActionLink("Delete", "DeleteEmployee", new { Eid = Employee.Eid },

new { onclick = "return confirm('Are you sure of deleting the record?')" })

</td>

</tr>

}

<tr><td colspan="8" align="center">@Html.ActionLink("Add New Employee", "AddEmployee")</td></tr>

</table>

**Add a view with the name DisplayEmployee.cshtml, selecting layout Checkbox and write the below code in it:**

@model MVCWithLinq3.Models.EmpDept

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Employee Details</h2>

<table border="1" align="center">

<tr> <td>Eid:</td> <td>@Model.Eid</td> </tr>

<tr> <td>Ename:</td> <td>@Model.Ename</td> </tr>

<tr> <td>Job:</td> <td>@Model.Job</td> </tr>

<tr> <td>Salary:</td> <td>@Model.Salary</td> </tr>

<tr> <td>Did:</td> <td>@Model.Did</td> </tr>

<tr> <td>Dname:</td> <td>@Model.Dname</td> </tr>

<tr> <td>Location:</td> <td>@Model.Location</td> </tr>

<tr>

<td colspan="2" align="center">@Html.ActionLink("Back to Employee Details", "DisplayEmployees")</td>

</tr>

</table>

**Add a view with the name AddEmployee.cshtml, selecting layout Checkbox and write the below code in it:**

@model MVCWithLinq3.Models.EmpDept

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Add New Employee</h2>

@using (Html.BeginForm("AddEmployee", "Employee"))

{

<div>@Html.LabelFor(E => E.Ename)<br />@Html.TextBoxFor(E => E.Ename)</div>

<div>@Html.LabelFor(E => E.Job)<br />@Html.TextBoxFor(E => E.Job)</div>

<div>@Html.LabelFor(E => E.Salary)<br />@Html.TextBoxFor(E => E.Salary)</div>

<div>

@Html.LabelFor(E => E.Dname)<br />

@Html.DropDownListFor(E => E.Did, Model.Departments, "-Select Dept-")

</div>

<div>

<input type="submit" value="Save" name="btnSave" />

<input type="reset" value="Reset" name="btnReset" />

</div>

}

**Add a view with the name EditEmployee.cshtml, selecting layout Checkbox and write the below code in it:**

@model MVCWithLinq3.Models.EmpDept

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Edit Employee Details</h2>

@using (Html.BeginForm("UpdateEmployee", "Employee"))

{

<div>@Html.LabelFor(E => E.Eid)<br />@Html.TextBoxFor(E => E.Eid, new { @readonly = "true" })</div>

<div>@Html.LabelFor(E => E.Ename)<br />@Html.TextBoxFor(E => E.Ename)</div>

<div>@Html.LabelFor(E => E.Job)<br />@Html.TextBoxFor(E => E.Job)</div>

<div>@Html.LabelFor(E => E.Salary)<br />@Html.TextBoxFor(E => E.Salary)</div>

<div>@Html.LabelFor(E => E.Dname)<br />@Html.DropDownListFor(E => E.Did, Model.Departments)</div>

<div>

<input type="submit" value="Update" name="btnUpdate" />

@Html.ActionLink("Cancel", "DisplayEmployees")

</div>

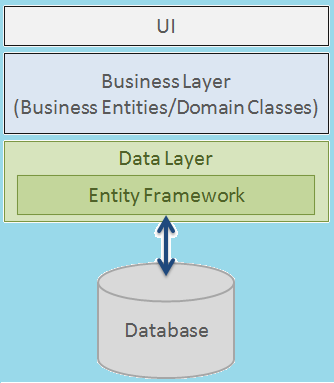
}

**Note:** while working with multiple tables, model binding is done with the class we have defined representing the 2 tables i.e., “EmpDept”, whereas while performing Insert, or Update or Delete operations we will be working with the original Model class only i.e., “Employee” or “Department”.

**Entity Framework**

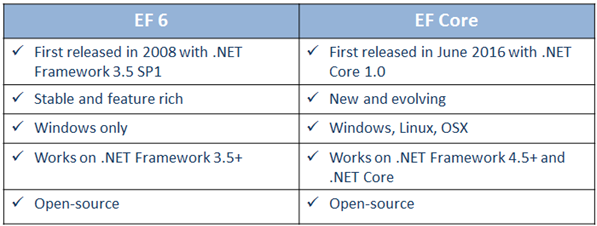
Prior to .NET 3.5, we (developers) often used to write “ADO.NET” code to save or retrieve application data from the underlying Database. We used to open a connection to the Database, create a “DataSet” or “DataReader” to fetch or submit the data to the Database and in this process, we convert data present in the “DataSet” or “DataReader” to .NET objects or vice-versa to apply business rules. This was a cumbersome and error prone process. Microsoft has provided a framework called “Entity Framework” to automate all these Database related activities for your application.

Entity Framework is an open source “ORM Framework” for .NET Applications supported by Microsoft. It enables developers to work with data using objects of domain specific classes without focusing on the underlying Database or Tables and Columns where this data is stored. With Entity Framework, developers can work at a higher level of abstraction when they deal with data and can create and maintain data-oriented applications with less code compared with traditional applications. “Entity Framework is an Object-Relational Mapper (O/RM) that enables .NET developers to work with a Database using .NET Objects. It eliminates the need for most of the data-access code that developers usually need to write.”



As per the above figure, Entity Framework fits between the business entities (domain classes) and the Database. It saves data stored in the properties of business entities and retrieves data from the Database and converts it to business entity objects automatically.

**Entity Framework Versions:** Microsoft introduced Entity Framework in 2008 with .NET Framework 3.5 SP1. Since then, it released many versions of Entity Framework. Currently, there are two latest versions of Entity Framework: “EF 6” and “EF Core”. The following table lists important difference between EF 6 and EF Core.



**EF 6 Version History:**

EF 3.5,

EF 4.0, EF 4.1, EF 4.1.1, EF 4.2, EF 4.3, EF 4.3.1,

EF 5.0,

EF 6.0, EF 6.0.1, EF 6.0.2, EF 6.1.0, EF 6.1.1, EF 6.1.2, EF 6.1.3, EF 6.2.0, EF 6.3.0, EF 6.4.0, EF 6.4.4

**EF Core Version History:**

EF Core 1.0, EF Core 1.1

EF Core 2.0, EF Core 2.1, EF Core 2.2

EF Core 3.0, EF Core 3.1

EF Core 5.0

EF Core 6.0

**Entity Framework Features:**

**Cross-platform:** EF Core is a cross-platform framework which can run on Windows, Linux, and Mac.

**Modelling:** EF (Entity Framework) creates an EDM (Entity Data Model) based on POCO (Plain Old CLR Object) entities with get/set properties of different data types. It uses this model when querying or saving entity data to the underlying Database.

**Querying:** EF allows us to use LINQ queries to retrieve data from the underlying database. The database provider will translate this LINQ queries to the database-specific query language (e.g., SQL for a relational database). EF also allows us to execute raw SQL queries directly to the database.

**Change Tracking:** EF keeps track of changes occurred to instances of your entities (Property values) which need to be submitted to the Database.

**Saving:** EF executes INSERT, UPDATE, and DELETE commands to the database based on the changes occurred to your entities when you call the SaveChanges() method. EF also provides the asynchronous SaveChangesAsync() method.

**Concurrency:** EF uses Optimistic Concurrency by default to protect overwriting changes made by another user since data was fetched from the database.

**Transactions:** EF performs automatic transaction management while querying or saving data. It also provides options to customize transaction management.

**Caching:** EF includes first level of caching out of the box. So, repeated querying will return data from the cache instead of hitting the database.

**Built-in Conventions:** EF follows conventions over the configuration programming pattern and includes a set of default rules which automatically configure the EF model.

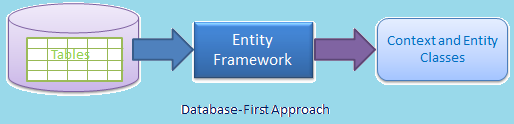
**Configurations:** EF allows us to configure the EF model by using Data Annotation attributes or Fluent API to override default conventions.

**Migrations:** EF provides a set of migration commands that can be executed on the NuGet Package Manager Console or the Command Line Interface to create or manage underlying database Schema.

**Development Approaches with Entity Framework:** There are 3 different approaches you can use while developing your application using Entity Framework:

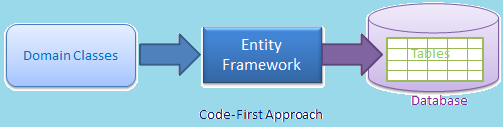
* **Database-First**
* **Code-First**
* **Model-First**

**Database-First Approach:** in this approach we generate the context and entity classes (model classes) for an existing database using EDM Wizard which is integrated into Visual Studio or executing EF commands.

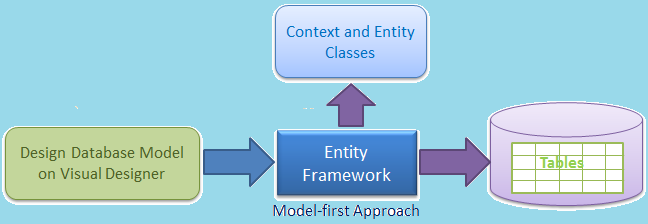


**Note:** EF 6 supports the database-first approach extensively whereas EF Core includes limited support for this approach.

**Code-First Approach:** in this approach we don’t have any existing database for our application and in such case, we start writing our entities (model) and context classes first and then create the database from these classes using migration commands. Developers who follow the “Domain-Driven Design (DDD)” principles, prefer to begin with coding their domain classes first and then generate the database required to persist their data.

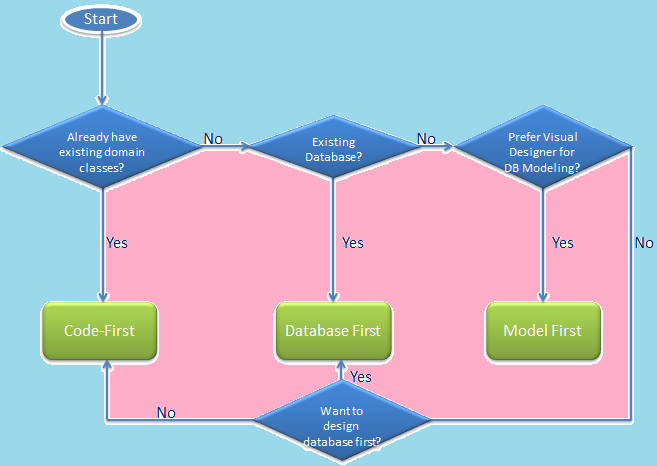


**Model-First Approach:** In this approach, you create entities, relationships, and inheritance hierarchies directly on the visual designer integrated in Visual Studio and then generate entities, the context class, and the database script from your visual model.



**Note:** EF 6 includes limited support for this, and EF Core does not support this approach.

**Choosing a Development Approach for our Application:** use the following flow chart to decide which will be the right approach to develop an application using Entity Framework:



**Database First Approach**

To work with Entity Framework, create a new “ASP.NET Web Application” project naming it as “MVCWithEFDBF1”, choose “MVC Project Template” and click on “Create” button. Now open Solution Explorer, right click on the Models folder and choose “Add => New Item” option and in the window opened select the item “ADO.NET Entity Data Model”, name it as “TestEF.edmx”, click “Ok” which opens a wizard and in that select the option “EF Designer from database” => click “Next” and in the window opened click on “New Connection” button and enter the connection details for our “MVCDB” database and click “Ok” button which will close the “New Connection” window, now select the radio button “Yes, include the sensitive data in the connection string.” => click “Next” button, choose the radio button “Entity Framework 6.x” => click “Next” button which will connect to Data Source and loads all the objects from there. Under tables select our “Department” and “Employee” tables and click “Finish”, which generates all the classes that are necessary for working with tables.

Under solution explorer if we expand “TestEF.edmx” item we find “TestEF.Context.tt” and if we expand this we find “TestEF.context.cs” and if we expand this we find “MVCDBEntities” item and if we double click on it, it opens “TestEF.context.cs” file and there we find a class with the name “MVCDBEntities” (DataContext class) inheriting from “DbContext”. DbContext is the main class that is responsible for interacting with the Database and it can perform the following activities:

**Querying:** Converts “LINQ-to-Entities” Queries to SQL Queries and sends them to the Database.

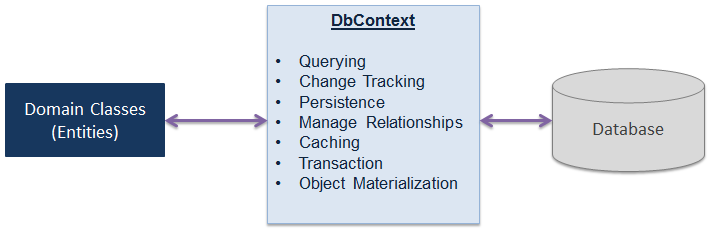
**Change Tracking:** Keeps track of changes that occurred on the entities after Querying from the database.

**Persisting Data:** Performs the Insert, Update and Delete operations to the DB, based on entity states.

**Caching:** Provides first level caching by default. It stores the entities which have been retrieved during the life time of a context class.

**Manage Relationship:** Manages relationships using CSDL, MSL and SSDL in Db-First or Model-First approach, and using fluent API configurations in Code-First approach.

**Object Materialization:** Converts raw data from the database into entity objects.



**Under MVCDBEntities class the code will be as following:**

public partial class MVCDBEntities : DbContext

{

public MVCDBEntities() : base("name=MVCDBEntities")

{

}

protected override void OnModelCreating(DbModelBuilder modelBuilder)

{

throw new UnintentionalCodeFirstException();

}

public virtual DbSet<Department> Departments { get; set; }

public virtual DbSet<Employee> Employees { get; set; }

}

**Note:** Departments and Employees properties of the above class provide a collection of Department and Employee entities as “DbSet<TEntity>” type using which we can access all the data from corresponding tables.

Now expand “TestEF.tt” and there we find “Department.cs” file which contains the Entity i.e. Department class (representing Department table) with all of its attributes (properties or columns), and also “Employee.cs” file which contains the Entity i.e. Employee class (representing Employee table) with all of its attributes (properties or columns) and in this class we also find a property “Department” (Navigation Property) which refers to the “Department” (1 to 1 relationship) entity which is the parent table for “Employee”. Same as the above under “Department” class we find a property “Employees” (Navigation Property) referring to “Employees” (1 to many relationship) corresponding to each Department.

**Under “Department” & “Employee” classes the code will be as following:**

public partial class Department

{

public Department()

{

this.Employees = new HashSet<Employee>();

}

public int Did { get; set; }

public string Dname { get; set; }

public string Location { get; set; }

public virtual ICollection<Employee> Employees { get; set; }

}

public partial class Employee

{

public int Eid { get; set; }

public string Ename { get; set; }

public string Job { get; set; }

public Nullable<decimal> Salary { get; set; }

public Nullable<int> Did { get; set; }

public bool Status { get; set; }

public virtual Department Department { get; set; }

}

**Generating Controllers and Views using Scaffolding:** we are provided with an option of generating the required Controllers, Action Methods and Views by using Scaffolding and to do that first build the project, and then right click on the Controllers folder and select “Add” => “Controller” which opens “Add New Scaffolded Item” window, in that window choose “MVC5 Controller with views, using EntityFramework” and click on “Add” button which opens “Add Controller” window , now in that window select “Model class” as “Employee”, “Data context class” as “MVCDBEntities”, and in the bottom it will display a name to the controller i.e., “EmployeesController” (either leave the same or change to EmployeeController) and click on “Add” button which will generate a Controller with all the required “Action Methods” and corresponding views to perform CRUD Operations. Run the project and watch the behaviour of the whole application by performing CRUD Operations.

**Performing CRUD operations manually without using Scaffolding:**

open a new “ASP.NET Web Application” project naming it as “MVCWithEFDBF2”, choose “MVC Project Template” and click on “Create” button. Now open the solution explorer right click on the Models folder and open the “Add New Item” window and select the item “ADO.NET Entity Data Model” and name it as “TestEF.edmx” and click “Ok” which opens a wizard and in that select the option “EF Designer from database” and click “Next” and in the window opened click on “New Connection” button and enter the connection details for our “MVCDB” database and then select the radio button “Yes, include the sensitive data in the connection string.”, click “Next” button, choose the radio button “Entity Framework 6.x”, click “Next” button which will connect to data sources and load all the object from it, now under tables select our “Department” and “Employee” tables we have and click Finish, which generates all the classes that are necessary for working with database. Now add a controller under Controller’s folder naming it as “EmployeeController.cs” and write the below code:

using System.Data.Entity;

using MVCWithEFDBF2.Models;

public class EmployeeController : Controller

{

MVCDBEntities dc = new MVCDBEntities();

public ViewResult DisplayEmployees()

{

var Emps = dc.Employees.Where(E => E.Status == true);

return View(Emps);

}

public ViewResult DisplayEmployee(int Eid)

{

var Emp = dc.Employees.Find(Eid);

return View(Emp);

}

public ViewResult AddEmployee()

{

ViewBag.Did = new SelectList(dc.Departments, "Did", "Dname");

return View();

}

[HttpPost]

public RedirectToRouteResult AddEmployee(Employee Emp)

{

Emp.Status = true;

dc.Employees.Add(Emp);

dc.SaveChanges();

return RedirectToAction("DisplayEmployees");

}

public ViewResult EditEmployee(int Eid)

{

Employee Emp = dc.Employees.Find(Eid);

ViewBag.Did = new SelectList(dc.Departments, "Did", "Dname", Emp.Did);

return View(Emp);

}

public RedirectToRouteResult UpdateEmployee(Employee Emp)

{

Emp.Status = true;

dc.Entry(Emp).State = EntityState.Modified;

dc.SaveChanges();

return RedirectToAction("DisplayEmployees");

}

public ViewResult DeleteEmployee(int Eid)

{

Employee Emp = dc.Employees.Find(Eid);

return View(Emp);

}

[HttpPost]

public RedirectToRouteResult DeleteEmployee(Employee Emp)

{

//If we want to update the status of employee use the below code:

dc.Entry(Emp).State = EntityState.Modified;

//If we want to delete the record permanently comment the above statement and un-comment the below:

//dc.Entry(Emp).State = EntityState.Deleted;

dc.SaveChanges();

return RedirectToAction("DisplayEmployees");

}

}

Add a view with the name DisplayEmployee.cshtml, selecting layout Checkbox and write the below code in it by deleting the whole content in the View:

@model IEnumerable<MVCWithEFDBF2.Models.Employee>

@{

ViewBag.Title = "Display Employees";

}

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Employee Details</h2>

<table border="1" align="center">

<tr>

<th>@Html.DisplayNameFor(E => E.Eid)</th>

<th>@Html.DisplayNameFor(E => E.Ename)</th>

<th>@Html.DisplayNameFor(E => E.Job)</th>

<th>@Html.DisplayNameFor(E => E.Salary)</th>

<th>@Html.DisplayNameFor(E => E.Status)</th>

<th>@Html.DisplayNameFor(E => E.Did)</th>

<th>@Html.DisplayNameFor(E => E.Department.Dname)</th>

<th>@Html.DisplayNameFor(E => E.Department.Location)</th>

<th>Actions</th>

</tr>

@foreach (var Employee in Model)

{

<tr>

<td>@Html.DisplayFor(E => Employee.Eid)</td>

<td>@Html.DisplayFor(E => Employee.Ename)</td>

<td>@Html.DisplayFor(E => Employee.Job)</td>

<td align="right">@Html.DisplayFor(E => Employee.Salary)</td>

<td align="center">@Html.DisplayFor(E => Employee.Status)</td>

<td align="center">@Html.DisplayFor(E => Employee.Did)</td>

<td>@Html.DisplayFor(E => Employee.Department.Dname)</td>

<td>@Html.DisplayFor(E => Employee.Department.Location)</td>

<td>

@Html.ActionLink("View", "DisplayEmployee", new { Eid = Employee.Eid })

@Html.ActionLink("Edit", "EditEmployee", new { Eid = Employee.Eid })

@Html.ActionLink("Delete", "DeleteEmployee", new { Eid = Employee.Eid })

</td>

</tr>

}

<tr><td colspan="9" align="center">@Html.ActionLink("Add New Employee", "AddEmployee")</td></tr>

</table>

Generate a view for DisplayEmployee action method and while adding the View, choose the Template as Empty, Model Class as Employee, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Employee Details</h2>

<table border="1" align="center">

<tr><td>Eid:</td><td>@Model.Eid</td></tr>

<tr><td>Ename:</td><td>@Model.Ename</td></tr>

<tr><td>Job:</td><td>@Model.Job</td></tr>

<tr><td>Salary:</td><td>@Model.Salary</td></tr>

<tr><td>Status:</td><td>@Html.DisplayFor(E => E.Status)</td></tr>

<tr><td>Did:</td><td>@Model.Did</td></tr>

<tr><td>Dname:</td><td>@Model.Department.Dname</td></tr>

<tr><td>Location:</td><td>@Model.Department.Location</td></tr>

<tr>

<td colspan="2" align="center">@Html.ActionLink("Back to Employee Details", "DisplayEmployees")</td>

</tr>

</table>

Generate a view for AddEmployee action method and while adding the View, choose the Template as Empty, Model Class as Employee, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Add New Employee</h2>

@using (Html.BeginForm("AddEmployee", "Employee"))

{

<div>@Html.LabelFor(E => E.Ename)<br />@Html.TextBoxFor(E => E.Ename)</div>

<div>@Html.LabelFor(E => E.Job)<br />@Html.TextBoxFor(E => E.Job)</div>

<div>@Html.LabelFor(E => E.Salary)<br />@Html.TextBoxFor(E => E.Salary)</div>

<div><label>Department</label><br />@Html.DropDownList("Did", "-Select Department-")</div>

<div>

<input type="submit" value="Save" name="btnSave" />

<input type="reset" value="Reset" name="btnReset" />

</div>

}

@Html.ActionLink("Back to Employee Details", "DisplayEmployees")

Generate a view for EditEmployee action method and while adding the View, choose the Template as Empty, Model Class as Employee, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Edit Employee</h2>

@using (Html.BeginForm("UpdateEmployee", "Employee"))

{

@Html.HiddenFor(E => E.Eid)

<div>@Html.LabelFor(E => E.Ename)<br />@Html.TextBoxFor(E => E.Ename)</div>

<div>@Html.LabelFor(E => E.Job)<br />@Html.TextBoxFor(E => E.Job)</div>

<div>@Html.LabelFor(E => E.Salary)<br />@Html.TextBoxFor(E => E.Salary)</div>

<div><label>Department</label><br />@Html.DropDownList("Did")</div>

<div>

<input type="submit" value="Update" name="btnUpdate" />

@Html.ActionLink("Cancel", "DisplayEmployees")

</div>

}

Generate a view for DeleteEmployee action method and while adding the View, choose the Template as Empty, Model Class as Employee, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Delete Employee</h2>

@using (Html.BeginForm("DeleteEmployee", "Employee"))

{

<table border="1">

<tr><td>Eid:</td><td>@Html.TextBoxFor(E => E.Eid, new { @readonly = "true" })</td></tr>

<tr><td>Ename:</td><td>@Html.TextBoxFor(E => E.Ename, new { @readonly = "true" })</td></tr>

<tr><td>Job:</td><td>@Html.TextBoxFor(E => E.Job, new { @readonly = "true" })</td></tr>

<tr><td>Salary:</td><td>@Html.TextBoxFor(E => E.Salary, new { @readonly = "true" })</td></tr>

<tr><td>Did:</td><td>@Html.TextBoxFor(E => E.Did, new { @readonly = "true" })</td></tr>

</table>

<font color="red">Are you sure of deleting the current record?</font>

<input type="submit" value="Yes" /><br />

@Html.ActionLink("Cancel", "DisplayEmployees")

}

**Eager Loading Vs Lazy Loading in Entity Framework:** eager loading is the process whereby a query for one type of entity also loads related entities as part of the query, so that we don’t need to execute a separate query for related entities. Eager loading is achieved using Include() method. In our above project under the “DisplayEmployees” action method we have accessed data of Employee entity as following:

MVCDBEntities dc = new MVCDBEntities();

var Emps = dc.Employees.Where(E => E.Status == true);

Default loading is lazy loading only and if we want to use eager loading then we need to first set “<DbContextClass>.Configuration.LazyLoadingEnabled = false”, and the above code should be replaced as below:

MVCDBEntities dc = new MVCDBEntities();

dc.Configuration.LazyLoadingEnabled = false;

var Emps = dc.Employees.Where(E => E.Status == true).Include(E => E.Department);

To enable eager loading in “DisplayEmployees” and “DisplayEmployee” methods re-write the code under both the methods as below:

public ViewResult DisplayEmployees()

{

dc.Configuration.LazyLoadingEnabled = false;

var Emps = dc.Employees.Where(E => E.Status == true).Include(E => E.Department);

return View(Emps);

}

public ViewResult DisplayEmployee(int Eid)

{

dc.Configuration.LazyLoadingEnabled = false;

var Emp = (dc.Employees.Where(E => E.Eid == Eid).Include(E => E.Department)).Single();

return View(Emp);

}

Lazy loading is delaying the loading of related data, until you specifically request for it. It is the opposite of eager loading. For example, the Employee entity contains the Department entity. In the lazy loading, the context first loads the Employee entity data from the Database, and then it will load the Department entity when we access the Department property.

MVCDBEntities dc = new MVCDBEntities();

List<Employee> Emps = dc.Employees.ToList(); //Loads Employees details only

Department Dept = Emps[0].Department; //Loads Department for particular Employee only

**To convert the above code to eager loading, re-write it as below:**

MVCDBEntities dc = new MVCDBEntities();

dc.Configuration.LazyLoadingEnabled = false;

List<Employee> Emps = dc.Employees.Include(E => E.Department).ToList();

Department Dept = Emp[0].Department;

**Calling Stored Procedures and performing CRUD Operations**

Create a new “ASP.NET Web Application” project naming it as “MVCWithEFDBF3”, choose “MVC Project Template” and click on “Create” button. Now open Solution Explorer, right click on the Models folder, open the “Add New Item” window and select the item “ADO.NET Entity Data Model” naming it as “TestEF.edmx” and click “Ok”, this opens a wizard and in that select the option “EF Designer from database” and click “Next”, in the window opened click on “New Connection” button and enter the connection details for our “MVCDB” database and then select the radio button “Yes, include the sensitive data in the connection string.” and click “Next” button, in the new window choose the radio button “Entity Framework 6.x” and click “Next” button which will connect to data sources and load all the object from it, now under Stored Procedures node select our Student\_Select, Student\_Insert, Student\_Update and Student\_Delete Stored Procedures we have created earlier and click Finish, which generates Methods mapping with Stored Procedures under MVCDBEntities class and the Method names will be same as Procedure names.

In our Procedures, we have a Select Procedure which is fetching 5 columns out of the 6 columns present in our table so mapping to the results of this Stored Procedure, it defines a new class whose name will be <ProcedureName>\_Result, because the procedure name is Student\_Select, the class name will be “Student\_Select\_Result” and this class will contain 5 properties representing the 5 columns we are fetching. To view that class, open Solution Explorer and under Models folder expand TestEF.edmx, under that expand TestEF.tt, under that we find a file Student\_Select\_Result.cs which contains the class Student\_Select\_Result and this class is what we will be using for model binding the views, which will be as following:

public partial class Student\_Select\_Result

{

public int Sid { get; set; }

public string Name { get; set; }

public Nullable<int> Class { get; set; }

public Nullable<decimal> Fees { get; set; }

public string Photo { get; set; }

}

**Note:** even if we are fetching all 6 columns of the table also, still it creates this class and in such cases we can delete this class and map the results with original Student class.

Add a folder under the project naming it as “Uploads” and then add a new Controller class in Controllers folder naming it as StudentController.cs and write the below code in it:

public class StudentController : Controller

{

MVCDBEntities dc = new MVCDBEntities();

public ViewResult DisplayStudents()

{

return View(dc.Student\_Select(null, true));

}

public ViewResult DisplayStudent(int sid)

{

return View(dc.Student\_Select(sid, true).Single());

}

public ViewResult AddStudent()

{

Student\_Select\_Result student = new Student\_Select\_Result();

return View(student);

}

[HttpPost]

public RedirectToRouteResult AddStudent(Student\_Select\_Result student, HttpPostedFileBase selectedFile)

{

if (selectedFile != null)

{

string PhysicalPath = Server.MapPath("~/Uploads/");

if (!Directory.Exists(PhysicalPath))

Directory.CreateDirectory(PhysicalPath);

selectedFile.SaveAs(PhysicalPath + selectedFile.FileName);

student.Photo = selectedFile.FileName;

}

dc.Student\_Insert(student.Sid, student.Name, student.Class, student.Fees, student.Photo);

return RedirectToAction("DisplayStudents");

}

public ViewResult EditStudent(int sid)

{

var student = dc.Student\_Select(sid, true).Single();

TempData["Photo"] = student.Photo;

return View(student);

}

public RedirectToRouteResult UpdateStudent(Student\_Select\_Result student, HttpPostedFileBase selectedFile)

{

if (selectedFile != null)

{

string PhysicalPath = Server.MapPath("~/Uploads/");

if (!Directory.Exists(PhysicalPath))

Directory.CreateDirectory(PhysicalPath);

selectedFile.SaveAs(PhysicalPath + selectedFile.FileName);

student.Photo = selectedFile.FileName;

}

else if (TempData["Photo"] != null)

{

student.Photo = TempData["Photo"].ToString();

}

dc.Student\_Update(student.Sid, student.Name, student.Class, student.Fees, student.Photo);

return RedirectToAction("DisplayStudents");

}

public ViewResult DeleteStudent(int sid)

{

return View(dc.Student\_Select(sid, true).Single());

}

[HttpPost]

public RedirectToRouteResult DeleteStudent(Student\_Select\_Result student)

{

dc.Student\_Delete(student.Sid);

return RedirectToAction("DisplayStudents");

}

}

Add a view with the name DisplayStudent.cshtml, selecting layout Checkbox and write the below code in it by deleting the whole content in the View:

@model IEnumerable<MVCWithEFDBF3.Models.Student\_Select\_Result>

@{

ViewBag.Title = "Display Students";

}

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Student Details</h2>

<table border="1" align="center">

<tr>

<th>@Html.DisplayNameFor(S => S.Sid)</th>

<th>@Html.DisplayNameFor(S => S.Name)</th>

<th>@Html.DisplayNameFor(S => S.Class)</th>

<th>@Html.DisplayNameFor(S => S.Fees)</th>

<th>@Html.DisplayNameFor(S => S.Photo)</th>

<th>Actions</th>

</tr>

@foreach (var Student in Model)

{

<tr>

<td>@Html.DisplayFor(S => Student.Sid)</td>

<td>@Html.DisplayFor(S => Student.Name)</td>

<td>@Html.DisplayFor(S => Student.Class)</td>

<td>@Html.DisplayFor(S => Student.Fees)</td>

<td><img src='/Uploads/@Student.Photo' width="85" height="30" alt="No Image"/></td>

<td>

@Html.ActionLink("View", "DisplayStudent", new { Sid = Student.Sid })

@Html.ActionLink("Edit", "EditStudent", new { Sid = Student.Sid })

@Html.ActionLink("Delete", "DeleteStudent", new { Sid = Student.Sid })

</td>

</tr>

}

<tr><td colspan="6" align="center">@Html.ActionLink("Add New Student", "AddStudent")</td></tr>

</table>

Generate a view for DisplayStudent action method and while adding the View, choose the Template as Empty, Model Class as Student, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Student Details</h2>

<table border="1" align="center">

<tr>

<td rowspan="4"><img src='/Uploads/@Model.Photo' width="200" height="200" alt="No Image" /></td>

<td>Sid: @Model.Sid</td>

</tr>

<tr><td>Name: @Model.Name</td></tr>

<tr><td>Class: @Model.Class</td></tr>

<tr><td>Fees: @Model.Fees</td></tr>

<tr><td colspan="2" align="center">@Html.ActionLink("Back to Student Details", "DisplayStudents")</td></tr>

</table>

Generate a view for AddStudent action method and while adding the View, choose the Template as Empty, Model Class as Student, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Add New Student</h2>

@using (Html.BeginForm("AddStudent", "Student", FormMethod.Post, new { enctype = "multipart/form-data" }))

{

<div>@Html.LabelFor(S => S.Sid)<br />@Html.TextBoxFor(S => S.Sid)</div>

<div>@Html.LabelFor(S => S.Name)<br />@Html.TextBoxFor(S => S.Name)</div>

<div>@Html.LabelFor(S => S.Class)<br />@Html.TextBoxFor(S => S.Class)</div>

<div>@Html.LabelFor(S => S.Fees)<br />@Html.TextBoxFor(S => S.Fees)</div>

<div>@Html.LabelFor(S => S.Photo)<br /><input type="file" name="selectedFile" /></div>

<div>

<input type="submit" value="Save" name="btnSave" />

<input type="reset" value="Reset" />

</div>

@Html.ActionLink("Back to Student Details", "DisplayStudents")

}

Generate a view for EditStudent action method and while adding the View, choose the Template as Empty, Model Class as Student, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Edit Student</h2>

@using (Html.BeginForm("UpdateStudent","Student",FormMethod.Post, new { enctype = "multipart/form-data"}))

{

<div>@Html.LabelFor(S => S.Sid)<br />@Html.TextBoxFor(S => S.Sid)</div>

<div>@Html.LabelFor(S => S.Name)<br>@Html.TextBoxFor(S => S.Name)</div>

<div>@Html.LabelFor(S => S.Class)<br />@Html.TextBoxFor(S => S.Class)</div>

<div>@Html.LabelFor(S => S.Fees)<br />@Html.TextBoxFor(S => S.Fees)</div>

<div>

@Html.LabelFor(S => S.Photo)<br />

<img src='/Uploads/@Model.Photo' width="100" height="100" />

<input type="file" name="selectedFile" />

</div>

<div>

<input type="submit" value="Update" name="btnUpdate" />

@Html.ActionLink("Cancel", "DisplayStudents")

</div>

}

Generate a view for DeleteStudent action method and while adding the View, choose the Template as Empty, Model Class as Student, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Delete Student</h2>

@using (Html.BeginForm("DeleteStudent", "Student"))

{

<table border="1">

<caption>Student Details</caption>

<tr>

<td rowspan="4"><img src='/Uploads/@Model.Photo' width="200" height="200" /></td>

<td>Sid: @Model.Sid @Html.HiddenFor(S => S.Sid)</td>

</tr>

<tr><td>Name: @Model.Name</td></tr>

<tr><td>Class: @Model.Class</td></tr>

<tr><td>Fees: @Model.Fees</td></tr>

</table>

<font color="red">Are you sure of deleting the current record?</font>

<input type="submit" value="Yes" />

}

@using (Html.BeginForm("DisplayStudents", "Student"))

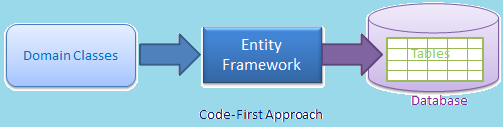
{

<text>Click</text> <input type="submit" value="No" /> @:for going back to Student Details.

}

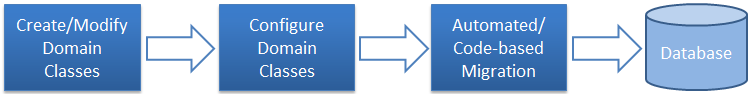
**Code-First Approach**

Entity Framework introduced the Code-First approach with Entity Framework 4.1. Code-First is mainly useful in Domain Driven Design. In the Code-First approach, we focus on the domain of your application and start creating classes for our domain entity rather than design our database first and then create the classes which match your database design. The following figure illustrates the code-first approach.



As you can see in the above figure, EF API will create the database based on your domain classes and configurations. This means you need to start coding first in C# or VB.NET languages and then EF will create the database from your code.

**Code-First Workflow:** The below figure illustrates the code-first development workflow.



To work with Code First Approach, create a new “ASP.NET Web Application” project naming it as “MVCWithEFCF1”, choose “MVC Project Template” and click on the “Create” button. Now do the following actions:

**Step 1:** Install Entity Framework in our project and to do that open “Nuget Package Manager”, go to Browse tab, search for “Entity Framework” and install “Entity Framework by Microsoft”. This will add all the references that are required to work with Entity Framework in our project.

**Step 2:** Add 3 Classes into the Models folder naming them as “Category.cs”, “Product.cs” and “StoreDbContext.cs”, and we call them as Domain Classes and then write the below code under them:

public class Category

{

public int CategoryId { get; set; }

public string CategoryName { get; set; }

public string Description { get; set; }

public ICollection<Product> Products { get; set; }

}

public class Product

{

public int Id { get; set; }

public string ProductName { get; set; }

public int CategoryId { get; set; }

public decimal UnitPrice { get; set; }

public byte[] ProductImage { get; set; }

public string ProductImageName { get; set; }

public bool Discontinued { get; set; }

public Category Category { get; set; }

}

using System.Data.Entity;

public class StoreDbContext : DbContext

{

public DbSet<Category> Categories { get; set; }

public DbSet<Product> Products { get; set; }

}

**Step 3:** Go to “Web.config” file and write the below code inside of <configuration></configuration> tag:

<connectionStrings>

<add name="StoreDbContext" connectionString="Data Source=Server;User Id=Sa;Password=123;

Database=StoreDB" providerName="System.Data.SqlClient" />

</connectionStrings>

**Step 4:** Go to “\_Layout.cshtml” and add 2 menus to work with Categories and Products. To do this, add 2 ActionLinks below the following statement:

<li>@Html.ActionLink("Contact", "Contact", "Home")</li>

**Write the below code, under the above statement:**

<li>@Html.ActionLink("Categories", "DisplayCategories", "Category")</li>

<li>@Html.ActionLink("Products", "DisplayProducts", "Product")</li>

**Step 5:** Add a controller in Controllers folder naming it as “CategoryController.cs”, define all the required Action methods and also create Views that are necessary to perform CRUD operations on “Categories” table.

using System.Data.Entity;

using MVCWithEFCF1.Models;

public class CategoryController : Controller

{

StoreDbContext dc = new StoreDbContext();

public ViewResult DisplayCategories()

{

var categories = dc.Categories;

return View(categories);

}

public ViewResult AddCategory()

{

return View();

}

[HttpPost]

public RedirectToRouteResult AddCategory(Category category)

{

dc.Categories.Add(category);

dc.SaveChanges();

return RedirectToAction("DisplayCategories");

}

public ViewResult EditCategory(int CategoryId)

{

Category category = dc.Categories.Find(CategoryId);

return View(category);

}

public RedirectToRouteResult UpdateCategory(Category category)

{

dc.Entry(category).State = EntityState.Modified;

dc.SaveChanges();

return RedirectToAction("DisplayCategories");

}

public RedirectToRouteResult DeleteCategory(int CategoryId)

{

Category category = dc.Categories.Find(CategoryId);

dc.Categories.Remove(category);

dc.SaveChanges();

return RedirectToAction("DisplayCategories");

}

}

Add a View with the name DisplayCategories.cshtml, selecting layout Checkbox and write the below code in it by deleting the whole content in the View:

@model IEnumerable<MVCWithEFCF1.Models.Category>

@{

ViewBag.Title = "Display Categories";

}

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Categories List</h2>

<table border="1" align="center">

<tr>

<th>@Html.DisplayNameFor(C => C.CategoryId)</th>

<th>@Html.DisplayNameFor(C => C.CategoryName)</th>

<th>@Html.DisplayNameFor(C => C.Description)</th>

<th>Actions</th>

</tr>

@foreach (var Category in Model)

{

<tr>

<td>@Html.DisplayFor(C => Category.CategoryId)</td>

<td>@Html.DisplayFor(C => Category.CategoryName)</td>

<td>@Html.DisplayFor(C => Category.Description)</td>

<td>

@Html.ActionLink("Edit", "EditCategory", new { CategoryId =Category.CategoryId })

@Html.ActionLink("Delete", "DeleteCategory", new { CategoryId = Category.CategoryId },

new { onclick = "return confirm('Are you sure of deleting the record?')" })

</td>

</tr>

}

<tr><td colspan="4" align="center">@Html.ActionLink("Add New Category", "AddCategory")</td></tr>

</table>

Generate a view for AddCategory action method and while adding the View, choose the Template as Empty, Model Class as Category, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Add New Category</h2>

@using (Html.BeginForm("AddCategory", "Category"))

{

<div>@Html.LabelFor(C => C.CategoryName)<br />@Html.TextBoxFor(C => C.CategoryName)</div>

<div>@Html.LabelFor(C => C.Description)<br />@Html.TextAreaFor(C => C.Description)</div>

<div>

<input type="submit" value="Save" name="btnSave" />

<input type="reset" value="Reset" name="btnReset" />

</div>

}

@Html.ActionLink("Back to Category Details", "DisplayCategories")

Generate a view for EditCategory action method and while adding the View, choose the Template as Empty, Model Class as Category, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Update Category</h2>

@using (Html.BeginForm("UpdateCategory", "Category"))

{

<div>

@Html.LabelFor(C => C.CategoryId)<br />@Html.TextBoxFor(C => C.CategoryId, new { @readonly = "true" })

</div>

<div>@Html.LabelFor(C => C.CategoryName)<br />@Html.TextBoxFor(C => C.CategoryName)</div>

<div>@Html.LabelFor(C => C.Description)<br />@Html.TextAreaFor(C => C.Description)</div>

<div>

<input type="submit" value="Save" name="btnSave" />

@Html.ActionLink("Cancel", "DisplayCategories")

</div>

}

**Step 6:** Add another controller in Controllers folder naming it as “ProductController.cs”, define all the required Action methods and also create Views that are necessary to perform CRUD operations on “Products” table.

using System.IO;

using System.Data.Entity;

using MVCWithEFCF1.Models;

public class ProductController : Controller

{

StoreDbContext dc = new StoreDbContext();

public ViewResult DisplayProducts()

{

dc.Configuration.LazyLoadingEnabled = false;

var products = dc.Products.Include(P => P.Category).Where(P => P.Discontinued == false);

return View(products);

}

public ViewResult DisplayProduct(int Id)

{

dc.Configuration.LazyLoadingEnabled = false;

Product product = (dc.Products.Include(P => P.Category).Where(

P => P.Id == Id && P.Discontinued == false)).Single();

return View(product);

}

public ViewResult AddProduct()

{

ViewBag.CategoryId = new SelectList(dc.Categories, "CategoryId", "CategoryName");

Product product = new Product();

return View(product);

}

[HttpPost]

public RedirectToRouteResult AddProduct(Product product, HttpPostedFileBase selectedFile)

{

if(selectedFile != null)

{

string DirectoryPath = Server.MapPath("~/Uploads/");

if (!Directory.Exists(DirectoryPath))

{

Directory.CreateDirectory(DirectoryPath);

}

selectedFile.SaveAs(DirectoryPath + selectedFile.FileName);

BinaryReader br = new BinaryReader(selectedFile.InputStream);

product.ProductImage = br.ReadBytes(selectedFile.ContentLength);

product.ProductImageName = selectedFile.FileName;

}

dc.Products.Add(product);

dc.SaveChanges();

return RedirectToAction("DisplayProducts");

}

public ViewResult EditProduct(int Id)

{

Product product = dc.Products.Find(Id);

TempData["ProductImage"] = product.ProductImage;

TempData["ProductImageName"] = product.ProductImageName;

ViewBag.CategoryId = new SelectList(dc.Categories, "CategoryId", "CategoryName", product.CategoryId);

return View(product);

}

public RedirectToRouteResult UpdateProduct(Product product, HttpPostedFileBase selectedFile)

{

if (selectedFile != null)

{

string DirectoryPath = Server.MapPath("~/Uploads/");

if (!Directory.Exists(DirectoryPath))

{

Directory.CreateDirectory(DirectoryPath);

}

selectedFile.SaveAs(DirectoryPath + selectedFile.FileName);

BinaryReader br = new BinaryReader(selectedFile.InputStream);

product.ProductImage = br.ReadBytes(selectedFile.ContentLength);

product.ProductImageName = selectedFile.FileName;

}

else if(TempData["ProductImage"] != null && TempData["ProductImageName"] != null)

{

product.ProductImage = (byte[])TempData["ProductImage"];

product.ProductImageName = (string)TempData["ProductImageName"];

}

dc.Entry(product).State = EntityState.Modified;

dc.SaveChanges();

return RedirectToAction("DisplayProducts");

}

public RedirectToRouteResult DeleteProduct(int Id)

{

Product product = dc.Products.Find(Id);

product.Discontinued = true;

dc.Entry(product).State = EntityState.Modified;

dc.SaveChanges();

return RedirectToAction("DisplayProducts");

}

}

Add a View with the name DisplayProducts.cshtml, selecting layout Checkbox and write the below code in it by deleting the whole content in the View:

@model IEnumerable <MVCWithEFCF1.Models.Product>

@{

ViewBag.Title = "Display Products";

}

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Display Products</h2>

<table border="1" align="center">

<tr>

<th>@Html.DisplayNameFor(P => P.Id)</th>

<th>@Html.DisplayNameFor(P => P.ProductName)</th>

<th>@Html.DisplayNameFor(P => P.UnitPrice)</th>

<th>@Html.DisplayNameFor(P => P.ProductImage)</th>

<th>@Html.DisplayNameFor(P => P.CategoryId)</th>

<th>@Html.DisplayNameFor(P => P.Category.CategoryName)</th>

<th>@Html.DisplayNameFor(P => P.Category.Description)</th>

<th>Actions</th>

</tr>

@foreach (var Product in Model)

{

<tr>

<td>@Html.DisplayFor(P => Product.Id)</td>

<td>@Html.DisplayFor(P => Product.ProductName)</td>

<td>@Html.DisplayFor(P => Product.UnitPrice)</td>

<td><img src='/Uploads/@Product.ProductImageName' width="40" height="25" alt="No Image" /></td>

<td>@Html.DisplayFor(P => Product.CategoryId)</td>

<td>@Html.DisplayFor(P => Product.Category.CategoryName)</td>

<td>@Html.DisplayFor(P => Product.Category.Description)</td>

<td>

@Html.ActionLink("View", "DisplayProduct", new { Id = Product.Id })

@Html.ActionLink("Edit", "EditProduct", new { Id = Product.Id })

@Html.ActionLink("Delete", "DeleteProduct", new { Id = Product.Id },

new { onclick = "return confirm('Are you sure of deleting the record?')" })</td>

</tr>

}

<tr><td colspan="9" align="center">@Html.ActionLink("Add New Product", "AddProduct")</td></tr>

</table>

Generate a view for DisplayProduct action method and while adding the View, choose the Template as Empty, Model Class as Product, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Display Product</h2>

<table border="1" align="center">

<tr>

<td rowspan=7>

<img src='~/Uploads/@Model.ProductImageName' width="200" height="200" alt="No Image" />

</td>

<td>ProductId: @Model.Id</td>

</tr>

<tr><td>ProductName: @Model.ProductName</td></tr>

<tr><td>UnitPrice: @Model.UnitPrice</td></tr>

<tr><td>CategoryId: @Model.CategoryId</td></tr>

<tr><td>CategoryName: @Model.Category.CategoryName</td></tr>

<tr><td>Description: @Model.Category.Description</td></tr>

<tr><td colspan="2" align="center">@Html.ActionLink("Back to Product Details", "DisplayProducts")</td></tr>

</table>

Generate a view for AddProduct action method and while adding the View, choose the Template as Empty, Model Class as Product, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Add New Product</h2>

@using (Html.BeginForm("AddProduct", "Product", FormMethod.Post, new { enctype = "multipart/form-data" }))

{

<div>@Html.LabelFor(P => P.ProductName)<br />@Html.TextBoxFor(P => P.ProductName)</div>

<div>@Html.LabelFor(P => P.UnitPrice)<br />@Html.TextBoxFor(P => P.UnitPrice)</div>

<div>@Html.LabelFor(P => P.ProductImage)<br /><input type="file" name="selectedFile" /></div>

<div>@Html.Label("Category Name")<br />@Html.DropDownList("CategoryId", "-Select Category-")</div>

<div>

<input type="submit" value="Save" name="btnSave" />

<input type="reset" value="Reset" />

</div>

}

@Html.ActionLink("Back to Product Details", "DisplayProducts")

Generate a view for EditProduct action method and while adding the View, choose the Template as Empty, Model Class as Product, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Update Product</h2>

@using (Html.BeginForm("UpdateProduct", "Product", FormMethod.Post, new {enctype="multipart/form-data" }))

{

<div>@Html.LabelFor(P => P.Id)<br />@Html.TextBoxFor(P => P.Id, new { @readonly = "true" })</div>

<div>@Html.LabelFor(P => P.ProductName)<br />@Html.TextBoxFor(P => P.ProductName)</div>

<div>@Html.LabelFor(P => P.UnitPrice)<br />@Html.TextBoxFor(P => P.UnitPrice)</div>

<div>

@Html.LabelFor(P => P.ProductImage)<br />

<img src='/Uploads/@Model.ProductImageName' width="200" height="200" /><br />

<input type="file" name="selectedFile" />

</div>

<div>@Html.LabelFor(P => P.CategoryId)<br />@Html.DropDownList("CategoryId")</div>

<div>

<input type="submit" value="Update" name="btnUpdate" />

@Html.ActionLink("Cancel", "DisplayProducts")

</div>

}

**Step 7:** Now if we want the Database and Tables to be created on the Database Server, we need to perform Migrations. Migration is a feature “Entity Framework Code First” provides which is used to keep the “Domain Classes” and “Database” in sync with each other. Entity Framework 6 provides 2 different types of Migrations whereas in Entity Framework Core we have only 1.

**Migration types supported in EF 6:**

* Automatic Migrations [d]
* Manual Migrations

Now when we run the application it launches the “HomeController’s”, “Index View” and the Menu in Layout will display “Categories” and “Products” links on top of the Page and when we click on the “Categories” link it will immediately create the Database on the server with the name “StoreDB”.

To test this, run the project, click on “Categories” link on the top and then it will display the View “Category List” providing options for adding a new category. Now go to SQL Server Database and watch, we will find a new Database with the name “StoreDB” (we specified this in Web.config file) and under the Database we will find Categories and Products tables (names of tables are taken based on DbSet properties in DbContext class).

**Note:** in our “Web.config” file we specified the name of “Connection String” as “StoreDbContext” and this name is the same name of our “DbContext” class, so we don’t require writing any code to read the “ConnectionString” into our application. If we want to give our own name for Connection String in “Web.config” without using the name “StoreDbContext”, we need to explicitly specify that name by defining a default constructor in “StoreDbContext” class and call its base class constructor using “base” keyword and pass the “Connection String” name as a parameter to it. For example, in “Web.config”, if we give the name of “Connection String” as “ConStr” but not “StoreDbContext”, then we need to define a constructor in our Context class as below:

public StoreDbContext() : base("ConStr")

{

}

**Database Initialization Strategies:** right now, when we run the project for first time it will create the “Database and Tables” and from next time on wards it will use the same “Database and Tables” when we run the application. There are various options to decide for us whether we want to use the existing Database next time or re-create it every time, and that is based on Database Initialization Strategies. To handle this, we have to use one of the Database Initialization Strategies which should be specified in our Context class constructor as following:

Database.SetInitializer(new CreateDatabaseIfNotExists<ContextClassName>());

**Entity Framework Supports 3 different initialization strategies like**:

**CreateDatabaseIfNotExists:** This is the default initializer. As the name suggests, it will create the Database if none exists as per the configuration. However, if you change the model class and then run the application with this initializer, then it will throw an Exception.

**DropCreateDatabaseIfModelChanges:** This initializer drops an existing Database and creates a new if your model classes (entity classes) have been changed. So, you don’t have to worry about maintaining your Database schema, when your model classes change.

**DropCreateDatabaseAlways:** As the name suggests, this initializer drops an existing Database every time you run the application, irrespective of whether your model classes have changed or not.

**To try them go to constructor of our Context class i.e., “StoreDbContext” and use any one of the following:**

Database.SetInitializer(new CreateDatabaseIfNotExists<StoreDbContext>()); //Default Strategy

Database.SetInitializer(new DropCreateDatabaseIfModelChanges<StoreDbContext>());

Database.SetInitializer(new DropCreateDatabaseAlways<StoreDbContext>());

**Turn off the DB Initializer:** you can even turn off the Database initializer for your application if you don’t want to lose existing data in production environment, then you can turn off initializer, as shown below:

Database.SetInitializer<StoreDbContext>(null);

**EF 6 Code-First Conventions:** conventions are a set of default rules which automatically configure a conceptual model based on our domain classes when working with the Code-First approach. As you have seen in the previous example, EF API configured PrimaryKeys, ForeignKeys, Relationships, and Column Data Types etc. from the domain classes without any additional configurations. This is because of the EF Code-First conventions. If they are followed in domain classes, then the database schema will be configured based on the conventions. These EF 6.x Code-First conventions are defined in the “System.Data.Entity.ModelConfiguration.Conventions” namespace.

**The following table lists default code first conventions**

| **Default Convention For** | **Description** |
| --- | --- |
| Schema | By default, EF creates all the DB objects into the **dbo** schema. |
| Table Name | <Entity Class Name> + 's'  EF will create a Database table with the entity class name suffixed by ‘s’ for example “Student” domain class (entity) would map to “Students” table. |
| Primary Key Name | 1) A property with the name “Id”. 2) <Entity Class Name> + “Id” (case in-sensitive)  EF will create a primary key column for the property named Id or <Entity Class Name> + “Id” (case in-sensitive). |
| Foreign Key Property Name | By default, EF will look for the foreign key property with the same name as the principal entity primary key name. If the foreign key property does not exist, then EF creates an FK column in the table with <Dependent Navigation Property Name> + "\_" + <Principal Entity Primary Key Property Name>, for example EF will create “Category\_CategoryId” foreign key column in Products table if the Product entity does not contain a foreign key property. |
| Null Column | EF creates a null column for all reference type properties and nullable value properties e.g., string, Nullable<int> or int?, Student etc. |
| Not Null Column | EF creates Not Null columns for Primary Key properties and non-nullable value type properties e.g., int, float, decimal, DateTime etc. |
| DB Columns Order | EF will create DB columns in the same order like the properties in an entity class. However, primary key columns would be moved first. |
| Properties Mapping to DB | By default, all properties will map to the database. Use the [NotMapped] attribute to exclude property or class from DB mapping. |
| Cascade Delete & Update | Enabled by default for all types of relationships. |

**The following table list C# data types mapped with SQL Server data types:**

| **C# Data Type** | **Mapping to SQL Server Data Type** |
| --- | --- |
| int | Int |
| string | nvarchar(Max) |
| decimal | decimal(18,2) |
| float | Real |
| byte[] | varbinary(Max) |
| datetime | Datetime |
| bool | Bit |
| byte | Tinyint |
| short | Smallint |
| long | Bigint |
| double | float |
| char | No Mapping (Throws Exception) |
| sbyte | No Mapping (Throws Exception) |
| object | No Mapping (Throws Exception) |

**Data Annotations:** Data Annotations are .NET attributes which can be applied on an entity class or properties to override default conventions in EF 6 and EF Core. Data Annotations are provided in EF 6 and EF Core under the namespaces System.ComponentModel.DataAnnotations and System.ComponentModel.DataAnnotations.Schema. These attributes can be used in Entity Framework as well as with ASP.NET MVC Data Controls.

**System.ComponentModel.DataAnnotations Attributes:**

| **Attribute** | **Description** |
| --- | --- |
| [Key](http://www.entityframeworktutorial.net/code-first/key-dataannotations-attribute-in-code-first.aspx) | Can be applied to a property to specify a key property in an entity and make the corresponding column a “Primary Key” column in the Database. |
| [Timestamp](http://www.entityframeworktutorial.net/code-first/TimeStamp-dataannotations-attribute-in-code-first.aspx) | Can be applied to a property to specify the data type of a corresponding column in the Database as “Row Version”. |
| [ConcurrencyCheck](http://www.entityframeworktutorial.net/code-first/concurrencycheck-dataannotations-attribute-in-code-first.aspx) | Can be applied to a property to specify that the corresponding column should be included in the optimistic concurrency check. |
| [Required](http://www.entityframeworktutorial.net/code-first/required-attribute-dataannotations-in-code-first.aspx) | Can be applied to a property to specify that the corresponding column is a “Not Null” column in the Database. |
| [MinLength](http://www.entityframeworktutorial.net/code-first/maxlength-minlength-dataannotations-attribute-in-code-first.aspx) | Can be applied to a property to specify the minimum string length allowed in the corresponding column in the Database. |
| [MaxLength](http://www.entityframeworktutorial.net/code-first/maxlength-minlength-dataannotations-attribute-in-code-first.aspx) | Can be applied to a property to specify the maximum string length allowed in the corresponding column in the Database. |
| [StringLength](http://www.entityframeworktutorial.net/code-first/stringlength-dataannotations-attribute-in-code-first.aspx) | Can be applied to a property to specify the maximum string length allowed in the corresponding column in the Database. |

**System.ComponentModel.DataAnnotations.Schema Attributes:**

| **Attribute** | **Description** |
| --- | --- |
| [Table](http://www.entityframeworktutorial.net/code-first/table-dataannotations-attribute-in-code-first.aspx) | Can be applied to an entity class to configure the corresponding table name and schema in the database. |
| [Column](http://www.entityframeworktutorial.net/code-first/column-dataannotations-attribute-in-code-first.aspx) | Can be applied to a property to configure the corresponding column name, order and data type in the database. |
| [Index](http://www.entityframeworktutorial.net/EntityFramework6/index-attribute-in-code-first.aspx) | Can be applied to a property to configure that the corresponding column should have an Index in the database. (EF 6.1 onwards only) |
| [ForeignKey](http://www.entityframeworktutorial.net/code-first/foreignkey-dataannotations-attribute-in-code-first.aspx) | Can be applied to a property to mark it as a foreign key property. |
| [NotMapped](http://www.entityframeworktutorial.net/code-first/notmapped-dataannotations-attribute-in-code-first.aspx) | Can be applied to a property or entity class which should be excluded from the model and should not generate a corresponding column or table in the database. |
| DatabaseGenerated | Can be applied to a property to configure how the underlying database should generate the value for the corresponding column e.g., identity, computed or none. |
| [InverseProperty](http://www.entityframeworktutorial.net/code-first/inverseproperty-dataannotations-attribute-in-code-first.aspx) | Can be applied to a property to specify the inverse of a navigation property that represents the other end of the same relationship. |
| ComplexType | Marks the class as complex type in EF 6. EF Core 2.0 does not support this attribute. |

To test overriding the default Code First Conventions with Data Annotations create a new “ASP.Net Web Application” project naming it as “MVCWithEFCF2”, choose MVC Project Template and click on “Create” button. Install Entity Framework in the project and then add 3 new classes into the Models folder naming them as “Supplier.cs”, “Customer.cs” and “CompanyDbContext.cs”, and write the below code under them:

using System.ComponentModel.DataAnnotations;

using System.ComponentModel.DataAnnotations.Schema;

[Table("Supplier")] //Specifying Name for the table being created in database.

public class Supplier

{

[Key] //Setting this column as Primary Key column.

[DatabaseGenerated(DatabaseGeneratedOption.None)] //Setting identity off, so will not autogenerate values.

public int Sid { get; set; }

[MaxLength(100)] //Setting MaxLength as 100 for this column.

[Column("Sname", TypeName = "Varchar")] //Setting column name and data type of the column.

public string SupplierName { get; set; }

public ICollection<Customer> Customers { get; set; }

}

using System.ComponentModel.DataAnnotations;

using System.ComponentModel.DataAnnotations.Schema;

[Table("Customer")]

public class Customer

{

[Column(TypeName = "Money")]

public decimal? Balance { get; set; }

[Index] //Setting Index attribute for this column in database.

[Required] //Setting not null constraint for this column in database.

[MaxLength(50)]

[Column("Cname", TypeName = "Varchar")]

public string CustomerName { get; set; }

[StringLength(1000)]

[Column(TypeName = "Varchar")]

public string Address { get; set; }

[Key]

[DatabaseGenerated(DatabaseGeneratedOption.None)]

public int Custid { get; set; }

public int Sid { get; set; }

[ForeignKey("Sid")] //Setting the foreign key column for the table.

public Supplier Supplier { get; set; }

}

using System.Data.Entity;

public class CompanyDbContext : DbContext

{

public CompanyDbContext() : base("ConStr")

{

Database.SetInitializer(new DropCreateDatabaseAlways<CompanyDbContext>());

}

public DbSet<Supplier> Suppliers { get; set; }

public DbSet<Customer> Customers { get; set; }

}

**Now open Web.config file and write the following code between <configuration></configuration> tag:**

<connectionStrings>

<add name="ConStr"

connectionString="Data Source=Server;Database=CompanyDB;User Id=Sa;Password=123"

providerName="System.Data.SqlClient" />

</connectionStrings>

**Add a controller naming it as SupplierController and write the below code under it by deleting existing code:**

using MVCWithEFCF2.Models;

public class SupplierController : Controller

{

CompanyDbContext dc = new CompanyDbContext();

public ActionResult Index()

{

Supplier s1 = new Supplier { Sid = 101, SupplierName = "Ashok Distributors." };

Supplier s2 = new Supplier { Sid = 102, SupplierName = "Meghna Distributors." };

Supplier s3 = new Supplier { Sid = 103, SupplierName = "Diamond Distributors." };

Supplier s4 = new Supplier { Sid = 104, SupplierName = "Prasad Distributors." };

dc.Suppliers.Add(s1); dc.Suppliers.Add(s2);

dc.Suppliers.Add(s3); dc.Suppliers.Add(s4);

dc.SaveChanges();

return View(dc.Suppliers);

}

}

Add a view to the Index action method and while adding the View, in “Add View” window choose “Template:” as “List”, “Model class:” as “Supplier (MVCWithEFCF2.Models)”, “Data context class:” as “CompanyDbContext (MVCWithEFCF2.Models)” and click on “Add” button. Run the view we have created which will create the Database and Tables under SQL Server.

**Using Stored Procedure to Perform Insert, Update and Delete operations in Code First:**

Entity Framework Code-First provides the ability to create Stored Procedures for insert, update and delete operations when the “SaveChanges” method is called, which will create all the procedures and uses them in place of SQL Statements. To test this, create a new “ASP.NET Web Application” Project naming it as “MVCWithEFCF3”, choose “MVC Project Template” and click on “Create” button. Install Entity Framework in the project, then add 2 new classes with the name Student and SchoolDbContext in Models folder and write the below code under them:

using System.ComponentModel.DataAnnotations;

using System.ComponentModel.DataAnnotations.Schema;

[Table("Student")]

public class Student

{

[Key]

[DatabaseGenerated(DatabaseGeneratedOption.None)]

public int Sid { get; set; }

[Required]

[MaxLength(100)]

[Column("Sname", TypeName = "Varchar")]

public string StudentName { get; set; }

[Column("Class")]

public byte StudentClass { get; set; }

[MaxLength(1000)]

[Column(TypeName = "Varchar")]

public string Address { get; set; }

public float Fees { get; set; }

}

using System.Data.Entity;

public class SchoolDbContext : DbContext

{

public SchoolDbContext() : base("Constr")

{

Database.SetInitializer(new DropCreateDatabaseAlways<SchoolDbContext>());

}

public DbSet<Student> Students { get; set; }

protected override void OnModelCreating(DbModelBuilder modelBuilder)

{

modelBuilder.Entity<Student>().MapToStoredProcedures();

}

}

**Note:** we need to call “MapToStoredProcedures()” method on “DbModelBuilder” object, to map an entity with default Stored Procedures and those Stored Procedures will be created by “EF API” and to do that we need to override the method “OnModelCreating” under our “SchoolDbContext” class and call “MapToStroredProcedures”.

**Go to Web.config file and write the following code between <configuration></configuration> tag:**

<connectionStrings>

<add name="ConStr"

connectionString="Data Source=Server;Database=SchoolDB;User Id=Sa;Password=123" providerName="System.Data.SqlClient"/>

</connectionStrings>

**Add a controller under the Controllers folder naming it as “StudentController.cs” and write below code in it:**

using MVCWithEFCF3.Models;

public class StudentController : Controller

{

public ActionResult Index()

{

SchoolDbContext dc = new SchoolDbContext();

Student s1 = new Student { Sid = 101, StudentName = "Tej", StudentClass = 10, Fees = 50000.00f,

Address = "Sanathnagar, Hyderabad - 18" };

Student s2 = new Student { Sid = 102, StudentName = "Raju", StudentClass = 10, Fees = 50000.00f,

Address = "Jubliee Hills, Hyderabad - 32" };

Student s3 = new Student { Sid = 103, StudentName = "Vijay", StudentClass = 10, Fees = 50000.00f,

Address = "Madhapur, Hyderabad - 81" };

Student s4 = new Student { Sid = 104, StudentName = "Naidu", StudentClass = 10, Fees = 50000.00f,

Address = "Ameerpet, Hyderabad - 16" };

Student s5 = new Student { Sid = 105, StudentName = "Suresh", StudentClass = 10, Fees = 50000.00f,

Address = "Banjara Hills, Hyderabad - 22" };

dc.Students.Add(s1); dc.Students.Add(s2); dc.Students.Add(s3); dc.Students.Add(s4); dc.Students.Add(s5);

dc.SaveChanges();

return View(dc.Students);

}

}

Add a view to the Index action method and while adding the View, in “Add View” window choose “Template:” as “List”, “Model class:” as “Student (MVCWithEFCF3.Models)”, “Data context class:” as “SchoolDbContext (MVCWithEFCF3.Models)” and click on “Add” button. Run the view we have created which will create the Database, Tables and Stored Procedures under SQL Server.

Now in the Database along with the Table it also creates 3 Stored Procedures with the name “Student\_Insert”, “Student\_Update” and “Student\_Delete” and Entity Framework will internally use these Stored Procedures to perform insert, update and delete operations. It is also possible to give our own names to the Stored Procedures, provided we are not satisfied with the existing names and to do that we need to write code under “OnModelCreating” method as following in place of the previous:

protected override void OnModelCreating(DbModelBuilder modelBuilder)

{

modelBuilder.Entity<Student>().MapToStoredProcedures(S => S.Insert(X => X.HasName("Insert\_Student")));

modelBuilder.Entity<Student>().MapToStoredProcedures(S => S.Update(X => X.HasName("Update\_Student")));

modelBuilder.Entity<Student>().MapToStoredProcedures(S => S.Delete(X => X.HasName("Delete\_Student")));

}

**Note:** in this case the names of the procedures will be Insert\_Student to perform Insert operation, Update\_Student to perform Update operation and Delete\_Student to perform Delete operation.

**Inheritance Strategies in Entity Framework:**

We can design domain classes using inheritance, Entity Framework will create tables based on the entity class’s hierarchy and there are 3 approaches to represent an inheritance hierarchy in Code-First:

**Table per Hierarchy (TPH):** This approach suggests one table for the entire class inheritance hierarchy. The table includes a discriminator column which distinguishes between inheritance classes. This is a default inheritance mapping strategy in Entity Framework.

**Table per Type (TPT):** This approach suggests a separate table for each domain class.

**Table per Concrete Class (TPC):** This approach suggests one table for one concrete class, but not for the parent class. So, we need to make the parent class as abstract, so that the properties of the abstract class will be part of each table of the concrete class.

To test Inheritance Strategies, create a new “ASP.NET Web Application” project naming it as “MVCWithEFCF4”, choose “MVC Project Template” and click on “Create” button. Install Entity Framework in our project, add 4 new classes in to the Models folder with the names “Person”, “Student”, “Teacher”, “SchoolDbContext” and write the below code under them:

public class Person

{

public int Id { get; set; }

public string Name { get; set; }

public string Phone { get; set; }

public string Address { get; set; }

}

public class Student : Person  
{

public int Class { get; set; }

public float Marks { get; set; }

public float Fees { get; set; }

}

public class Teacher : Person

{

public string Subject { get; set; }

public double Salary { get; set; }

public string Designation { get; set; }

}

using System.Data.Entity;

public class SchoolDbContext : DbContext

{

public SchoolDbContext() : base("ConStr")

{

Database.SetInitializer(new DropCreateDatabaseAlways<SchoolDbContext>());

}

public DbSet<Person> People { get; set; }

}

**Go to Web.config file and write the following code between <configuration></configuration> tags:**

<connectionStrings>

<add name="ConStr"

connectionString="Data Source=Server;Database=SchoolDB;User Id=Sa;Password=123" providerName="System.Data.SqlClient"/>

</connectionStrings>

**Add a new controller under Controllers folder naming it as “SchoolController” and write the below code in it:**

using MVCWithEFCF4.Models;

public class SchoolController : Controller

{

SchoolDbContext dc = new SchoolDbContext();

public ActionResult Index()

{

Student s1 = new Student { Name = "Rajesh", Phone = "23746666", Address = "Pune", Class = 10,

Marks = 450.00f, Fees = 5000.00f };

Student s2 = new Student { Name = "Ajay", Phone = "23747777", Address = "Mumbai", Class = 10,

Marks = 450.00f, Fees = 5000.00f };

Student s3 = new Student { Name = "Venkat", Phone = "23748888", Address = "Delhi", Class = 10,

Marks = 450.00f, Fees = 5000.00f };

Teacher t1 = new Teacher { Name = "Raju", Phone = "23741234", Address = "Delhi", Designation = "Lecturer",

Salary = 25000.00, Subject = "Physics" };

Teacher t2 = new Teacher { Name = "Suresh", Phone = "23745678", Address = "Delhi", Designation = "Lecturer",

Salary = 25000.00, Subject = "Maths" };

Teacher t3 = new Teacher { Name = "Rahul", Phone = "23747890", Address = "Delhi", Designation = "Lecturer",

Salary = 25000.00, Subject = "Chemistry" };

dc.People.Add(s1); dc.People.Add(s2); dc.People.Add(s3);

dc.People.Add(t1); dc.People.Add(t2); dc.People.Add(t3);

dc.SaveChanges();

return View();

}

public ViewResult DisplayPeople()

{

var People = from S in dc.People select S;

return View(People);

}

public ViewResult DisplayStudents()

{

var Students = from S in dc.People.OfType<Student>() select S;

return View(Students);

}

public ViewResult DisplayTeachers()

{

var Teachers = from S in dc.People.OfType<Teacher>() select S;

return View(Teachers);

}

}

Now add a normal view for “Index” action method and model bounded views for “DisplayPeople”, “DisplayStudents” and “DisplayTeachers” action methods and write the below code under them:

**Index.cshtml:**

@Html.ActionLink("Show All People Details", "DisplayPeople")

**DisplayPeople.cshtml:**

@model IEnumerable<MVCWithEFCF4.Models.Person>

<table border="1" align="center">

<caption>Details</caption>

<tr>

<th>@Html.DisplayNameFor(P => P.Id)</th>

<th>@Html.DisplayNameFor(P => P.Name)</th>

<th>@Html.DisplayNameFor(P => P.Phone)</th>

<th>@Html.DisplayNameFor(P => P.Address)</th>

</tr>

@foreach (var item in Model)

{

<tr>

<td>@Html.DisplayFor(P => item.Id)</td>

<td>@Html.DisplayFor(P => item.Name)</td>

<td>@Html.DisplayFor(P => item.Phone)</td>

<td>@Html.DisplayFor(P => item.Address)</td>

</tr>

}

</table>

<center>

@Html.ActionLink("Display All Students", "DisplayStudents")

@Html.ActionLink("Display All Teachers", "DisplayTeachers")

</center>

**DisplayStudents.cshtml:**

@model IEnumerable<MVCWithEFCF4.Models.Student>

<table border="1" align="center">

<caption>Student Details</caption>

<tr>

<th>@Html.DisplayNameFor(P => P.Id)</th>

<th>@Html.DisplayNameFor(P => P.Name)</th>

<th>@Html.DisplayNameFor(P => P.Phone)</th>

<th>@Html.DisplayNameFor(P => P.Address)</th>

<th>@Html.DisplayNameFor(P => P.Class)</th>

<th>@Html.DisplayNameFor(P => P.Marks)</th>

<th>@Html.DisplayNameFor(P => P.Fees)</th>

</tr>

@foreach (var item in Model)

{

<tr>

<td>@Html.DisplayFor(P => item.Id)</td>

<td>@Html.DisplayFor(P => item.Name)</td>

<td>@Html.DisplayFor(P => item.Phone)</td>

<td>@Html.DisplayFor(P => item.Address)</td>

<td>@Html.DisplayFor(P => item.Class)</td>

<td>@Html.DisplayFor(P => item.Marks)</td>

<td>@Html.DisplayFor(P => item.Fees)</td>

</tr>

}

</table>

<center>@Html.ActionLink("Back to home page", "DisplayPeople")</center>

**DisplayTeachers.cshtml:**

@model IEnumerable<MVCWithEFCF4.Models.Teacher>

<table border="1" align="center">

<caption>Student Details</caption>

<tr>

<th>@Html.DisplayNameFor(P => P.Id)</th>

<th>@Html.DisplayNameFor(P => P.Name)</th>

<th>@Html.DisplayNameFor(P => P.Phone)</th>

<th>@Html.DisplayNameFor(P => P.Address)</th>

<th>@Html.DisplayNameFor(P => P.Subject)</th>

<th>@Html.DisplayNameFor(P => P.Designation)</th>

<th>@Html.DisplayNameFor(P => P.Salary)</th>

</tr>

@foreach (var item in Model)

{

<tr>

<td>@Html.DisplayFor(P => item.Id)</td>

<td>@Html.DisplayFor(P => item.Name)</td>

<td>@Html.DisplayFor(P => item.Phone)</td>

<td>@Html.DisplayFor(P => item.Address)</td>

<td>@Html.DisplayFor(P => item.Subject)</td>

<td>@Html.DisplayFor(P => item.Designation)</td>

<td>@Html.DisplayFor(P => item.Salary)</td>

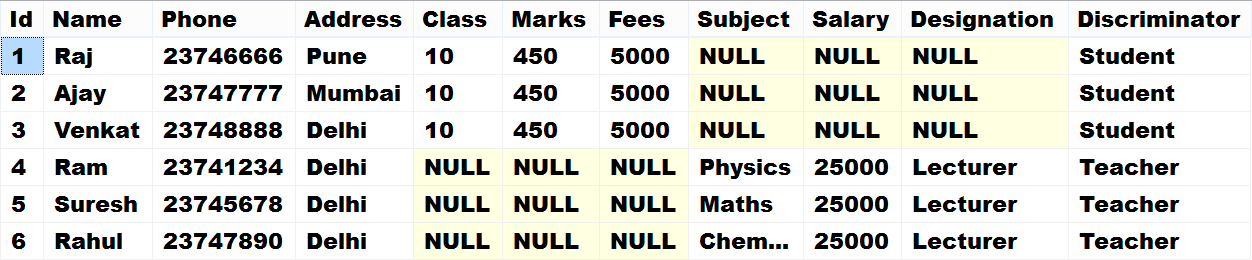
</tr>

}

</table>

<center>@Html.ActionLink("Back to home page", "DisplayPeople")</center>

**Table Per Hierarchy:** now run the Index action method and “SchoolDB” Database gets created on SQL Server with a table “People” and it contains columns representing all the properties of our 3 Model Classes because the inheritance strategy we used is “TPH” i.e., Table Per Hierarchy and in that table we find 10 columns representing the 10 attributes of the 3 Model Classes and also we find an additional column with the name “Discriminator” which is used to identify to which entity the record belongs to, as following:



**Table Per Type:** in our above example inheritance strategy is “TPH” and if we want to make it as “TPT” i.e., Table Per Type then we need to override “OnModelCreating” method in our “SchoolDbContext” class and implement the logic in it as below. To test this, add the below code in “SchoolDbContext” class and run the “Index” method again:

protected override void OnModelCreating(DbModelBuilder modelBuilder)

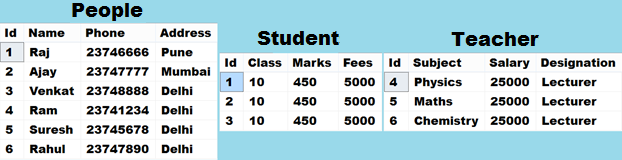
{

modelBuilder.Entity<Student>().ToTable("Student");

modelBuilder.Entity<Teacher>().ToTable("Teacher");

}

Run the project again and verify the SchoolDB Database, where we will find 3 separate tables created for People, Student and Teacher containing data as following:



In the above case Student and Teacher tables also will contain an Id column which is a primary key for those tables as well as that column is also a foreign key referring to the Id column (primary key) in People table.

**Table Per Concrete Class:** if we want to change the above example code to “TPC” i.e., Table Per Concrete Class do the following changes:

**Change 1:** change the person class as Abstract so that EF will not create a table for this entity and also for the Id Property in the class set the Identity option as none by using “Database Generated” data annotation, because in this strategy EF will create 2 separate tables combining the attributes of Person class, so both tables will have an “Id” column and identity will generate the “Id” values randomly into the 2 table and to avoid this, remove Identity option. After making these changes, Person class should be looking as following:

using System.ComponentModel.DataAnnotations.Schema;

public abstract class Person

{

[DatabaseGenerated(DatabaseGeneratedOption.None)]

public int Id { get; set; }

public string Name { get; set; }

public string Phone { get; set; }

public string Address { get; set; }

}

**Change 2:** now re-write the code under “OnModelCreating” method as following:

protected override void OnModelCreating(DbModelBuilder modelBuilder)

{

modelBuilder.Entity<Student>().Map(M =>

{

M.MapInheritedProperties();

M.ToTable("Student");

});

modelBuilder.Entity<Teacher>().Map(M =>

{

M.MapInheritedProperties();

M.ToTable("Teacher");

});

}

**Change 3:** Now while inserting records provide an Id for Student and Teacher in the Index action method which should be as following:

Student s1 = new Student { Id = 101, Name = "Raj", Phone = "23746666", Address = "Pune", Class = 10,

Marks = 450.00f, Fees = 5000.00f };

Student s2 = new Student { Id = 102, Name = "Ajay", Phone = "23747777", Address = "Mumbai", Class = 10,

Marks = 450.00f, Fees = 5000.00f };

Student s3 = new Student { Id 103, Name = "Venkat", Phone = "23748888", Address = "Delhi", Class = 10,

Marks = 450.00f, Fees = 5000.00f };

Teacher t1 = new Teacher { Id = 1001, Name = "Ram", Phone = "23741234", Address = "Delhi",

Designation = "Lecturer", Salary = 25000.00, Subject = "Physics" };

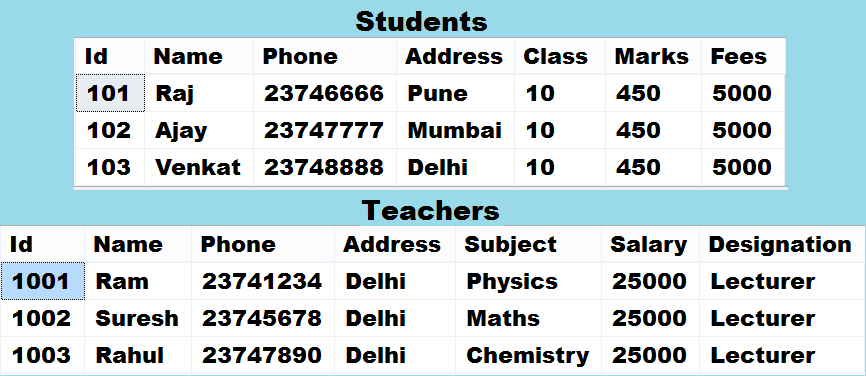
Teacher t2 = new Teacher { Id = 1002, Name = "Suresh", Phone = "23745678", Address = "Delhi",

Designation = "Lecturer", Salary = 25000.00, Subject = "Maths" };

Teacher t3 = new Teacher { Id = 1003, Name = "Rahul", Phone = "23747890", Address = "Delhi",

Designation = "Lecturer", Salary = 25000.00, Subject = "Chemistry" };

Run the project again and verify the “SchoolDB” Database and there we will find 2 tables with the name “Students” and “Teachers” with data as below:



**Entity Framework Relationships:**

Let’s learn how Entity Framework manages the relationships between entities. Entity Framework supports three types of relationships, same as database:

* One-to-Zero or One
* Many-to-Many
* One-to-Many

**One-to-Zero or One:** a “One-to-Zero-or-One” relationship happens when a Primary Key of one table becomes Primary Key and Foreign Key in another table. To test “One-to-Zero or One” relationship, create a new “ASP.NET Web Application” project naming it as “MVCWithEFCF5”, choose “MVC Project Template” and click on “Create” button. Install Entity Framework in to the project and then add 3 new classes in to the Models folder naming them as “Player”, “Spouse” and “FamilyDbContext” and write the below code under them:

using System.ComponentModel.DataAnnotations.Schema;

public class Player

{

[DatabaseGenerated(DatabaseGeneratedOption.None)]

public int PlayerId { get; set; }

public string Name { get; set; }

public string Profession { get; set; }

public Spouse Spouse { get; set; }

}

using System.ComponentModel.DataAnnotations;

using System.ComponentModel.DataAnnotations.Schema;

public class Spouse

{

[DatabaseGenerated(DatabaseGeneratedOption.None)]

[Key, ForeignKey("Player")]

public int PlayerId { get; set; }

public string SpouseName { get; set; }

public string SpouseProfession { get; set; }

public Player Player { get; set; }

}

**Note:** We need to configure the above entities in such a way that EF creates the Players and Spouses tables in the DB and makes the “PlayerId” column in Players table as Primary Key and “PlayerId” column in the Spouses table as Primary Key and Foreign Key.

using System.Data.Entity;

public class FamilyDbContext : DbContext

{

public FamilyDbContext() : base("ConStr")

{

}

public DbSet<Player> Players { get; set; }

public DbSet<Spouse> Spouses { get; set; }

}

**Go to Web.config file and write the below code in it:**

<connectionStrings>

<add name="ConStr"

connectionString="Data Source=Server;Database=FamilyDB; User Id=Sa;Password=123"

providerName="System.Data.SqlClient" />

</connectionStrings>

**Add a controller under the Controllers folder naming it as “FamilyController” and write the below code in it:**

using MVCWithEFCF5.Models;

public class FamilyController : Controller

{

FamilyDbContext dc = new FamilyDbContext();

public ActionResult Index()

{

Player p1 = new Player { PlayerId = 101, Name = "Sachin Ramesh Tendulkar", Profession = "Cricketer" };

Player p2 = new Player { PlayerId = 102, Name = "Rishab Pant", Profession = "Cricketer" };

Player p3 = new Player { PlayerId = 103, Name = "Mahindra Singh Dhoni", Profession = "Cricketer" };

Spouse s1 = new Spouse { PlayerId = 101, SpouseName = "Anjali", SpouseProfession = "Doctor" };

Spouse s2 = new Spouse { PlayerId = 103, SpouseName = "Sakshi", SpouseProfession = "Home Maker" };

dc.Players.Add(p1); dc.Players.Add(p2); dc.Players.Add(p3);

dc.Spouses.Add(s1); dc.Spouses.Add(s2);

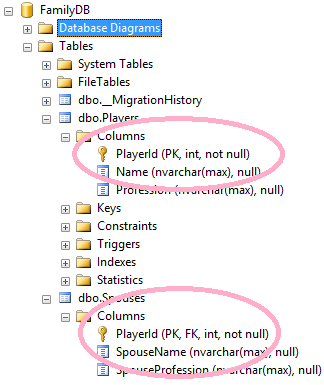
dc.SaveChanges();

return View(dc.Players);

}

}

Add a view to the Index action method and while adding the View, in “Add View” window choose “Template:” as “List”, “Model class:” as “Player (MVCWithEFCF5.Models)”, “Data context class:” as “FamilyDbContext (MVCWithEFCF5.Models)” and click on “Add” button. Run the view we have created which will create the Database and Tables SQL Server. When we verify the “FamilyDB” Database created under SQL Server there we find the tables “Players” and “Spouses” and for each player there can only be one entry for spouse or no entry also. In the Player table “PlayerId” will be “Primary Key” and in Spouse table “PlayerId” will be “Primary Key” and “Foreign Key” also as below:



**Many-to-Many:** in a many-to-many relationship, a row in table “A” can have many matching rows in table “B”, and vice versa. A many-to-many relationship could be thought of as 2 one-to-many relationships, linked by an intermediary table. The intermediary table is typically referred to as a “junction table” (also as a “cross-reference table”). This table is used to link the other 2 tables together. It does this by having two fields that reference the primary key of each of the other two tables. Entity Framework includes default conventions for many-to-many relationships. You need to include a collection navigation property at both ends. For example, the Customer class should have a collection navigation property of Product type, and the Product class should have a collection navigation property of Customer type to create a many-to-many relationship between them.

To test Many-to-Many relationship create a new “ASP.NET Web Application” project naming it as “MVCWithEFCF6”, choose “MVC Project Template” and click on “Create” button. Install “Entity Framework” and then add 3 new classes into the Models folder naming them as “Product”, “Customer” & “StoreDbContext”, and write the below code under them:

using System.ComponentModel.DataAnnotations.Schema;

public class Product

{

[DatabaseGenerated(DatabaseGeneratedOption.None)]

public int ProductId { get; set; }

public string ProductName { get; set; }

public ICollection<Customer> Customers { get; set; }

}

using System.ComponentModel.DataAnnotations.Schema;

public class Customer

{

[DatabaseGenerated(DatabaseGeneratedOption.None)]

public int CustomerId { get; set; }

public string CustomerName { get; set; }

public ICollection<Product> Products { get; set; }

}

using System.Data.Entity;

public class StoreDbContext : DbContext

{

public StoreDbContext() : base("ConStr")

{

}

public DbSet<Customer> Customers { get; set; }

public DbSet<Product> Products { get; set; }

}

**Go to Web.config file and write the below code in it:**

<connectionStrings>

<add name="ConStr"

connectionString="Data Source=Server;Database=StoreDB;User Id=Sa;Password=123" providerName="System.Data.SqlClient"/>

</connectionStrings>

**Add a controller under the Controllers folder naming it as “StoreController” and write the below code in it:**

using MVCWithEFCF6.Models;

public class StoreController : Controller

{

StoreDbContext dc = new StoreDbContext();

public ActionResult Index()

{

Customer c1 = new Customer { CustomerId = 101, CustomerName = "Raju" };

Customer c2 = new Customer { CustomerId = 102, CustomerName = "Ajay" };

Customer c3 = new Customer { CustomerId = 103, CustomerName = "Suresh" };

Product p1 = new Product { ProductId = 1001, ProductName = "Soap" };

Product p2 = new Product { ProductId = 1002, ProductName = "Perfume" };

Product p3 = new Product { ProductId = 1003, ProductName = "Pen" };

dc.Customers.Add(c1); dc.Customers.Add(c2); dc.Customers.Add(c3);

dc.Products.Add(p1); dc.Products.Add(p2); dc.Products.Add(p3);

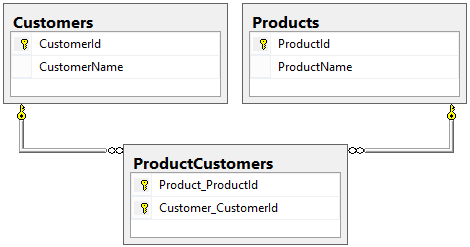
dc.SaveChanges();

return View();

}

}

Add a view to Index action method, run the project and verify the “StoreDB” Database creaed under SQL Server, where we find 3 tables “Customers”, “Products” and “ProductCustomers” and the 3rd table is known as a Junction Table which includes the “Primary Keys” of both “Customers” and “Products” tables as following:



**One-to-Many:** this is the most common relationship type. In this type of relationship, a row in table “A” can have many matching rows in table “B”, but a row in table “B” can have only one matching row in table “A”. One-to-Many relationships can also be viewed as Many-to-One relationships, depending on which way you look at it. There are certain conventions in Entity Framework which if followed in entity classes (domain classes) will automatically result in a one-to-many relationship between two tables in the database.

* There should be a reference (scalar) navigation property in the detail entity of its master entity.
* There should be a collection navigation property in master entity to its detail entities.

For example, if we want to establish a “one-to-many” relationship between “Department” & “Employee” entities where many “Employees” are associated with “1 Department”, it means that each Employee entity points to a Department. This can be achieved by including a scalar navigation property of type Department in Employee entity class and a collection navigation property in Department entity of type “ICollection<Employee>”.

To test Many-to-Many relationship create a new “ASP.NET Web Application” project naming it as “MVCWithEFCF7”, choose “MVC Project Template” and click “Install” button. Install “Entity Framework” and add 3 new classes in the Models folder naming them as “Department”, “Employee” & “CompanyDbContext”, and then write the below code under them:

using System.ComponentModel.DataAnnotations;

using System.ComponentModel.DataAnnotations.Schema;

public class Department

{

[Key]

[DatabaseGenerated(DatabaseGeneratedOption.None)]

public int Did { get; set; }

public string Dname { get; set; }

public string Location { get; set; }

public ICollection<Employee> Employees { get; set; }

}

using System.ComponentModel.DataAnnotations;

using System.ComponentModel.DataAnnotations.Schema;

public class Employee

{

[Key]

public int Eid { get; set; }

public string Ename { get; set; }

public string Job { get; set; }

public double Salary { get; set; }

public int Did { get; set; }

[ForeignKey("Did")]

public Department Department { get; set; }

}

using System.Data.Entity;

public class CompanyDbContext : DbContext

{

public CompanyDbContext() : base("ConStr")

{

Database.SetInitializer(new DropCreateDatabaseIfModelChanges<CompanyDbContext>());

}

public DbSet<Department> Departments { get; set; }

public DbSet<Employee> Employees { get; set; }

}

**Go to Web.config file and write the below code in it:**

<connectionStrings>

<add name="ConStr"

connectionString="Data Source=Server;Database=CompanyDB;User Id=Sa;Password=123"

providerName="System.Data.SqlClient"/>

</connectionStrings>

**Add a controller under the Controllers folder naming it as “CompanyController” and write the below code in it:**

using MVCWithEFCF7.Models;

public class CompanyController : Controller

{

CompanyDbContext dc = new CompanyDbContext();

public ActionResult Index()

{

Department d1 = new Department { Did = 10, Dname = "Sales", Location = "Hyderabad" };

Department d2 = new Department { Did = 20, Dname = "Research", Location = "Delhi" };

Department d3 = new Department { Did = 30, Dname = "HR", Location = "Mumbai" };

Department d4 = new Department { Did = 40, Dname = "Finance", Location = "Chennai" };

dc.Departments.Add(d1); dc.Departments.Add(d2); dc.Departments.Add(d3); dc.Departments.Add(d4);

Employee e1 = new Employee { Ename = "Raju", Job = "Manager", Salary = 25000.00, Did = 10 };

Employee e2 = new Employee { Ename = "John", Job = "Clerk", Salary = 10000.00, Did = 10 };

Employee e3 = new Employee { Ename = "Pankaj", Job = "Manager", Salary = 25000.00, Did = 20 };

Employee e4 = new Employee { Ename = "Suneel", Job = "Manager", Salary = 25000.00, Did = 30 };

dc.Employees.Add(e1); dc.Employees.Add(e2); dc.Employees.Add(e3); dc.Employees.Add(e4);

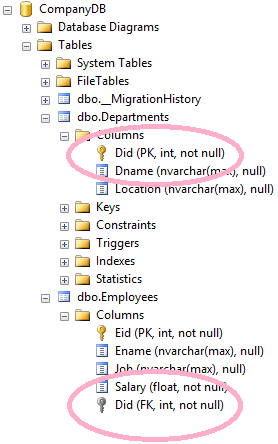
dc.SaveChanges();

return View(dc.Employees);

}

}

Add a view to the Index action method and while adding the View, in “Add View” window choose “Template:” as “List”, “Model class:” as “Employee (MVCWithEFCF7.Models)”, “Data context class:” as “CompanyDbContext (MVCWithEFCF7.Models)” and click on “Add” button. Run the project and verify SQL Server Database where we find “CompanyDB” Database created and under it we find the 2 tables “Departments” and “Employees”. “Employee” table will be having a “Foreign Key” column “Did” referring to “Department” table’s “Primary Key” column “Did” as below:



**Seed Data in Entity Framework Code-First:**

We can insert data into our Database tables during the Database initialization process. This will be important when we want to provide some “default - master data” for any table in the application, for example in our previous application if we want to insert default data into “Department” table then we need to use the concept of “Seed” and insert default data into the table. To seed data into any table, we need to implement the logic in “Seed” method of any DBInitializer classes (“CreateDatabaseIfNotExists”, “DropCreateDatabaseAlways”, “DropCreateDatabaseIfModelChanges”) and to do that we have to define a custom “DBInitializer” class inheriting from any of the above 3 “DBInitializer” classes and then override the “Seed” method. To test this process, add a new class in the Models folder of our previous project with the name “CompanyDBInitializer.cs” and write the below code in it:

using System.Data.Entity;

public class CompanyDBInitializer : DropCreateDatabaseIfModelChanges<CompanyDbContext>

{

protected override void Seed(CompanyDbContext context)

{

Department d1 = new Department { Did = 10, Dname = "Sales", Location = "Hyderabad" };

Department d2 = new Department { Did = 20, Dname = "Research", Location = "Delhi" };

Department d3 = new Department { Did = 30, Dname = "HR", Location = "Mumbai" };

Department d4 = new Department { Did = 40, Dname = "Finance", Location = "Chennai" };

context.Departments.Add(d1); context.Departments.Add(d2);

context.Departments.Add(d3); context.Departments.Add(d4);

context.SaveChanges();

}

}

**Go to “CompanyDbContext” class and re-write the constructor of the class as below:**

public CompanyDbContext() : base("ConStr")

{

Database.SetInitializer(new CompanyDBInitializer());

}

Go to “CompanyController” class and delete the below code, because we have implemented the Seed method in “CompanyDBInitializer” class and it will insert data into Department table during the database initialization process, so this code is no more required in the “CompanyController” class.

Department d1 = new Department { Did = 10, Dname = "Sales", Location = "Hyderabad" };

Department d2 = new Department { Did = 20, Dname = "Research", Location = "Delhi" };

Department d3 = new Department { Did = 30, Dname = "HR", Location = "Mumbai" };

Department d4 = new Department { Did = 40, Dname = "Finance", Location = "Chennai" };

dc.Departments.Add(d1); dc.Departments.Add(d2); dc.Departments.Add(d3); dc.Departments.Add(d4);

**Entity Framework Code First Migrations:**

Entity Framework Code-First has different Database initialization strategies like “CreateDatabaseIfNotExists”, “DropCreateDatabaseIfModelChanges”, “DropCreateDatabaseAlways” however, there are problems with these strategies. In the first case Model changes will not be updated to the Database and also throws an error when we run the project, whereas in the second and third cases Model changes will be updated to the Database but if we already have data (other than seed data) or we created our own Stored Procedures, Triggers, Views etc. in our Database then these strategies will drop the entire Database and recreates it, so we will lose the data and Database objects also.

To overcome the above problems “Entity Framework” introduced “Migrations” that automatically updates the Database schema whenever our model changes without losing any existing data or other Database objects. To do that we need to use a new Database Initializer called “MigrateDatabaseToLatestVersion”.

**There are 2 kinds of Migration available like:**

* Automated Migration
* Code-based Migration

**Automated Migration:** Entity Framework provides automated migration option so that you don’t have to process Database migration manually for each change you make in your domain classes. The automated migrations can be implemented by executing the “enable-migrations” command in the Package Manager Console.

To test “Automated Migrations”, create a new “ASP.NET Web Application” project naming it as “MVCWithEFCF8”, choose “MVC Project Template” and click on “Create” button. Install Entity Framework, add 2 classes under Models folder with names *“*Student*”* and “SchoolDbContext” and write the below code under them:

public class Student

{

public int StudentId { get; set; }

public string Name { get; set; }

}

using System.Data.Entity;

public class SchoolDbContext : DbContext

{

public SchoolDbContext() : base("ConStr")

{

}

public DbSet<Student> Students { get; set; }

}

**Go to Web.config file and write the below code between <configuration></configuration> tag:**

<connectionStrings>

<add name="ConStr" providerName="System.Data.SQLClient"

connectionString="Data Source=Server;Database=SchoolDB;User Id=Sa;Password=123" />

</connectionStrings>

**Add a controller under the Controllers folder naming it as “SchoolController” and write the below code in it:**

using MVCWithEFCF8.Models;

public class StudentController : Controller

{

SchoolDbContext dc = new SchoolDbContext();

public ActionResult Index()

{

Student s = new Student { Name = "Raju" };

dc.Students.Add(s);

dc.SaveChanges();

return View();

}

}

Add a view to “Index” action method, run the project which will create “SchoolDB” Database under SQL Server and in that “Student” Table is created with 2 Columns and also 1 record is inserted into the Table.

Now if we make any changes to the Model class like adding new attributes (properties) or modifying existing attributes and run the project we get an error because by default the Database Initialization Strategy is “CreateDatabaseIfNotExists” and if we try to change the Database Initialization Strategy to “DropCreateDatabaseIfModelChanges” or “DropCreateDatabaseAlways” we will be losing the existing data in the table and to overcome this problem let’s use “Migrations”.

**Automatic Migrations:** to use Automatic Migrations we need to enable migrations in our project and to do that go to “Package Manager Console” window from “Tools Menu” => “Nuget Package Manager” => “Package Manager Console” and run the below command there:

**PM> Enable-Migrations -EnableAutomaticMigration:$true**

The above command will add a “Migrations” folder in our project and under that folder we find a file “Configuration.cs” which contains a class called “Configuaration” with the below code in it:

internal sealed class Configuration : DbMigrationsConfiguration<MVCWithEFCF8.Models.SchoolDbContext>

{

public Configuration() {

AutomaticMigrationsEnabled = true;

ContextKey = "MVCWithEFCF8.Models.SchoolDbContext";

}

protected override void Seed(MVCWithEFCF8.Models.SchoolDbContext context) {

//This method will be called after migrating to the latest version.

//You can use the DbSet<T>.AddOrUpdate() helper extension method to avoid creating duplicate seed data.

}

}

Now go to our “SchoolDbContext” class and write the below statement in its constructor by importing the namespace “MVCWithEFCF8.Migrations”.

**Database.SetInitializer(new MigrateDatabaseToLatestVersion<SchoolDbContext, Configuration>());**

With this action everything is set ready for Automatic Migrations, and to test this either add new properties to Student Class or add new Model classes in the project and the next time when we run the project, we see all the changes reflecting under the database. However, sometimes when you modify or remove existing properties in domain classes we get “System.Data.Entity.Migrations.Infrastructure.AutomaticDataLossException”, and this is because we may lose data in corresponding column of the Table. So, to handle this kind of scenario, we have to set “AutomaticMigrationDataLossAllowed = true” in the “Configuration” class Constructor. To do that go to “Configuration” class in “Migrations” folder and add the above statement which should now look as following:

public Configuration()

{

AutomaticMigrationsEnabled = true;

AutomaticMigrationDataLossAllowed = true;

ContextKey = "MVCWithEFCF8.Models.SchoolDbContext";

}

**Code Based Migrations:** code-based migration provides more control on the migration and allows you to configure additional things such as setting a default value to a column, change data type of a column, add not null constraints on a column, configure a computed column etc.

In order to use code-based migration we need to execute the following commands in “Package Manager Console” window under Visual Studio:

Enable-Migrations: enables the migration in your project by creating a Configuration class.

Add-Migration: creates a new migration class as per specified name with the Up() and Down() methods.

Update-Database: executes the last migration file created by the Add-Migration command and applies changes to the database schema.

To test Code Based Migrations create a new “ASP.NET Web Application” project naming it as “MVCWithEFCF9”, choose “MVC Project Template” and click on “Create” button. Install Entity Framework in the project, add 2 new classes in to Models folder naming them as “Student” and “SchoolDbContext”, and write the below code under them:

using System.ComponentModel.DataAnnotations;

using System.ComponentModel.DataAnnotations.Schema;

public class Student

{

public int StudentId { get; set; }

public string Name { get; set; }

public int Class { get; set; }

[MaxLength(1)]

[Column(TypeName = "Varchar")]

public string Section { get; set; }

}

using System.Data.Entity;

public class SchoolDbContext : DbContext

{

public SchoolDbContext() : base("ConStr")

{

}

public DbSet<Student> Students { get; set; }

}

**Go to Web.config file and write the below code between <configuration></configuration> tag:**

<connectionStrings>

<add name="ConStr" providerName="System.Data.SQLClient"

connectionString="Data Source=Server;Database=SchoolDB;User Id=Sa;Password=123" />

</connectionStrings>

**Add a controller under the Controllers folder naming it as “SchoolController” and write the below code in it:**

using MVCWithEFCF9.Models;

public class StudentController : Controller

{

SchoolDbContext dc = new SchoolDbContext();

public ActionResult Index()

{

Student s1 = new Student { Name = "Raju", Class = 10, Section = "A" };

Student s2 = new Student { Name = "Venkat", Class = 10, Section = "B" };

Student s3 = new Student { Name = "Srinivas", Class = 10, Section = "C" };

dc.Students.Add(s1); dc.Students.Add(s2); dc.Students.Add(s3);

dc.SaveChanges();

return View();

}

}

Add a view to Index action method and run the project which will create “SchoolDB” Database on SQL Server and under that Database, “Student” table is created with 4 columns in it.

**Working with Code Based Migrations:** To work with code-based migrations, first execute the “enable-migrations” command in the “Package Manager Console” and to do that go to Tools menu => Nuget Package Manager => Package Manager Console and run the below command over there:

**PM>Enable-Migrations**

This command will create the Configuration class same as we saw in case of “Automated Migrations” but in this case Configuration class Constructor will have “AutomaticMigrationsEnabled = false” because we are using Code Based Migrations now, and this command also creates a “<timestamp>\_InitialCreate.cs” file containing a class “InitialCreate” with “Up() and Down()” methods as following:

public partial class InitialCreate : DbMigration

{

public override void Up()

{

CreateTable("dbo.Students", c => new

{

StudentId = c.Int(nullable: false, identity: true),

Name = c.String(),

Class = c.Int(nullable: false),

Section = c.String(maxLength: 1, unicode: false),

}).PrimaryKey(t => t.StudentId);

}

public override void Down()

{

DropTable("dbo.Students");

}

}

As we can see the “Up()” method contains code for creating Database objects and the “Down()” method contains code for dropping or deleting Database objects. You may also write your own custom code for additional configurations and that is the advantage of Code Based Migrations over Automated Migrations.

Now go to “SchoolDbContext” class and write the below code in its constructor by importing the namespace “MVCWithEFCF9.Migrations”:

Database.SetInitializer(new MigrateDatabaseToLatestVersion<SchoolDbContext, Configuration>());

From now when ever we make changes to existing Model classes or add new Model classes we need to create a new Migration class by using the “Add-Migration” command in the “Package Manager Console” with a name to the class (any name) as following:

**Syntax** => PM> Add-Migration <Some Name>

**To test this go to Student class and add a new property into the class as following:**

public float Fees { get; set; }

**Open Package Manager Console (PMC) and create a new migration file by executing the following statement:**

PM> Add-Migration SchoolDB-V1

The above action will create a new migration file with the name “<timestamp>\_SchoolDB-v1.cs” and in the same way we can create any no. of migration files as above whenever we make changes to the Model classes and to discriminate between each file give a different name every time.

PM>Add-Migration SchoolDB-v2

PM>Add-Migration SchoolDB-v3

PM>Add-Migration SchoolDB-v4

After creating a migration file as above, we have to execute the “Update-Database” command in the “Package Manager Console” and update the Database as below:

PM>Update-Database

**Note:** to view the SQL statements being applied to the target Database use “-verbose” option as following: PM>Update-Database –Verbose

The above statement when executed will run the last or latest migration file and alters the Database based on the changes, we have made to domain classes.

Let’s now add another 2 properties in the “Student” class and to do that go to “Student.cs” file and write the below code in the class:

public float Marks { get; set; }

public string Address { get; set; }

**Create another migration file at the Package Manager Console as following:**

PM> Add-Migration SchoolDB-V2

**Note:** the above action will create a new migration file with the name “<timestamp>\_SchoolDB-v2.cs”.

**Get Migrations:** right now we have 3 migrations files that are created but what we have applied on the Database is only 2 and to check what migration are applied on the Database use the “Get-Migrations” command at Package Manager Console as below:

PM>Get-Migrations

Now let’s apply the 3rd migration file also to the Database i.e. “SchoolDB-V2” and to do that run the following statement at Package Manager Console:

PM>Update-Database -Verbose

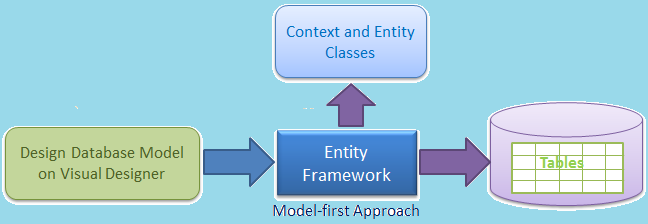
**Rollback Migration:** suppose if we want to roll back the Database schema to any of the previous states, then you can execute the “update-database” command with the “-TargetMigration” parameter to the point which you want to roll back to. For example, suppose there are many migrations applied to the above “SchoolDB” Database but you want to roll back to “SchoolDB-V1” migration then execute the below command:

PM>Update-Database -TargetMigration:SchoolDB-V1

**Note:** this statement will execute the “Down” method in the migration file and drops the 2 columns from the Database table, which are added in “SchoolDB-V2” migration. This action will not delete the migration file under “Migrations” folder, so if we don’t want it we need to explicitly delete the file on our own.

**Model-First Approach**

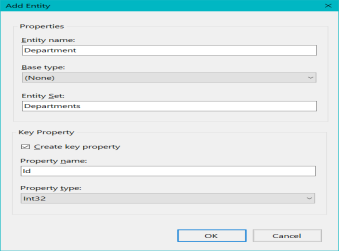
In Model-First approach, we create entities, relationships, and inheritance hierarchies directly on visual designer integrated in Visual Studio and then generate entities, context class, and the Database script from your visual model.



**Note:** EF 6 includes limited support for this, and EF Core does not support this approach at all.

To work with Entity Framework Model First Approach, create a new “ASP.NET Web Application” project naming it as “MVCWithEFMF”, choose “MVC Project Template” and click on “Create” button. Open Solution Explorer, right click on the Models folder and choose “Add => New Item” option and in the window opened select the item “ADO.NET Entity Data Model” name it as “TestEF” and click on the “Add” button and in the window opened select “Empty EF Designer Model” and click on “Finish” button. This will add “TestEF.edmx” item under Models folder and under this item we will find 2 items with the names “TestEF.Designer.cs” and “TestEF.edmx.diagram”. We also see “TestEF.edmx [Diagram1]” displayed in document window and by using this we can design Model classes.

**Creating a Department Entity:** now right click on the “TestEF.edmx [Diagram1]”, in the document window and select the option “Add New” => “Entity”, which will open “Add Entity” window => enter the “Entity name” as “Department” and this will automatically fill the other details in the window, watch them and click on “Ok” button which will add the “Department” entity with “Id” attribute.



**Adding new Properties to Department Entity:** right click on the Department Entity and select “Add New” => “Scalar Property” which will add a new property name it as “Dname”, right click on “Dname” property and select the option “Properties” which opens “Property Window” and in that window we can set various attributes like Type, Nullable, Length etc, and by default the Type will be “String” which is ok for “Dname” so leave it and set the “Max Length” property value as “50”, “Unicode” property value as “false” and “Nullable” property value as “false”. Repeat the same process again and add another property with the name “Location” and set the “Max Length” property value as “50”, “Unicode” property value as “false” and “Nullable” property value as “true”.

**Creating an Employee Entity:** right click on the document window and select the option “Add New” => “Entity”, which will open “Add Entity” window => enter the “Entity name” as “Employee” which will automatically fill the other details, watch them and click on the “Ok” button which will add the “Employee” entity with “Id” attribute.

**Adding new Properties to Employee Entity:** now add all the other required properties to “Employee” Entity with the following names and attribute values:

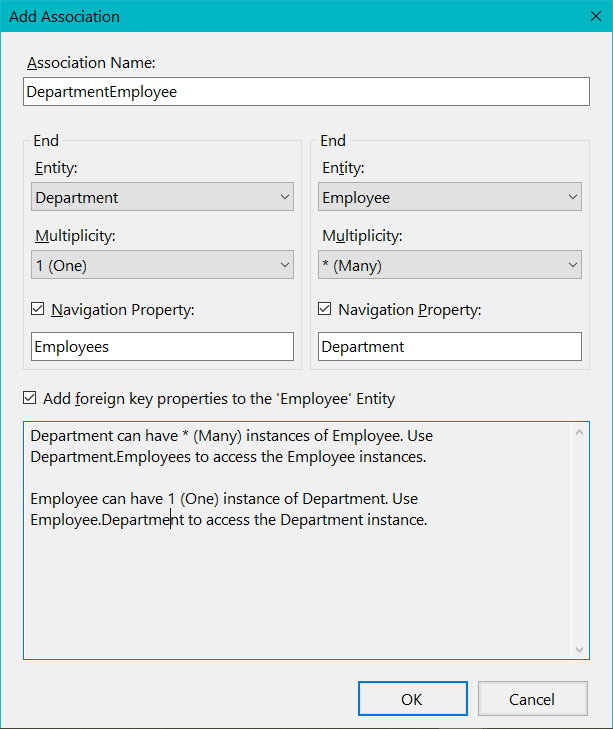
Ename: Type: String, Max Length: 50, Unicode: False, Nullable: False

Job: Type: String, Max Length: 50, Unicode: False, Nullable: True

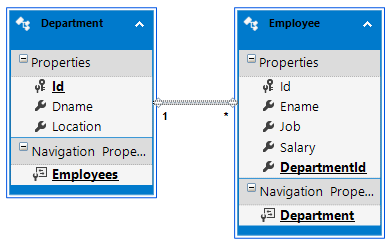
Salary: Type: Decimal, Precision: 9, Scale: 2, Nullable: True

Status: Type: Boolean, Default Value: True, Nullable: False

**Adding a relationship between the tables:** to add a relationship between the 2 tables right click, on the document window and select the option “Add New” => “Association” and in the window opened it will display the following details, verify them, change if anything is not as per our requirements (as of now everything is perfectly set, so no need to make any changes) and click on the “Ok” button.



This will add a “DepartmentId” column to the “Employee” entity, also adds navigation properties in both the entities and this will also create a relationship between the tables as following:



**Generating Model Classes and Database with Tables:** right click on the document window and select the option “Generate Database from Model” which will open a window and in that click on “New Connection” button and enter the connection details like “Server Name”, “Authentication Details” and in “Select or enter a database name:” TextBox enter Database Name as “CompanyDB” (make sure this Database is not existing under SQL Server) and when we click on the “Ok” button it will ask for creating the Database because it is not existing, click on the “Yes” button which will create the Database and launches a new window, here select the radio button “Yes, include the sensitive data in the connection string.” => Click “Next” and select the Entity Framework version i.e., “6.x” => Click “Next” which displays the required “SQL Script” code that is generated for creating tables and this code will be saved into our “Models” folder with the name “TestEF.edmx.sql” and click on the “Finish” button to complete the configuration which will also install “Entity Framework” in our project.

Now open “Solution Explorer” and watch the “TestEF.edmx” item under “Models” folder there we find new items added with the names “TestEF.Context.tt” and “TestEF.tt”. We find a “Context” class with the name “TestEFContainer” under the file “TestEF.Context.cs” which is present under “TestEF.Context.tt” item, and we also find Model classes under “TestEF.tt” item, which when expanded will show “Department.cs” and “Employee.cs” files containing “Department” and “Employee” classes.

**Note:** In the Context class i.e., “TestEFContainer” Constructor, we find a class to its base or parent class Constructor and under that we find the the name of “Connection String” which is nothing but “TestEFContainer”, so in the “Web.config” file we will find the “Connection String” with this name. Even if it is not required to specify the name and call base class constructor because we have already learnt that if the “Context” class name and “Connection String” name are same no need to specify that explicitly, but “Entity Framework Model First” will include that code in Constructor.

**Creating Tables on Database Server:** after all the above actions i.e., Entity Framework generating required Context and Model Classes, now we need to create the tables under our Database i.e., “CompanyDB” and to create the tables, inside of the Model’s folder we find a SQL Script file with name “TestEF.edmx.sql” which is generated by “Entity Framework Code First” which we need to execute and to do that, open the script file, right click on it in document window and select the option “Execute” which will open “Connect” window, in that expand the node “Local” and under that we find our “Server Name” (Server in my case) select it, and in the below specify the Authentication Details and choose the Database as “CompanyDB” under “Database Name” DropDownList and click connect which will create the tables on Database. Now we can start working with those tables by creating the required Controllers, Action Methods and Views.

**ADO.NET**

Pretty much every application deal with data in some manner, whether that data comes from memory, databases, XML files, text files, or something else. The location where we store the data can be called as a Data Source or Data Store where a Data Source can be a file, database, address books or indexing server etc.

Programming Languages cannot communicate with Data Sources directly because each Data Source adopts a different Protocol (set of rules) for communication, so to overcome this problem long back Microsoft has introduced intermediate technologies like ODBC and Ole DB which works like bridge between the Applications and Data Sources to communicate with each other.

**ODBC (Open Database Connectivity)** is a standard C programming language middleware API for accessing database management systems (DBMS). ODBC accomplishes DBMS independence by using an ODBC driver as a translation layer between the application and the DBMS. The application uses ODBC functions through an ODBC driver manager with which it is linked, and the driver passes the query to the DBMS. An ODBC driver will be providing a standard set of functions for the application to use and implementing DBMS-specific functionality. An application that can use ODBC is referred to as "ODBC-Compliant". Any ODBC-Compliant application can access any DBMS for which a driver is installed. Drivers exist for all major DBMS’s as well as for many other data sources like Microsoft Excel, and even for Text or CSV files. ODBC was originally developed by Microsoft in 1992.

It's a collection of drivers, where these drivers sit between the App's and Data Source's to communicate with each other and more over we require a separate driver for each and every data source.

ODBC drivers comes along with your Windows O.S. and we can find them at the following location:

Control Panel => Administrative Tools => ODBC Data Sources

To consume these ODBC Drivers first we need to configure them with the data source by creating a "DSN" (Data Source Name).

ODBC drivers are open source i.e. there is an availability of these ODBC Drivers for all the leading O.S's in the market.

**Drawbacks with ODBC Drivers:**

These drivers must be installed on every machine where the application is executing from and then the application, driver and data source should be manually configured with each other.

ODBC Drivers are initially designed for communication with Relational DB only.

**OLE DB (Object Linking and Embedding, Database, sometimes written as OLEDB or OLE-DB)**, an API designed by Microsoft, allows accessing data from a variety of data sources in a uniform manner. The API provides a set of interfaces implemented using the Component Object Model (COM) and SQL. Microsoft originally intended OLE DB as a higher-level replacement for, and successor to, ODBC, extending its feature set to support a wider variety of non-relational databases, such as object databases and spreadsheets that do not necessarily implement SQL. OLE DB is conceptually divided into consumers and providers. The consumers are the applications that need access to the data, and the providers are the software components that implement the interface and thereby provide the data to the consumer. An OLE DB provider is a software component enabling an OLE DB consumer to interact with a data source. OLE DB providers are alike to ODBC drivers. OLE DB providers can be created to access such simple data stores as a text file and spreadsheet, through to such complex databases as Oracle, Microsoft SQL Server, and many others. It can also provide access to hierarchical data stores. These OLE DB Providers are introduced by Microsoft around the year 1996.

It’s a collection of providers where these providers sit between the App's and Data Source to communicate with each other, and we require a separate provider for each data source.

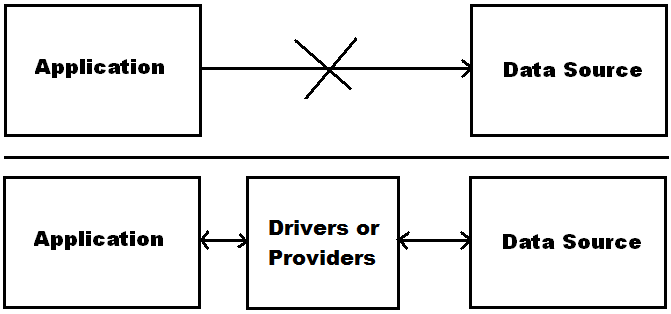
OLE DB Providers are designed for communication with relational & non-relational Data Sources also i.e. it provides support for communication with any Data Source.

OLE DB Providers sits on server machine so they are already configured with data source and when we connect with any data source they will help in the process of communication.

OLE DB Providers are developed by using COM and SQL Languages, so they are also un-managed.

Microsoft introduced OLEDB as a replacement for ODBC for its Windows Systems.

OLE DB is a pure Microsoft technology which works only on Windows Platform.



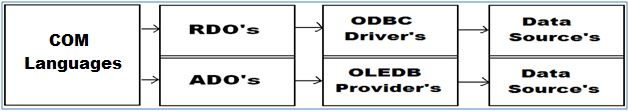
**Things to remember while working with ODBC and OLE DB:**

* ODBC and OLE DB are un-managed or platform dependent.
* ODBC and OLE DB are not designed targeting any particular language i.e., they can be consumed by any language like: C, CPP, Visual Basic, Visual CPP, Java, CSharp etc.

**Note:** If any language wants to consume ODBC Drivers or OLE DB Providers, they must use some built-in libraries of the language in which we are developing the application without writing complex coding.

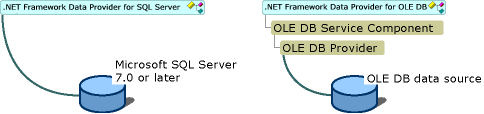
**RDO’s and ADO’s in COM Language:**

COM Language used RDO’s (Remote Data Objects) and ADO’s (ActiveX Data Objects) for data source communication without having to deal with the comparatively complex ODBC or OLEDB API.



**.NET Framework Providers:**

The .NET Framework Data Provider for SQL Server uses its own protocol to communicate with SQL Server. It is lightweight and performs well because it is optimized to access a SQL Server directly without adding an OLE DB or ODBC layer and it supports SQL Server software version 7.0 or later. The .NET Framework Data Provider for Oracle (Oracle Client) enables data access to Oracle data sources through Oracle client connectivity software. The data provider supports Oracle client software version 8.1.7 or later.



**ADO.NET:** It is a set of types that expose data access services to the .NET programmer. ADO.NET provides functionality to developers writing managed code similar to the functionality provided to native COM developers by ADO. ADO.NET provides consistent access to data sources such as Microsoft SQL Server, as well as data sources exposed through OLE DB and XML. Data-sharing consumer applications can use ADO.NET to connect to these data sources and retrieve, manipulate, and update data. It is an integral part of the .NET Framework, providing access to relational data, XML, and application data. ADO.NET supports a variety of development needs, including the creation of front-end database clients and middle-tier business objects used by applications or Internet browsers.

**ADO.Net provides libraries for Data Source communication under the following namespaces:**

* System.Data
* System.Data.Odbc
* System.Data.Oledb
* System.Data.SqlClient
* System.Data.OracleClient

**Note:** System.Data, System.Data.Odbc, System.Data.Oledb and System.Data.SqlClient namespaces are under the assembly System.Data.dll whereas System.Data.OracleClient is under System.Data.OracleClient.dll assembly.

**System.Data:** types of this namespace are used for holding and managing of data on client machines. This namespace contains following set of classes in it: **DataSet,** **DataTable, DataRow, DataColumn, DataView, DataRelation**, etc.

**System.Data.Odbc:** types of this namespace can communicate with any Relational Data Source using Un-Managed Odbc Drivers.

**System.Data.Oledb:** types of this namespace can communicate with any Data Source using Oledb Providers (Un-Managed COM Providers).

**System.Data.SqlClient:** types of this namespace can purely communicate with Sql Server database only using SqlClient Provider (Managed .Net Framework Provider).

**System.Data.OracleClient:** types of this namespace can purely communicate with Oracle database only using OracleClient Provider (Managed .Net Framework Provider).

All the above 4 namespaces contains same set of types as following: **Connection, Command, DataReader, DataAdapter, Parameter and CommandBuilder etc**, but here each class is referred by prefixing with Odbc, Oledb, Sql and Oracle keywords before the class name to discriminate between each other as following:

| OdbcConnection | OdbcCommand | OdbcDataReader | OdbcDataAdapter | OdbcCommandBuilder | OdbcParameter |
| --- | --- | --- | --- | --- | --- |
| OledbConnection | OledbCommand | OledbDataReader | OledbDataAdapter | OledbCommandBuilder | OledbParameter |
| SqlConnection | SqlCommand | SqlDataReader | SqlDataAdapter | SqlCommandBuilder | SqlParameter |
| OracleConnection | OracleCommand | OracleDataReader | OracleDataAdapter | OracleCommandBuilder | OracleParameter |

**Performing Operations on a DataSource:** the operations we perform on a Data Source will be Select, Insert, Update and Delete, and each operation we perform on a Data Source involves in 3 steps, like:

Establishing a connection with the data source.

Sending a request to Data Source by using SQL.

Capturing the results given by the data source.

**Establishing a Connection with Data Source:**

It's a process of opening a channel for communication between Application and Data Source that is present either on a local or remote machine to perform DB Operations and to open the channel for communication we use Connection class.

**Constructors of the Class:**

Connection() Connection(string ConnectionString)

**Note:** ConnectionString is a collection of attributes that are required for connecting with a DataSource, those are:

* DSN
* Provider
* Data Source
* User Id and Password
* Integrated Security
* Database or Initial Catalog
* Extended Properties

**DSN:** this is the only attribute that is required if we want to connect with a data source by using ODBC Drivers and by using this attribute we need to specify the DSN Name.

**Provider:** this attribute is required when we want to connect to the data source by using Oledb Providers. So, by using this attribute we need to specify the provider name based on the data source we want to connect with.

Oracle: Msdaora or ORAOLEDB.ORACLE Sql Server: SqlOledb

MS-Access or MS-Excel: Microsoft.Jet.Oledb.4.0 MS-Indexing Server: Msidxs

**Data Source:** this attribute is required to specify the server’s name if the data source is a database or else if the data source is a file, we need to specify path of the file and this attribute is required in case of any provider communication.

**User Id and Password:** This attribute is required to specify the credentials for connection with a database and this attribute is required in case of any provider communication.

Oracle: Scott/tiger SQL Server: Sa/123

**Integrated Security:** this attribute is used while connecting with **SQL Server Database only** to specify that we want to connect with the Server by using Windows Authentication and in this case, we should not use User Id and Password attributes and this attribute is required in case of any provider communication.

**Database or Initial Catalog:** these attributes are used while connecting with **SQL Server Database only** to specify the name of DB we want to connect with, and this attribute is required in case of any provider communication.

**Extended Properties:** this attribute is required only while connecting with MS-Excel using Oledb Provider.

List of attributes which are required in case of Odbc Drivers, Oledb and .Net Framework Providers:

| **Attribute** | **ODBC Driver** | **OLEDB Provider** | **.NET Framework Provider** |
| --- | --- | --- | --- |
| DSN | Yes | No | No |
| Provider | No | Yes | No |
| Data Source | No | Yes | Yes |
| User Id and Password | No | Yes | Yes |
| Integrated Security\* | No | Yes | Yes |
| Database or Initial Catalog\* | No | Yes | Yes |
| Extended Properties\*\* | No | Yes | - |

\*Only for Sql Server \*\*Only for Microsoft Excel

**Connection String for SqlServer to connect by using different options:**

*OdbcConnection con = new OdbcConnection("Dsn=<Dsn Name>");*

*OledbConnection con = new OledbConnection("Provider=SqlOledb;Data Source=<Server Name>;*

*Database=<DB Name>;User Id=<User Name>;Password=<Pwd>");*

*SqlConnection con = new SqlConnection("Data Source=<Server Name>;Database=<DB Name>;*

*User Id=<User Name>;Password=<Pwd>");*

**Note:** in case of Windows Authentication in place of User Id and Password attributes we need to use Integrated Security = SSPI (Security Support Provider Interface).

**Connection String for Oracle to connect by using different options:**

*OdbcConnection con = new OdbcConnection("Dsn=<Dsn Name>");*

*OledbConnection con = new OledbConnection("Provider=Msdaora (o)r* ORAOLEDB.ORACLE*;*

*Data Source=<Server Name>;User Id=<User Name>;Password=<Pwd>");*

*OracleConnection con = new OracleConnection("Data Source=<Server Name>;*

*User Id=<User Name>;Password=<Pwd>");*

**Connection String for MS-Excel to connect by using different options:**

*OdbcConnection con = new OdbcConnection("Dsn=<Dsn Name>");*

*OledbConnection con = new OledbConnection("Provider=Microsoft.Jet.Oledb.4.0;*

*Data Source=<Path of Excel Document>;Extended Properties=Excel 8.0”);*

**Members of Connection class:**

**Open():** a method which opens a connection with data source.

**Close():** a method which closes the connection that is open.

**State:** an enumerated property which is used to get the status of connection.

**ConnectionString:** a property which is used to get or set a connection string that is associated with the connection object.

**Object of class Connection can be created in any of the following ways:**

*Connnection con = new Connection();*

*con.ConnectionString = "<connection string>";*

*or*

*Connection con = new Connection("<connection string>");*

**Sending request to Data Source by using SQL:**

In this process we send a request to Data Source by specifying the type of action we want to perform by using a SQL Statement like Select, Insert, Update, and Delete or by calling a Stored Procedure present under the Data Source. To send and execute SQL Statements or call Stored Procedures in Data Source we use Command class.

**Constructors of the class:**

Command()

Command(string CommandText, Connection con)

**Note:** CommandText means it can be any SQL Statement like Select or Insert or Update or Delete Statements or Stored Procedure Name, whereas “Connection” refers to instance of Connection class created in 1st step.

**Properties of Command Class:**

Connection: sets or gets the connection object associated with command object.

CommandText: sets or gets the SQL statement or SP name associated with command object.

CommandType: sets or gets whether Command is configured to execute a SQL Statement [default] or S.P.

**The object of class Command can be created in any of the following ways:**

Command cmd = new Command(); cmd.Connection = <con>; cmd.CommandText = "<Sql Stmt or SP Name>";

or

Command cmd = new Command("<Sql Stmt or SP Name>", <con>);

**Methods of Command class:**

ExecuteReader() => DataReader

ExecuteScalar() => object

ExecuteNonQuery() => int

**Note:** after creating object of Command class, we need to call any of the execute methods to execute the stmt’s.

Use **ExecuteReader()** method when we want to execute a Select Statement that returns data as rows and columns. The method returns an object of class DataReader which holds data that is retrieved from data source in the form of rows and columns.

Use **ExecuteScalar()** method when we want to execute a Select Statement that returns a single value result. The method returns result of the query in the form of an object.

Use **ExecuteNonQuery()** method when we want to execute any SQL statement other than select, like Insert or Update or Delete etc. The method returns an integer that tells the no. of rows affected by the statement.

**Note:** The above process of calling a suitable method to capture results is our third step i.e., capturing the results.

**DataReader:** it's a class designed for holding the data on client machines in the form of Rows and Columns.

**Features of DataReader:**

* Can hold multiple tables in it at a time and to load multiple tables into a DataReader pass multiple Select Statements as “CommandText” to command separated by a semi-colon.
* Faster access to data from the Data Source because it is “Connection Oriented”.

**Drawbacks of DataReader:**

* As it is connection oriented requires a continuous connection with data source while we are accessing the data, so there are chances of performance degradation if there are more no. of clients accessing data at the same time.
* It gives forward only access to the data i.e., allows going either to next record or table but not to previous record or table.
* It is a read only object which will not allow any changes to data that is present in it.

**Accessing data from a DataReader:** DataReader is a class which can hold data in the form of rows and columns, to access data from DataReader it provides the following members:

**GetName(int ColumnIndex) => string**

Returns name of the column for given index position.

**Read() => bool**

Moves record pointer from current location to next row and returns a Boolean value which tells whether the row to where it moved contains any data or not, which will be true if data is present or false if data is not present.

**GetValue(int ColumnIndex) => object**

**Indexer[int ColumnIndex] => object**

**Indexer[string ColumnName] => object**

All the 3 are used for retrieving column values from the row to which pointer was pointing by specifying the Column Index or Column Name.

**FieldCount => int**

This property returns the no. of columns fetched into the DataReader

**NextResult() => bool**

Moves record pointer from current table to next table and returns a Boolean value which tells whether the location to which it moved contains a table or not, which will be true if present or false if not present.

**Dis-Connected Architecture**: ADO.Net supports 2 different models for accessing data from Data Sources:

Connection Oriented Architecture

Disconnected Architecture

In the first case we require a continuous connection with Data Source for accessing data from it and in this case, we use DataReader class for holding data on client machines, whereas in the 2nd case we don’t require a continuous connection with Data Source for accessing the data from it i.e., we require a connection only for loading data from Data Source and in this case, we use DataSet class for holding data on client machines.

**Working with DataSet**

**DataSet:** It's a class present under System.Data namespace designed for holding and managing of the data on client machines apart from DataReader. DataSet class provides the following features:

DataSet is also capable of holding multiple tables like a DataReader whereas in case of DataSet those tables can be loaded from different Data Sources.

It is designed in disconnected architecture which requires a connection just for loading data but not for holding and accessing the data.

It provides scrollable navigation to data which allows us to move in any direction i.e., either top to bottom or bottom to top.

It is updatable i.e., changes can be made to data present in it and those changes can be sent back to DB for update.

It provides options for searching and sorting of data that is present under it.

It provides options for establishing relations between the tables that are present under it.

**Loading Data into DataSet's:** The class which is responsible for loading data into DataReader from a DataSource is Command, in the same way DataAdapter class is required for communication between DataSource and DataSet.

**DataSource <= Command => DataReader**

**DataSource <=> DataAdapter <=> DataSet**

**Note:** DataAdapter is internally a collection of 4 commands like “SelectCommand”, “InsertCommand”, “UpdateCommand” and “DeleteCommand” where each command is an instance of Command class, and by using these commands DataAdapter will perform Select, Insert, Update and Delete operations on a table.

**Constructors of DataAdapter class:**

DataAdapter()

DataAdapter(Command SelectCmd)   
DataAdapter(string SelectCommandText, Connection con)

DataAdapter(string SelectCommandText, string ConnectionString)

**Note:** Select Command Text means it can be a Select Stmt or a Stored Procedure which contains a Select Stmt.

**Instance of DataAdapter class can be created in any of the following ways:**

Connection con = new Connection(“<Connection String>”);

Command cmd = new Command(“<Select Stmt or SP Name>”, con);

DataAdapter da = new DataAdapter();

da.SelectCommand = cmd;

Or

Connection con = new Connection(“<Connection String>”);

Command cmd = new Command(“<Select Stmt or SP Name>”, con);

DataAdapter da = new DataAdapter(cmd);

Or

Connection con = new Connection(“<Connection String>”);

DataAdapter da = new DataAdapter(“<Select Stmt or SPName>”, con);

or

DataAdapter da = new DataAdapter(“<Select Stmt or SPName>”, “<Connection String>”);

**Properties of DataAdapter:**

SelectCommand

InsertCommand

UpdateCommand

DeleteCommand

**Methods of DataAdapter:**

Fill(DataSet ds, string tableName)

Update(DataSet ds, string tableName)

Fill method is used for loading data from DataSource into the DataSet and Update method is used for updating any changes made in the DataSet back to DataSource:

**Fill: DataSource => DataAdapter => DataSet**

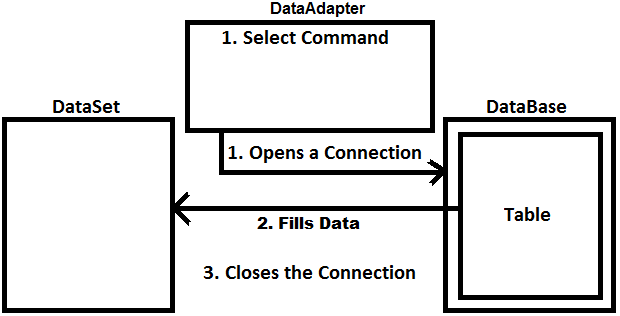
**Update: DataSource <= DataAdapter <= DataSet**

When we call Fill method on DataAdapter class, then following actions will take place internally:

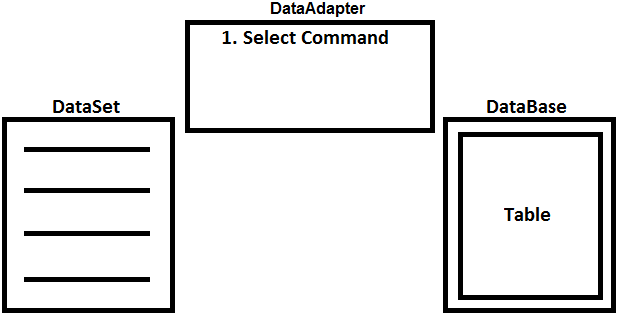
DataAdapter will open a connection with the Data Source.

Executes the SelectCommand present in it on the DataSource and loads data from table to DataSet.

Closes the connection.



Once the execution of Fill method is completed data gets loaded into the DataSet as below:

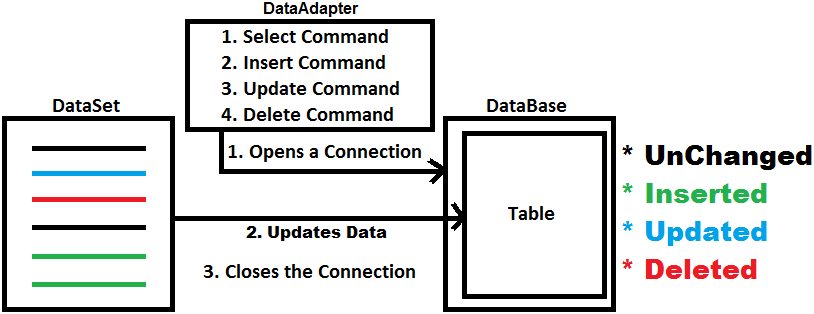


As we are discussing DataSet is updatable, we can make changes to the data that is loaded into it like adding, and modifying and deleting of records and after making changes to data in DataSet if we want to send those changes back to DataSource we need to call Update method on DataAdapter, which performs the following:

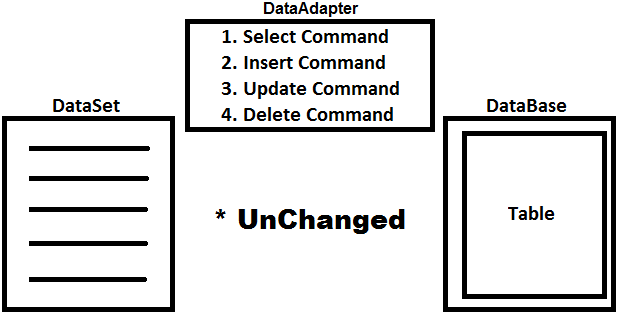
DataAdapter will re-open the connection with Data Source.

Changes that are made to data in DataSet will be sent back to corresponding table, where in this process it will make use of Insert, Update and Delete commands of DataAdapter.

Closes the connection.



**Once Update method execution is completed data gets re-loaded into DataSet as below with unchanged rows:**



**Accessing data from DataSet:** DataReader’s provides pointer-based access to the data, so we can get data only in a sequential order whereas DataSet provides index-based access to the data, so we can get data from any location randomly. DataSet is a collection of tables where each table is represented as a class DataTable and identified by its index position or name. Every DataTable is again collection of Rows and collection of Columns where each row is represented as a class DataRow and identified by its index position and each column is represented as a class DataColumn and identified by its index position or name.

**Accessing a DataTable from DataSet:** <dataset>.Tables[index] or <dataset>.Tables[name]

E.g.: ds.Tables[0] or ds.Tables["Employee"]

**Accessing a DataRow from DataTable:** <datatable>.Rows[index]

E.g.: ds.Tables[0].Rows[0]

**Accessing a DataColumn from DataTable:** <datatable>.Columns[index] or <datatable>.Columns[name]

E.g.: ds.Tables[0].Columns[0] or ds.Tables[0].Columns["Eno"]

**Accessing a Cell from DataTable:** <datatable>.Rows[row][col]

E.g.: ds.Tables[0].Rows[0][0] or ds.Tables[0].Rows[0]["Eno"]

Create a new ASP.NET Web Application project naming it as “MVCWithADO”, choose “MVC Project Template” and click on the “Create” button. Under the Model’s folder add a class with the name “Student.cs” to represent our Student Entity and write the below code in it:

using System.ComponentModel.DataAnnotations;

public class Student

{

[Display(Name = "Student Id")]

public int? Sid { get; set; }

public string Name { get; set; }

public int? Class { get; set; }

public decimal? Fees { get; set; }

public string Photo { get; set; }

}

**Open Web.config file and add Connection String for connecting to DB under <configuration> tag as following:**

<connectionStrings>

<add name="ConStr" connectionString="Data Source=Server;Database=MVCDB;User Id=Sa; Password=123"

providerName="System.Data.SqlClient" />

</connectionStrings>

**Now add another class in Model’s folder with the name “StudentDAL.cs” and write the following code in it:**

using System.Data;

using System.Configuration;

using System.Data.SqlClient;

public class StudentDAL

{

SqlCommand cmd;

SqlConnection con;

public StudentDAL()

{

string ConStr = ConfigurationManager.ConnectionStrings["ConStr"].ConnectionString;

con = new SqlConnection(ConStr);

cmd = new SqlCommand();

cmd.Connection = con;

cmd.CommandType = CommandType.StoredProcedure;

}

public Student GetStudent(int Sid, bool? Status)

{

Student student = null;

try

{

cmd.CommandText = "Student\_Select";

cmd.Parameters.Clear();

cmd.Parameters.AddWithValue("@Sid", Sid);

if (Status != null)

{

cmd.Parameters.AddWithValue("@Status", Status);

}

con.Open();

SqlDataReader dr = cmd.ExecuteReader();

if(dr.Read())

{

student = new Student();

student.Sid = Convert.ToInt32(dr["Sid"]);

student.Name = dr["Name"].ToString();

student.Class = Convert.ToInt32(dr["Class"]);

student.Fees = Convert.ToDecimal(dr["Fees"]);

student.Photo = dr["Photo"].ToString();

}

}

catch (Exception ex)

{ throw ex; }

finally

{ con.Close(); }

return student;

}

public List<Student> GetStudents(bool? Status)

{

List<Student> students = new List<Student>();

try

{

cmd.CommandText = "Student\_Select";

cmd.Parameters.Clear();

if (Status != null)

cmd.Parameters.AddWithValue("@Status", Status);

con.Open();

SqlDataReader dr = cmd.ExecuteReader();

while (dr.Read())

{

Student student = new Student

{

Sid = Convert.ToInt32(dr["Sid"]),

Name = dr["Name"].ToString(),

Class = Convert.ToInt32(dr["Class"]),

Fees = Convert.ToDecimal(dr["Fees"]),

Photo = dr["Photo"].ToString(),

};

students.Add(student);

}

}

catch (Exception ex)

{ throw ex; }

finally

{ con.Close(); }

return Students;

}

public int InsertStudent(Student student)

{

int Count = 0;

try

{

cmd.CommandText = "Student\_Insert";

cmd.Parameters.Clear();

cmd.Parameters.AddWithValue("@Sid", student.Sid);

cmd.Parameters.AddWithValue("@Name", student.Name);

cmd.Parameters.AddWithValue("@Class", student.Class);

cmd.Parameters.AddWithValue("@Fees", student.Fees);

if (student.Photo != null && student.Photo.Length != 0)

cmd.Parameters.AddWithValue("@Photo", student.Photo);

con.Open();

Count = cmd.ExecuteNonQuery();

}

catch (Exception ex)

{ throw ex; }

finally

{ con.Close(); }

return Count;

}

public int UpdateStudent(Student student)

{

int Count = 0;

try

{

cmd.CommandText = "Student\_Update";

cmd.Parameters.Clear();

cmd.Parameters.AddWithValue("@Sid", student.Sid);

cmd.Parameters.AddWithValue("@Name", student.Name);

cmd.Parameters.AddWithValue("@Class", student.Class);

cmd.Parameters.AddWithValue("@Fees", student.Fees);

if (student.Photo != null && student.Photo.Length != 0)

cmd.Parameters.AddWithValue("@Photo", student.Photo);

con.Open();

Count = cmd.ExecuteNonQuery();

}

catch (Exception ex)

{ throw ex; }

finally

{ con.Close(); }

return Count;

}

public int DeleteStudent(int Sid)

{

int Count = 0;

try

{

cmd.CommandText = "Student\_Delete";

cmd.Parameters.Clear();

cmd.Parameters.AddWithValue("@Sid", Sid);

con.Open();

Count = cmd.ExecuteNonQuery();

}

catch (Exception ex)

{ throw ex; }

finally

{ con.Close(); }

return Count;

}

}

**Add a Controller under Controllers folder with the name “StudentController” and write the following code in it:**

using System.IO;

using MVCWithADO.Models;

public class StudentController : Controller

{

StudentDAL obj = new StudentDAL();

public ViewResult DisplayStudents()

{

return View(obj.GetStudents(true));

}

public ViewResult DisplayStudent(int Sid)

{

return View(obj.GetStudent(Sid, true));

}

public ViewResult AddStudent()

{

return View();

}

[HttpPost]

public RedirectToRouteResult AddStudent(Student student, HttpPostedFileBase selectedFile)

{

if (selectedFile != null)

{

string PhysicalPath = Server.MapPath("~/Uploads/");

if (!Directory.Exists(PhysicalPath)) {

Directory.CreateDirectory(PhysicalPath);

}

selectedFile.SaveAs(PhysicalPath + selectedFile.FileName);

student.Photo = selectedFile.FileName;

}

obj.InsertStudent(student);

return RedirectToAction("DisplayStudents");

}

public ViewResult EditStudent(int Sid)

{

Student student = obj.GetStudent(Sid, null);

TempData["Photo"] = student.Photo;

return View(s);

}

public RedirectToRouteResult UpdateStudent(Student student, HttpPostedFileBase selectedFile)

{

if (selectedFile != null)

{

string PhysicalPath = Server.MapPath("~/Uploads/");

if (!Directory.Exists(PhysicalPath)) {

Directory.CreateDirectory(PhysicalPath);

}

selectedFile.SaveAs(PhysicalPath + selectedFile.FileName);

student.Photo = selectedFile.FileName;

}

else

{

student.Photo = TempData["Photo"].ToString();

}

obj.UpdateStudent(student);

return RedirectToAction("DisplayStudents");

}

public RedirectToRouteResult DeleteStudent(int Sid) {

obj.DeleteStudent(Sid);

return RedirectToAction("DisplayStudents");

}

}

Add a view with the name DisplayStudents.cshtml, selecting layout Checkbox and write the below code in it by deleting the whole content in the View:

@model IEnumerable<MVCWithADO.Models.Student>

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Student Details</h2>

<table border="1" align="center" class="table-condensed">

<tr>

<th>@Html.DisplayNameFor(S => S.Sid)</th>

<th>@Html.DisplayNameFor(S => S.Name)</th>

<th>@Html.DisplayNameFor(S => S.Class)</th>

<th>@Html.DisplayNameFor(S => S.Fees)</th>

<th>@Html.DisplayNameFor(S => S.Photo)</th>

<th align="center">Actions</th>

</tr>

@foreach (MVCWithADO.Models.Student student in Model)

{

<tr>

<td>@Html.DisplayFor(S => student.Sid)</td>

<td>@Html.DisplayFor(S => student.Name)</td>

<td>@Html.DisplayFor(S => student.Class)</td>

<td>@Html.DisplayFor(S => student.Fees)</td>

<td><img src='/Uploads/@student.Photo' width="40" height="25" alt="No Image" />

</td>

<td>

@Html.ActionLink("View", "DisplayStudent", new { Sid = student.Sid })

@Html.ActionLink("Edit", "EditStudent", new { Sid = student.Sid })

@Html.ActionLink("Delete", "DeleteStudent", new { Sid = student.Sid },

new { onclick = "return confirm('Are you sure of deleting the record?')" })

</td>

</tr>

}

<tr><td colspan="6" align="center">@Html.ActionLink("Add New Student", "AddStudent")</td></tr>

</table>

Generate a view for DisplayStudent action method and while adding the View, choose the Template as Empty, Model Class as Student, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element present in it:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Student Details</h2>

<table border="1" align="center">

<tr>

<td rowspan=4><img src='~/Uploads/@Model.Photo' width="200" height="200" alt="No Image" /> </td>

<td>Sid: @Model.Sid</td>

</tr>

<tr><td>Name: @Model.Name</td></tr>

<tr><td>Class: @Model.Class</td></tr>

<tr><td>Fees: @Model.Fees</td></tr>

<tr><td colspan="2" align="center">@Html.ActionLink("Back to Student Details", "DisplayStudents")</td></tr>

</table>

Generate a view for AddStudent action method and while adding the View, choose the Template as Empty, Model Class as Student, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element present in it:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Add New Student</h2>

@using (Html.BeginForm("AddStudent", "Student", FormMethod.Post, new { enctype = "multipart/form-data" }))

{

<div>@Html.LabelFor(S => S.Sid)<br />@Html.TextBoxFor(S => S.Sid)</div>

<div>@Html.LabelFor(S => S.Name)<br />@Html.TextBoxFor(S => S.Name)</div>

<div>@Html.LabelFor(S => S.Class)<br />@Html.TextBoxFor(S => S.Class)</div>

<div>@Html.LabelFor(S => S.Fees)<br />@Html.TextBoxFor(S => S.Fees)</div>

<div>@Html.LabelFor(S => S.Photo)<br /><input type="file" name="selectedFile" /></div>

<div>

<input type="submit" value="Save" name="btnSave" />

<input type="reset" value="Reset" name="btnReset" />

</div>

}

@Html.ActionLink("Back to Student Details", "DisplayStudents")

Generate a view for EditStudent action method and while adding the View, choose the Template as Empty, Model Class as Student, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element present in it:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Edit Student Details</h2>

@using (Html.BeginForm("UpdateStudent", "Student", FormMethod.Post, new {enctype="multipart/form-data" }))

{

<div>@Html.LabelFor(S => S.Sid)<br />@Html.TextBoxFor(S => S.Sid, new { @readonly = "true" })</div>

<div>@Html.LabelFor(S => S.Name)<br />@Html.TextBoxFor(S => S.Name)</div>

<div>@Html.LabelFor(S => S.Class)<br />@Html.TextBoxFor(S => S.Class)</div>

<div>@Html.LabelFor(S => S.Fees)<br />@Html.TextBoxFor(S => S.Fees)</div>

<div>

@Html.LabelFor(S => S.Photo)<br />

<img src='~/Uploads/@Model.Photo' width="100" height="100" alt="No Image" style="border:dashed red" />

<input type="file" name="selectedFile" />

</div>

<div>

<input type="submit" value="Update" name="btnUpdate" />

@Html.ActionLink("Cancel", "DisplayStudents")

</div>

}

**MVC Filters**

In ASP.NET MVC, a user request is routed to an appropriate Controller and Action Method. However, there may be circumstances where you want to execute some logic before or after an Action Method executes or before or after an ActionResult executes, and to achieve this ASP.NET MVC provides Filters. Filters are used to inject extra logic at the different levels of MVC Framework’s request processing pipeline which provide a way for cross cutting concerns like logging, authorization and caching.

Initially ASP.NET MVC Framework supports four different types of filters like Authorization Filters, Action Filters, Result Filters and Exception Filters whereas Authentication Filters are introduced with ASP.NET MVC 5 and each Filter allows us to introduce logic at different points during the request processing pipeline.

In MVC, filters are classes, and all those classes implement some interface. The following table lists filter types and the interface which they implemented:

| **Filter Types** | **Interface** | **Description** |
| --- | --- | --- |
| Authentication | IAuthenticationFilter | These filters run before any other filters run or action method executes. |
| Authorization | IAuthorizationFilter | These filters run next of Authentication Filters and before any other filters run or action method executes. |
| Action | IActionFilter | These filters run before and after an action method executes. |
| Result | IResultFilter | These filters run before and after the action result executes. |
| Exception | IExceptionFilter | These filters run only if any filter or action method or action result throws an exception. |

**Authentication Filters:** Authentication filter runs before any other filter or action method executes. Authentication confirms that you are a valid or invalid user, and these filters must implement the IAuthenticationFilter interface.

**Authorization Filters:** Authorization Filters are responsible for checking User Access and these filters must implement the IAuthorizationFilter interface. These filters are used to implement authorization for controllers and action methods. The Authorize Attribute is the example of Authorization Filters.

**Action Filters:** Action Filters can be applied to a controller action method or an entire controller. These filters will be called before the action method starts executing and after the action method has executed. Action filters implement the IActionFilter interface that has 2 methods OnActionExecuting and OnActionExecuted. OnActionExecuting method executes before an action method and gives an opportunity to cancel the Action call and OnActionExecuted method executes after an action method and gives an opportunity to modify the view data that a controller action method returns.

**Result Filters:** These filters contain logic that is executed before and after a view result is executed like if we want to modify a view result right before the view is rendered to browser. OutputCacheAttribute is an example of Result Filter and these filters implement IResultFilter interface which contains OnResultExecuting and OnResultExecuted methods.

**ExceptionFilters:** These filters can be used to handle errors raised by either a controller action methods or action results i.e., they execute if there are any unhandled exceptions thrown during the execution pipeline. The HandleErrorAttribute is an example of ExceptionFilters, and they implement IExceptionFilter interface.

**List of pre-defined filters provided by ASP.NET MVC:**

**ChildActionOnly:** This filter ensures that an action method can be called only as a child method from a view of another action method. We tend to use this filter to prevent action methods from being invoked directly and if we try to do that it will throw an error.

**OutputCache:** One of the best ways to improve the performance of an ASP.NET MVC Application is by caching. With the help of caching, we can reduce hosting server and database Server round trips. We can apply OutputCache Action Filter to achieve caching either on an Action Method or on the whole controller. OutputCache filter has several properties like CacheProfile, Duration, Location, VaryByParam, VaryByHeader etc.

* **Duration:** Gets or sets the cache duration in seconds.
* **VaryByParam:** Gets or sets the vary-by-param value and if not specified default value is none.
* **VaryByCustom:** Gets or sets the vary-by-custom value.
* **Location:** Gets or sets the location value which is to specify where the output must be cached, it takes an Enum value which can be Server, Client, Downstream (Proxy Server), ServerAndClient, Any and None, default is any.
* **CacheProfile:** Gets or Sets the cache profile value from Web.config file.

**ValidateInput:** Cross Site Scripting (CSS/XSS) attack is very common and is a well-known attack for web applications, for example a CSS/XSS attack is basically the result of poor form validation. How CSS/XSS attacks work is at first the hacker does inject some HTML code into a HTML input field and the data along with the HTML tag is saved to the database. Now, when there is a need to display the data in a user interface then we will get it from the Database and a legitimate browser will parse it as HTML code. If the hacker then injects a normal HTML string, then there is no problem at all but if they inject harmful Java Script code from an input field that might steal valuable information from the user’s computer, but we are very sure that we never want to allow a user to inject a HTML element through a form. In traditional Web Form applications, we use a form validation script (in Java Script very often) to validate user’s input whereas in MVC the library has done all the job for us, so we need not validate or write lengthy code externally. In MVC by default it prevents the HTML element as form data, anyway we can use the ValidateInput attribute to prevent HTML explicitly in this way: [ValidateInput(true)] which can be used either on controller or action method.

**ValidateAntiForgeryToken:** This is a built-in functionality provided by Microsoft which developers often use in their applications for security purposes i.e., to stop CSRF (Cross Site Request Forgery) from hackers. Cross Site Request forgery can be defined as, a forgery request, i.e., a fraud or fake request, which comes on an authenticated site from a cross site and is treated as an authenticated request. For avoiding this situation, Microsoft provides ValidateAntiForgeryToken functionality which we can use in our application so that no one can hack our site or invade some critical information.

**HandleError:** This is an Exception Filters to handle errors in ASP.NET MVC which can be applied over the action method as well as Controller or at the global level. The HandleError Error filter has a set of properties that are very useful in handling the exception. This comes under Exception Filter.

* **ExceptionType:** Type of exception to be catch. If this property is not specified, then the HandleError filter handles all exceptions.
* **View:** Name of the view page for displaying the exception information.
* **Master:** Master View for displaying the exception.
* **Order:** Order in which the action filters are executed. The Order property has an integer value, and it specifies the priority from 1 to any positive integer value. 1 means highest priority and greater the value of the integer is, the lower is the priority of the filter.
* **AllowMultiple:** indicates whether more than one instance of error filter attribute can be specified.

**Authorize:** specifies that access to a controller or action method is restricted to users who meet the authorization requirement. You can apply the Authorize attribute to individual methods as well as the controller class. If you add the Authorize attribute to the controller class, then any action methods on the controller will be available only to authenticated users. The Authorize attribute is inheritable which means that you can add it to a base controller class of yours and thereby ensure that any methods of the derived controllers are also subject to authentication.

**AllowAnonymous:** when applied to a method, the AllowAnonymous attribute instructs the ASP.MVC runtime to accept and process the call even if the caller is not authenticated. The scenario when the AllowAnonymous comes handy is when you apply Authorize at the class level and then need to enable free access to some methods like login action method, registration action methods etc. This comes under Authorization Filter.

To test filters, create a new Table in our “MVCDB” Database with the name Customer as following, and insert some records into the table:

CreateTableCustomer (CustidIntPrimaryKey,NameVarchar(50),BalanceMoney,CityVarchar(50),StatusBitDefault1NotNull)

Create a new “ASP.NET Web Application” project naming it as “MVCFilters”; choose “Empty Project Template”, select “MVC” CheckBox and click on “Create” button. First host the Web Application on IIS and then under Model’s folder add “ADO.NET Entity Data Model” naming it as “TestEF”, choose “EF Designer from database” (DB First), provide the connection details for our “MVCDB” Database and choose “Department”, “Employee” and “Customer” tables. Add a controller under Controller’s folder naming it as “HomeController”, delete existing content under the class and write the code:

using System.Web.UI;

using MVCFilters.Models;

public class HomeController : Controller

{

MVCDBEntities dc = new MVCDBEntities();

#region ChildActionOnly Filter

public ViewResult DisplayDepts()

{

return View(dc.Departments);

}

public ViewResult DisplayEmpsByDept(int Did)

{

var Emps = from E in dc.Employees where E.Did == Did select E;

return View(Emps);

}

#endregion

#region OutputCache Filter

public ViewResult DisplayCustomers1()

{

return View(dc.Customers);

}

[OutputCache(Duration = 45, Location = OutputCacheLocation.Server)]

public ViewResult DisplayCustomers2()

{

return View(dc.Customers);

}

[OutputCache(Duration = 45, Location = OutputCacheLocation.Server, VaryByParam = "City")]

public ViewResult DisplayCustomers3(string City)

{

return View(from C in dc.Customers where C.City == City select C);

}

[OutputCache(Duration = 45, Location = OutputCacheLocation.Server, VaryByCustom = "browser")]

public ViewResult DisplayCustomers4()

{

return View(dc.Customers);

}

public ViewResult DisplayCustomers5()

{

return View(dc.Customers);

}

#endregion

#region ValidateInput Filter

public ViewResult GetComments()

{

return View();

}

[HttpPost]

public string GetComments(string txtComments)

{

return txtComments;

}

#endregion

#region ValidateAntiForgeryToken Filter

public ViewResult AddEmployee()

{

return View();

}

[HttpPost]

public string AddEmployee(Employee Emp)

{

Emp.Status = true;

dc.Employees.Add(Emp);

dc.SaveChanges();

return "Record Inserted";

}

#endregion

#region HandleError Filter

public ViewResult DivideNums()

{

return View();

}

[HttpPost]

public string DivideNums(int num1, int num2)

{

int result = num1 / num2;

return "Result is: " + result;

}

#endregion

}

Add a view with the name “DisplayEmpsByDept.cshtml”, selecting layout Checkbox and write the below code in it by deleting the existing code in the file:

@model IEnumerable<MVCFilters.Models.Employee>

@{

Layout = null;

}

<table align="center">

<tr>

<th>@Html.DisplayNameFor(E => E.Eid)</th>

<th>@Html.DisplayNameFor(E => E.Ename)</th>

<th>@Html.DisplayNameFor(E => E.Job)</th>

<th>@Html.DisplayNameFor(E => E.Salary)</th>

<th>@Html.DisplayNameFor(E => E.Status)</th>

</tr>

@foreach (var Emp in Model)

{

<tr>

<td>@Html.DisplayFor(E => Emp.Eid) </td>

<td>@Html.DisplayFor(E => Emp.Ename) </td>

<td>@Html.DisplayFor(E => Emp.Job) </td>

<td align="right">@Html.DisplayFor(E => Emp.Salary) </td>

<td align="center">@Html.CheckBoxFor(E => Emp.Status)</td>

</tr>

}

</table>

Add a view with the name “DisplayDepts.cshtml”, selecting layout Checkbox and write the below code in it by deleting the existing code in the file:

@model IEnumerable<MVCFilters.Models.Department>

@{

ViewBag.Title = "Display Depts";

}

<table border="1" align="center">

<caption>Department Details</caption>

<tr>

<th>@Html.DisplayNameFor(D => D.Did)</th>

<th>@Html.DisplayNameFor(D => D.Dname)</th>

<th>@Html.DisplayNameFor(D => D.Location)</th>

<th>Employees</th>

</tr>

@foreach (var Dept in Model)

{

<tr>

<td>@Html.DisplayFor(D => Dept.Did) </td>

<td>@Html.DisplayFor(D => Dept.Dname) </td>

<td>@Html.DisplayFor(D => Dept.Location) </td>

<td>@Html.Action("DisplayEmpsByDept", new { Did = Dept.Did })</td>

</tr>

}

</table>

**ChildActionOnly:** in the above case “DisplayDepts” view is internally invoking “DisplayEmpsByDept” action method so under each “Department” it will display the “Employees” corresponding to that “Department”. If required we can also directly call “DisplayEmpsByDept” action method from browser as below and access “Employee” data corresponding to a particular “Department”.

<http://localhost/MVCFilters/Home/DisplayEmpsByDept/10>

If we want to restrict accessing the “DisplayEmpsByDept” action method directly from a browser as above we need to decorate the method with [ChildActionOnly] attribute, so that we are not authorized to call that method directly and should be invoked only as a child action. To test that go to “HomeController” and add the “ChildActionOnly” attribute to “DisplayEmpsByDept” action method as following:

[ChildActionOnly]

public ViewResult DisplayEmpsByDept(int Id)

{

var Emps = from E in dc.Employees where E.Did == Id select E;

return View(Emps);

}

**Note:** now if we try to access “DisplayEmpsByDept” action method directly from a browser we get an error and to test that try calling the method directly from the browser.

Add a view for “DisplayCustomers1” action method, choosing the layout CheckBox and write the below code in it by deleting all the existing content in the file:

@model IEnumerable<MVCFilters.Models.Customer>

@{

ViewBag.Title = "Display Customer";

}

<table align="center" border="1">

<tr>

<td colspan="5">

<h3 style="text-align:center">Request Processed Time: @DateTime.Now.ToString("T")</h3></td>

</tr>

<tr>

<th>@Html.DisplayNameFor(C => C.Custid)</th>

<th>@Html.DisplayNameFor(C => C.Name)</th>

<th>@Html.DisplayNameFor(C => C.Balance)</th>

<th>@Html.DisplayNameFor(C => C.City)</th>

<th>@Html.DisplayNameFor(C => C.Status)</th>

</tr>

@foreach (var Customer in Model)

{

<tr>

<td>@Html.DisplayFor(C => Customer.Custid)</td>

<td>@Html.DisplayFor(C => Customer.Name)</td>

<td align="right">@Html.DisplayFor(C => Customer.Balance)</td>

<td>@Html.DisplayFor(C => Customer.City)</td>

@if (Customer.Status == true)

{

<td>Active</td>

}

else

{

<td>In-Active </td>

}

</tr>

}

</table>

**Note:** same as the above create views for the remaining 4 “DisplayCustomers” action methods also with the same code.

**OutputCache:** in the above case “DisplayCustomers1” is not cached, so whenever we refresh the View the Processed Time on top of the view will change which provides clarity for us that every time the View is refreshed the page gets re-processed. Rest of the 3 “DisplayCustomers” action methods are cached for “45” seconds because we specified that in the “Duration” property, so in that time period if a new request is sent to those action methods it will display the cached output of the View only without processing the whole View again and again.

Location attribute is used on “DisplayCustomers2” action method to specify the cache copy should be created on the server because the default value is “Any” and in this case server decides where to store the cache copy, but when changed to Server then cache copy will be stored on the Server Machine only.

VaryByParam attribute is used on “DisplayCustomers3” action method to specify that there should be a separate cache copy created for each parameter value that is sent to the “City” attribute.

<http://localhost/MVCFilters/Home/DisplayCustomers3?City=Bengaluru>

<http://localhost/MVCFilters/Home/DisplayCustomers3?City=Chennai>

<http://localhost/MVCFilters/Home/DisplayCustomers3?City=Delhi>

VaryByCustom attribute is used on “DisplayCustomers4” action method to specify that there should be a separate cache copy created for each type of browser i.e., 1 copy for Edge and 1 copy for IE, etc.

Without specifying cache details on the top of an action method we can use “CacheProfiles” i.e., by storing the details of cache under “Web.config” file and then we can use them on action methods.

**To test this, go to “Web.config” file and write the following code under <system.web> tag:**

<caching>

<outputCacheSettings>

<outputCacheProfiles>

<add name="MyCacheProfile" duration="45" />

</outputCacheProfiles>

</outputCacheSettings>

</caching>

**Now on the top of “DisplayCustomers5” action method specify the “Cache Profile” details as following:**

[OutputCache(CacheProfile = "MyCacheProfile") ]

public ViewResult DisplayCustomers5()

**Add a View to “GetComments” action method, choosing the layout CheckBox and write the below code in it:**

@using(Html.BeginForm())

{

<div>

@Html.Label("Comments:")<br />@Html.TextArea("txtComments")

</div>

<div>

<input type="submit" value="Submit" name="btnComment" />

</div>

}

**ValidateInput:** Run the above view, enter some input into the TextArea and click on the “Submit” button which will display the output on browser. Whereas if we try to enter the Comments with any Html tags, for example “<b>Hello World</b>” we get an error as following: “A potentially dangerous Request.Form value was detected from the client (txtComments="<b>Hello</b>").”, because by default “ValidateInput” filters value is “true” only which will not allow any “Html Elements”, whereas if we want to allow Html Elements as input then set the “ValidateInput” filter value as “false” for “GetComments” Post action method as following:

[HttpPost, ValidateInput(false)]

public string GetComments(string txtComments)

**Add a View to “AddEmployee” action method choosing the layout CheckBox and write the below code in it:**

@model MVCFilters.Models.Employee

@using (Html.BeginForm())

{

<div>@Html.LabelFor(E => E.Ename)<br />@Html.TextBoxFor(E => E.Ename)</div>

<div>@Html.LabelFor(E => E.Job)<br />@Html.TextBoxFor(E => E.Job)</div>

<div>@Html.LabelFor(E => E.Salary)<br />@Html.TextBoxFor(E => E.Salary)</div>

<div>@Html.LabelFor(E => E.Did)<br />@Html.TextBoxFor(E => E.Did)</div>

<div>

<input type="submit" value="Save" name="btnSave" />

<input type="reset" value="Reset" />

</div>

}

**ValidateAntiForgeryToken:** run the above view to add a new Employee. The problem in the above is if we use the “View Page Source” option of browser, copy the content from <form> to </form> tag, paste it in a new file and change the “action” attribute value of <form> tag from “MVCFilters/Home/AddEmployee” to “<http://localhost/MVCFilters/Home/AddEmployee>”, save the file as “AddEmployee.html” and when we open the “AddEmployee.html” file in browser using it’s physical path and try to add a new Employee, still it adds a record into the table. To restrict this, we need to use the “ValidateAntiForgeryToken” filter and to test it do the following:

**Step 1: re-write the AddEmployee, HttpPost method as following:**

[HttpPost, ValidateAntiForgeryToken]

public string AddEmployee(Employee Emp)

**Step 2**: in “AddEmployee.cshtml” file write “@Html.AntiForgeryToken()” statement inside the “<form>” tag, so that if anyone copies the source code and try to use it for adding a new record i.e., same as we discussed above will not be able to invoke the action method to add a record into the table.

**Add a view to “DivideNums” action method choosing the layout CheckBox and write the below code in it:**

@using (Html.BeginForm())

{

<div>@Html.Label("Enter 1st Number: ")<br />@Html.TextBox("num1")</div>

<div>@Html.Label("Enter 2nd Number: ")<br />@Html.TextBox("num2")</div>

<div>

<input type="submit" value="Divide" name="btnDiv" />

<input type="reset" value="Reset" />

</div>

}

**HandleError:** in the above view if we give the value of 2nd number as zero or enter any non-integer values in both Textbox’s or if the entered integer value is beyond the size of an integer, Exception gets raised in the program and display the error details on browser screen. To avoid the problem of displaying error details of the “Exception” on-screen do the following:

**Step 1:** add a view in Shared folder of views with the name “Error.cshtml” without choosing a layout and write the below code under its “<div>” tag:

<h1 style="background-color:lightgoldenrodyellow;color:orangered;text-align:center;text-decoration:underline">

Error Page

</h1>

<h3>An error occurred while processing your request. Re-check your input or contact customer support.</h3>

**Step 2:** go to “Web.config” file and “On” the “custom errors” option by writing the following code under “<system.web>” tag:

<customErrors mode="On">

**Step 3: now in the HomeController class re-write the “DivideNums” HttpPost method as below:**

[HttpPost, HandleError]

public string DivideNums(int num1, int num2)

Now if we get any Internal Server Errors (Exceptions) in “DivideNums” methods it will automatically redirect to “Error.cshtml”.

**Now in “HomeController” add a new action method “ShowView” as following:**

[HandleError]

public ViewResult ShowView()

{

return View();

}

For the above action method, we have not created any view, so if we try to call this action method from a browser it will raise an error and redirect to “Error.cshtml” view only because we have decorated the method with “HandleError” attribute.

Now if we try to call any action method which is not existing in the application then we get an “on screen error” again without displaying “Error.cshtml” with Http Status Code 404 because currently “HandleError” attribute will handle only the errors with Status Code 5XX series only i.e., Internal Server Errors or Exceptions, whereas if we want to handle client errors with their appropriate “Http Status Codes” do the following:

**Step 1: add a new controller in Controller’s folder naming it as ErrorController and write the below code in it:**

public class ErrorController : Controller

{

public ActionResult BadRequest()

{

return View();

}

public ActionResult Unauthorized()

{

return View();

}

public ActionResult PaymentRequired()

{

return View();

}

public ActionResult Forbidden()

{

return View();

}

public ActionResult NotFound()

{

return View();

}

}

**Step 2:** now under Shared folder of Views folder, add a new view naming it as “NotFound.cshtml” without choosing a layout and write the below code under the “<div>” tag:

<h1 style="background-color:lightgoldenrodyellow;color:orangered;text-align:center;text-decoration:underline">

Page Not Found

</h1>

<h3>The requested page is either not available or moved to a different location or it's under construction or maintanance.</h3>

**Step 3: now go to “Web.config” file and re-write the custom errors element as following:**

<customErrors mode="On">

<error statusCode="400" redirect="~/Error/BadRequest"/>

<error statusCode="401" redirect="~/Error/Unauthorized"/>

<error statusCode="402" redirect="~/Error/PaymentRequired"/>

<error statusCode="403" redirect="~/Error/Forbidden"/>

<error statusCode="404" redirect="~/Error/PageNotFound"/>

</customErrors>

**Note:** same as the above we add a separate error page for each Http Status Code as per your requirements.

**Handling Errors Controller Level:** in the above case to handle errors we are applying “HandleError” attribute for each action method and without doing that we can apply “HandleError” attribute directly on the Controller class so that it applies to all action methods under that Controller and to test that delete “HandleError” attribute we have used on “Http Post” action method of “DivideNums” and “ShowView” action method, and then use it on the Controller class i.e., “HomeController” as following:

[HandleError]

public class HomeController : Controller

**Handling Errors Globally:** in the above approach we are applying “HandleError” attribute on Controller class which must be done on every Controller in the project to handle the errors. To avoid this, we can apply filters globally to the whole application or project and to do that do the following:

**Step 1: Add a Code File under “App\_Start” folder, naming it as “FilterConfig.cs” and write the below code in it:**

using System.Web.Mvc;

namespace MVCFilters

{

public class FilterConfig

{

public static void RegisterGlobalFilters(GlobalFilterCollection filters)

{

filters.Add(new HandleErrorAttribute());

}

}

}

**Step 2: go to “Global.asax.cs” file in the project and write the below statement in “Application\_Start” method:**

FilterConfig.RegisterGlobalFilters(GlobalFilters.Filters);

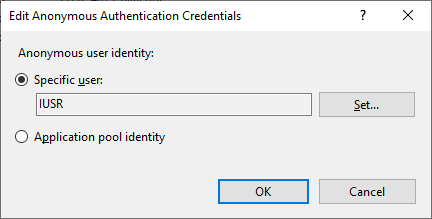
**Note:** with the above action, errors that occur in all the action methods of all the controllers get handled.

**Authentication and Authorization:** Authentication is the process of obtaining identification credentials such as username (Id) and password from a user and validating those credentials against some authority. If the credentials are valid, the user that submitted the credentials is considered an authenticated user. Once the user has been authenticated, the authorization process determines whether that user has access to a resource or not.

**ASP.NET supports different types of authentications like:**

* Anonymous Authentication
* Windows Authentication
* Forms Authentication
* Open Authentication

**Anonymous Authentication:** This gives users access to the public areas of our Application without asking them for a username or password. By default, the “IUSR” account, which was introduced in IIS 7.0 is used to allow anonymous access. By default, IIS uses Anonymous authentication for every Application. To test this, open “IIS Manager” and in the LHS we find “Connections Panel” and under that we find the “Server Name” (which will be same as our computer name), expand it and under that we find a node “Sites”, expand it and under that we find a node “Default Web Site”, expand it and under that we find our project “MVCFilters” (because we hosted it in IIS from our Visual Studio by creating a Virtual Directory), select it and then in the RHS we find “Authentication” icon, click on it which display the various authentication modes available and under that we can see “Anonymous Authentication” is enabled. Right click on the “Anonymous Authentication” and select “Edit” which display the user account i.e., “IUSR” which is used for “Anonymous Authentication” as below:



**Windows Authentication:** we use Windows authentication when our “IIS Server” runs on a corporate network that is using Microsoft Active Directory service domain identities or other Windows accounts to identify users. Windows Authentication is a secure form of Authentication because the username and password are hashed before being sent across the network. When you enable Windows Authentication, the client browser sends a strongly hashed version of the password in a cryptographic exchange to the Web Server. This Authentication mode is best suitable for Intranet Applications.

**Implementing Windows Authentication using Authorize Attribute:** Create a new “ASP.NET Web Application” project, naming it as “MVCAppWithWindowsAuth”, choose Empty Project Template, select “MVC CheckBox” and click on the “Create Button”. Now host the project under IIS by creating a Virtual Directory and then open IIS Manager select our “MVCAppWithWindowsAuth” project under the “Default Web Site” and now on the RHS select the option “Authentication” will displays Authentication options and in that if you notice “Anonymous Authentication” is enabled by default, so right click on it and select the option “Disable” and then right click on the “Windows Authentication” and select the option “Enable” because by default it is “Disabled”.

Add a controller under Controller’s folder naming it as HomeController, add a view to Index action method choosing a layout, delete the existing content in it and write the below code over there:

@{ ViewBag.Title = "Site - Home Page"; }

<h2>Site Home Page</h2>

<h3>

@Html.ActionLink("Manager Home Page", "Home", "Manager") <br />

@Html.ActionLink("Manager Help Page", "Help", "Manager") <br />

@Html.ActionLink("Staff Home Page", "Home", "Staff") <br />

@Html.ActionLink("Staff Help Page", "Help", "Staff")

</h3>

Add another 2 controllers under the Controllers folder with the names “ManagerController” and “StaffController”, delete the existing Index Action method under the classes and write the below code in the 2 new controller classes:

public class ManagerController : Controller

{

public ActionResult Home()

{

return View();

}

public ActionResult Help()

{

return View();

}

}

public class StaffController : Controller

{

public ActionResult Home()

{

return View();

}

public ActionResult Help()

{

return View();

}

}

Now add views to all the above action methods, choosing a layout and write the following code under them by deleting the existing code in it:

**Code under Manager’s Home - Action Method’s view:**

@{ ViewBag.Title = "Manager - Home Page"; }

<h2>Manager Home Page</h2>

<h3>This page is accessible only to Managers.</h3>

<h4>Current User: @HttpContext.Current.User.Identity.Name</h4>

<br />

Back to site @Html.ActionLink("home page", "Index", "Home")

**Code under Manager’s Help - Action Method’s view:**

@{ ViewBag.Title = "Manager - Help Page"; }

<h2>Manager Help Page</h2>

<h3>This page is accessible to everyone.</h3>

<h4>Current User: @HttpContext.Current.User.Identity.Name</h4><br />

Back to site @Html.ActionLink("home page", "Index", "Home")

**Code under Staff Home - Action Method’s view:**

@{ ViewBag.Title = "Staff - Home Page"; }

<h2>Staff Home Page</h2>

<h3>This page is accessible only to Staff Members.</h3>

<h4>Current User: @HttpContext.Current.User.Identity.Name</h4><br />

Back to site @Html.ActionLink("home page", "Index", "Home")

**Code under Staff Help - Action Method’s view:**

@{ ViewBag.Title = "Staff - Help Page"; }

<h2>Staff Help Page</h2>

<h3>This page is accessible to everyone.</h3>

<h4>Current User: @HttpContext.Current.User.Identity.Name</h4><br />

Back to site @Html.ActionLink("home page", "Index", "Home")

Now run Home Controller’s Index Action method which will display links for navigating to Manager Home Page, Manager Help Page, Staff Home Page and Staff Help Page, and once we click on any link those pages get opened without any restrictions because currently the site is running in Anonymous Authentication whereas if we want Manager Home Page to be accessible only to Manager’s and Staff Home Page to be accessible only to Staff, we can do that by using “Authorize” filter.

To do that first we need to create new user accounts on our machine and to create new user accounts do the following, open “Computer Management” window and in that we find “Local Users and Groups” in LHS, expand it and select Users which display users on your computer. To create a new user account right click on “Users” and select “New User” option which opens a window and in that enter “UserName”, “Password” and “Confirm Password” values, uncheck the CheckBox “User must change password at next logon” and check the CheckBox’s “User cannot change password” and “Password never expires”, and then click “Create” button to create the user. Follow this process and create 6 new user accounts with the name Manager1, Manager2, Staff1, Staff2, Staff3, Staff4, Staff5 and Staff6.

**Now go to ManagerController class and use Authorize attribute on Home Action method as following:**

[Authorize(Users = "Server\\Manager1, Server\\Manager2")]

public ActionResult Home()

**Same as above go to StaffController class and use Authorize attribute on Home Action method as following:**

[Authorize(Users = "Server\\Staff1, Server\\Staff2, Server\\Staff3, Server\\Staff4, Server\\Staff5, Server\\Staff6")]

public ActionResult Home()

**Note:** in the above case Server is my machine name and same as that you need to write your machine name there.

Now use the switch user option in your machine, log in by using any new user account and based on the user you have logged in those Index Action Methods will be accessible whereas rest of other Action Methods in the controller will run in Anonymous Authentication.

**Applying Authorize Filter - Controller Level:** if required we can use Authorize Filter Controller level and in that case all the Action Methods of that controller will be accessible to valid users only and we do that as following:

[Authorize(Users = "Server\\Manager1, Server\\Manager2")]

public class ManagerController : Controller

{

}

[Authorize(Users = "Server\\Staff1, Server\\Staff2, Server\\Staff3, Server\\Staff4, Server\\Staff5, Server\\Staff6")]

public class StaffController : Controller

{

}

**Allowing Anonymous Authentication to some Action Methods in case we apply Authorize Filter Controller level:** when we apply Authorize Filter in controller level all action methods in that controller will be running under Authentication Mode and if we want any action method to be running in Anonymous Authentication mode we need to use “AllowAnonymous” filter on those Action Methods. In our above example we want Help Action Methods of ManagerController and StaffController to run in Anonymous Authentication and to do that add “AllowAnonymous” attribute to those methods in both controllers as following:

[AllowAnonymous]

public ActionResult Help()

**Role Based Authentication:** in the above case we have given authentication to users by specifying their names in a comma-separated list but if at all we have multiple users like 5 Managers and 20 Staff Members we need to specify the complete list of members under Authorize Filter and to avoid this we have an option of Role Based Authentication.

**User Groups:** under the Operating System apart from Users we also find Groups and to check this open “Computer Management” window, expand “Local Users and Groups” option which displays Users and Groups below, when we select users, it displays existing users and when we select groups displays existing groups. Every group is a collection of users and every user must be members of some group, to check this, select users, double click on any username which displays a window “Administrator Properties” and in that we find a tab “Member Of” click on it which displays the list of groups to which this user belongs to and these groups are what we call as roles in our MVC Applications.

We can also create our own groups or roles under O.S. and to do that right click on Groups, select “New Group” which opens a Window, enter group name in it as “ManagerGroup”, click on “Add” button which opens a window in that under the last TextBox enter “Manager1” click “Check Names” button which displays “ComputerName\Manager1” and repeat the same process to add “Manager2” also to this group. Now follow the same process to create “StaffGroup” and add the 4 Staff members to this group.

Now replace “Users” property under Authorize filter to “Roles” and specify the role name which should be as below for ManagerController and StaffController:

[Authorize(Roles = "ManagerGroup")]

public class ManagerController : Controller

[Authorize(Roles = "StaffGroup")]

public class StaffController : Controller

**Custom Filters:**

In MVC, filters are used to inject logic at different levels of request processing and allow us to share logics across Controllers and Action Methods. We are provided with various filters in MVC which we have used above and apart from that we can also create our own filters to implement logic at various levels and we call them as “Custom Filters”. We write custom filters for various reasons, like logging or for saving data to a Database before any action execution or we could also create a filter for fetching data from the Database and setting them as global values of our application. For example, let’s say we want to run security logic or a logging logic across the controllers, and to do so; we can write a filter containing those logics and enable them across all controllers. When we enable a filter across all controllers or actions, the filter executes on all upcoming HTTP requests. As discussed earlier, in ASP.NET MVC we have 5 types of filters and the sequence of running those filters is as follows:

* The Authentication filter runs before any other filter or action method.
* The Authorization filter runs after the Authentication filter and before any other filter or action method.
* The Action filter runs before and after any action method.
* The Result filter runs before and after execution of any action result.
* The Exception filter runs only if filters or action methods or action results throw an exception.

**The below diagram, explains the sequence of filter execution as shown below:**



**To create a custom filter, we need to perform the following tasks:**

* Define a class inheriting from the pre-defined class “FilterAttribute” class.
* Override any of the methods that are present in “FilterAttribute” class as per our requirements (optional).
* Implement any of the 5 filter “Interfaces” based on the type of Filter we are implementing, for example if we are implementing Authentication Filters, we should implement IAuthenticationFilter interface and if we are implementing Authorization Filters, we should implement IAuthorizationFilter interface and so on.
* Apply the new filter on the Controller class or Action method where we want to use it.

**Implementing Forms Authentication by defining a Custom Filter:**

Create a new “ASP.NET Web Application” project naming it as “MVCAppWithFormsAuth”, choose Empty Project Template, select “MVC Check Box” and click on the “Create Button”. Host the project on IIS by creating a Virtual Directory. Add a controller in Controller’s folder naming it as “HomeController”, add a view to Index action method by choosing the layout and write below code in it:

<h1 style="background-color:red;color:yellow;text-align:center">Home Page</h1>

<h4>This is Home Page of the site.</h4>

Right now, we can run the Index View or any other Views in the site directly because Anonymous Authentication is enabled, but if we want to implement Forms Authentication, so that only Registered Users can access the pages in site, we need to do that by following the below process:

**Step 1:** create a new table under our “MVCDB” database as following:

CreateTableUsers (UserIdVarchar(20)PrimaryKey,NameVarchar(50),PasswordVarchar(16),EmailVarchar(50),MobileVarchar(10),StatusBitNotNullDefault1)

**Step 2:** add Ado.Net Entity Data Model (DB First) in the “Models” folder naming it as “TestEF”, choose “EF Designer from database” (DB First), provide the connection details for our “MVCDB” Database and choose “Users” table which will create the necessary classes for working with data and here the Model class representing “Users” table will be having the name as “User”.

**Step 3:** now we need to design Register and Login forms which requires data validations and to validate the data we need to use data annotations. To do that let’s define 2 new classes “RegisterModel” and “LoginModel”, and apply data annotations on those classes, so that we can use those classes for designing the Views by performing Model Binding and we call this as MVVM (Model View – View Model) architecture.

Add 2 new classes in Model’s folder naming them as “RegisterModel.cs” and “LoginModel.cs” and write the below code under the 2 classes:

using System.ComponentModel.DataAnnotations;

public class RegisterModel

{

[Required(ErrorMessage = "Can't leave the field empty.")]

[RegularExpression("[A-Za-z0-9]{6,20}", ErrorMessage = "User Id value is invalid.")]

public string UserId { get; set; }

[Required(ErrorMessage = "Can't leave the field empty.")]

[RegularExpression("[A-Za-z\\s]{3,50}", ErrorMessage = "Name value is invalid.")]

public string Name { get; set; }

[DataType(DataType.Password)]

[Required(ErrorMessage = "Can't leave the field empty.")]

[RegularExpression("[A-Z]{1}[a-z0-9@#$%\_-]{7,15}", ErrorMessage = "Password is invalid.")]

public string Password { get; set; }

[Display(Name = "Confirm Password")]

[DataType(DataType.Password)]

[Compare("Password")]

public string ConfirmPassword { get; set; }

[Required(ErrorMessage = "Can't leave the field empty.")]

[DataType(DataType.EmailAddress)]

public string Email { get; set; }

[Required(ErrorMessage = "Can't leave the field empty.")]

[RegularExpression("[6-9]\\d{9}", ErrorMessage = "Phone is invalid.")]

public string Mobile { get; set; }

}

using System.ComponentModel.DataAnnotations;

public class LoginModel

{

[Display(Name = "User Id")]

[Required(ErrorMessage = "Can't leave the field empty.")]

[RegularExpression("[A-Za-z0-9]{6,20}", ErrorMessage = "User Id value is invalid.")]

public string UserId { get; set; }

[DataType(DataType.Password)]

[Required(ErrorMessage = "Can't leave the field empty.")]

[RegularExpression("[A-Z]{1}[a-z0-9@#$%\_-]{7,16}", ErrorMessage = "Password is invalid.")]

public string Password { get; set; }

}

**Step 4:** add a new Controller under Controller’s folder naming it as “AccountController” and write the below code in it by deleting all the existing code under the class:

using MVCAppWithFormsAuth.Models;

public class AccountController : Controller

{

MVCDBEntities dc = new MVCDBEntities();

public ViewResult Register()

{

return View();

}

[HttpPost, ValidateAntiForgeryToken]

public ActionResult Register(RegisterModel model)

{

if (!ModelState.IsValid)

{

return View(model);

}

else

{

User user = new User { UserId = model.UserId, Name = model.Name, Password = model.Password,

Email = model.Email, Mobile=model.Mobile, Status = true };

dc.Users.Add(user);

dc.SaveChanges();

return RedirectToAction("Login");

}

}

public ViewResult Login()

{

return View();

}

[HttpPost, ValidateAntiForgeryToken]

public ActionResult Login(LoginModel model)

{

if (!ModelState.IsValid)

{

return View(model);

}

else

{

var user = from u in dc.Users where u.UserId == model.UserId && u.Password == model.Password &&

u.Status == true select u;

if(user.Count() == 0)

{

ModelState.AddModelError("", "Invalid Credentials");

return View(model);

}

else

{

Session["UserKey"] = Guid.NewGuid();

return RedirectToAction("Index", "Home");

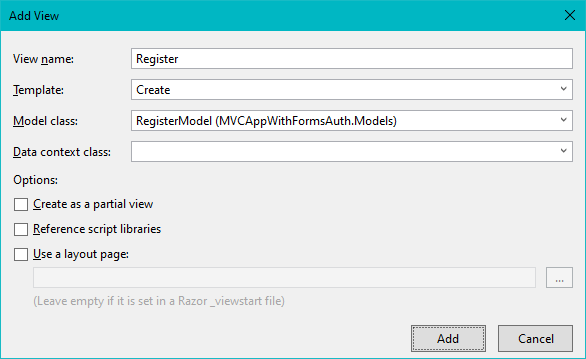
}

}

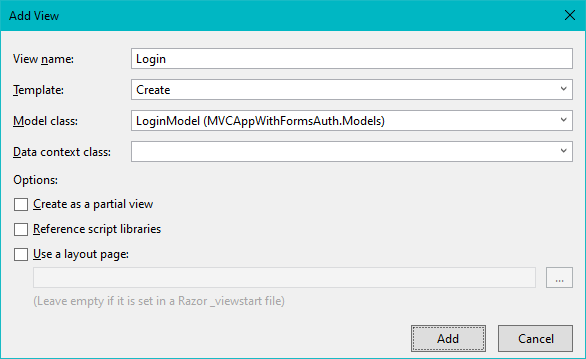
}

}

**Step 5:** Add a view to Registration Action method by choosing “Create” under “Template:” DropDownList, “RegisterModel (MVCAppWithFormsAuth.Models)” under “Model class:” DropDownList, uncheck all the CheckBox’s on the screen and click on “Add” button:



Same as the above add a View to Login Action method by choosing “Create” under “Template:” DropDownList, “LoginModel (MVCAppWithFormsAuth.Models)” under “Model class:” DropDownList, uncheck all the CheckBox’s on the screen and click on “Add” Button:



Install “Bootstrap”, “jQuery”, “jQuery.Validation”, and “Microsoft.jQuery.Unobtrusive.Validation” libraries in our project using “Nuget Package Manager” and then drag and drop the following files into the “<head>” section of “Register.cshtml” and “Login.cshtml”: “jquery-3.6.0.min.js”, “jquery.validate.min.js”, “jquery.validate.unobtrusive.min.js” from Script’s folder and “bootstrap.min.css” from Content’s folder.

Now we can create new user accounts by using “Register View” and login into the application by using “Login View” and once we successfully login, it will take to “HomeController’s - Index Page”, but we can open this Page even by directly calling it also because, right now we did not apply “Authentication” in our application.

**Step 6:** to apply Authentication let us define a custom “Authentication Filter” class under the Project. To do that, first add a new folder under the project naming it as “Filters” and under that folder add a class naming it as “AuthenticateFilter.cs” and write the following under the class:

using System.Web.Mvc;

using System.Web.Mvc.Filters;

public class AuthenticateFilter : FilterAttribute, IAuthenticationFilter

{

public void OnAuthentication(AuthenticationContext filterContext)

{

if (string.IsNullOrEmpty(Convert.ToString(filterContext.HttpContext.Session["UserKey"])))

{

filterContext.Result = new HttpUnauthorizedResult();

}

}

public void OnAuthenticationChallenge(AuthenticationChallengeContext filterContext)

{

if (filterContext.Result == null || filterContext.Result is HttpUnauthorizedResult)

{

filterContext.Result = new RedirectResult("~/Account/Login");

}

}

}

**Note:** as explained above every filter should inherit from “FilterAttribute” class and implement any of the 5 pre-defined filter Interfaces based on the type of filter we want to implement. In the current context we are implementing an Authentication Filter, so we need to implement “IAuthenticationFilter” interface and write the logic for the 2 abstract methods of the interface and those are: “OnAuthentication” and “OnAuthenticationChallenge”.

**Step 7:** now go to “HomeController.cs” file and apply the “AuthenticateFilter” attribute on the class so that Authentication comes into picture when we try to access the Action methods of “HomeController” class and to that first import the namespace “MVCAppWithFormsAuth.Filters” and then apply the filter on “HomeController” class as following:

[AuthenticateFilter]

public class HomeController : Controller

From now when we try to access any Action Method of “Home Controller”, first “AuthenticateFilter” class will check whether the “User” has a “UserKey” value which we have given on successful login to each User by storing it in a Session. If that “UserKey” value is missing then it will redirect the User to “Login View” of “Account Controller”, so that unless and until a user is logged in to the application he/she can’t access any page of “Home Controller”.

**Note**: If we want to apply this behavior to all the other Controllers in our Application, use the “AuthenticateFilter” attribute on all the Controller Classes in the project except on “Account Controller” class.

**Ajax and JQuery**

Ajax stands for Asynchronous JavaScript and XML is a web development technique using many web technologies on the client side to create asynchronous web applications. With Ajax, Web Pages can send and retrieve data from a server asynchronously (in the background) without interfering with the display and behavior of the existing page. By de-coupling the data interchange layer from the presentation layer, Ajax allows web pages to change content dynamically without the need to reload the entire page.

Ajax is not a single technology but rather a group of technologies like HTML and CSS are used in combination, to mark up and style the information. The Web Page will be modified by Java Script to dynamically display and allow the user to interact with the new information. The built-in “XMLHttpRequest” object within Java Script is used to execute Ajax on Web Pages allowing Web Applications to load content on to the screen without refreshing the page. XML or JSON are used for inter-change of the data. Ajax is not a new technology, or different language, just existing technologies used in new ways.

**Note:** different browsers implement the Ajax differently that means if you’re adopting the typical Java Script way to implement the Ajax you must write different code for different browsers to ensure that Ajax would work cross-browser. But fortunately, JQuery simplifies the process of implementing Ajax by taking care of those browser differences. It offers simple methods such as load(), $.get(), $.post(), etc. to implement the Ajax that works seamlessly across all the browsers. XML is commonly used as the format for receiving server data, although any format, including plain text, can be used. In practice, modern implementations commonly utilize JSON instead of XML due to the advantage of JSON being native to Java Script.

To work with Ajax and JQuery, create a new “ASP.NET Web Application” project, naming it as “MVCAppUsingAjax”, choose “Empty Project Template”, select MVC - Check Box and click on the Create - Button. Add a folder under the project naming it as “Matches”, add an “XML File” under this folder naming it as “Score.xml” and write the following code in it:

<Match1>

<Score>Match starts at 7:00 PM IST</Score>

</Match1>

To work with JQuery, we need to install the JQuery plug-in in our project and to do that open “Nuget Package Manager”, search for “JQuery” and install “jQuery by jQuery Foundation, Inc.,” (current version is 3.6.0), which will add a new folder under the project with the name Scripts and installs all the JQuery files into the folder.

**Add a Controller in Controller’s folder naming it as “HomeController” and write the below code in the class:**

using System.Xml.Linq; //For using LINQ to XML

public string GetScore()

{

//Gets the physical path of the file for the given virtual path

string physicalPath = Server.MapPath("~/Matches/Score.xml");

//Loads the XML file into the application from the specified location

var doc = XElement.Load(physicalPath);

//Reads the value or content of “Score” element from the xml file which is loaded

string score = doc.Element("Score").Value;

return score;

}

Now add a view to “Index” action method without choosing any layout and drag & drop the JQuery file “jquery-3.6.0.min.js” from “Scripts” folder into the head section and write the below code under “<body>” tag by deleting the existing “<div>” tag in it:

<body onload="LoadData()">

<div style="background-color:lightgreen;color:blueviolet">

Date & Time: @DateTime.Now.ToString()

</div>

<div style="background-color:yellow;color:red">

<marquee id="m1" behavior="alternate">Match will start by 8:00 P.M. today.</marquee>

</div>

<div style="background-color:coral;color:chartreuse">

Date & Time: @DateTime.Now.ToString()

</div>

<script>

function LoadData()

{

$.ajax({

url: "/Home/GetScore",

type: "get",

cache: false,

success: F1,

error: F2

});

window.setTimeout("LoadData()", 1000);

}

function F1(responseString)

{

$("#m1").html(responseString);

}

function F2()

{

window.alert("Error in server.");

}

</script>

</body>

Now run the Index View and watch the output which will display the current score value that is present inside of “<Score>” element under the XML file and whenever we change the value under “<Score>” element it will automatically display the modified score value with-in the “<marquee>” element of the page, because we have called the “setTimeout” function with an interval of 1 second (1000 MilliSeconds) and all this happens behind the screen without submitting the page to server, by Ajax.

**Implementing Auto-Complete TextBox using Ajax and JQuery:** Add “ADO.NET Entity Data Model” item under Model’s folder of our previous project i.e., “MVCAppUsingAjax”, naming it as “TestEF”, choose “EF Designer from database”, configure it with “Northwind” Database and choose the table “Products”. Add a controller under Controller’s folder naming it as “ProductController” and write the below code in it:

using MVCAppUsingAjax.Models;

public class ProductController : Controller

{

NorthwindEntities dc = new NorthwindEntities();

public ViewResult DisplayProducts()

{

return View(dc.Products);

}

[HttpPost]

public ViewResult SearchProduct(string SearchTerm)

{

List<Product> Products;

if (SearchTerm.Trim().Length == 0)

{

Products = dc.Products.ToList();

}

else

{

Products = dc.Products.Where(P => P.ProductName.Contains(SearchTerm)).ToList();

}

return View("DisplayProducts", Products);

}

public JsonResult GetProducts(string term)

{

List<string> Products = dc.Products.Where(

P => P.ProductName.StartsWith(term)).Select(P => P.ProductName).ToList();

return Json(Products, JsonRequestBehavior.AllowGet);

}

}

Install “JQuery.UI.Combined” (for “AutoComplete” functionality) and “JQuery.UI.Theme.uidarkness” (for setting a “Theme” for “AutoComplete” output) plug-ins in our project using “Nuget Package Manager”, add a view to “DisplayProducts” Action method without choosing any layout and do the following in the View file:

**Add the below statement on top of the View:**

@model IEnumerable<MVCAppUsingAjax.Models.Product>

**Drag and drop the below “CSS” and “JS” files under the <head> tag:**

<script src="~/Scripts/jquery-3.6.0.min.js"></script>

<script src="~/Scripts/jquery-ui-1.13.2.min.js"></script>

<link href="~/Content/themes/ui-darkness/jquery.ui.theme.css" rel="stylesheet" />

**Write the below logic for “AutoComplete” within the <head> tag:**

<script>

$(function () {

$("#SearchTerm").autocomplete({

source: '@Url.Action("GetProducts")'

});

});

</script>

**Now write the following code under <div> tag of body:**

@using (Html.BeginForm("SearchProduct", "Product"))

{

<center>

<b>Product Name:</b>

@Html.TextBox("SearchTerm")

<input type="submit" id="btnSubmit" value="Search" />

</center>

}

<table border="1" align="center">

<caption>Product Details</caption>

<tr>

<th>@Html.DisplayNameFor(P => P.ProductID)</th>

<th>@Html.DisplayNameFor(P => P.ProductName)</th>

<th>@Html.DisplayNameFor(P => P.CategoryID)</th>

<th>@Html.DisplayNameFor(P => P.UnitPrice)</th>

<th>@Html.DisplayNameFor(P => P.UnitsInStock)</th>

</tr>

@foreach (var Product in Model)

{

<tr>

<td>@Html.DisplayFor(P => Product.ProductID)</td>

<td>@Html.DisplayFor(P => Product.ProductName)</td>

<td>@Html.DisplayFor(P => Product.CategoryID)</td>

<td>@Html.DisplayFor(P => Product.UnitPrice)</td>

<td>@Html.DisplayFor(P => Product.UnitsInStock)</td>

</tr>

}

</table>

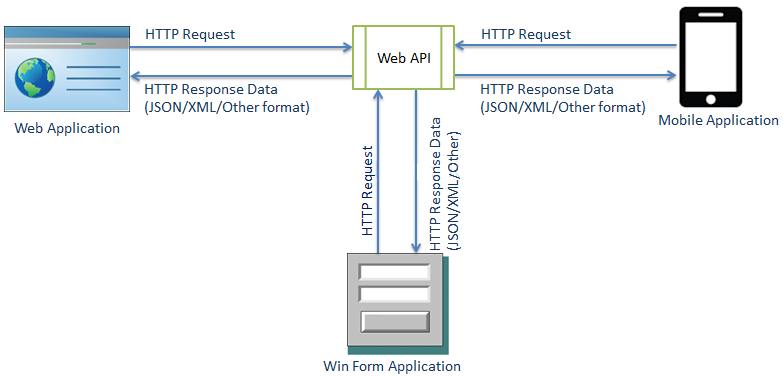
**ASP.NET Web API**

ASP.NET Web API (Application Programming Interface) is a framework for building HTTP Services that can be accessed from any client including browsers, desktops, and mobile devices. It is an ideal platform for building “Restful Applications” on the .NET Framework.

In computer programming, an API is a set of sub-routines (methods) definitions, protocols, and tools for building software and applications. Putting in simple terms, API is interface which has a set of methods that allow programmers to access specific features or data of an application, operating system, or other services.

Web API as the name suggests, is an API over the Web which can be accessed using HTTP protocol. It is a concept and not a technology. We can build Web API using different technologies such as Java, .NET etc. For example, Twitter’s REST APIs provide programmatic access to read and write data using which we can integrate twitter's capabilities into our own application.

The ASP.NET Web API is an extensible framework for building HTTP based services that can be accessed in different applications on different platforms such as Web, Windows, Mobile etc. It works the same way as an ASP.NET MVC Web Application except that it sends Data as a response instead of Views. It is like a Web Service or WCF Service, but the exception is that it only supports HTTP Protocol.



**Background of Web API:** Connectivity between applications is a very important aspect from a business applications perspective. Nowadays there are a lot of mobile applications and single page applications are being created and such applications needs a strong service end that can provide these applications with the data and CRUD operations on the data.

**SOAP and ASP.NET Web Services:** Traditionally, Web Services using SOAP and XML provided a great way of creating connected web applications. SOAP is a standard XML based protocol that communicates over HTTP. We can think of SOAP as message format for sending messages between applications using XML. It is independent of technology, platform, and language too. ASP.NET Web Services provided an excellent way of creating SOAP based Web Services.

**Problems with SOAP and Web Services:** SOAP offered an excellent way of transferring the data between the applications, but the problem with SOAP was that along with data a lot of other Metadata also needs to get transferred with each request and response. This extra information is needed to find out the capabilities of the service and other Meta data related to the data that is being transferred coming from the server. This makes the payload heavy even for small data. Also, Web services needed the clients to create the proxy on their end. These proxies will do the marshaling and un-marshaling of SOAP WSDL and make the communication between the application and the web service possible. The problem with this proxy is that if the service is updated and the proxy on the client is not, then the application might behave incorrectly.

**Introduction of REST:** REST stands for Representational State Transfer. This is a protocol for exchanging data over a distributed environment. The main idea behind REST is that we should treat our services as resources, and we should be able to use simple HTTP protocols to perform various operations on that resource. For example, when we talk about the Database as a resource, we usually talk in terms of CRUD operations i.e., Create (Insert), Retrieve (Select), Update and Delete. Now the philosophy of REST is that for a remote resource all these operations should be possible, and they should be possible using simple HTTP Protocols. Now the basic CRUD operations are mapped to the HTTP Protocols in the following manner:

GET: this maps to the R (Retrieve) part of the CRUD operation. This will be used to retrieve the required data from the remote resource.

POST: This map to the C (Create) part of the CRUD operation. This will create a new entry for the current data that is being sent to the server.

PUT: This map to the U (Update) part of the CRUD operation. This protocol will update the current representation of the data on the remote server.

DELETE: This map to the D (Delete) part of the CRUD operation. This will delete the specified data from the remote server.

Let’s take a simple example of some remote resource that contains a Database for list of movies and the list of movies can be retrieved using a URL like: [www.moviewebsite.com/api/movies](http://www.moviewebsite.com/api/movies)

To retrieve any specific movie, let’s think there is some ID for each movie that we can use to retrieve the movie; the possible URL might look like: [www.moviewebsite.com/api/movies/123](http://www.moviewebsite.com/api/movies/123)

Since these are GET requests, data can only be retrieved from the server. To perform other operations, if we use similar URI structure with PUT, POST or DELETE operation, we should be able to create, update and delete the resource from server. Now if we compare REST API with SOAP, we can understand the benefits of REST like:

* Firstly, only the data will be traveling to-and-fro from the server because the capabilities of the service are mapped to the URIs and Protocols.
* Secondly, there is no need to have a Proxy at the client end because its only data that is coming and the application can directly receive and process the data.

**WCF REST Services:** Windows Communication Foundation (WCF) came into existence much later than the web service. It provided a much secure and mature way of creating the services to achieve whatever we were not able to achieve using traditional Web Services, i.e., other protocols support and even duplex communication. With WCF, we can define our service once and then configure it in such a way that it can be used via HTTP, TCP, IPC, and even Message Queues. We can even configure WCF services to create REST services too i.e., WCF REST Services.

The problem with using WCF Restful Services is that we need to do a lot of configurations in a WCF Service to make it a Restful Service. WCF is suited for scenarios where we want to create a service that should support special action such as one way messaging, message queues, duplex communication or the services that need to conform to WS\* specifications, whereas using WCF for creating restful services, that will provide fully resource-oriented services over HTTP is a little complex. Still WCF is the only option for creating the Restful services if there is a limitation of using .NET 3.5 Framework.

**Evolution of Web API:** To overcome the above problems, Microsoft came up with ASP.NET Web API to facilitate the creation of Restful Services that can provide fully resource-oriented services for broad range of clients including desktops, browsers, mobiles, and tablets. ASP.NET Web API is a framework for building REST Services easily and in a rather simple way.

**ASP.NET Web API Characteristics:**

* ASP.NET Web API is an ideal platform for building Restful Services.
* ASP.NET Web API is built on top of ASP.NET and supports ASP.NET request/response pipeline.
* ASP.NET Web API maps HTTP Verbs to method names.
* ASP.NET Web API supports different formats of response data and built-in support for JSON, XML, and BSON format.
* ASP.NET Web API can be hosted in IIS, Self-Hosted or other Web Servers that supports .NET 4.0+.
* ASP.NET Web API framework includes new “HTTPClient” class to communicate with Web API server. Http Client can be used in ASP.MVC App’s, Windows Form App’s, Console App’s, or other Apps.

**Creating a Web API Service:** Create a new “ASP.Net Web Application” project naming it as “WebApiService”, choose “Empty Project Template”, select “Web Api” CheckBox (which adds all the folders and references for working with Web Api) and click on the “Create” Button.

**Note:** the folder structure here also will be same as the folder structure of an MVC Project like Controllers, Models etc., but her we will not have View’s folder.

**Adding a Web Api Controller:** to add a Web Api Controller, right click on the Controllers folder and select the option Add => Controller and in the window opened, select “Web Api” in the LHS and then select “Web Api 2 Controller - Empty” in RHS and name it as “TestController” which adds a Controller under the project, but this controller class inherits from “ApiController” which is present under the namespace “System.Web.Http”. Write the below code in “TestController” class:

public class TestController : ApiController

{

//Declaring a List of strings and storing a set of colors in it

static List<String> Colors = new List<string>()

{

"Red", "Blue", "Green", "Purple", "Magenta"

};

//Responds for Get (Select) request

public IEnumerable<String> Get()

{

return Colors;

}

//Responds for Get (Select with condition) request with a parameter - id

public string Get(int id)

{

return Colors[id];

}

//Responds for Post (Insert) request

public void Post([FromBody] string color)

{

Colors.Add(color);

}

//Responds for Put (Update) request

public void Put(int id, [FromBody] string color)

{

Colors[id] = color;

}

//Responds for Delete (Delete) request

public void Delete(int id)

{

Colors.RemoveAt(id);

}

}

Run the project which will display the Uri http://localhost:port in the browser address bar, add “/Api/Test” to it in the last, which will display all the Colors on the browser in XML Format, because by default every browser will be sending a “Get” request to the Server, so Get method got executed displaying all the colors. If we add “/3” after “Test” then also “Get” method only gets executed but the “Get” method which takes “Id” as a parameter will execute and displays a single color in XML format.

http://localhost:port/Api/Test //For getting all the colors

http://localhost:port/Api/Test/3 //For getting single color with index 3

If we want to test Post, Put and Delete methods we need to use any Web Debugging Tool like Fiddler, Postman, etc., so let’s use Fiddler and to do that first install “Fiddler.exe” by downloading it from the following location: <https://www.telerik.com/download/fiddler>.

**Working with Fiddler:** To test all the operations of our Web Api Service using Fiddler, first host the application on IIS Web Server, then launch Fiddler and run the service with this URL: <http://localhost/WebApiService/Api/Test> in any browser which will display the output on browser, as well as this is recorded by fiddler also. To test that go to Fiddler and watch in the LHS there you can find your request, when we double click on it, will display information about the request on the RHS and right now the response is in XML Format. If we want to get the output in JSon format, click on the Composer tab on the top and this page is used to compose a new request, there we find a Dropdown displaying GET and beside that we find a TextBox, drag and drop the URL from the LHS List into the TextBox and click on Execute button which will execute the service and if we want to view the results, click on the URL in LHS window and now also the output will be in XML format only. To change the output to JSon format, in the composer tab below the TextBox where we entered the URL we find another TextBox displaying various Headers information and in that we find a Header Accept: and the value of this header will be something like: “text/html,.....” which should be changed to text/json and click on Execute button again which will now get the output in JSon format.

**Testing Post Method:** post means insert or add, and to test this go to Composer tab, and in the drop-down change GET to POST which will display a TextBox below with the caption Request Body and in that enter the value we want to add in quotes, for example lets enter the value as “Black” (Data should be in double quotes) and click on execute button which gives an error Unsupported Media Type and to view details of the error double click on the URL in LHS. To fix the error go to Composer tab again and in the TextBox, which is present below the drop down and address bar will be showing some values in it, add this statement in the last: Content-Type: application/json and execute which will insert the record and to check the output change POST to GET in drop-down, delete the content in Request Body TextBox and click on Execute button again.

**Note:** If we want to test Put (Update) and Delete we need to make setting in Web.config file because when the application is hosted on IIS, it will not support Put and Delete actions and to resolve this problem do the following:

**Step 1:** go to Web.config file and there we find a node <system.webServer> and under that we find <handlers> node, write the following statement inside of that <handlers> node:

<remove name="WebDAV" />

**Step 2:** now under <system.webServer> if you find <modules> node, add the following under it:

<remove name="WebDAVModule"/>

Or else add the following:

<modules> <remove name="WebDAVModule"/> </modules>

**Testing Put Method:** to test Put or Update, go to Composer tab and in the drop-down change GET to PUT. To update a value we need to the key to refer to the item we want to update and in our case Index is the key, so let’s update the 3rd item in the List which means index 2 and to do that add “/2” to the URL in the address bar which should now look as following: <http://localhost/WebApiService/Api/Test/2> and in the Request Body TextBox enter a value we want to update, for example lets enter the value as “Yellow” (Data should be in double quotes) and click on execute button which will update the record and to check the output change PUT to GET in drop down, delete the content in Request Body TextBox and also delete “/2” in the URL and click on the Execute button again.

**Testing Delete Method:** to test Delete go to Composer tab, and in the drop-down change GET to Delete. To delete a value also we need to the key to refer to the item we want to delete and in our case Index is the key, so let’s delete the 4th item in the List which means index 3 and to do that add “/3” to the URL in the address bar which should now look as following: <http://localhost/WebApiService/Api/Test/3> and click on the Execute button which will Delete the record and to check the output change Delete to GET in drop-down and also delete “/3” in the URL and click on the Execute button again.

**Developing a Web Api Service to perform CRUD Operations with Database:** under the Models folder add “Ado.Net Entity Data Model”, naming it as “TestEF” and choose “EF Designer from database” => Configure it with our “MVCDB” database and choose the “Customer” Table. Add a new “Web Api 2 Controller - Empty” under the project naming it as “CustomerController” and write the below code in the class:

using System.Data.Entity;

using WebApiService.Models;

public class CustomerController : ApiController

{

MVCDBEntities dc = new MVCDBEntities();

public List<Customer> Get()

{

return dc.Customers.ToList();

}

public Customer Get(int id)

{

return dc.Customers.Find(id);

}

public HttpResponseMessage Post(Customer c)

{

try

{

c.Status = true;

dc.Customers.Add(c);

dc.SaveChanges();

return new HttpResponseMessage(HttpStatusCode.Created);

}

catch (Exception)

{

throw new HttpResponseException(HttpStatusCode.InternalServerError);

}

}

public HttpResponseMessage Put(Customer c)

{

try

{

Customer obj = dc.Customers.Find(c.Custid);

if (obj == null)

{

return new HttpResponseMessage(HttpStatusCode.NotFound);

}

obj.Name = c.Name;

obj.Balance = c.Balance;

obj.City = c.City;

dc.Entry(obj).State = EntityState.Modified;

dc.SaveChanges();

return new HttpResponseMessage(HttpStatusCode.OK);

}

catch (Exception)

{

throw new HttpResponseException(HttpStatusCode.InternalServerError);

}

}

public HttpResponseMessage Delete(int id)

{

try

{

Customer obj = dc.Customers.Find(id);

if (obj == null)

{

return new HttpResponseMessage(HttpStatusCode.NotFound);

}

obj.Status = false;

dc.Entry(obj).State = EntityState.Modified;

dc.SaveChanges();

return new HttpResponseMessage(HttpStatusCode.OK);

}

catch (Exception)

{

throw new HttpResponseException(HttpStatusCode.InternalServerError);

}

}

}

**Consuming the WebApi Service using JQuery from the same project in which WebApi was developed:** add an “MVC Controller” in the current project naming it as “HomeController” and this action will raise errors in the application because we have opened a “Web API Project” and now adding an “MVC Controller”. To fix the errors we need to install 2 “Nuget Packages” => “Microsoft.AspNet.MVC” and “Microsoft.AspNet.Web.Optimization”.

After installing the above 2 pacakges, open “Global.asax.cs” file and call “RegisterRoutes” method of “RouteConfig” class, and to do that write the below statement under “Application\_Start” method in the last line:

RouteConfig.RegisterRoutes(RouteTable.Routes);

Add a view to the existing “Index” Action method of “HomeController” without choosing any layout. Install “JQuery” into the project using “Nuget Package Manager”, and write the below code in “<head>” section:

<script src="~/Scripts/jquery-3.6.0.min.js"></script>

<script>

function GetCustomers() {

$.ajax({

url: 'http://localhost/WebApiService/api/Customer',

type: 'get',

datatype: 'json',

success: BuildTable,

error: DisplayError

});

}

function BuildTable(Customers) {

$('#tblCustomers tbody').empty();

$.each(Customers, function (Index, Customer) {

var Status = (Customer.Status) ? 'Active' : 'In-Active';

$('#tblCustomers').append('<tr><td align=center>' + Customer.Custid + '</td><td>' + Customer.Name +

'</td><td align=right>' + Customer.Balance + '</td><td>' + Customer.City + '</td><td align=center>' + Status +

'</td></tr>');

});

}

function DisplayError() {

window.alert("Error on the server, could not load the data.");

}

function GetCustomer() {

$.ajax({

url: 'http://localhost/WebApiService/api/Customer',

type: 'get',

datatype: 'json',

data: {

'id': $('#Custid').val()

},

success: function (Customer) {

if (Customer == null) {

window.alert("No customer exists with the given id.");

$('#frmCustomer').trigger("reset");

$('#Custid').focus();

}

else {

$('#Name').val(Customer.Name);

$('#Balance').val(Customer.Balance);

$('#City').val(Customer.City);

}

},

error: DisplayError

});

}

function AddCustomer() {

$.ajax({

url: 'http://localhost/WebApiService/api/Customer',

type: 'post',

datatype: 'json',

data: $('#frmCustomer').serialize(),

success: ClearAndLoad,

error: DisplayError

});

}

function UpdateCustomer() {

$.ajax({

url: 'http://localhost/WebApiService/api/Customer',

type: 'put',

datatype: 'json',

data: $('#frmCustomer').serialize(),

success: ClearAndLoad,

error: DisplayError

});

}

function DeleteCustomer() {

var Status = confirm('Are you sure of deleting the current record?');

if (Status) {

$.ajax({

url: 'http://localhost/WebApiService/api/Customer/' + $('#Custid').val(),

type: 'delete',

datatype: 'json',

success: ClearAndLoad,

error: DisplayError

});

}

}

function ClearAndLoad() {

$('#frmCustomer').trigger("reset");

GetCustomers();

$('#Custid').focus();

}

</script>

**Now write the below code under “<body>” tag by deleting the existing “<div>” tag over there:**

<body onload="GetCustomers()">

<table width="100%">

<tr>

<td valign="top">

<table border="1" align="center" id="tblCustomers">

<caption>Customer Details</caption>

<thead>

<tr>

<th>Custid</th><th>Name</th><th>Balance</th><th>City</th><th>Status</th>

</tr>

</thead>

<tbody></tbody>

</table>

</td>

<td valign="top">

<form id="frmCustomer">

<table align="center">

<tr>

<td>Custid:</td>

<td>

<input id="Custid" name="Custid" />

<input type="button" id="btnSearch" name="btnSearch" value="..." onclick="GetCustomer()" />

</td>

</tr>

<tr>

<td>Name:</td><td><input id="Name" name="Name" /></td>

</tr>

<tr>

<td>Balance:</td><td><input id="Balance" name="Balance" /></td>

</tr>

<tr>

<td>City:</td><td><input id="City" name="City" /></td></tr>

<tr>

<td colspan="2" align="center">

<input type="button" id="btnInsert" name="btnInsert" value="Insert" onclick="AddCustomer()" />

<input type="button" id="btnUpdate" name="btnUpdate" value="Update"

onclick="UpdateCustomer()" />

<input type="button" id="btnDelete" name="btnDelete" value="Delete" onclick="DeleteCustomer()" />

<input type="reset" id="btnReset" name="btnReset" value="Clear" />

</td>

</tr>

</table>

</form>

</td>

</tr>

</table>

</body>

**Consuming the Web Api Service from an MVC Application using JQuery from a different project:** to test consuming our “Web Api service” in a new MVC Project, create a new “ASP.NET Web Application” Project naming it as “WebApiConsumer1”, choose Empty Project Template and select the “MVC” Check Box. Install “JQuery” package using Nuget Package Manager. Add a controller in the project naming it as “HomeController” and add a view to the existing Index Action Method without choosing a layout, copy the complete code which we implemented in “Index.cshtml” of previous project i.e., “WebApiService” and paste it into the current “Index.cshtml” by deleting all existing content.

Run the project but we will not get the output because of “CORS (Cross Origin Resource Sharing)” i.e., by default for security reasons, browsers restrict Cross-Origin HTTP Requests initiated thru Scripts and to resolve the problem we need to enable “CORS” in our “WebApiService” project so that it lets a Web Application running at one origin (domain) to access resources from a Server at a different origin.

To enable CORS in our “WebApiService” project we need to install a “Nuget Package” i.e., “Microsoft.AspNet.WebApi.Cors”, so open the Nuget Package Manager and install the package. After installing the packing, we can enable CORS either for the whole Project or to a particular “Web Api” Controller class.

**To enable CORS for a particular Web Api Controller class, do the following:**

**Step: 1** To enable CORS for a particular Api Controller class go to CustomerController.cs file and add [EnableCors] attribute to CustomerController class by importing the namespace “System.Web.Http.Cors” as following:

[EnableCors("\*", "\*", "\*") ]

public class CustomerController : ApiController

**EnableCors attribute expects 3 parameters and those are:**

* Origins, which should be a comma separated list of origins that are allowed to access the resource or use “\*” to allow all.
* Headers, which should be a comma separated list of headers that are supported by the resource or use “\*” to allow all or use “null” or empty string to allow none.
* Methods, which should be a comma separated list of methods that are supported by the resource or use “\*” to allow all or use “null” or empty string to allow none.

**Step 2:** Now go to “WebApiConfig.cs” file which is present under “App\_Start” folder and write the following code in the end of Register method which is present inside the class “WebApiConfig”:

config.EnableCors();

**To enable CORS for the whole project do the following:** to enable CORS for the whole project, without adding “[EnableCors]” attribute to each Web Api Controller class, directly go to “WebApiConfig.cs” file which is present under “App\_Start” folder and write the below code in the end of Register method which is present inside of the class “WebApiConfig” by importing the namespace “System.Web.Http.Cors”:

EnableCorsAttribute obj = new EnableCorsAttribute("\*", "\*", "\*");

config.EnableCors(obj);

**Note:** after enabling Cors either Controller Level or Project Level we can start accessing the Web API from other projects also.

**Developing a new Web Api Service class with Image loading:**

**Step 1:** Create a Table under our MVCDB Database with the name Students as following:

CreateTableStudents (IdIntPrimaryKey,NameVarchar(50),PhotoImage,StatusBitNotNullDefault1);

**Step 2:** Open the “TestEF.edmx” file under our “WebApiService” project, right click on it and choose the option “Update Model from Database” and choose the “Students” table which we have created right now, from the “Update Wizard” and click on Ok Button, which will add the “Students” table as an entity, with the name “Student” beside the “Customer” entity which we have added earlier.

**Step 3:** Now add a “Web APi 2 Controller” under the Controllers folder naming it as “StudentController” and write the below code in the class:

using System.Data.Entity;

using WebApiService.Models;

public class StudentController : ApiController

{

MVCDBEntities dc = new MVCDBEntities();

public List<Student> Get()

{

return dc.Students.Where(S => S.Status == true).ToList();

}

public Student Get(int Id)

{

return dc.Students.Find(Id);

}

public HttpResponseMessage Post(Student student)

{

try

{

student.Status = true;

dc.Students.Add(student);

dc.SaveChanges();

return new HttpResponseMessage(HttpStatusCode.Created);

}

catch(Exception)

{

throw new HttpResponseException(HttpStatusCode.InternalServerError);

}

}

public HttpResponseMessage Put(Student student)

{

try

{

Student obj = dc.Students.Find(student.Id);

if (obj == null)

{

return new HttpResponseMessage(HttpStatusCode.NotFound);

}

else

{

obj.Name = student.Name;

obj.Photo = student.Photo;

obj.Status = true;

dc.Entry(obj).State = EntityState.Modified;

dc.SaveChanges();

return new HttpResponseMessage(HttpStatusCode.OK);

}

}

catch (Exception)

{

throw new HttpResponseException(HttpStatusCode.InternalServerError);

}

}

public HttpResponseMessage Delete(int Id)

{

try

{

Student obj = dc.Students.Find(Id);

if (obj == null)

{

return new HttpResponseMessage(HttpStatusCode.NotFound);

}

else

{

obj.Status = false;

dc.Entry(obj).State = EntityState.Modified;

dc.SaveChanges();

return new HttpResponseMessage(HttpStatusCode.OK);

}

}

catch (Exception)

{

throw new HttpResponseException(HttpStatusCode.InternalServerError);

}

}

}

**Note:** build the project and compile it, so that we can consume it from other projects.

**Consuming the Web Api Service from an MVC Application using C# Code:** to test consuming the above “Web Api service” from an MVC Project, create a new “ASP.NET Web Application” project naming it as “WebApiConsumer2”, choose “Empty Project Template”, select “MVC” Check Box and click on “Create” button.

To call Web API from an MVC Application using C# code we need to first Install a Nuget Package “Microsoft.AspNet.WebApi.Client” in our project which provides all the types for invoking a Web API Service from an “MVC Controller-Action Methods”.

Right now, our MVC Application is not getting its data from a Database, so we don’t have LINQ or Entity Framework providing the Model Classes. Our MVC Application is getting its data from a Web API Service, so in this case we are responsible to define the Model Classes explicitly in our project and to do that add a new class under the Models folder naming it as “Student” and write the below code in it:

public class Student

{

public int Id { get; set; }

public string Name { get; set; }

public byte[] Photo { get; set; }

}

The current MVC Application is being designed to consume a Web API Service and to refer the service we need the URL of the Service. So, go to “Web.config” file and add the following element under “<appSettings>” tag:

<add key="WebApiUrl" value="http://localhost/WebApiService/Api/" />

Add a controller in the Controllers folder naming it as “StudentController” and write the below code in it deleting the existing Index action method:

using System.IO;

using System.Net.Http;

using System.Configuration;

using System.Threading.Tasks;

using WebApiConsumer2.Models;

public class StudentController : Controller

{

HttpClient client = new HttpClient();

string serviceUrl = ConfigurationManager.AppSettings.Get("WebApiUrl");

public ViewResult DisplayStudents()

{

client.BaseAddress = new Uri(serviceUrl);

Task<HttpResponseMessage> getTask = client.GetAsync("Student");

getTask.Wait();

HttpResponseMessage message = getTask.Result;

List<Student> students = message.Content.ReadAsAsync<List<Student>>().Result;

return View(students);

}

public ViewResult DisplayStudent(int Id)

{

client.BaseAddress = new Uri(serviceUrl);

Task<HttpResponseMessage> getTask = client.GetAsync("Student/" + Id);

getTask.Wait();

HttpResponseMessage message = getTask.Result;

Student student = message.Content.ReadAsAsync<Student>().Result;

return View(student);

}

public ViewResult AddStudent()

{

return View(new Student());

}

[HttpPost]

public ActionResult AddStudent(Student student, HttpPostedFileBase selectedFile)

{

if (selectedFile != null)

{

BinaryReader br = new BinaryReader(selectedFile.InputStream);

student.Photo = br.ReadBytes(selectedFile.ContentLength);

}

client.BaseAddress = new Uri(serviceUrl);

Task<HttpResponseMessage> postTask = client.PostAsJsonAsync("Student", student);

postTask.Wait();

HttpResponseMessage message = postTask.Result;

if (message.IsSuccessStatusCode)

{

return RedirectToAction("DisplayStudents");

}

else

{

return View();

}

}

public ViewResult EditStudent(int Id)

{

client.BaseAddress = new Uri(serviceUrl);

Task<HttpResponseMessage> getTask = client.GetAsync("Student/" + Id);

getTask.Wait();

HttpResponseMessage message = getTask.Result;

Student student = message.Content.ReadAsAsync<Student>().Result;

if (student.Photo != null)

{

Session["Photo"] = student.Photo;

}

else

{

Session["Photo"] = null;

}

return View(student);

}

public ActionResult UpdateStudent(Student student, HttpPostedFileBase selectedFile)

{

if (selectedFile != null)

{

BinaryReader br = new BinaryReader(selectedFile.InputStream);

student.Photo = br.ReadBytes(selectedFile.ContentLength);

}

else if (Session["Photo"] != null)

{

student.Photo = (byte[])Session["Photo"];

}

else

{

student.Photo = null;

}

client.BaseAddress = new Uri(serviceUrl);

Task<HttpResponseMessage> putTask = client.PutAsJsonAsync<Student>("Student", student);

putTask.Wait();

HttpResponseMessage message = putTask.Result;

if (message.IsSuccessStatusCode)

{

return RedirectToAction("DisplayStudents");

}

else

{

return View(student);

}

}

public ActionResult DeleteStudent(int Id)

{

client.BaseAddress = new Uri("http://localhost/WebApiService/Api/");

Task<HttpResponseMessage> deleteTask = client.DeleteAsync("Student/" + Id);

deleteTask.Wait();

HttpResponseMessage message = deleteTask.Result;

if (message.IsSuccessStatusCode)

{

return RedirectToAction("DisplayStudents");

}

else

{

return View();

}

}

}

Add a view with the name DisplayStudents.cshtml, selecting layout Checkbox and write the below code in it by deleting the whole content in the View:

@model IEnumerable<WebApiConsumer2.Models.Student>

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Add New Student</h2>

<table border="1" align="center">

<caption>Student Details</caption>

<tr>

<th>@Html.DisplayNameFor(S => S.Id)</th>

<th>@Html.DisplayNameFor(S => S.Name)</th>

<th>@Html.DisplayNameFor(S => S.Photo)</th>

<th>Actions</th>

</tr>

@foreach (var Student in Model)

{

<tr>

<td>@Html.DisplayFor(S => Student.Id)</td>

<td>@Html.DisplayFor(S => Student.Name)</td>

@{

string imgSrc = "";

if (Student.Photo != null)

{

var base64 = Convert.ToBase64String(Student.Photo);

imgSrc = String.Format("data:image/jpeg;base64,{0}", base64);

}

}

<td><img src='@imgSrc' width="40" height="25" /></td>

<td>

@Html.ActionLink("View", "DisplayStudent", new { Id = Student.Id }) &nbsp;

@Html.ActionLink("Edit", "EditStudent", new { Id = Student.Id }) &nbsp;

@Html.ActionLink("Delete", "DeleteStudent", new { Id = Student.Id },

new { onclick = "return confirm('Are you sure of deleting the record?')" })

</td>

</tr>

}

<tr>

<td colspan="4" align="center">@Html.ActionLink("Add New Student", "AddStudent")</td>

</tr>

</table>

Generate a view for DisplayStudent action method and while adding the View, choose the Template as Empty, Model Class as Student, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element present in it:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Add New Student</h2>

@{

string imgSrc = "";

if (Model.Photo != null)

{

var base64 = Convert.ToBase64String(Model.Photo);

imgSrc = String.Format("data:image/jpeg;base64,{0}", base64);

}

}

<table border="1" align="center">

<caption>Student Details</caption>

<tr>

<td rowspan="2"><img src='@imgSrc' width="200" height="200" /></td>

<td>Sid: @Model.Id</td>

</tr>

<tr><td>Name: @Model.Name</td></tr>

<tr><td colspan="2" align="center">@Html.ActionLink("Back to Student Details", "DisplayStudents")</td></tr>

</table>

Generate a view for AddStudent action method and while adding the View, choose the Template as Empty, Model Class as Student, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element present in it:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Add New Student</h2>

@using (Html.BeginForm("AddStudent", "Student", FormMethod.Post, new { enctype = "multipart/form-data" }))

{

<div>@Html.LabelFor(S => S.Id)<br />@Html.TextBoxFor(S => S.Id)</div>

<div>@Html.LabelFor(S => S.Name)<br />@Html.TextBoxFor(S => S.Name)</div>

<div>@Html.LabelFor(S => S.Photo)<br /><input type="file" name="selectedFile" /></div>

<div>

<input type="submit" value="Save" name="btnSave" />

<input type="reset" value="Reset" name="btnReset" />

</div>

}

@Html.ActionLink("Back to Student Details", "DisplayStudents")

Generate a view for EditStudent action method and while adding the View, choose the Template as Empty, Model Class as Student, choose “Use a layout page” CheckBox in the “Add View” window and write the below code over there by deleting the existing “<h2>” element present in it:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Edit Student</h2>

@{

string imgSrc = "";

if (Model.Photo != null)

{

var base64 = Convert.ToBase64String(Model.Photo);

imgSrc = String.Format("data:image/jpeg;base64,{0}", base64);

}

}

@using (Html.BeginForm("UpdateStudent","Student",FormMethod.Post,new { enctype = "multipart/form-data" }))

{

<div>@Html.LabelFor(S => S.Id) <br />@Html.TextBoxFor(S => S.Id, new { @readonly = "true" })</div>

<div>@Html.LabelFor(S => S.Name)<br />@Html.TextBoxFor(S => S.Name)</div>

<div>

@Html.LabelFor(S => S.Photo) <br /><img src='@imgSrc' width="200" height="200" />

<input type="file" name="selectedFile" />

</div>

<div>

<input type="submit" value="Save" name="btnSave" />

</div>

}

Add a view for DeleteStudent Action method choosing a layout and write the below code in it by deleting the existing “<h2>” element present in it:

<h2 style="text-align:center;background-color:yellowgreen;color:orangered">Delete Student Failed</h2>

<font color="red" size="4">

Delete student action resulted in an error.

</font>

@Html.ActionLink("Back to Student Details", "DisplayStudents")

**ASP.NET Core**

Nowadays, when it comes to the software development, everyone is talking about free, open-source, and cross-platform development. As we all know Microsoft is well known for its Windows-based products. Now we are in the new age of software development and for this, a new revolutionary product came into the market from Microsoft, and it is ASP.NET Core.

**History of ASP.NET:** As we know, ASP.NET is a framework that has been used to develop data-driven Web Applications for many years. Since then, ASP.NET Framework went through a steady evolutionary change, and finally, the most decent evolution is ASP.NET Core.

ASP.NET Core is not a continuous part of the ASP.NET 4.x Framework, but instead it is a completely new Framework. This Framework is actual a re-write of the current ASP.NET 4.x Framework, but with much smaller and a lot more modular. Some people think that many things remain the same, but that is not completely true. The ASP.NET Core is a big fundamental change to the ASP.NET Framework.

**What is ASP.NET Core?**

ASP.NET Core is a new version of ASP.NET Web Framework mainly targeted to run on .NET Core. It is free, open-source, high-performance, lightweight, and cross-platform framework for building cloud-based applications, such as Web Apps, IoT Apps and Mobile Apps. It is designed to run on the cloud as well as on-premises.

Same as .NET Core it was architected modular with minimum overhead and then other more advanced features can be added as NuGet Packages as per application requirements. This result in high performance, require less memory, less deployment size, and easy to maintain.

ASP.NET Core 6.0, 5.0 and 3.x application can be targeted to develop and run-on top of the .NET Core only whereas ASP.NET Core 1.x and 2.x application can be targeted to develop and run-on top of the .NET Core (Cross-platform) as well as .NET Framework (Windows only).

**Note:** ASP.NET Core was initially launched as ASP.NET 5 but later it's renamed to ASP.NET Core.

**Why ASP.NET Core?**

Nowadays, the ASP.NET Core Framework became more and more popular among developers. There are several reasons why modern developers are using it which are listed below:

**Open Source:** ASP.NET Core Framework is Open Source, and this is the main reason behind its popularity. The entire source code of this ASP.NET Core is available at => “https://github.com/aspnet” and you are free to download the source code and even you can also modify and compile your own version of it. “.NET Core” team is always there to support your effort in the seamless development of the application.

**Cross-Platform:** The ASP.NET Core Framework is designed from scratch to keep in mind to be Cross-Platform for both development and deployment also. So, we don’t need to build different applications for different Platforms using different Framework’s. The earlier version of ASP.NET Framework applications can run only on Windows Platforms, whereas ASP.NET Core applications can be developed as well as run on different platforms such as Windows, Mac, or Linux. We can host the earlier ASP.NET Framework applications on IIS only whereas we can host the ASP.NET Core applications on IIS, Nginx, Docker, Apache, or even self-host deployment.

**Editors:** To develop ASP.NET Core applications we have multiple options like Visual Studio or Visual Studio Code as well as if required, we can also use any third-party editors as per your choice.

**CLI Support:** Using CLI (Command Line Interface) commands you can develop and run .NET applications as well as you can also publish the application using CLI command.

**Fast:** ASP.NET Core no longer depends on “System.Web.dll” for browser-server communication. ASP.NET Core allows us to include packages that we need for the application and this will reduce the request pipelines and improves performance and scalability.

**IoC Container:** One of the most important used design patterns in the real-time application is the “Dependency Injection-Design Pattern”. It includes the built-in IoC (Inversion of Control) container for automatic dependency injection which makes it maintainable and testable.

**Unified MVC and Web API Framework:** The ASP.NET Core provides a unified programming model for developing both Web Apps and Web API. That means a single controller class can be used to handle both. A Controller we create in ASP.NET Core (either Web App’s or Web API) application is going to inherit from the Controller base class and all their action methods returns the “IActionResult” interface. The “IActionResult” interface provides several implementations like “JsonResult”, “ViewResult” etc.

**Integration with Modern UI Framework:** It allows you to use and manage modern UI frameworks such as AngularJS, Angular, React JS, and Bootstrap, etc.

**Handling Request and Response Pipeline:** We can handle the request and response in the ASP.NET Core application by using new Middleware Components. In earlier ASP.NET 4.x we generally use Handlers and Modules to handle the Request and Response pipeline. The ASP.NET Core Framework provides lot of built-in Middleware Components and we can use those Components to handle the request and response pipeline. If we want, we also can also create our own middleware components and use them.

**Hosting:** ASP.NET Core Web App’s can be hosted on multiple platforms with-in any web server such as IIS, Apache, Nginx, Docker, etc. It is not dependent only on IIS as our standard .NET Framework Web App’s.

**Side-by-Side Application Versioning:** ASP.NET Core runs in .NET Core, which supports the simultaneous running of multiple versions of applications.

**Smaller Deployment Footprint:** ASP.NET Core application runs on .NET Core, which is smaller than the full .NET Framework. So, application which uses “.NET Core FX” libraries will be having a smaller deployment size, and this reduces the deployment footprint.

**Note:** Many people are confused between “ASP.NET Core” and “.NET Core”. Please note that ASP.NET Core and .NET Core are not the same. They are different, just like ASP.NET and .NET Framework are different. To understand .NET Core is a fast, lightweight, modular, and open-source framework for creating Web Applications, Desktop Applications (CUI, GUI), Mobile Applications, Microservices, Cloud, Machine Learning, Game Development and Internet of Things (IOT) that can run on Windows, Linux, and macOS, whereas ASP.NET Core is a Web Application Framework under .NET Core for building Web Applications. So, .NET Core is a Software Platform on which ASP.NET Core Applications run.

**.NET Core vs. ASP.NET Core**

| **.NET Core** | **ASP.NET Core** |
| --- | --- |
| .NET Core is Open-Source and Cross-Platform. | ASP.NET Core is Open-Source and Cross-Platform. |
| .NET Core is a Runtime to execute applications which are built on it. | ASP.NET Core is a Web Framework to build Web, IoT and Mobile App’s on the top of .NET Core. |
| Install .NET Core Runtime to run applications and install .NET Core SDK to build applications. | There is no separate runtime and SDK are available for ASP.NET Core. .NET Core runtime and SDK includes ASP.NET Core libraries. |
| .NET Core 6.0 - latest version. | ASP.NET Core 6.0 - latest version. |

**Note:** There is no separate versioning for ASP.NET Core. It is the same as the .NET Core versions.

**What ASP.NET Core doesn’t have?**

If you are coming from ASP.NET 4.x, then you will not find the following things in ASP.NET Core:

* Global.asax File
* Web.config File
* HTTP Handlers and HTTP Modules
* ASP.NET Page Life-Cycle Model

**Creating ASP.NET Core Web Application**

To create an ASP.NET Core Web Application, open Visual Studio 2022, click on the Create a new project button which will open “Create a new project” window. This window displays different .NET Core application templates, choose “ASP.NET Core Empty” template and click on the Next button which will open “Configure your new project” window and here we need to give a name for our project for example “CoreTestProject1.Core5.0”, and specify the location to save and click on the Next button, which will open “Additional Information” window and here we need to select the “Target Framework” to build the application choose “.NET 5.0 (Out of support)” and also uncheck all the checkboxes on this window and click on Create button. Once we click on the Create button, it will create a new “ASP.NET Core Empty Project” and here we can understand how different components fit together to develop an “ASP.NET Core application”. The project will be created with the following files and folder structure:

**CoreTestProject1.Core5.0**

* Connected Services
* Dependencies
* Properties
  + launchSettings.json
* appsettings.json
* appsettings.Development.json
* Program.cs
* Startup.cs

Now same as the above create one more project with the name “CoreTestProject1.Core6.0” and here select the “Target Framework” as “.NET 6.0 (Long-term support)”, un-check “Configure for HTTPS” and “Enable Docker” Checkbox’s, and check “Do not use top-level statements” Checkbox on this window and click on Create button. This project will be created with the following files and folder structure:

**CoreTestProject1.Core6.0**

* Connected Services
* Dependencies
* Properties
  + launchSettings.json
* appsettings.Development.json
* appsettings.json
* Program.cs

**Note:** Up to ASP.NET Core 5.0 we find the file “Startup.cs” whereas from ASP.NET Core 6.0 we will not have “Startup.cs” file any more.

Run the ASP.NET Core Application’s which will open a browser and displays the output as “Hello World!” and this output comes from the Configure method of the Startup class which is present inside the “Startup.cs” file in case of ASP.NET Core 5.0, open the file and watch the code present in the Configure method and there you will find the below statement in end of the method:

await context.Response.WriteAsync("Hello World!");

If we are working with ASP.NET Core 6.0 then this output comes from “Program.cs” file, open the file and watch the code present over there, which displays a statement as below:

app.MapGet("/", () => "Hello World!");

Change the “Hello World!” string to something else and re-run the projects again which will display the output accordingly. For example, let’s change the WriteAsync and MapGet methods code as following:

5.0 => await context.Response.WriteAsync(".NET Core Empty Web Application created using ASP.NET Core 5.0");

6.0 => app.MapGet("/", () => ".NET Core Empty Web Application created using ASP.NET Core 6.0");

**ASP.NET Core Web App (Model-View-Controller) Template**

The ASP.NET Core Web App (Model-View-Controller) template contains everything that is required to create an ASP.NET Core MVC Web Application and this creates Models, Views, and Controller’s folders by default. It also adds web-specific things such as Java Script, CSS files, Layout files, etc. which are necessary and required to develop an MVC Application.

To create an MVC Application, open Visual Studio, click on create a new project button, in the window opened choose “ASP.NET Core Web App (Model-View-Controller)” template and click on Next button, in the window opened provide a name to the project as “CoreMVCProject”, specify the location to save and click on Next button, in the window opened choose Target Framework as “.NET 5.0 (Out of support)” and click on the Create button and the Project is created with the following files and folder structure:

**CoreMVCProject**

* Connected Services
* Dependencies
* Properties
* launchSettings.json
* wwwroot
* css
* js
* lib
* Controllers
* Models
* Views
* appsettings.json
* appsettings.Development.json
* Program.cs
* Startup.cs

**Connected Services:** This is the first element in our project structure and possibly the less used one. It is intended to automate the steps necessary to connect a project to an external service (like Azure Storage).

**Dependencies:** This element of your project structure contains information of all packages and projects on which our project depends. There are four main parts inside this node:

1. **Analyzers:** They help you make your code better, cleaner, and error-free. Each analyzer checks that your code satisfies a list of rules incorporated in it. If any part of your code does not apply to one of the rules, you will see either Warning or an Error while you build your project. Please note that analyzers work only at compile time and do not affect your resulting application.
2. **Frameworks:** This contains a list of frameworks your project depends on. This information is important if you publish your web application to a Server (as opposed to a self-contained one). In this case, all the frameworks listed here must be installed on the Server where you will run your app.
3. **Packages:** This is the main item which lists all the NuGet packages you added to your project. If any of those packages depend on other packages, they will be installed automatically and listed as sub-nodes of the root-level packages. You can remove each installed package here (right-click => Remove).
4. **Projects:** This is the list of other projects our project depends on in the current solution. You can reference other projects by using the “Add Project Reference” command from the right-click menu.

**Properties:** This contains different properties of our project that we can modify by double-clicking on this node in the Solution Explorer. Most of the properties here, affect the compile-time and debug-time behavior of your project. The only item inside of this node is “launchSettings.json” file that contains the list of the launch profiles. Each profile defines how to run your project, whether the browser should be opened or not, which port to use, which environment variables should be set when we “Run” the project, etc. By default, we will be finding 2 profiles to run the ASP.NET Core Web Application and those are: “IIS Express” profile and “CoreMVCProject” profile. The “launchSettings.json” file is as below in the project we have created:

{

"iisSettings": {

"windowsAuthentication": false,

"anonymousAuthentication": true,

"iisExpress": {

"applicationUrl": "http://localhost:35126",

"sslPort": 0

}

},

"profiles": {

"IIS Express": {

"commandName": "IISExpress",

"launchBrowser": true,

"environmentVariables": {

"ASPNETCORE\_ENVIRONMENT": "Development"

}

},

"CoreMVCProject": {

"commandName": "Project",

"dotnetRunMessages": "true",

"launchBrowser": true,

"applicationUrl": "http://localhost:5000",

"environmentVariables": {

"ASPNETCORE\_ENVIRONMENT": "Development"

}

}

}

}

**Note:** We can edit “launchSettings.json” file by using the project properties window also and to do that double click on the Properties node in Solution Explorer and in the window opened, click “Debug Tab” in LHS and this provides the option for editing “LaunchSettings” and to do that click on “Open debug launch profiles UI”, link.

**wwwroot:** This folder is known as a “web root” folder and contains all the static files of our web application like CSS files, Java Script files, Html files, and Image files. As you might figure out from its name, this will be the root folder of our web application. So, if we add a new folder under “wwwroot” with the name “images” and under the folder if we add an image file with the name “Autumn.jpg”, then we can access that image from browser by using the address: “/images/Autumn.jpg”. To test this run the application hitting “F5” and then append “images/Autumn.jpg” to the “URL” in the address which should now look as following: <http://localhost:35126/images/Autumn.jpg>

**Note:** In traditional ASP.NET Application (i.e., Framework), static files can be served from the root folder of an application or any other folder under it, which has been changed in ASP.NET Core. Now only those files that are present in the web root - “wwwroot” folder can be served over an http request. All other files are blocked and can’t be served by default. Generally, there will be separate folders for different types of static files such as Java Script, CSS, Images, Library Scripts etc. in the “wwwroot” folder. We can rename “wwwroot” folder to any other name as per our choice and set it as a web root while preparing hosting environment in “Program.cs”. For example, if we change the “wwwroot” folder name as “myroot” we need to specify that in Program class under “CreateHostBuilder” method.

**By default, code in the method will be as following:**

public static IHostBuilder CreateHostBuilder(string[] args) =>

Host.CreateDefaultBuilder(args)

.ConfigureWebHostDefaults(webBuilder =>

{

webBuilder.UseStartup<Startup>();

});

**Change the above code as below to register our myroot folder as web root folder:**

public static IHostBuilder CreateHostBuilder(string[] args) =>

Host.CreateDefaultBuilder(args)

.ConfigureWebHostDefaults(webBuilder =>

{

webBuilder.UseStartup<Startup>().UseWebRoot("myroot");

});

**Controllers:** this folder contains all the Controller classes we define in our project.

**Models:** this folder contains Model classes i.e., Classes representing the Entities and Properties representing the Attributes of Entities as well as all the Methods to manipulate the data.

**Views:** this folder contains all the View files that are required for this application and the extension of these files will be “.cshtml” and we call these files as “Razor Pages”.

Till now we have looked over all the main folder's that are present with-in the “ASP.NET Core MVC Application” project, now let's take a closer look at the files stored in the project’s root folder which are also most important part of the project.

**appsettings.json:** this file is used to store information such as connection strings or application specific settings and they are stored in JSON format, as the file extension suggests. If you are familiar with ASP.NET you may notice that the function of this file is like “Web.config” file, and right now we find the below code in it:

{

"Logging": {

"LogLevel": {

"Default": "Information",

"Microsoft": "Warning",

"Microsoft.Hosting.Lifetime": "Information"

}

},

"AllowedHosts": "\*"

}

The settings in the file have a hierarchical structure and can be accessed with the “Configuration” object defined in the Startup class or in any other place of your program where you injected “IConfiguration” service. For example, if we want to read the value of key “Default” then the code will be as following:

var Data1 = Configuration.GetValue<string>("Logging:LogLevel:Default");

var Data2 = Configuration.GetValue<string>("Logging:LogLevel:Microsoft");

By default, in addition to “appsettings.json” file, the ASP.NET Core Project also includes an “appsettings.Development.json” file and all the settings defined in this file are loaded only in the Development Environment and are not available in Production. Same as this we can also define “appsettings.Production.json” for settings in Production Environment and “appsettings.Testing.json” for settings in UAT Environment.

**Program.cs:** This file contains a class in it with the name Program and a static “Main” method which is the entry point of our “Application”. Just like our Console App’s and Windows App’s, ASP.NET Core App’s also starts from Program class only. The purpose of this method is to define the “host” and then pass the control to the “Startup” class.

**Code in Program class will be as following by default:**

public class Program

{

public static void Main(string[] args)

{

CreateHostBuilder(args).Build().Run();

}

public static IHostBuilder CreateHostBuilder(string[] args) =>

Host.CreateDefaultBuilder(args)

.ConfigureWebHostDefaults(webBuilder =>

{

webBuilder.UseStartup<Startup>();

});

}

A host is an object that encapsulates an app’s resources, such as: Logging, Dependency Injection (DI), Configuration, IHostedService Implementations, etc. As shown in the above code, CreateHostBuilder() method returns an object that implements the IHostBuilder interface. Host is a static class that can be used for creating an instance of IHostBuilder with pre-configured defaults by calling CreateDefaultBuilder() method which will create a new instance of HostBuilder with pre-configured defaults.

**Startup.cs:** This file contains a class in it with the name “Startup” and it will serve three main purposes:

* It performs all initialization tasks like setting, application - wide constants.
* It registers all the services that are injected in this project thru the DI (Dependency Injection) container.
* It defines the middleware pipeline of your web-application.

**Note:** This class initially contains lot of code (as per the project i.e., Empty or Web App or MVC or Web API, that has just been created) from the very beginning and will become even bigger when you start adding new features to your application.

**By default, Startup class in the ASP.NET Core application includes three main parts:**

1. The Constructor, where you can initialize variables, set some configuration settings, or performs application-wide initializations. By default, the ASP.NET Core project template contains 1 line of code in the constructor which initializes the in-class property Configurations with the configuration object passed by the Dependency Injection container, so we can use it in other methods and right now the code in the constructor is as below:

public IConfiguration Configuration { get; }

public Startup(IConfiguration configuration)

{

Configuration = configuration;

}

1. The ConfigureServices method, where we register all necessary services like “Authentication/Authorization Service”, “MVC or Razor Page Services”, “Service for working with Database”, as well as we register different “Application Services to DI (Dependency Injection) Container” here and by default in an ASP.NET Core MVC Application the method contains below code in it:

public void ConfigureServices(IServiceCollection services)

{

services.AddControllersWithViews();

}

**Note:** the order of the services you register in “ConfigureServices” method is not important and this method is executed only once upon application start and this method contains calls such as “services.AddDbContext”, “services.AddRazorPages”, “services.AddControllersWithViews” and similar. All these methods are extension methods.

1. The Configure method, is the place where we can set up the Middleware Pipeline for our ASP.NET Core Web Application project. Unlike the services registered in the ConfigureServices (remember, their order is not important), the order of all Middleware’s defined in Configure method has crucial significance.

**What is a Middleware?**

**Ans:** ASP.NET Core introduced a new concept called Middleware. A middleware is nothing but a class which is executed on every request in ASP.NET Core Application. There will be multiple Middleware’s in an ASP.NET Core Application. It can be either Framework provided Middleware added via NuGet or our own custom Middleware. We can set the order of Middleware execution in the request pipeline. Each Middleware adds or modifies Http Request and passes control to the next Middleware component.

At the beginning of the pipeline, we need to place the “Middleware’s” that are necessary for auxiliary tasks (like logging or authentication), and that don't consume a lot of memory and processing time.

**By default, in an ASP.NET Core MVC Application the method contains below code in it:**

public void Configure(IApplicationBuilder app, IWebHostEnvironment env)

{

if (env.IsDevelopment())

{

app.UseDeveloperExceptionPage();

}

else

{

app.UseExceptionHandler("/Home/Error");

}

app.UseStaticFiles();

app.UseRouting();

app.UseAuthorization();

app.UseEndpoints(endpoints =>

{

endpoints.MapControllerRoute(

name: "default",

pattern: "{controller=Home}/{action=Index}/{id?}");

});

}

**Exception Handling Middleware:** the first line in the method defines different middleware’s for Development and Production modes i.e., if we are in the Development Mode, we define middleware’s that will catch all exceptions in the pipeline and show a special page with extra information about the error (exception message, stack trace, etc.), whereas in the Production Mode, we catch all exceptions and then re-direct the request to the specified path i.e., “Home/Error” in our case.

**Processing static files (UseStaticFiles) Middleware:** the next middleware in the pipeline is “UseStaticFiles()” which takes care of all static files, i.e., if the application gets a request for “.js”, “.css”, or an image files, this middleware looks for a file with the requested name inside of the “wwwroot” folder and returns it back if found. If not found it will send back a response with a 404-status code (not found).

**Routing (UseRouting and UseEndpoints):** the next pair of middleware’s are, the most important ones in the pipeline since they define the routing for all other endpoints in your web application. In simple words, they match a particular request to a particular endpoint, a piece of executable code that handles the request.

**How exactly does it work?**

**Ans:** In the Configure method first we call “app.UseRouting()” middleware to add the “Endpoint Routing” middleware to our pipeline and after that, we need to call “app.UseEndpoints()” middleware to add “Endpoint” middleware to the pipeline and define the endpoints. Each endpoint is an object that contains (as mentioned above) a delegate (so, a piece of code) that handles the request. We can use such extension methods as MapGet, MapPost, and others to add an endpoint that matches a particular request path or a path template. For example, the following pattern “/something/{path\*}”, will be matched for all requests started with “/something/”. To test this, change the pattern in the code as following:

pattern: "NIT/{controller=Home}/{action=Index}/{id?}");

**Now all the requests should contain the word "NIT" before the controller’s name, as following:**

http://localhost:port/NIT/Controller\_Name/Action\_Name => http://localhost:port/NIT/Home/Index

When the web application gets a new request, it’s not processed by any middleware defined before “UseRouting” middleware and then the Endpoint Routing Middleware matches it to some endpoint. Then Endpoint Middleware calls the endpoint’s delegate to handle the request. All other middleware’s that are added after app.UseRouting() and before app.UseEndpoints() can see which endpoint was selected by EndpointRouting Middleware and they can change something (e.g., apply an authorization policy) before EndpointMiddleware dispatches to the selected endpoint.

**Authorization (UseAuthorization):** this middleware is added for authorizing a user if the current request is anonymous, but the selected endpoint requires authorization.

Both “ConfigureServices” and “Configure” methods are called implicitly while the application starts. You just only need to define the services and middleware’s here correspondingly.

**Note:** If the same project is created using .NET 6.0 (Long-term support) Framework then we will not find the class “Startup” and the code of this class will be present directly under “Program” class only. By default, the code under “Program.cs” file will be with-out any class over there because .NET 6.0 uses C# 10.0 version and in this version, we are provided with a feature called Top-Level Statement’s i.e., if the project has a single Main method and all the code, if required to be defined under the Main method only then with-out explicitly defining a Class and Main method we can directly write the code in the file as below:

var builder = WebApplication.CreateBuilder(args);

// Add services to the container.

builder.Services.AddControllersWithViews();

//Statements above this are equivalent to code in ConfigureServices method of Startup class in ASP.NET Core 5.0

var app = builder.Build();

//Statements below this are equivalent to code in Configure method of Startup class in ASP.NET Core 5.0

// Configure the HTTP request pipeline.

if (!app.Environment.IsDevelopment())

{

app.UseExceptionHandler("/Home/Error");

}

app.UseStaticFiles();

app.UseRouting();

app.UseAuthorization();

app.MapControllerRoute(

name: "default",

pattern: "{controller=Home}/{action=Index}/{id?}");

app.Run();

**Note:** if you still want to see the class; while creating the project, in the window where we select the Framework version, select the Checkbox “Do not use top-level statements” so that you will find the code with a class and Main method also as below:

namespace CoreMVCProject

{

public class Program

{

public static void Main(string[] args)

{

var builder = WebApplication.CreateBuilder(args);

// Add services to the container.

builder.Services.AddControllersWithViews();

//Statements above this are equivalent to code in ConfigureServices method of Startup class in ASP.NET Core 5.0

var app = builder.Build();

//Statements below this are equivalent to code in Configure method of Startup class in ASP.NET Core 5.0

// Configure the HTTP request pipeline.

if (!app.Environment.IsDevelopment())

{

app.UseExceptionHandler("/Home/Error");

}

app.UseStaticFiles();

app.UseRouting();

app.UseAuthorization();

app.MapControllerRoute(

name: "default",

pattern: "{controller=Home}/{action=Index}/{id?}");

app.Run();

}

}

}

Because we don’t have Startup class here and all code need to be defined in the Main method of Program class only, follow the below guidelines to write the code:

* All the code we need to write under “ConfigureServices” method of “Startup” class should be implemented before this statement => “var app = builder.Build();”.
* All the code we need to write under “Configure” method of “Startup” class should be implemented after this statement => “var app = builder.Build();”.

**Why do we have a Main method in ASP.NET Core?**

**Ans:** The most important point that you need to keep in mind is, an ASP.NET Core Web Application initially starts as a “Console Application” and the Main method is an entry point to that application. When we execute the ASP.NET Core Web Application first it looks for Main method and this is the method from where the execution starts. Main method will then configure ASP.NET Core and starts it, and at this point of time the application becomes a Web Application. If we look at the body of Main method, there we will find that, it makes a call to “CreateHostBuilder()” method by passing the command line arguments “args” as a parameter value and the code in the “Main” method will be as following:

public static void Main(string[] args)

{

CreateHostBuilder(args).Build().Run();

}

Within the Main method, on this “IHostBuilder” object, the Build method is called which builds a Web Host. Then it hosts our ASP.NET Core Web Application within that Web Host. Finally, on the Web Host, it calls the Run method, which will run the Web Application and it starts listening to the incoming HTTP Requests.

CreateHostBuilder method returns an object that implements IHostBuilder interface. Host is a static class that can be used for creating an instance of IHostBuilder with pre-configured defaults by calling its CreateDefaultBuilder method which will create a new instance of HostBuilder with pre-configured defaults. Internally, it will also configure Kestrel (Internal Web Server for ASP.NET Core), IIS Integration, and other configurations. Below is the code we find in CreateHostBuilder method:

public static IHostBuilder CreateHostBuilder(string[] args) =>

Host.CreateDefaultBuilder(args)

.ConfigureWebHostDefaults(webBuilder =>

{

webBuilder.UseStartup<Startup>();

});

**As part of setting the Web Host, the CreateDefaultBuilder method will do several things, like:**

* Setting up the Web Server.
* Loading the application configuration from various configuration sources.
* Configuring logging.

**Configuring and setting up the Web Server by CreateDefaultBuilder method:**

ASP.NET Core Web Application can be hosted in “IIS Express” or “IIS” or “Kestrel” Web Servers and supports 2 different hosting models, those are:

* In Process Hosting
* Out of Process Hosting

**Note:** when we create a new ASP.NET Core MVC Application by default it is created with In-Process hosting model for hosting the application in IIS or IIS Express or Kestrel. To verify that, open Project Properties Window and in that on LHS select the option “Debug” and on the right, click on “Open debug launch profiles UI” link which opens a window and, in that select, “IIS Express” on LHS and on the right we find “Hosting Model” option with the default value “In Process”.

In case of In-Process hosting, “CreateDefaultBuilder” method when sees the value as In-Process will internally host the application inside “IIS Worker Process” i.e., “iisexpress.exe” for “IIS Express”, “w3wp.exe” for “IIS” and “<ProjectName>.exe” in case of “Kestrel”. By default, Visual Studio uses IIS Express to run Web Applications in ASP.NET Core 5.0 and Kestrel to run Web Applications in ASP.NET Core 6.0.

**What is IIS Express?**

**Ans:** IIS Express is a lightweight, self-contained version of IIS which is designed for Web Application Development. The most important point that you need to remember is we use IIS Express only in development, not on production and in production we generally use IIS.

**What is IIS Web Server and how to run ASP.NET Core Web Application in IIS Web Server?**

**Ans:** Internet Information Services (IIS) is a flexible, secure and manageable Web Server for hosting anything on the Web. To host our ASP.NET Core Web Application on IIS Web Server first open Visual Studio in Administrator Mode, go to Project Properties => select Debug Tab in the LHS and on the right, click on “Open debug launch profiles UI” link which opens a window and, in that click on “Create a new profile” option in the LHS-Top and select the option IIS which adds a new Profile with the name as “Profile1” rename it as “IIS” and now on the right fill the following details:

* Under “Environment Variables” Textbox enter the value as “ASPNETCORE\_ENVIRONMENT=Development”.
* Check the “CheckBox” Launch Browser.
* Under “App URL” Textbox enter the value as: <http://localhost/CoreMVCProject>

Leave rest of the options as is and close the window. Now in the “Standard Toolbar” under “Debug Target DropDownList” by default it will be showing “IIS Express” in ASP.NET Core 5.0 and “Project Name (Kestrel)” in ASP.NET Core 6.0, change it to “IIS”, and run the project and watch the URL in address bar. Now if we open the “launchSettings.json” file we will find some changes made to the file as following:

**Under “iisSettings” it will add a new “Name-Value” item as following:**

"iis": {

"applicationUrl": "http://localhost/CoreMVCProject",

"sslPort": 0

}

**In the bottom of the file, it will create a new Profile i.e., “IIS” Profile as following:**

"IIS": {

"commandName": "IIS",

"launchBrowser": true,

"environmentVariables": {

"ASPNETCORE\_ENVIRONMENT": "Development"

}

}

**What is Kestrel Web Server and how to run ASP.NET Core Web Application in Kestrel Web Server?**

**Ans:** As we already know that ASP.NET Core is a Cross-Platform Framework, which means it supports us to develop and run our applications on different Operating System’s such as Windows, Linux, or Mac. The Kestrel is the Cross-Platform Web Server for ASP.NET Core App’s, which means this Web Server supports all the platforms and versions that ASP.NET Core supports. By default, it is included as the Internal Web Server in the .NET Core Application.

The Kestrel Web Server generally used as an edge server i.e., the internet facing Web Server which directly processes incoming HTTP Request from the clients. In case of Kestrel Web Server, the Process Name that is used to host and run the ASP.NET Core Application is our Project Name only and to check this open “launchSettings.json” file and we will find the below code:

"CoreMVCProject": {

"commandName": "Project",

"launchBrowser": true,

"environmentVariables": {

"ASPNETCORE\_ENVIRONMENT": "Development"

},

"applicationUrl": [http://localhost:5000](http://localhost:5000/),

"dotnetRunMessages": "true"

}

Under profile settings we find 3 profiles “IIS Express”, “CoreMVCProject” (our Project Name) and “IIS” (which we have created explicitly). “IIS Express” profile is used to run the application under IIS Express and we find the “iisSettings” on the top of “launchSettings.json” file and the Application URL is: [http://localhost:3](http://localhost:3/)5126 (35126 is Port No. on my system and this will vary from project to project and machine to machine) and below this we also find SSL Port as “0” because we did not create our project for “https” protocol and if we have selected that option while creating the project, it will also show the SSL Port No. is place of “0”. “CoreMVCProject” profile is used to run the application by using the Kestrel Web Server and the Application URL’s are: [http://localhost:5000](http://localhost:5000/) and [https://localhost:5001](https://localhost:5001/) (if SSL option has been selected by us while creating the project).

In the “Standard Tool Bar” under “Debug Target DropDownList” of Visual Studio, we find “IIS Express” selected by default, so when we hit F5 and run the project it will run using “IIS Express.exe” and in the browsers address bar we see the Port No. which is shown in “launchSettings.json” file. We can change the profile from “IIS Express” to “CoreMVCProject” so that the application runs on Kestrel Web Server and now we see the Port No. as 5000 for Http Protocol and 5001 for Https Protocol, and notice that it will launch a new Command Window running the Kestrel Web Server on Port No. 5000 and 5001 (Provided Https option is selected while project creation).

**Note:** We can also run the ASP.NET Core Application from the command line also by using the “.NET Core CLI (Command Line Interface)” which will use Kestrel as Web Server. To run .NET Core Application using .NET Core CLI Command, open “Developer Command Prompt for VS”. Now change the directory to the folder where we saved our Project i.e., “<Drive>:\<Personal\_Folder>\CoreMVCProject\CoreMVCProject”, so change to that folder and execute the “dotnet run” command as shown below:

**<Drive>:\<Personal\_Folder>\CoreMVCProject\CoreMVCProject>** **dotnet run**

Once we type the “dotnet run” command and press enter key, .NET Core CLI builds and runs the application and it also shows the URL to access our application as following => [http://localhost:5000](http://localhost:5000/) and [https://localhost:5001](https://localhost:5001/) (provided Https option is selected while project creation), and if you remember these port are configured in “launchSettings.json” file of our application under “CoreMVCProject” profile which is nothing but the profile for the Kestrel Web Server. Now open any browser and navigate to [http://localhost:5000](http://localhost:5000/) or [https://localhost:5001](https://localhost:5001/) (provided Https option is selected while project creation), which displays the output.

**Note:** Till now even we ran our application in “IIS Express” or “IIS” or “Kestrel Web Server” all these are “In-Process Hosting” only and now let’s learn about “Out of Process Hosting”.

**Out-Of-Process Hosting:** to run the application in “OutOfProcess” we need to configure it either in the “Project File” or under “Debug” option of Project Properties Window.

**Option 1: Configuring in Project File:** in Solution Explorer, right click on the Project and select the option “Edit Project File” which will open “CoreMVCProject.csproj” file in the document window. This file is an XML File, and we need to add the <AspNetCoreHostingModel> tag under <PropertyGroup> tag with value as “OutOfProcess” as shown below:

<AspNetCoreHostingModel>OutOfProcess</AspNetCoreHostingModel>

**Option 2: Specify the Hosting Model as OutOfProcess in Project Properties Window:** open the Project Properties Window, select Debug tab in LHS and on the right click on “Open debug launch profiles UI” link and change the value of “Hosting Model” in the DropDownList as “Out of Process”.

**What is Out of Process Hosting in ASP.NET Core?**

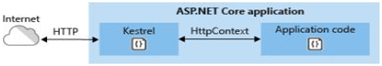
**Ans:** In case of ASP.NET Core => “Out of Process” Hosting Model there will be 2 Web Servers.

1. An internal Web Server which is the Kestrel Web Server.
2. An external Web Server which can be IIS Express or IIS or Apache or Nginx, etc.

The very important point that we need to keep in mind is depending on how you are running your application with the “Out of Process” hosting model, the external Web Server may or may not come into picture. As we already discussed that Kestrel Web Server is a Cross-Platform Web Server that is already embedded with your ASP.NET Core Application. So, if we are using “Out of Process” Hosting Model for our ASP.NET Core Application, then Kestrel Web Server can be used in one of the following ways:

**Option 1:** we can use Kestrel Web Server as an internet-facing Web Server which will directly process the incoming HTTP Requests and in this scenario only Kestrel Web Server is used, and external Web Server is not going to be used at all. So, when we run the application using the .NET Core CLI then Kestrel is the only Web Server that is going to be used to handle and process all the incoming HTTP Requests. To test this, open Visual Studio Developer Command Prompt and run the application as explained earlier.

Now open any browser and navigate to the Url: [http://localhost:500](http://localhost:5001/)0, which will display the output on the browser, and in this case even if we specified the ASP Net Core Hosting Model as “OutOfProcess” also it host the application in Kestrel and it only will respond for the incoming requests.



**Option 2:** The Kestrel Web Server can also be used with the combination of a reverse proxy server such as IIS Express, IIS, Tomcat, Apache, or Nginx. When we run our ASP.NET Core Application directly from Visual Studio choosing IIS or IIS Express Profile, setting the “AspNetCoreHostingModel” element value as “OutOfProcess” then IIS or IIS Express will be used as Reverse Proxy Server and Kestrel is used as Internal Web Server. To test this go to “Startup.cs” file in our project, import the namespace “Microsoft.AspNetCore.Http” and then in the “Configure” method we find “app.UseEndPoints” method call and we need to change the code of it.

**By default, the code in it will be as following:**

app.UseEndpoints(endpoints =>

{

endpoints.MapControllerRoute(

name: "default",

pattern: "{controller=Home}/{action=Index}/{id?}");

});

**Re-write the code in the method as below:**

app.UseEndpoints(endpoints =>

{

endpoints.MapGet("/", async context =>

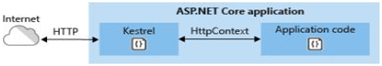
{

await context.Response.WriteAsync(System.Diagnostics.Process.GetCurrentProcess().ProcessName);

});

});

Now set the hosting model as “Out of Process” either in the project property window or in project file and then choose “CoreMVCProject” profile to run the project which will display the process name as “CoreMVCProject” only which means the Kestrel Web Server is processing our incoming request directly and the URL in the address bar is pointing to Port No. 5000, so there is no “Reverse Proxy Server” in usage.



Now choose “IIS” or “IISExpress” profile and run the project which will display the process name as “CoreMVCProject”, which means the Kestrel Web Server is processing our incoming request, and if we watch the URL in the address bar it is pointing to IIS or IIS Express, so in this case there is a “Reverse Proxy Server” in usage i.e., IIS Express or IIS which is taking the incoming request and Kestrel Web Server which is processing the requests.



**Now the question that comes to our mind is, if Kestrel can be used by itself as a Web Server which can directly handle and process the incoming HTTP Request’s, then why do we need a reverse proxy server?**

**Ans:** This is all because, the reverse proxy server provides an additional layer of security and configuration which is not available with Kestrel Server and it also maintains load balancing. So, it is a good choice to use Kestrel Server along with a Reverse Proxy Server. When we use Kestrel along with the Reverse Proxy Server, then the Reverse Proxy Server will receive all the incoming HTTP Requests from client’s and then forwards that request to the Kestrel Web Server for processing. Once the Kestrel Web Server process that request, then it sends the response back to the reverse proxy server which then sends response back to the requested client over the internet.

**Working with ASP.NET Core MVC Applications**

Create a new “ASP.NET Core Empty” project, naming it as “CoreTestProject”, choose the Target Framework as “.NET 5.0 (Out of support) or .NET 6.0 (Long term support)”, select the Checkbox “Configure for HTTPS” and click on the “Create” button.

**Note:** If you are working with .NET 6.0 (Long term support), as explained earlier it uses a new feature “Top Level Statements” i.e., it generates the code in Program class with out a namespace, class and Main method also. If you don’t want to generate it like that, after selecting the Target Framework as .NET 6.0 (Long term support) we will find a Checkbox below “Do not use top-level statements”, select it so that we get all the code as usual with a namespace, class and Main method.

Right now, we have chosen an “Empty Project Template”, so we can configure it as a ASP.NET Core Web App or Web API or MVC Application also. To make it as an MVC Application, do the following:

**ASP.NET Core 5.0** **=>** Open “Startup.cs” file and write the below code under “ConfigureServices” method of the class:

**services.AddControllersWithViews();**

**ASP.NET Core 6.0** **=>** Open “Program.cs” file and write the below statement just above the statement “var app = builder.Build();”.

**builder.Services.AddControllersWithViews();**

**ASP.NET Core 5.0** **=>** Now under the Configure method of Startup class add “UseStaticFiles” middleware above “app.UseRouting” statement as following:

**app.UseStaticFiles();**

**ASP.NET Core 6.0** **=>** Now under Program class write the above statement just below the statement “var app = builder.Build();”.

**ASP.NET Core 5.0** **=>** Delete all the code that is present in “UseEndpoints” block and write the below code over there which should now look as following:

app.UseEndpoints(endpoints =>

{

endpoints.MapControllerRoute(

name: "default",

pattern: "{controller=Home}/{action=Index}/{id?}");

});

**ASP.NET Core 6.0** **=>** Now in the bottom of “Program.cs” file we find a statement “app.MapGet("/", () => "Hello World!");” comment it or delete it and write the below code over there:

app.MapControllerRoute(

name: "default",

pattern: "{controller=Home}/{action=Index}/{id?}");

**Note:** after all the above changes our application is now an “MVC Application”, so we can now add “wwwroot”, “Controllers”, “Models” and “Views” folders as per our requirements. So let us add all the 4 folders under our Project from Solution Explorer.

**Adding a Controller in Controllers Folder:** Now let’s add a new Controller choosing the option “MVC Controller – Empty” under “Add New Scaffolded Item” window, naming it as “HomeController”. If we observe the parent class of “HomeController”, it is “Controller” only just like in our “ASP.NET MVC” but, this class is defined in “Microsoft.AspNetCore.Mvc” namespace, whereas in “ASP.NET MVC” the class “Controller” is defined in “System.Web.Mvc” namespace.

In the “HomeController” by default we find a “Action Method” with the name “Index” and the return type of the method is “IActionResult” Interface which is the parent of all the “Action Results” in an ASP.NET Core MVC Application, whereas in ASP.NET MVC Applications the parent of all “ActionResults” is a class i.e., “ActionResult”.

**Adding a View to Index Action Method:** Now right click on the “Index” action method which is present in “HomeController” class and select the option “Add View” and in the window opened, choose “Razor View – Empty” and click on the “Add” button which will add a new View with the name “Index.cshtml” by creating a folder under the “Views” folder with the name “Home” and the View gets added into the “Home” folder. Write the below code in it and execute:

<h3>Home Controller - Index View</h3>

Now hit “F5” and run the project which will display a Message Box asking about SSL Certificate because we have chosen “Configure for HTTPs” option while creating the project click on “Yes” button which will display a Security Warning window asking for installing the certification on your machine click “Yes” button again which will launch the browser and displays the output.

**Note:** now if you observe the URL in Browser’s - Address Bar, the protocol will be “HTTPs”. In ASP.NET Core 6.0 the default Web Server - Visual Studio uses to run the Web App’s is Kestrel and the Port used for HTTPS in Kestrel will be different and for HTTP will be different. We can verify the ports used in “launchSettings.json” file. You can even change the Server by choosing a Profile in Debug Target Dropdown List that is present in Standard Toolbar.

**Routing:** This is responsible for matching incoming HTTP Requests and then dispatching those requests to the applications executable Endpoints. Endpoints are the applications units of executable request-handling code which are defined in the application and configured when the app starts. The Endpoint matching process can extract values from the requests URL and provide those values for request processing. All ASP.NET Core templates include routing in their generated code. Routing is registered in the middleware pipeline of Startup class in ASP.NET Core 5.0 and Program class in ASP.NET Core 6.0.

**MVC Supports 2 different types of Routings:**

1. Conventional Routing
2. Attribute Routing

**Conventional Routing:** this is a pattern matching system for URL, which maps incoming requests to a particular Controller and Action method. In conventional routing we set all the routes in “RouteConfig.cs” file in “ASP.NET MVC” by calling the method “MapRoute”, whereas in “ASP.NET Core MVC” we do that by calling “MapControllerRoute” method in Startup class for ASP.NET Core 5.0 and Program class for ASP.NET Core 6.0.

**Attribute Routing:** this is a simple routing mechanism, compared to conventional routing. All the concepts are just like the conventional approach only but here, we define routes and attributes on a Controller or Action method. This was introduced from “ASP.NET MVC 5” and was available in “ASP.NET Core MVC” also. To use attribute routing in “ASP.NET MVC 5” we need to call the method “MapMvcAttributeRoutes” in “RouteConfig.cs” file whereas in case of “ASP.NET Core MVC” we need to call the method “MapControllers” in Startup class for ASP.NET 5.0 and Program class in ASP.NET Core 6.0.

| **Route Type** | **Method to use in MVC 5** | **Methods to use in MVC Core** |
| --- | --- | --- |
| Conventional: | MapRoute | MapControllerRoute |
| Attribute: | MapMvcAttributeRoutes | MapControllers |

To test “Attribute Routing” go to “Startup.cs” file (ASP.NET Core MVC 5.0) of our current project i.e., “CoreTestProject”, delete the code which we have implemented in “UseEndPoints” block earlier and then call “MapControllers” method over there and it should now look as below:

**Old Code (Conventional):** app.UseEndpoints(endpoints =>

{

endpoints.MapControllerRoute(

name: "default",

pattern: "{controller=Home}/{action=Index}/{id?}");

});

**New Code (Attribute):** app.UseEndpoints(endpoints =>

{

endpoints.MapControllers();

});

If you are working with ASP.NET Core MVC 6.0 go to Program class, delete or comment the method call “MapControllerRoute” and call the method “MapControllers”.

**Old Code (Conventional):** app.MapControllerRoute(

name: "default",

pattern: "{controller=Home}/{action=Index}/{id?}");

**New Code (Attribute):** app.MapControllers();

**Note:** after doing the above action if we try to run the “Index.cshtml” view we get a “404 – Page Not Found” error because there is no routing pattern defined anywhere.

To define the routing pattern, go to “Home Controller” class and write the following statements above the “Index” action method which should now look as following:

[Route("")] //http://localhost:Port

[Route("Home")] //http://localhost:Port/Home

[Route("Home/Index")] //http://localhost:Port/Home/Index

public IActionResult Index()

{

return View();

}

**Note:** The above statements when added on the top of action method will be launching the view when we use the corresponding URL's.

We can even set attribute routes on Controllers also and to test this write the below statement above the Controller class which should now like as following:

[Route("Home")]

public class HomeController : Controller

In this case we don’t require using controller name while setting the route for Index action method and it should be as following:

[Route("/")] //http://localhost:Port

[Route("")] //http://localhost:Port/Home

[Route("Index")] //http://localhost:Port/Home/Index

public IActionResult Index()

In attribute routing we can hide the original name of the controller and action method so that end users can’t view the name of the controller and action method and to do that we need specify the alias name in the route as following:

**Specifying an alias name to Controller:**

[Route("Test")]

public class HomeController : Controller

**Specifying an alias name to Action Method:**

[Route("/")] //http://localhost:Port

[Route("")] //http://localhost:Port/Test

[Route("Demo")] //http://localhost:Port/Test/Demo

public IActionResult Index()

Without hard coding controller names or action method names in attribute routes we can use the concept of “Token Replacements”, for example we can define the route for Controller as:

[Route("[controller]")]

public class HomeController : Controller

In the above case "[controller]" is a token which is replaced with the name of the Controller in runtime and same as this we can also do this for action methods also as following:

[Route("/")] //http://localhost:Port

[Route("")] //http://localhost:Port/Home

[Route("[action]")] //http://localhost:Port/Home/Index

public IActionResult Index()

**We can also use "[controller]/[action]" token on Controller class as following:**

[Route("[controller]/[action]")]

public class HomeController : Controller

**In this case route for Index action method will be as following:**

[Route("/")] //http://localhost:Port

[Route("/Home")] //http://localhost:Port/Home

[Route("")] //http://localhost:Port/Home/Index

public IActionResult Index()

**Route Constraints:** we use these to restrict the browser requests to match a particular route and we can even use regular expressions to specify a route constraint.

alpha => Accepts only alphabets (Upper or Lower Case) {x:alpha}

bool => Accepts only boolean values {x:bool}

datetime => Accepts only DateTime values {x:datetime}

decimal => Accepts only decimal values {x:decimal}

double => Accepts a 64-bit floating-point value {x:double}

float => Accepts a 32-bit floating-point value {x:float}

int => Accepts a 32-bit integer value {x:int}

long => Accepts a 64-bit integer value {x:long}

max => Accepts a numeric up to a given maximum value {x:max(10)}

min => Accepts a numeric up to a given minimum value {x:min(5)}

range => Accepts a numeric within given range of values {x:range(10,50)}

length => Accepts a string with a specified length {x:length(6)}

Or

=> Accepts a specified range of characters {x:length(1,9)}

maxlength => Accepts a string with a given maximum length {x:maxlength(9)}

minlength => Accepts a string with a given minimum length {x:minlength(5)}

regex => Matches a given value with a specified regular expression. {x:regex(^\d{{4}}-\d{{4}}-\d{{4}}$)}

**To practice route constraints first set the route for controller as below:**

Route("[controller]")]

public class HomeController : Controller

**Define a new action method in the Controller class as following:**

[Route("Display1/{id?}")]

public string Display1(int id)

{

return "Value of id is: " + id;

}

**The above action method gets executed when we use the below URL’s:**

http://localhost:port/Home/Display1 //Valid

http://localhost:port/Home/Display1/10 //Valid

http://localhost:port/Home/Display1/A //Valid

http://localhost:port/Home/Display1/false //Valid

http://localhost:port/Home/Display1/Hello //Valid

http://localhost:port/Home/Display1/34.56 //Valid

In the above case we defined "{id?}" as a route parameter and it is optional so if we do not pass a value to id or if we pass a value of different data types, it will not raise any error but id value will be "0", whereas if we want the parameter value to be an integer, or any other particular data type or if we want to apply any other restrictions on the action method parameters, we use route constraints.

**Add a new action method into the Home Controller class as following:**

[Route("Display2/{id:int}")]

public string Display2(int id)

{

return "Value of id is: " + id;

}

In the above case we need to call the Display2 action method by explicitly passing an integer value only, whereas if we try to pass any other type of values or if we do not pass a value, we get error.

http://localhost:port/Home/Display2/10 //Valid

http://localhost:port/Home/Display2 //Error

http://localhost:port/Home/Display2/Hello //Error

http://localhost:port/Home/Display2/34.56 //Error

http://localhost:port/Home/Display2/false //Error

http://localhost:port/Home/Display2/A //Error

**Note:** if you want to call the above method without passing a value make int as nullable int i.e., “int?”.

[Route("Display3/{id:double?}")]

public string Display3(double id)

{

return "Value of id is: " + id;

}

In the above method id parameter is defined to accept a double value so we can pass an integer or a double also as following:

http://localhost:port/Home/Display3 //Valid

http://localhost:port/Home/Display3/10 //Valid

http://localhost:port/Home/Display3/34.56 //Valid

http://localhost:port/Home/Display3/A //Error

http://localhost:port/Home/Display3/Hello //Error

http://localhost:port/Home/Display3/false //Error

[Route("Display4/{id:min(50)}")]

public string Display4(int id)

{

return "Value of id is: " + id;

}

The above method is defined with a constraint to accept an integer with a minimum value of 50, so any value less than 50 throws an error:

http://localhost:port/Home/Display4 //Error

http://localhost:port/Home/Display4/49 //Error

http://localhost:port/Home/Display4/50 //Valid

http://localhost:port/Home/Display4/51 //Valid

[Route("Display5/{id:max(100)}")]

public string Display5(int id)

{

return "Value of id is: " + id;

}

The above method is defined with a constraint to accept an integer with a maximum value of 100, so any value greater than 100 throws an error:

http://localhost:port/Home/Display5 //Error

http://localhost:port/Home/Display5/99 //Valid

http://localhost:port/Home/Display5/100 //Valid

http://localhost:port/Home/Display5/101 //Error

http://localhost:port/Home/Display5/0 //Valid

http://localhost:port/Home/Display5/-10 //Valid

[Route("Display6/{id:range(51, 100)}")]

public string Display6(int id)

{

return "Value of id is: " + id;

}

The above method is defined with a constraint to accept an integer within a range of 51 to 100, so any value less than 51 and greater than 100 throws an error:

http://localhost:port/Home/Display6 //Error

http://localhost:port/Home/Display6/50 //Error

http://localhost:port/Home/Display6/51 //Valid

http://localhost:port/Home/Display6/100 //Valid

http://localhost:port/Home/Display6/101 //Error

[Route("Display7/{name:length(5)}")]

public string Display7(string name)

{

return "Name of the user is: " + name;

}

The above method is defined with a constraint to accept a string value with a length of 5 characters, so any value less than 5 or greater than 5 characters, throws an error:

http://localhost:port/Home/Display7 //Error

http://localhost:port/Home/Display7/Abcd //Error

http://localhost:port/Home/Display7/Abcde //Valid

http://localhost:port/Home/Display7/Abcdef //Error

http://localhost:port/Home/Display7/false //Valid

http://localhost:port/Home/Display7/12345 //Valid

[Route("Display8/{name:length(3, 10)}")]

public string Display8(string name)

{

return "Name of the user is: " + name;

}

The above method is defined with a constraint to accept a string value with a minimum length of 3 characters and maximum length of 10 characters, so any value less than 3 characters or greater than 10 characters, throws an error:

http://localhost:port/Home/Display8 //Error

http://localhost:port/Home/Display8/AB //Error

http://localhost:port/Home/Display8/Sai //Valid

http://localhost:port/Home/Display8/Venkat //Valid

http://localhost:port/Home/Display8/Bangarraju //Valid

http://localhost:port/Home/Display8/DavidWarner //Error

[Route("Display9/{name:minlength(3)}")]

public string Display9(string name)

{

return "Name of the user is: " + name;

}

The above method is defined with a constraint to accept a string value with a minimum length of 3 characters, so any value less than 3 characters, throws an error:

http://localhost:port/Home/Display9 //Error

http://localhost:port/Home/Display9/AB //Error

http://localhost:port/Home/Display9/Sai //Valid

http://localhost:port/Home/Display9/Bangarraju //Valid

http://localhost:port/Home/Display9/DavidWarner //Valid

[Route("Display10/{name:maxlength(10)}")]

public string Display10(string name)

{

return "Name of the user is: " + name;

}

The above method is defined with a constraint to accept a string value with a maximum length of 10 characters, so any value greater than 10 characters, throws an error:

http://localhost:port/Home/Display10 //Error

http://localhost:port/Home/Display10/AB //Valid

http://localhost:port/Home/Display10/Sai //Valid

http://localhost:port/Home/Display10/Bangarraju //Valid

http://localhost:port/Home/Display10/DavidWarner //Error

[Route("Display11/{name:alpha}")]

public string Display11(string name)

{

return "Name of the user is: " + name;

}

The above method is defined with a constraint to accept only string values so any value other than string, throws an error:

http://localhost:port/Home/Display11 //Error

http://localhost:port/Home/Display11/Raju //Valid

http://localhost:port/Home/Display11/1234 //Error

http://localhost:port/Home/Display11/34.56 //Error

http://localhost:port/Home/Display11/false //Valid

[Route("Display12/{flag:bool}")]

public string Display12(bool flag)

{

if (flag)

return "Hello India!";

else

return "Hello World!";

}

The above method is defined with a constraint to accept only boolean values so any value other than boolean, throws an error:

http://localhost:port/Home/Display12 //Error

http://localhost:port/Home/Display12/true //Valid

http://localhost:port/Home/Display12/Hello //Error

http://localhost:port/Home/Display12/34.56 //Error

http://localhost:port/Home/Display12/false //Valid

[Route("Display13/{aadhar:regex(^\\d{{4}}-\\d{{4}}-\\d{{4}}$)}")]

public string Display13(string aadhar)

{

return "Aadhar Id of the user is: " + aadhar;

}

The above method is defined with a constraint to accept Aadhar Id by using a regular expression, so any value that doesn't match with the expression will throw an error:

http://localhost:port/Home/Display13 //Error

http://localhost:port/Home/Display13/1234-1234-1234 //Valid

http://localhost:port/Home/Display13/1234-1234-123 //Error

http://localhost:port/Home/Display13/1234-1234-12345 //Error

http://localhost:port/Home/Display13/1234-1234\_1234 //Error

http://localhost:port/Home/Display13/1234-1234=1234 //Error

[Route("Display14/{id}/{name}")]

public string Display11(int id, string name)

{

return "Id of the user is: " + id + " and name of the user is: " + name;

}

The above method is defined with 2 mandatory parameters id and name, so if we try to call it with any other value other than those it will throw an error:

<http://localhost:50293/Home/Display14> //Error

<http://localhost:50293/Home/Display14/101> //Error

<http://localhost:50293/Home/Display14/101/Raju> //Valid

<http://localhost:50293/Home/Display14/101/Raju/50.56> //Error

**Creating Views (User Interfaces) in MVC CORE**

Create a new “ASP.NET Core Empty” project naming it as “MVCCoreTagHelpers”, choose Target Framework as “.NET 5.0 (Out of support)” or “.NET 6.0 (Long term support)” and click on the Create button. Because we have chosen an empty project template, configure the project to work as an MVC Application as explained earlier and then do the following:

Add a new folder under the project naming it as “Models”, add a new class in to that folder naming it as “LoginModel” and write the below code in it importing “System.ComponentModel.DataAnnotations” namespace:

public class LoginModel

{

[EmailAddress]

public string Email { get; set; }

[DataType(DataType.Password)]

public string Password { get; set; }

public bool RememberMe { get; set; }

}

Add a new folder under the project naming it as “Controllers”, add a new Controller class into the folder naming it as “AccountController”, and write the below code in it by deleting the existing Index action method:

public ViewResult Login()

{

return View(model);

}

Add a view to “Login” action method and to do that right click on the method that is present in the Controller class, select the option “Add View” which launches a window, in that select “Razor View-Empty”, click on “Add” button which opens a window asking for a name, enter name as “Login.cshtml” and click “Add” button.

**Note:** now in the view we need to import the Model class to access the properties of Model class, as following:

@model MVCCoreTagHelpers.Models.LoginModel

In the above statement we are prefixing the “Namespace-Name” before the “Model Class-Name”, and we need to do this in every View where we are using “Model Binding”. To simply the coding or decrease the typing work MVC Core introduced an option called as “ViewImports” i.e., it is a new “.cshtml” file present under the Views folder just like “\_ViewStart.cshtml”, but with the name “\_ViewImports.cshtml” and we can use this file to importing all the required namespaces for views, so that we don’t require to do that again and again in each View.

If we create a project of type “ASP.NET Core Empty” then we will not have “\_ViewImports.cshtml” by default in our project so we need to explicitly add it, and to do that right click on the Views folder and select the option Add => View which will open a new window and in that window select “Razor View Empty” and click on the “Add” button which opens another window and in that window select the template “Razor View Imports” which displays “\_ViewImports.cshtml” as the name of file, click on “Add” button to add it to the Project. By default, the file will be empty and, in the file, write the below statement:

@using MVCCoreTagHelpers.Models

**Note:** If we create a project of type “ASP.NET Core Web App (Model-View-Controller)”, then we don’t require doing all the above things because my default “\_ViewImports.cshtml” file is added, and the Models namespace is also imported.

Now in “Login.cshtml” without prefixing the namespace name before Model class name we can directly write it as following:

@model LoginModel

**Installing Bootstrap for designing Views:** if we want to use bootstrap for styling of elements, we need to first install bootstrap in our projects and we can do that either by using “NuGet Package Manager” or “Library Manager” for managing all the client-side libraries.

**Working with Library Manager:** Right-click on the Project in Solution Explorer and choose Add => Client-Side Library, which launches “Add Client-Side Library” dialog over there, and in that window fill the following details:

* **Provider:** cdnjs (default)
* **Library:** [twitter-bootstrap@5.2.2](about:blank) (5.2.2 is the latest version by the time of preparing this document).
* Select Include all library files radio button.
* **Target Location:** wwwroot/lib/bootstrap

Click install and this will install bootstrap in our project under the specified target location and this will also add a file in the project with the name “libman.json” and under this file the details of all the libraries installed will be present.

Now write the below code in the “Login.cshtml” file by deleting all the content in the file except the Model class import statement, for creating the Login Form using “HtmlHelpers”:

<!DOCTYPE html>

<html>

<head>

<title>Login Form</title>

<link href="~/lib/bootstrap/css/bootstrap.css" rel="stylesheet" />

</head>

<body>

<h1>Login Form</h1>

<section>

@using (Html.BeginForm("Login","Account",FormMethod.Post,new {@class="form-horizontal",role="form"}))

{

@Html.AntiForgeryToken()

<hr />

<div class="form-group">

@Html.LabelFor(m => m.Email, new { @class = "col-md-2 control-label" })

@Html.TextBoxFor(m => m.Email, new { @class = "col-md-4 form-control" })

</div>

<div class="form-group">

@Html.LabelFor(m => m.Password, new { @class = "col-md-2 control-label" })

@Html.PasswordFor(m => m.Password, new { @class = "col-md-4 form-control" })

</div>

<div class="form-group">

@Html.CheckBoxFor(m => m.RememberMe)

@Html.LabelFor(m => m.RememberMe)

</div>

<div class="form-group">

<input type="submit" value="Log In" class="btn btn-primary" />

<input type="reset" value="Reset" class="btn btn-primary" />

</div>

}

</section>

</body>

</html>

In the View what we have created above, we used “Html Helpers” to design the UI or View whereas “MVC Core” provided us “Tag Helpers” for UI or View designing.

**How to use Tag Helpers?**

**Ans:** To use the In-built Tag Helpers, we must import them by using “@addTagHelper” directive in “\_ViewImports.cshtml” file. If our project is “ASP.NET Core Empty” we need to perform importing explicitly whereas if the project is “ASP.NET Core Web App (Model-View-Controller)” then it is automatically imported and to check that go to “\_ViewImports.cshtml” and watch the code, and there we find the below statement and if not found do it manually:

@addTagHelper \*,Microsoft.AspNetCore.Mvc.TagHelpers

**Note:** The above statement will import all the Tag helpers that are present in the namespace “Microsoft.AspNetCore.Mvc.TagHelpers” and as discussed above if we import a library in “\_ViewImports.cshtml” file then it will be available for all the views. If you don’t want any views to use globally imported Tag Helpers, you can use @removeTagHelper in the respective view.

If we want to use these Tag Helpers in our Login Page, then delete all the content that is present inside of <section></section> tags in the code present there and write the below code inside of <section></section> tags:

<form **asp-controller**="Account" **asp-action**="Login" method="post">

<hr />

<div class="form-group">

<label **asp-for**="Email"></label>

<input **asp-for**="Email" class="col-md-4 form-control" />

</div>

<div class="form-group">

<label **asp-for**="Password"></label>

<input **asp-for**="Password" class="col-md-4 form-control" />

</div>

<div class="form-group">

<input **asp-for**="RememberMe" />

<label **asp-for**="RememberMe"></label>

</div>

<div class="form-group">

<input type="submit" value="Log In" class="btn btn-primary" />

<input type="reset" value="Reset" class="btn btn-primary" />

</div>

</form>

**MVC Core Tag Helpers:** these will enable server-side code to participate in creating and rendering HTML elements in Razor Pages. There are many built-in Tag Helpers for common tasks - such as creating forms, links, loading assets and more - and even more available in public GitHub repositories as NuGet packages as well as we can also create our own Tag Helpers.

Tag Helpers are authored in C#, and they target HTML Elements based on the element or attribute name. For example, the built-in “LabelTagHelper” class targets the HTML Label Element when the “LabelTagHelper” attributes are applied. If we are familiar with HTML Helpers in MVC 5, Tag Helpers will reduce the explicit transitions between HTML and C# in Razor views i.e., in many cases, HTML Helpers provide an alternative approach to a specific Tag Helper, but it’s important to recognize that Tag Helpers don’t replace HTML Helpers and there is no Tag Helper available for every HTML Helper.

**What Tag Helpers provide?**

**Ans:** Tag Helpers provide an HTML friendly development experience for the most part, Razor markup using Tag Helpers looks like standard HTML. Front-end designers who are familiar with HTML/CSS/JavaScript can edit Razor without learning C# Razor syntax.

Tag Helpers are a way to make developers more productive and be able to produce more robust, reliable, and maintainable code using information that is available on the server. For example, historically the mantra of updating images was to change the name of image whenever we change the image because Images will be cached by the browsers for performance reasons, and unless we change the name of an image, you risk clients getting a stale copy. Historically, after an image was edited, the name must be changed and each reference to the image in the web application needed to be updated. Not only this is labor intensive, but it’s also errors prone (you could miss a reference, accidentally enter the wrong string, etc.). The built-in “ImageTagHelper” can do this work automatically for us i.e., this will append a version number to the image name, so whenever the image changes, the server automatically generates a new unique version for the image, so clients are guaranteed to get the latest image. This robustness and labor savings comes essentially free by using the “ImageTagHelper”.

All the built-in Tag Helpers target the standard HTML Elements and provide server-side attributes for those elements. For example, the <input> element used in our views contains the “asp-for” attribute and this attribute extracts the name of the specified Model Property into the rendered HTML.

**What are Tag Helpers?**

**Ans:** Tag Helpers are Classes written in C# but are attached to HTML Elements to run server-side code from Razor Views, in other words, Views that are created in HTML do have their presentation logic defined in C#, which is ultimately executed on Web Server. Examples of some built-in Tag Helpers are Anchor tag, Environment tag, etc.

**Form TagHelper:** this is used for creating Form element.

**Tag helper we use:**

<form asp-controller="Home" asp-action="Index" method="post">

<!-- Input and Submit elements -->

</form>

**Rendered HTML will be as following:**

<form method="post" action="/Home/Index">

<!-- Input and Submit elements -->

<input name="\_\_RequestVerificationToken" type="hidden" value="<generated value>">

</form>

**Note:** MVC runtime generates action attribute value based on the Form Tag Helper Attributes => asp-controller and asp-action. The Form Tag Helper also generates a hidden Request Verification Token to prevent cross-site request forgery (when used with [ValidateAntiForgeryToken] filter attribute in HTTP Post action method). Protecting a pure HTML Form from cross-site request forgery is difficult; the Form Tag Helper provides this service free for you.

**Using a named route:** The asp-route Tag Helper attribute can also generate markup for the HTML action attribute. An application with a route named “RegisterRoute” could use the following markup for the Registration Page:

public class AccountController : Controller

{

[Route("/Account/Register", Name = "RegisterRoute")]

public ActionResult Registration()

{

return "This is a Registration Page.";

}

}

**Tag helper we use:**

<form asp-route="RegisterRoute" method="post">

<!-- Input and Submit elements -->

</form>

**This renders the below HTML:**

<form method="post" action="/Account/Register">

<!-- Input and Submit elements -->

<input name="\_\_RequestVerificationToken" type="hidden" value="<generated value>">

</form>

**Form Action Tag Helper:** This generates the form action attribute based on the Button or Input type - image tags. The form action attributes controls where a form submits its data. It binds to <input> elements of type image and <button> elements. The Form Action Tag Helper enables the usage of several “AnchorTagHelper” “asp- attributes” to control what “form action” link is generated for the corresponding element. For example, if we define a Controller class with a set of action methods using attribute routing along with a name to the route then we can use form action tag helper to generate submit links.

public class AccountController : Controller

{

[Route("/Account/Login", Name = "LoginRoute")]

public string Login()

{

return "This is a Login Page.";

}

[Route("/Account/Register", Name = "RegisterRoute")]

public string Register()

{

return "This is a Registration Page.";

}

}

**Submit to controller’s action method example:**

<form method="post">

//Place controls for Login

<button asp-controller="Account" asp-action="Login">Login</button>

//Place controls for Register

<button asp-controller="Account" asp-action="Register">Register</button>

</form>

**Submit to route example:**

<form method="post">

//Place controls for Login

<button asp-route="LoginRoute">Login</button>

//Place controls for Register

<button asp-route="RegisterRoute">Register</button>

</form>

**The Input Tag Helper:** This renders an Html input element.

<input asp-for="<Expression Name>">

**Note:** The Input Tag Helper sets the HTML “type” attribute based on the .NET type. The below table lists, some common .NET types, and generated HTML types:

| **.NET Type** | **Input Type** |
| --- | --- |
| bool | type="checkbox" |
| string | type="text" |
| DateTime | type="datetime-local" |
| Byte, int, single, double | type="number" |

The following table shows some common data annotations attributes that the input tag helper will map to specific input types:

| **Attribute** | **Input Type** |
| --- | --- |
| [EmailAddress] | type="email" |
| [Url] | type="url" |
| [HiddenInput] | type="hidden" |
| [Phone] | type="tel" |
| [DataType(DataType.Password)] | type="password" |
| [DataType(DataType.Date)] | type="date" |
| [DataType(DataType.Time)] | type="time" |

**The Select Tag Helper:** Generates select and associated option elements for properties of your model. The Select Tag Helper’s “asp-for” specifies the model property name for the select element and “asp-items” specifies the option for elements. For example:

public class CountryModel

{

public string Country { get; set; }

public List<SelectListItem> Countries { get; } = new List<SelectListItem>

{

new SelectListItem { Value = "C1", Text = "Delhi" },

new SelectListItem { Value = "C2", Text = "Kolkata" },

new SelectListItem { Value = "C3", Text = "Mumbai" },

new SelectListItem { Value = "C4", Text = "Chennai" },

new SelectListItem { Value = "C5", Text = "Bengaluru" },

new SelectListItem { Value = "C6", Text = "Hyderabad"}

};

}

**Tag helper we use:** <select **asp-for**="Country" **asp-items**="Model.Countries"></select >

**Multi-select:** The Select Tag Helper will automatically generate the multiple = "multiple" attribute if the property specified in the “asp-for” attribute is an “IEnumerable”. For example, given the following model:

public class CountryModel

{

public IEnumerable<string> Country { get; set; }

public List<SelectListItem> Countries { get; } = new List<SelectListItem>

{

new SelectListItem { Value = "C1", Text = "Delhi" },

new SelectListItem { Value = "C2", Text = "Kolkata" },

new SelectListItem { Value = "C3", Text = "Mumbai" },

new SelectListItem { Value = "C4", Text = "Chennai" },

new SelectListItem { Value = "C5", Text = "Bengaluru" },

new SelectListItem { Value = "C6", Text = "Hyderabad"}

};

}

**Tag helper we use:** <select **asp-for**="Country" **asp-items**="Model.Countries"></select >

**Anchor Tag Helper:** Anchor Tag Helper enhances the standard HTML anchor (<a ... ></a>) tag by adding new attributes.

public class StudentController : Controller

{

[Route("/Student/GetStudent", Name = "StudentGet")]

public ActionResult GetStudent()

{

return View();

}

}

**Tag helper we use:** <a **asp-controller**="Student" **asp-action**="GetStudent">Display all Students</a>

**asp-route:** The asp-route attribute is used for creating a URL link directly to a named route. Using routing attributes, a route can be named as shown in the “StudentController” and used in its “GetStudent” action:

**Tag helper we use:** <a **asp-route**="StudentGet">Student Details</a>

**Image Tag Helper:** The Image Tag Helper enhances the “<img>” tag to provide cache-busting behavior for static image files. Cache-busting string means a unique value representing the hash of the static image file appended to the asset’s URL. The unique string prompts clients (and some proxies) to reload the image from the host web server and not from the client's cache.

**Tag helper we use:** <a **src**="~/images/asplogo.png" **asp-append-version**="true">

**Environment Tag Helper:** The Environment Tag Helper conditionally renders its enclosed content based on the current hosting environment i.e., this Tag Helper’s include or exclude attributes can be used to specify a comma-separated list of environment names. If any of the given environment names match the current environment, the enclosed content is rendered.

To work with “Image” and “Environment” TagHelpers add 2 new action methods in “AccountController” class of “MVCCoreTagHelpers” project and write the below code under the existing Login method:

public ViewResult Index()

{

return View();

}

public ViewResult Register()

{

return View();

}

To work with “ImageTagHelper” add a new folder with the name “images” under “wwwroot” folder and copy an image into it with the name “Register.jpg”. Add a View to Register action method and write the below code in it by deleting the exiting content in it:

<!DOCTYPE html>

<html>

<head>

<title>Registration Form</title>

<link href="~/lib/bootstrap/css/bootstrap.css" rel="stylesheet" />

</head>

<body>

<h1>Registration Form</h1>

<img src="~/images/Register.jpg" class="card-img-top" />

</body>

</html>

Call the Register action method to launch “Register.cshtml” file, now replace the image in images folder with a new image but the image name should be “Register.jpg” only and launch Register view again but you will see old image only but not the new image because of the cache busting behavior of the browser and to resolve the problem add “asp-append-version="true"” to the image tag which should now look as following:

<img src="~/images/Register.jpg" class="card-img-top" asp-append-version="true" />

When we add the new attribute to Image Tag it will generate a unique hash value based on the image content and appends to the image name, so whenever image changes (not the name) a new hash value will be generated, appended to the image name, and then loads the image from the server without loading it from browser cache.

To work with EnvironmentTagHelper add a new view to Index action method and write the below code in it by deleting the exiting content in it:

@inject Microsoft.AspNetCore.Hosting.IWebHostEnvironment env

<!DOCTYPE html>

<html>

<head>

<title>Index Form</title>

<**environment** **include**="Development">

<link href="~/lib/bootstrap/css/bootstrap.css" rel="stylesheet" />

</**environment**>

<**environment** **exclude**="Development">

<link rel="stylesheet" href=<https://cdnjs.cloudflare.com/ajax/libs/bootstrap/5.1.1/css/bootstrap.min.css>

crossorigin="anonymous" referrerpolicy="no-referrer"

integrity="sha512-6KY5s6UI5J7SVYuZB4S/CZMyPylqyyNZco376NM2Z8Sb8OxEdp02e1jkKk/wZxIEmjQ6DRCEBhni+gpr9c4tvA==" />

</**environment**>

</head>

<body>

<h3>Environment: @env.EnvironmentName</h3>

</body>

</html>

The Environment Tag Helper conditionally renders its enclosed content based on the current hosting environment and to test this, run the Index view and in the browser use “View Page Source” option, and watch the “<link>” tag in “<head>” section which will be loading the assets from “local folder” because our project is right now running in “Development” environment and to change it open “launchSettings.json” file present under Properties and change ("ASPNETCORE\_ENVIRONMENT": "Development") as ("ASPNETCORE\_ENVIRONMENT": "Production") and run Index action method again and watch the “<link>” tag by using “View Page Source” which will now load the assets from “CDN”.

**Custom Tag Helpers:** We can also develop our own Tag Helpers and consume them in our applications and to do that we need to follow the below process:

**Step 1:** Add a new folder under the project with the name “TagHelpers”.

**Step 2:** Define a new class inheriting from the pre-defined class “TagHelper” which is present under the namespace

“Microsoft.AspNetCore.Razor.TagHelpers”. The name of the class should be same as the tag we are targeting suffixed with TagHelper.

**Step 3:** Now under the class define all the properties we are expecting for our tag.

**Step 4:** Implement logic under the class by overriding the method “Process” of “TagHelper” class.

**Step 5:** Import the project namespace in “\_ViewImports.cshtml” file.

**Step 6:** Start consuming the new TagHelper class in the required Views.

**Creating a Custom Tag Helper:**

**Step 1:** Add a new folder under the project naming it as “TagHelpers” and in to that folder add a new class naming it as “EmailTagHelper.cs” and write the below code in it by importing “Microsoft.AspNetCore.Razor.TagHelpers” namespace:

public class EmailTagHelper : TagHelper

{

public string MailTo { get; set; }

public string DomainName { get; set; }

public string TargetAddress { get; set; }

public string InnerHtml { get; set; }

public override void Process(TagHelperContext context, TagHelperOutput output)

{

output.TagName = "a";

if (!String.IsNullOrEmpty(TargetAddress))

output.Attributes.SetAttribute("href", $"mailto:{TargetAddress}");

else

output.Attributes.SetAttribute("href", $"mailto:{MailTo}@{DomainName}");

if (!String.IsNullOrEmpty(InnerHtml))

output.Content.SetContent(InnerHtml);

else if(!String.IsNullOrEmpty(TargetAddress))

output.Content.SetContent(TargetAddress);

else

output.Content.SetContent($"{MailTo}@{DomainName}");

}

}

In the above case we are targeting the “<email>” tag and implementing the logic so whenever we use the “<email>” tag in our View file it will be changing to “<a>” tag and the 4 properties we defined in the class (MailTo, DomainName, TargetAddress and InnerHtml) will be defining the way how “<a>” tag is rendered.

**Step 2:** go to “\_ViewImports.cshtml” file and import the project namespace on top of the file as following:

@addTagHelper \*, MVCCoreTagHelpers

**Step 3:** Write the below code in <body> tag of “Index.cshtml” file by deleting the existing code present there:

<h3>Click to navigate:</h3>

<a class="btn btn-primary" href="/Home/Login">Login</a>

@Html.ActionLink("Register", "Register", "Home", null, new { @class="btn btn-primary" })

<a class="btn btn-primary" asp-controller="Home" asp-action="About">About</a>

<br /><br />

<strong>Support:</strong>

<email target-address="support@nareshit.com"></email><br />

<strong>Marketing:</strong>

<email mail-to="marketing" domain-name="nareshit.com"></email><br />

<strong>Sales:</strong>

<email mail-to="sales" domain-name="nareshit.com" inner-html="Contact"></email>

**Note:** Now run the “Index.cshtml” file and watch the output of the “<email>” tag by using “View Page Source” option where we notice “<a>” tags getting generated for all “<email>” tags.

**Data Management using XML**

Create a new “ASP.NET Core Web App (Model-View-Controller)” naming it as “MVCDHProject”, choose Target Framework as “.NET 5.0 (Out of support)” or “.NET 6.0 (Long-term support)”, and click on the Create button. Add a new XML File in the Project naming it as “Customer.xml” and write the below code in it:

<Customers>

<Customer>

<Custid>101</Custid>

<Name>Scott</Name>

<Balance>25000</Balance>

<City>Hyderabad</City>

<Status>True</Status>

</Customer>

<Customer>

<Custid>102</Custid>

<Name>Smith</Name>

<Balance>35000.00</Balance>

<City>Chennai</City>

<Status>True</Status>

</Customer>

<Customer>

<Custid>103</Custid>

<Name>David</Name>

<Balance>45000.00</Balance>

<City>Bengaluru</City>

<Status>True</Status>

</Customer>

</Customers>

**Add a new class in to the Models folder naming it as “Customer” and write the below code in it:**

public class Customer

{

public int Custid { get; set; }

public string Name { get; set; }

public decimal? Balance { get; set; }

public string City { get; set; }

public bool Status { get; set; }

}

**Add another new class in to the Models folder naming it as “CustomerXmlDAL” and write the below code in it:**

using System.Data;

public class CustomerXmlDAL

{

DataSet ds;

public CustomerXmlDAL()

{

ds = new DataSet();

ds.ReadXml("Customer.xml");

//Adding Primary Key on Custid of DataTable

ds.Tables[0].PrimaryKey = new DataColumn[] { ds.Tables[0].Columns["Custid"] };

}

public List<Customer> Customers\_Select()

{

List<Customer> Customers = new List<Customer>();

foreach (DataRow dr in ds.Tables[0].Rows)

{

Customer obj = new Customer

{

Custid = Convert.ToInt32(dr["Custid"]),

Name = (string)dr["Name"],

Balance = Convert.ToDecimal(dr["Balance"]),

City = (string)dr["City"],

Status = Convert.ToBoolean(dr["Status"])

};

Customers.Add(obj);

}

return Customers;

}

public Customer Customer\_Select(int Custid)

{

//Finding a DataRow based on its Primary Key value

DataRow dr = ds.Tables[0].Rows.Find(Custid);

Customer obj = new Customer

{

Custid = Convert.ToInt32(dr["Custid"]),

Name = Convert.ToString(dr["Name"]),

Balance = Convert.ToDecimal(dr["Balance"]),

City = Convert.ToString(dr["City"]),

Status = Convert.ToBoolean(dr["Status"])

};

return obj;

}

public void Customer\_Insert(Customer customer)

{

//Creating a new DataRow based on the DataTable structure

DataRow dr = ds.Tables[0].NewRow();

//Assigning values to each Column of the DataRow

dr["Custid"] = customer.Custid;

dr["Name"]= customer.Name;

dr["Balance"] = customer.Balance;

dr["City"] = customer.City;

dr["Status"] = customer.Status;

//Adding the new DataRow to DataTable

ds.Tables[0].Rows.Add(dr);

//Saving data back to XML file

ds.WriteXml("Customer.xml");

}

public void Customer\_Update(Customer customer)

{

//Finding a DataRow based on its Primary Key value

DataRow dr = ds.Tables[0].Rows.Find(customer.Custid);

//Finding the Index of DataRow by calling IndexOf method

int Index = ds.Tables[0].Rows.IndexOf(dr);

//Overriding the old values in DataRow with new values based on the Index

ds.Tables[0].Rows[Index]["Name"] = customer.Name;

ds.Tables[0].Rows[Index]["Balance"] = customer.Balance;

ds.Tables[0].Rows[Index]["City"] = customer.City;

//Saving data back to XML file

ds.WriteXml("Customer.xml");

}

public void Customer\_Delete(int Custid)

{

//Finding a DataRow based on its Primary Key value

DataRow dr = ds.Tables[0].Rows.Find(Custid);

//Finding the Index of DataRow by calling IndexOf method

int Index = ds.Tables[0].Rows.IndexOf(dr);

//Deleting the DataRow from DataTable

ds.Tables[0].Rows[Index].Delete();

//Saving data back to XML file

ds.WriteXml("Customer.xml");

}

}

**Add a new Controller into Controllers folder naming it as “CustomerController” and write the below code in it:**

using MVCDHProject.Models;

public class CustomerController : Controller

{

CustomerXmlDAL obj = new CustomerXmlDAL();

public ViewResult DisplayCustomers()

{

return View(obj.Customers\_Select());

}

public ViewResult DisplayCustomer(int Custid)

{

return View(obj.Customer\_Select(Custid));

}

public ViewResult AddCustomer()

{

return View();

}

[HttpPost]

public RedirectToActionResult AddCustomer(Customer customer)

{

obj.Customer\_Insert(customer);

return RedirectToAction("DisplayCustomers");

}

public ViewResult EditCustomer(int Custid)

{

return View(obj.Customer\_Select(Custid));

}

public RedirectToActionResult UpdateCustomer(Customer customer)

{

obj.Customer\_Update(customer);

return RedirectToAction("DisplayCustomers");

}

public RedirectToActionResult DeleteCustomer(int Custid)

{

obj.Customer\_Delete(Custid);

return RedirectToAction("DisplayCustomers");

}

}

**Add a View to DisplayCustomers Action method and write the below code by deleting existing code over there:**

@model IEnumerable<Customer>

<h2 style="text-align:center;background-color:yellowgreen;color:red">Customer Details</h2>

<table border="1" align="center" class="table-condensed">

<tr>

<th>@Html.DisplayNameFor(C => C.Custid)</th>

<th>@Html.DisplayNameFor(C => C.Name)</th>

<th>@Html.DisplayNameFor(C => C.Balance)</th>

<th>@Html.DisplayNameFor(C => C.City)</th>

<th>@Html.DisplayNameFor(C => C.Status)</th>

<th>Actions</th>

</tr>

@foreach (Customer customer in Model)

{

<tr>

<td align="center">@Html.DisplayFor(C => customer.Custid)</td>

<td>@Html.DisplayFor(C => customer.Name)</td>

<td>@Html.DisplayFor(C => customer.Balance)</td>

<td>@Html.DisplayFor(C => customer.City)</td>

<td align="center">@Html.DisplayFor(C => customer.Status)</td>

<td>

<a **asp-action**="DisplayCustomer" **asp-route-Custid**="@customer.Custid">View</a> &nbsp;

<a **asp-action**="EditCustomer" **asp-route-Custid**="@customer.Custid">Edit</a> &nbsp;

<a **asp-action**="DeleteCustomer" **asp-route-Custid**="@customer.Custid"

onclick="return confirm('Are you sure of delting the record?')">Delete</a>

</td>

</tr>

}

<tr><td colspan="6" align="center"><a **asp-action**="AddCustomer">Add New Customer</a></td></tr>

</table>

**Add a View to DisplayCustomer Action method and write the below code by deleting existing code over there:**

@model Customer

<h2 style="text-align:center;background-color:yellowgreen;color:red">Customer Details</h2>

<table border="1" align="center">

<tr><td>Custid: </td><td>@Model.Custid</td></tr>

<tr><td>Name: </td><td>@Model.Name</td></tr>

<tr><td>Balance: </td><td>@Model.Balance</td></tr>

<tr><td>City: </td><td>@Model.City</td></tr>

<tr><td>Status: </td><td>@Model.Status</td></tr>

</table>

<div style="text-align:center">

<a **asp-action**="DisplayCustomers" align="center">Back to Customer Details</a>

</div>

**Add a View to AddCustomer Action method and write the below code by deleting existing code over there:**

@model Customer

<form **asp-controller**="Customer" **asp-action**="AddCustomer" method="post">

<div><label **asp-for**="Custid"></label><br /><input **asp-for**="Custid" /></div>

<div><label **asp-for**="Name"></label><br /><input **asp-for**="Name" /></div>

<div><label **asp-for**="Balance"></label><br /><input **asp-for**="Balance" /></div>

<div><label **asp-for**="City"></label><br /><input **asp-for**="City" /></div>

<div><label **asp-for**="Status"></label><br /><input **asp-for**="Status" /></div>

<div><input type="submit" value="Save" /><input type="reset" value="Reset" /></div>

<div><a **asp-action**="DisplayCustomers" align="center">Back to Customer Details</a></div>

</form>

**Add a View to EditCustomer Action method and write the below code by deleting existing code over there:**

@model Customer

<form **asp-controller**="Customer" **asp-action**="UpdateCustomer" method="post">

<div><label **asp-for**="Custid"></label><br /><input **asp-for**="Custid" readonly /></div>

<div><label **asp-for**="Name"></label><br /><input **asp-for**="Name" /></div>

<div><label **asp-for**="Balance"></label><br /><input **asp-for**="Balance" /></div>

<div><label **asp-for**="City"></label><br /><input **asp-for**="City" /></div>

<div><label **asp-for**="Status"></label><br /><input **asp-for**="Status" disabled /></div>

<div><input type="submit" value="Update" /><input type="reset" value="Reset" /></div>

<div><a **asp-action**="DisplayCustomers" align="center">Back to Customer Details</a></div>

</form>

**What is the Problem in the above implementation?**

**Ans:** As we can see in the above “CustomerController” class, to get the Customer Data, Controller depends on “CustomerXmlDAL” class. So, with-in the Controller class we have created the instance of “CustomerXmlDAL” class and then invoking all the methods of that class as per our requirements. So, there is a tight coupling between “CustomerController” class and “CustomerXmlDAL” classes. Tomorrow if the DAL implementation class is changed then we also need to change the code in all the Controller classes where we used “CustomerXmlDAL” because Controller and DAL are tightly coupled with each other.

**Note:** We can overcome this problem with the help of “Dependency Injection Design Pattern”.

**What is Dependency Injection (DI) Design Pattern?**

**Ans:** Dependency Injection is a process of injecting the object/instance of a class into another class that depends on it. The Dependency Injection is the most used “Design Pattern” nowadays to remove the dependencies between the objects/instances and this allows us to develop loosely coupled software components.

**Dependency Injection Pattern involves 3 types of classes:**

* **Client Class:** The Client class is a class that depends on the Service class.
* **Service Class:** The Service class is the interface that provides services to the Client class.
* **Injector Class:** The Injector class injects the service class object into the Client class.

**Dependency Injection in ASP.NET Core:** ASP.NET Core Framework is designed from scratch to provide in-built support for Dependency Injection. ASP.NET Core Framework injects objects/instances of dependency classes through constructor or method or property by using a built-in IoC (Inversion of Control) container.

**What are the advantages of using ASP.NET Core Dependency Injection?**

**Ans:** ASP.NET Core Dependency Injection allows us to develop loosely coupled software components. Using ASP.NET Core Dependency Injection, it is very easy to swap with a different implementation of a component/class.

**What type of Services ASP.NET Core Dependency Injection provides to us?**

**Ans:** there are two types of services that ASP.NET Core Dependency Injection provides us, those are:

1. **Framework Services:** services that are a part of ASP.NET Core Framework such as “IApplicationBuilder”, “IConfiguration”, “IServiceCollection”, “ILoggerFactory”, “IWebHostEnvironment”, etc.
2. **Application Services:** the services (custom types) which we as a programmer create for our application.

**Note:** To let the “IoC” container automatically inject our application services, we first need to register them with the “IoC” container.

**How to register a Service with ASP.NET Core Dependency Injection Container?**

**Ans:** We register a service with ASP.NET Core Dependency Injection Container within the “ConfigureServices” method of the “Startup” class in ASP.NET Core 5.0 and “Program” class in ASP.NET Core 6.0. Before we register a Service with the Dependency Injection Container, it is important to understand the lifetime of a service, i.e., when a client class receives the dependency object/instance through dependency injection, whether the instance it receives is unique or not, depends on the lifetime of the service. Setting the lifetime of the dependency object/instance determines how many times the dependency object needs to be created and we are provided with 3 options to set the lifetime of the service, those are:

1. **Singleton:** in this case, the “IoC” container will create and share a single object/instance of a service object throughout the application’s lifetime.
2. **Scoped:** in this case, the “IoC” container will create an object/instance of the specified service type once per request and will be shared in a single request.
3. **Transient:** in this case, the “IoC” container will create a new object/instance of the specified service type every time you ask for it (Single Call).

**How to register a service with Dependency Injection Container?**

**Ans:** ASP.NET Core Framework provides 3 extension methods to register a service with the ASP.NET Core Dependency Injection Container and those methods will determine the lifetime of that service.

* AddSingleton<Interface, Class>()
* AddScoped<Interface, Class>()
* AddTransient<Interface, Class>()

**Note:** The built-in “IoC” container manages the lifetime of a registered service i.e., it automatically disposes of a service object/instance based on the specified lifetime.

**AddSingleton:** when we use this method to register a service, then it will create a singleton service which means a single instance of that service is created and shared among all the components of the application that require it. This instance is created when the first request comes to the service (single instance for all users).

**AddScoped:** when we use this method to register a service, then it will create a scoped service i.e., an instance of the service is created once per each HTTP Request and uses that instance in other calls of the same request (one instance for each request).

**AddTransient:** when we use this method to register a service, then it will create a transient service. It means a new instance of the specified service is created each time when it is requested, and they are never shared (one instance for each method call).

**When to use what?**

**Ans:** In real-time, we need to register components such as Application-Wide Configuration as Singleton. Database access classes like Entity Framework Contexts are recommended to be registered as Scoped so that the connection can be re-used. If you want to run anything in Parallel, then it is better to register the component as Transient.

**What are the different Types of Dependency Injections in .NET Core?**

**Ans:** Injector class can inject the dependency objects (service class) into a client class in 3 different ways, those are:

1. **Constructor Injection:** when the Injector injects the dependency object i.e., service class object/instance through the client class constructor, then it is called Constructor Injection.
2. **Property Injection:** when the Injector injects the dependency object i.e., service class object/instance through the public property of client class, then it is called as Property Injection or Setter Injection.
3. **Method Injection:** when the Injector injects the dependency object i.e., service class object/instance through a public method of the client class, then it is called as Method Injection.

**Note:** we can also manually inject dependency object i.e., service into client class by implementing the below code:

var services = HttpContext.RequestServices;

var obj = (<Interface\_Name>)services.GetService(typeof(<Interface\_Name>));

**To implement “Depdendency Injection” into our application i.e., “MVCDHProject” do the following:**

**Step 1:** Define an interface under Model’s folder with the name “ICustomerDAL” and write the below code in it.

public interface ICustomerDAL

{

List<Customer> Customers\_Select();

Customer Customer\_Select(int Custid);

void Customer\_Insert(Customer customer);

void Customer\_Update(Customer customer);

void Customer\_Delete(int Custid);

}

**Step 2:** Go to “CustomerXmlDAL” class and make “ICustomerDAL” interface as its parent as following:

public class CustomerXmlDAL : ICustomerDAL

**Step 3:** Register the “Service Class” for “Dependency Injection” in “Startup class for ASP.NET Core 5.0” or “Program class for ASP.NET Core 6.0” by calling any of the 3 register methods => “AddSingleton” or “AddTransient” or “AddScoped” based on your requirement, importing “MVCDHProject.Models” namespace:

**ASP.NET Core 5.0:** Write the below code in “Startup” Class under “ConfigureServices” Method:

services.AddSingleton<ICustomerDAL, CustomerXmlDAL>();

**Or**

services.AddScoped<ICustomerDAL, CustomerXmlDAL>();

**Or**

services.AddTransient<ICustomerDAL, CustomerXmlDAL>();

**ASP.NET Core 6.0:** Write the below code in “Program” class just above the statement => var app = builder.Build();

builder.Services.AddSingleton<ICustomerDAL, CustomerXmlDAL>();

**Or**

builder.Services.AddScoped<ICustomerDAL, CustomerXmlDAL>();

**Or**

builder.Services.AddTransient<ICustomerDAL, CustomerXmlDAL>();

**Note:** for our application what we have been developing, “AddScoped” will be the best option because in Insert, Update and Delete we have multiple methods getting executed in each request.

**Step 4:** Now go to “CustomerController” class and in top of the class we have created instance of “CustomerXmlDAL” class, delete it and write the below code over there:

private readonly ICustomerDAL obj;

public CustomerController(ICustomerDAL obj)

{

this.obj = obj;

}

**Note:** after doing all the above changes run the Project again and check the output of all the Action Methods which executes as is. Now we can start implementing the DAL Class logic targeting different Data Sources.

**Implementing DAL Class targeting SQL Server**

Now let’s implement a new DAL Class targeting SQL Server, and to do that let’s use Entity Framework Core which is an extension to Entity Framework.

**Entity Framework Core:**

* This is the new version of Entity Framework after EF 6.x.
* It is open-source, lightweight, extensible and cross-platform version of Entity Framework data access technology.
* Entity Framework is an Object/Relational Mapping (O/RM) Framework.
* It is an enhancement to older ADO.NET that gives developers an automated mechanism for accessing and storing the data in Database.
* EF Core is intended to be used with .NET Core applications. However, it can also be used with standard .NET 4.5+ Framework-based applications.
* EF Core is a complete re-write, compared to EF 6 but maximum all options of EF 6 are available in EF Core.

**EF Core Development Approaches:** EF Core supports only 2 development approaches.

1. Code-First
2. Database-First

* EF Core mainly targets Code-First approach and provides very limited support for Database-First approach because the visual designer for DB Modeling is not supported.
* In Code-First approach, EF Core API creates Database and Tables using migrations, based on the conventions and configuration provided in our domain classes. This approach is useful in Domain Driven Design (DDD).
* In Database-First approach, EF Core API creates Domain and Context classes based on our existing Database using EF Core commands. This has limited support in EF Core as it doesn’t have Visual Designer or Wizard.

**EF Core Vs EF 6:** EF Core is a new and improved version of Entity Framework for .NET Core applications. EF Core continues to support the following features and concepts, same as EF 6:

1. DbContext and DbSet
2. Data Model
3. Querying using Linq-to-Entities
4. Change Tracking
5. Save Changes
6. Migrations

EF Core will include most of the features of EF 6 gradually. However, there are some features of EF 6 which are not supported in EF Core such as:

1. EDMX/Graphical Visualization of Model
2. Entity Data Model Wizard (for DB-First approach)
3. Automated Migration
4. Inheritance Strategies: Table per type (TPT) & Table per concrete class (TPC)
5. Many-to-Many without join entity
6. Lazy loading of related data
7. Stored procedure mapping with DbContext for CUD operation

EF Core includes the following new features which are not supported in EF 6:

1. Easy relationship configuration
2. Batch INSERT, UPDATE, and DELETE operations
3. In-memory provider for testing
4. Support for “IoC” (Inversion of Control)
5. Unique constraints
6. Shadow properties
7. Alternate keys
8. Global query filter
9. Field mapping
10. DbContext pooling
11. Better patterns for handling disconnected entity graphs

**EF Core Database Providers (Libraries):** Entity Framework Core uses provider model to access many different Database’s. Entity Framework Core provides access too many Databases through plug-in libraries called Database Providers and we need to install those providers as NuGet packages. List of available providers can be found at the following location: <https://docs.microsoft.com/en-us/ef/core/providers/?tabs=dotnet-core-cli>

**To work with Entity Framework Core in our applications we need to install the below 2 packages from NuGet:**

* Microsoft.EntityFrameworkCore.Tools
* Microsoft.EntityFrameworkCore.SqlServer

**Microsoft.EntityFrameworkCore.Tools:** contains a set of types and tools for Scaffolding, using which we can perform migrations. This is common for any Database we want to work with like SQL Server or Oracle or My SQL and this package internally depends on another package: **Microsoft.EntityFrameworkCore.Design.**

**Microsoft.EntityFrameworkCore.Design:** contains shared design-time components for Entity Framework Core Tools.

**Microsoft.EntityFrameworkCore.SqlServer:** contains a set of types which are required to work with SQL Server Database and this package internally depends on 2 other packages: **Microsoft.EntityFrameworkCore.Relational** and **Microsoft.Data.SqlClient**.

**Microsoft.EntityFrameworkCore.Relational:** contains all the types that are required in common to work with any Relational Database.

**Microsoft.Data.SqlClient:** contains all the types which are required to work with SQL Server Database.

To work with SQL Server using Entity Framework Core in our existing “MVCDHProject” application, perform the below actions:

**Step 1**: Install the above 2 specified NuGet packages.

**Step 2:** Go to “Customer.cs” file and apply “Data Annotations” on it by importing the required namespaces:

using System.ComponentModel.DataAnnotations;

using System.ComponentModel.DataAnnotations.Schema;

public class Customer

{

[Key]

[DatabaseGenerated(DatabaseGeneratedOption.None)]

public int Custid { get; set; }

[MaxLength(100)]

[Column(TypeName = "Varchar")]

public string Name { get; set; }

[Column(TypeName = "Money")]

public decimal? Balance { get; set; }

[MaxLength(100)]

[Column(TypeName = "Varchar")]

public string City { get; set; }

public bool Status { get; set; }

}

**Step 3:** Open “appSettings.json” file and write the “ConnectionString” for connecting to SQL Server just below the (“AllowedHosts”: “\*”) statement, that should now look as following:

{

"Logging": {

"LogLevel": {

"Default": "Information",

"Microsoft.AspNetCore": "Warning"

}

},

"AllowedHosts": "\*",

"ConnectionStrings": {

"ConStr": "Data Source=Server;User Id=Sa;Password=123;Database=MvcCoreDB"

}

}

**Step 4:** Now add a new class in to the Models folder with the name “MVCCoreDbContext” and this class is our “DbContext” and under this class write the below code:

using Microsoft.EntityFrameworkCore;

public class MVCCoreDbContext : DbContext

{

public MVCCoreDbContext(DbContextOptions options) : base(options)

{

}

public DbSet<Customer> Customers { get; set; }

}

**Note:** the above class “MVCCoreDbContext” is not specifically configured to work with SQL Server Database, but was designed generic to work with any Relational Database, so this is also loosely coupled with the Database we want to work with. We need to inject the information of Database we want to work with thru the Injector class i.e., either Startup in ASP.NET Core 5.0 or Program in ASP.NET Core 6.0.

**Step 5:** Because “MVCCoreDbContext” class is loosely coupled we need to register this class in Startup Class for ASP.NET Core 5.0 and Program Class for ASP.NET Core 6.0 to tell whether it has to connect with SQL Server or SQL Lite or My SQL or Oracle or Postgre SQL or Cosmos Database’s, so that the Dependency Injection Container will tell “MVCCoreDbContext” class to which Database it has to connect with, in runtime. To register the Context class, we need to use “AddDbContext” method and to do that write the below code:

**ASP.NET Core 5.0:** go to “ConfigureServices” method of “Startup” class, import “Microsoft.EntityFrameworkCore” namespace and write the below code:

services.AddDbContext<MVCCoreDbContext>(options =>

options.UseSqlServer(Configuration.GetConnectionString("ConStr")));

**ASP.NET Core 6.0:** go to “Program” class, import “Microsoft.EntityFrameworkCore” namespace and write the below code just above the statement => var app = builder.Build();

builder.Services.AddDbContext<MVCCoreDbContext>(options =>

options.UseSqlServer(builder.Configuration.GetConnectionString("ConStr")));

**Note:** “UseSqlServer” is an extension method under “DbContextOptionsBuilder” class which is added on install of “Microsoft.EntityFrameworkCore.SqlServer” package; same as this when we install the “Oracle Provider” package it will add another extension method with the name “UseOracle” and so on.

**Step 6:** Add a class in Model’s folder naming it “CustomerSqlDAL” and implement the interface “ICustomerDAL” and provide implementation to all the abstract methods of interface, targeting SQL Server Database.

public class CustomerSqlDAL : ICustomerDAL

{

private readonly MVCCoreDbContext context;

public CustomerSqlDAL(MVCCoreDbContext context)

{

this.context = context;

}

public List<Customer> Customers\_Select()

{

var customers = context.Customers.Where(C => C.Status == true).ToList();

return customers;

}

public Customer Customer\_Select(int Custid)

{

return context.Customers.Find(Custid);

}

public void Customer\_Insert(Customer customer)

{

context.Customers.Add(customer);

context.SaveChanges();

}

public void Customer\_Update(Customer customer)

{

customer.Status = true;

context.Update(customer);

context.SaveChanges();

}

public void Customer\_Delete(int Custid)

{

Customer customer = context.Customers.Find(Custid);

customer.Status = false;

context.SaveChanges();

}

}

**Note:** in the above class we are using Dependency Injection to inject the Context class object thru the Constructor.

**Step 7:** We are using the Code First Approach in our application and we are not provided with Automatic Migrations in EF Core, so we need to run few Scaffolding Commands to create the Database and Tables and to do that open “Package Manager Console” and run the below commands 1 after the other.

PM> Add-Migration InitialMigration

The above command will create a folder under the project with the name “Migrations” and in the folder it will create a file with the name “TimeStamp\_InitialMigration.cs” and in this file we find “Create Table” and other SQL Statements which must be executed on the Database, and to execute them run the below command:

PM> Update-Database //This command will create the Database and Table on SQL Server.

**Step 8:** Now go to Startup Class for ASP.NET Core 5.0 or Program Class for ASP.NET Core 6.0 and change the “Service Class Name” in the method where we registered the interface i.e., Service Class Name “CustomerXmlDAL” should be changed to “CustomerSqlDAL”, as below:

**ASP.NET Core 5.0:**

services.AddSingleton<ICustomerDAL, CustomerSqlDAL>();

Or

services.AddTransient<ICustomerDAL, CustomerSqlDAL>();

Or

services.AddScoped<ICustomerDAL, CustomerSqlDAL>(); //Preferred

**ASP.NET Core 6.0:**

builder.services.AddSingleton<ICustomerDAL, CustomerSqlDAL>();

Or

builder.services.AddTransient<ICustomerDAL, CustomerSqlDAL>();

Or

builder.services.AddScoped<ICustomerDAL, CustomerSqlDAL>(); //Preferred

For our application “AddScoped” is the right option because we are dealing with Database Connections. Now run the “CustomerController” and invoke the Action Methods to perform CRUD Operations, and the advantage here is the same Controller and Views can be used now also without re-writing them again.

**Migration in Entity Framework Core:** Migration is a feature which keeps the Database schema in sync with our Entity Classes by preserving data. EF Core API builds the EF Core Model from the Domain (Entity) Classes and EF Core Migrations will Create or Update the Database schema based on EF Core Model. Whenever we change the Domain Classes, you need to run Migration to keep the Database schema up to date. EF Core Migrations are a set of commands that we can executed in “NuGet Package Manager Console” or in “Dotnet Command Line Interface”.

**PMC Command** **Dotnet CLI Command**

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Add-Migration <migration name> Add <migration name>

**Usage:** Creates a migration by adding a migration snapshot.

Remove-Migration Remove

**Usage:** Removes the last migration snapshot.

Update-Database Update

**Usage:** Updates the database schema based on the last migration snapshot.

Script-Migration Script

**Usage:** Generates a SQL script by using all the migration snapshots.

**Adding a Migration:** At the very first time, when we define the initial Domain Classes and there is no Database for our Application then we need to create our first migration, to create the Database as well as whenever we change our Domain Classes, we need to create a new migration to update the Database.

**Package Manager Console:** **PM>** Add-Migration InitialMigration

**.NET CLI:** **<drive>:\<Personal Folder>\MVCDHProject\MVCDHProject>** dotnet ef migrations Add InitialMigration

**Note:** in the above statements, “InitialMigration” is the name of Migration which will create a Migration folder with 2 files in it:

1. **<timestamp>\_<InitialMigration>.cs:** this file includes migration operations in the Up() and Down() methods. The Up() method includes code for creating Database Objects and Down() method includes code for dropping Database objects.
2. **<contextclassname>ModelSnapshot.cs:** this is a snapshot of your current model which is used to determine what is changed when creating the next migration.

**Updating the Database:** we use this command to create or update Database schema based on the Migration we have created above.

**Package Manager Console:** **PM>** Update-Database

**.NET CLI: <drive>:\<Personal Folder>\MVCDHProject\MVCDHProject>** dotnet ef database Update

**Note:** This command will create the Database (if it is not existing) based on the Context, Domain Classes and the Migration Snapshot, which is created using the “add-migration” or “add” commands. If this is the first migration, it will also create a Table with the name “\_\_EFMigrationsHistory”, which will store the names of all migrations that are executed till now which are applied to the Database.

**Removing a Migration:** we can remove the last migration, provided it is not applied to the Database. Use the following remove commands to remove the last created migration files which will revert the model snapshot.

**Package Manager Console:** **PM>** Remove-Migration

**.NET CLI: <drive>:\<Personal Folder>\MVCDHProject\MVCDHProject>** dotnet ef migrations Remove

**Note:** if the migration is already applied to Database, then it will throw an exception and displays below error message:

The migration “<Migration Name>” has already been applied to the database. Revert it and try again. If the migration has been applied to other databases, consider reverting its changes using a new migration instead.

**Reverting a Migration:** suppose we changed our domain classes and created a second migration with the name “NewMigration1” using the “add-migration” command and applied that migration to Database using “Update Command” but, for some reason, we want to revert or rollback the Database to its previous state then we need to use the “Update-Database <migration name>” command to revert the Database to the specified previous migration snapshot.

**Package Manager Console:** **PM>** Update-Database InitialMigration

**.NET CLI:** **<drive>:\<Personal Folder>\MVCDHProject\MVCDHProject>** dotnet ef database Update InitialMigration

The above command will revert the Database based on specified migration named “InitialMigration” and removes all the changes applied for second migration named “NewMigration1”. This will also remove the entry from the “\_\_EFMigrationsHistory” table in the Database. But this will not remove the migration file related to “NewMigration1”, so we need to use the Remove command and remove them from the project.

**Generating a SQL Script:** use this command to generate a SQL script for the database.

**Package Manager Console:** **PM>** script-migration

**.NET CLI:** **<drive>:\<Personal Folder>\MVCDHProject\MVCDHProject> dotnet ef migrations script**

The above command will include a script for all the migrations by default, and we can specify a range of migrations also by using the “-to” and “-from” options.

**Help Commands:** Package Manager Console provides us a command called “get-help” using which we can get help about any required topic.

**Package Manager Console:** **PM>** Get-Help EntityFramework

The above command will provide information about the “EF Core Commands” and same as this we can also use “Get-Help” on each “EFCore” Commands as following:

**Package Manager Console:** **PM>** Get-Help Add-Migration

**To try the above commands, do the following:**

**Step 1:** Go to Customer class and add a new property in the class as below:

public string State { get; set; }

**Step 2:** Open Package Manager Console and create a new migration as below:

**PM>** Add-Migration Update1

The above action will create a new migration file under “Migrations” folder with the name “<time stamp>\_Update1.cs” which contains an “Up” method for adding the new column and “Down” method for dropping the column. The Snapshot file will contain the modifications that are made.

**Step 3:** Go to Customer class again and add a new property as below:

public string Country { get; set; }

**Step 4:** Open PMC and create a new migration as below:

**PM>** Add-Migration Update2

The above action will create a new migration file under “Migrations” folder with the name “<time stamp>\_Update2.cs” which contains an “Up” method for adding the new column and “Down” method for dropping the column. The Snapshot file will contain the modifications that are made.

**Step 5:** we can now use the Remove Migration command to remove the last created migration file as following at Package Manager Console:

**PM>** Remove-Migration

The above action will remove the last migration file i.e., “Update2” and this action will also update the Snapshot file.

**Step 6:** let us apply “Update1” migration on the Database and to do that use the below command at Package Manager Console:

**PM>** Update-Database

The above action will update the last migration file i.e., “Update1” to the Database but the property “Country” is not removed from the “Customer” class, which should be explicitly removed by us or we can even create a new “Migration” for that property update.

**Step 7:** Open Package Manager Console and create a new migration as below:

**PM>** Add-Migration Update2

The above action will create a new migration file under “Migrations” folder with the name “<time stamp>\_Update2.cs” which contains an “Up” method for adding the new column and “Down” method for dropping the column. The Snapshot file will contain the modifications that are made.

**Step 8:** Go to Customer class again and add a new property as below:

public string Continent { get; set; }

**Step 9:** Open Package Manager Console and create a new Migration as below:

**PM>** Add-Migration Update3

The above action will create a new migration file under “Migrations” folder with the name “<time stamp>\_Update3.cs” which contains an “Up” method for adding the new column and “Down” method for dropping the column. The Snapshot file will contain the modifications that are made.

**Step 10:** Open Package Manager Console and update the Database as below:

**PM>** Update-Database

The above action will update both Migrations to the Database i.e., “Update2” and “Update3” also, and we can verify this by connecting to SQL Server and querying on the table: “\_\_EFMigrationsHistory” which will show the history of all migrations we have created till now.

**Note:** now if we try to use the “Remove-Migration” command it will throw an error as all the migrations are updated to the Database and to test that go to Package Manager Console and use the below command:

**PM>** Remove-Migration

**Rollback Migration:** If we want to bring our Database Schema, back to its any state i.e., to any of the Migrations we applied, we can revert to a migration and to do that, we need to use “Update-Database” command with the “Migration Name” (you can get the name of Migration to where we want to rollback, from the “\_\_EFMigrationsHistory” table) we want to revert, and to test that go to Package Manager Console and use the below command:

**PM>** Update-Database <time stamp value>\_InitialMigration

The above action will roll back to “InitialMigration” and updates the table “\_\_EFMigrationsHistory” but it will not remove the Migration Files under the project and to remove them we need to use “Remove-Migration” command for 3 times because each time it remove only 1 migration.

**Note:** these actions will not remove the properties we added in our Customer class so go there and explicitly delete them also.

**Data Seeding:** this is a process of populating Database-Tables with some initial data and to do that we need to override “OnModelCreating” method in our “DataContext” class i.e., “MVCCoreDbContext”, and to test this process write the below code in the class:

protected override void OnModelCreating(ModelBuilder modelBuilder)

{

modelBuilder.Entity<Customer>().HasData(

new Customer { Custid = 101, Name = "Sai", Balance = 50000.00m, City = "Delhi", Status = true },

new Customer { Custid = 102, Name = "Sonia", Balance = 40000.00m, City = "Mumbai", Status = true },

new Customer { Custid = 103, Name = "Pankaj", Balance = 30000.00m, City = "Chennai", Status = true },

new Customer { Custid = 104, Name = "Samuels", Balance = 25000.00m, City = "Bengaluru", Status = true }

);

}

**Note:** generally, seed data is performed in the initial stages only i.e., the first time we create the Database then only we will perform data seeding (preferably in initial migration).

**Step 2:** go to Package Manager Console and create a new migration as below:

**PM>** Add-Migration SeedData

**Step 3:** update the Database from Package Manager Console using the below statement:

**PM>** Update-Database

**Note:** This action will update the migration “SeedData” to the Database and inserts the 4 records into Table but before updating the migration, go to the Database and delete if there are any existing records in the table.

**Handling Errors in ASP.NET Core MVC Applications**

In Web Applications we generally come across 2 different types of Errors:

1. Http Status Code Based Errors (4XX) => Client Errors
2. Exceptions (5XX) => Server Errors

**Handling Client Errors:** These errors occur if at all the request contains bad syntax or cannot be fulfilled. This category of status codes is intended for situations in which the error seems to have been caused by client. For example, if we try to send a request for a page which is not existing then it is “404; Not Found Error”. To handle these errors, MVC Core provides us 3 Middle Ware components and they are:

1. UseStatusCodePages
2. UseStatusCodePagesWithRedirects
3. UseStatusCodePagesWithReExecute

**Note:** to test these, first change the “ASPNETCORE\_ENVIRONMENT” setting to “Production” in “launchSettings.json” under “IIS Express” and “Kestrel Web Server” profile because by default it is “Development”.

To use these Middleware’s first let’s try to access a page which is not existing in the site, for example: http://localhost:port/Customer/GetCustomer this will display an error page to the user which we generally see in real-time when a resource was not found.

**UseStatusCodePage:** this Middleware component adds a “StatusCodePage” with a default response that displays the “Status Code” and “Status Msg”. To use the above Middleware, do the following below in “Startup.cs” file for ASP.NET Core 5.0 and “Program.cs” file in ASP.NET Core 6.0:

**ASP.NET Core 5.0:** go to “Startup.cs” file and change the existing code that is present under “Configure” method of the class as below. Old code you find in the method will be as following:

if (env.IsDevelopment())

{

app.UseDeveloperExceptionPage();

}

else

{

app.UseExceptionHandler("/Home/Error");

app.UseHsts();

}

**Change it as below:**

if (env.IsDevelopment())

{

app.UseDeveloperExceptionPage();

}

else

{

app.UseStatusCodePages();

app.UseExceptionHandler("/Home/Error");

app.UseHsts();

}

**ASP.NET Core 6.0:** go to “Program.cs” file and change the existing code that is present under the class as below. Old code you find over there will be as following:

if (!app.Environment.IsDevelopment())

{

app.UseExceptionHandler("/Home/Error");

// The default HSTS value is 30 days. You may want to change this for production scenarios, see

https://aka.ms/aspnetcore-hsts.

app.UseHsts();

}

**Change it as below:**

if (!app.Environment.IsDevelopment())

{

app.UseStatusCodePages();

app.UseExceptionHandler("/Home/Error");

// The default HSTS value is 30 days. You may want to change this for production scenarios, see

https://aka.ms/aspnetcore-hsts.

app.UseHsts();

}

Now try to access a page which is not existing again, but now we see the Error Page displaying the Status Code and Status Message as following: “Status Code: 404; Not Found”.

**UseStatusCodePagesWithRedirects:** this Middleware specifies that the response should be handled by redirecting to the given location URL template which may include “{0}” => Place Holder for Status Code. To use this Middleware, do the following:

**Step 1:** Add a controller in our “MVCDHProject” naming it as “ErrorController” and write the below code in it by deleting the existing code in the class:

[Route("ClientError/{StatusCode}")]

public IActionResult ClientErrorHandler(int StatusCode)

{

switch(StatusCode)

{

case 400:

ViewBag.ErrorTitle = "Bad Request";

ViewBag.ErrorMessage = "The server can’t return a response due to an error on the client’s end.";

break;

case 401:

ViewBag.ErrorTitle = "Unauthorized or Authorization Required";

ViewBag.ErrorMessage = "Returned by server when the target resource lacks authentication credentials.";

break;

case 402:

ViewBag.ErrorTitle = "Payment Required";

ViewBag.ErrorMessage = "Processing the request is not possible due to lack of required funds.";

break;

case 403:

ViewBag.ErrorTitle = "Forbidden";

ViewBag.ErrorMessage = "You are attempting to access the resource that you don’t have permission to view.";

break;

case 404:

ViewBag.ErrorTitle = "Not Found";

ViewBag.ErrorMessage = "The requested resource does not exist, and server does not know if it ever existed.";

break;

case 405:

ViewBag.ErrorTitle = "Method Not Allowed";

ViewBag.ErrorMessage = "Hosting server supports the method received, but the target resource doesn’t.";

break;

}

return View("ClientErrorView");

}

**Step 2:** Add a new View in the Shared folder of our project naming it as “ClientErrorView” and write the below code in it:

<h2 class="alert-danger">

Client Error Page - @ViewBag.ErrorTitle

</h2>

<p style="text-align:justify;font-size:large">

@ViewBag.ErrorMessage

</p>

**Step 3:** Go to “Startup.cs” or “Program.cs” file (based on the version you are targeting), comment the method “UseStatusCodePages();” and in that place call the method “UseStatusCodePagesWithRedirects” as following:

**app.UseStatusCodePagesWithRedirects("/ClientError/{0}");**

In this case when we get any status code-based error or client error it will redirect to “ErrorController” passing the “StatusCode” as a parameter and invokes the method “ClientErrorHandler” because we have defined a route to “UseStatusCodePagesWithRedirects” method as “[Route("ClientError/{StatusCode}")]” and now “ClientErrorHandler” method will launch the view i.e., “ClientErrorView” and displays the details of error.

**Note:** whenever a client error occurs “UseStatusCodePagesWithRedirects” Middleware will transfer the control to browser with a redirection response (302) and then browser will send a fresh request to the action method with the route “ClientError” and passes the status code 404 (in our case now) so that the URL in address bar gets updated to http://localhost:port/Error/404. The drawback in this case is there is an extra round trip between the Browser and Web Server.

**UseStatusCodePagesWithReExecute:** this Middleware specifies that the response body should be generated by re-executing the request pipeline using an alternate path which may include “{0}” Placeholder for Status Code. We can overcome the problem of “UseStatusCodePagesWithRedirects” with “UseStatusCodePagesWithReExecute” Middleware, because in this case it will not perform a re-direction but transfers the control directly on server from 1 page to another page directly on the server itself, so the URL in browsers address bar will not be updated i.e., it will be still showing the original requested URL only. To test this, go to “Startup.cs” or “Program.cs” file (based on the version you are targeting), comment the method call “UseStatusCodePagesWithRedirects” and call the new method “UseStatusCodePagesWithReExecute” as following:

**app.UseStatusCodePagesWithReExecute("/ClientError/{0}");**

**Handling Server Errors:** to handle server errors we need to configure the middleware “UseExceptionHandler” and specify the address where it has to be redirected when there is a server error. Currently in an “MVC Project” it is already configured, so if we observe the code in Configur” method of Startup class (ASP.NET Core 5.0) and Program class (ASP.NET Core 6.0) we notice the statement: “app.UseExceptionHandler("/Home/Error");”, and right now this is already configured to invoke the “Error” action method of “Home” Controller, so whenever there is a server error it will redirect to the Home Controller - Error Action method. If we want to handle the error on our own without using the pre-defined code, do the following:

**Step 1:** Go to “Startup.cs” or “Program.cs” file (based on the version you are targeting), change the code which is calling the method “UseExceptionHandler” as below, so that whenever there is an error without going to Home Controller - Error Action method, it will redirect to the Action Method with the route name as “ServerError”:

app.UseExceptionHandler("/Home/Error"); => app.UseExceptionHandler("/ServerError");

**Step 2:** Go to “ErrorController” class and add the below action method in that class by importing the namespace “Microsoft.AspNetCore.Diagnostics”:

[Route("ServerError")]

public IActionResult ServerErrorHandler()

{

var ExceptionDetails = HttpContext.Features.Get<IExceptionHandlerPathFeature>();

ViewBag.ErrorTitle = ExceptionDetails.Error.GetType().Name;

ViewBag.Path = ExceptionDetails.Path;

ViewBag.ErrorMessage = ExceptionDetails.Error.Message;

return View("ServerErrorView");

}

**Note:** The “ServerErrorHandler” action method is defined with the route as "ServerError" so it gets invoked when there is a server error as we configured it in Startup Class (ASP.NET Core 5.0) and Program Class (ASP.NET Core 6.0), which launches the view "ServerErrorView" by passing the details of the error thru ViewBag.

**Step 3:** Add a View in Shared folder of our project, naming it as "ServerErrorView.cshtml" and write the below code in it:

<h2 class="align-content-xl-center alert-danger">

Server Error Page - @ViewBag.ErrorTitle

</h2>

<h4>There is a error at @ViewBag.Path, and the details of the error are:</h4>

<p style="text-align:justify;font-size:large;color:red">

@ViewBag.ErrorMessage

</p>

**ASP.NET Core Identity Framework**

It is an API that supports UI Login functionality by managing users, passwords, profile data, roles, tokens, email confirmation, and more. Users can create an account with the login information stored in Identity or they can use external login providers that include Facebook, Google, Microsoft, and Twitter Accounts. Identity is typically configured using an SQL Server Database to store usernames, passwords, and profile data. Alternatively, another persistent store can be used, for example, Azure Table Storage.

**To work with ASP.NET Core Identity, do the following:**

**Step 1:** Install “Microsoft.AspNetCore.Identity.EntityFrameworkCore” package by using NuGet Package Manager.

**Step 2:** Go to our context class i.e., “MVCCoreDbContext” and change the parent class of it from “DbContext” to “IdentityDbContext” by importing “Microsoft.AspNetCore.Identity.EntityFrameworkCore” namespace and this “IdentityDbContext” class internally inherits from “DbContext” class.

**Step 3:** In our “DbContext” class i.e., “MVCCoreDbContext” with-in the existing “OnModelCreating” method which we have overridden earlier, write the below statement in top of the method, so that the base class i.e., “IdentityDbContext”, “OnModelCreating” method also gets executed, and we need to do this call because there is some logic implemented in the parent class for setting “IdentityUserLogin” model’s key property:

base.OnModelCreating(modelBuilder);

**Step 4:** Register “IdentityFramework” in our application by importing “Microsoft.AspNetCore.Identity” namespace:

**ASP.NET Core 5.0:** Go to “Startup.cs” file, and write the below code under “ConfigureServices” method:

services.AddIdentity<IdentityUser, IdentityRole>().AddEntityFrameworkStores<MVCCoreDbContext>();

**ASP.NET Core 6.0:** Go to “Program.cs” file, and write the below code just above the statement “var app = builder.Build();”:

builder.Services.AddIdentity<IdentityUser, IdentityRole>().AddEntityFrameworkStores<MVCCoreDbContext>();

**Step 5:** Add Authentication Middleware to request pipeline using the below statement:

app.UseAuthentication();

**ASP.NET Core 5.0:** Go to “Startup.cs” file, and write the above statement in “Configure” method between “UseRouting” and “UseAuthorization” Middleware’s.

**ASP.NET Core 6.0:** Go to “Program.cs” file, and write the above statement between “UseRouting” and “UseAuthorization” Middleware’s:

**Step 6:** Now open Package Manager Console and create a new Migration as below:

**PM>** Add-Migration AddIdentity

**Step 7:** Update the new migration i.e., “AddIdentity” as below, so that all the required Tables gets created on our Database i.e., “MVCCoreDb”:

**PM>** Update-Database

**Step 8:** Now under the Models folder define the below classes:

using System.ComponentModel.DataAnnotations;

public class UserModel

{

[Required]

public string Name { get; set; }

[Required]

[DataType(DataType.Password)]

public string Password { get; set; }

[DataType(DataType.Password)]

[Display(Name = "Confirm Password")]

[Compare("Password", ErrorMessage = "Confirm password should match with password.")]

public string ConfirmPassword { get; set; }

[Required]

[EmailAddress]

[Display(Name = "Email Id")]

public string Email { get; set; }

[Required]

[RegularExpression("[6-9]\\d{9}", ErrorMessage = "Mobile No. Is Invalid")]

public string Mobile { get; set; }

}

using System.ComponentModel.DataAnnotations;

public class LoginModel

{

[Required]

public string Name { get; set; }

[Required]

[DataType(DataType.Password)]

public string Password { get; set; }

[Display(Name = "Remember Me")]

public bool RememberMe { get; set; }

}

**Step 9:** Now under the Controllers folder add a new controller with the name “AccountController”, delete the existing Index Action method in it and write the below code:

using MVCDHProject.Models;

using Microsoft.AspNetCore.Identity;

public class AccountController : Controller

{

private readonly UserManager<IdentityUser> userManager;

private readonly SignInManager<IdentityUser> signInManager;

public AccountController(UserManager<IdentityUser> userManager, SignInManager<IdentityUser> signInManager)

{

this.userManager = userManager;

this.signInManager = signInManager;

}

public IActionResult Register()

{

return View();

}

[HttpPost]

public async Task<IActionResult> Register(UserModel userModel)

{

if (ModelState.IsValid)

{

//IdentityUser represents a new user with a given set of attributes

IdentityUser identityUser = new IdentityUser { UserName = userModel.Name, Email = userModel.Email,

PhoneNumber = userModel.Mobile };

//Creates a new user and returns a result which tells about success or failure

var result = await userManager.CreateAsync(identityUser, userModel.Password);

if (result.Succeeded)

{

//Performing a Sign-In into the appliction

await signInManager.SignInAsync(identityUser, false);

return RedirectToAction("Index", "Home");

}

else

{

foreach (var Error in result.Errors)

{

//Displaying error details to the user

ModelState.AddModelError("", Error.Description);

}

}

}

return View(userModel);

}

}

**UserManager** class provides options for managing users in a persistence store.

**IdentityUser** class represents a user in the identity system.

**SignInManager** class provides options for user sign in.

**Adding a Register View:** right click on the Register action method in the “AccountController” class, select “Add View”, in the window opened select “Razor View”, click “Add” button, in the window opened select Template as “Create” Model Class as “UserModel (MVCDHProject.Models)” and click on the “Add” button which will create a View with the name “Register.cshtml”. After the View is created, make any changes in the design (if required) and then run the view to register new users.

**Note:** When we want to create a new user account a set of rules are pre-defined on Username and Password, under 2 classes: “UserOptions” and “PasswordOptions”.

“UserOptions” class defines options for user validations and in this class, there is a property “AllowedUserNameCharacters” which contains the list of allowed characters for the “Username” and in this the code is as following:

public class UserOptions

{

public string AllowedUserNameCharacters { get; set; } =

"abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789-.\_@+";

public bool RequireUniqueEmail { get; set; }

}

“PasswordOptions” class defines options for password validations and in this class, there are properties like RequiredLength, RequiredDigit, RequiredLowerCase, RequiredUpperCase, etc. to validate the password, and in this class the code is as following:

public class PasswordOptions

{

public int RequiredLength { get; set; } = 6;

public int RequiredUniqueChars { get; set; } = 1;

public bool RequireNonAlphanumeric { get; set; } = true;

public bool RequireLowercase { get; set; } = true;

public bool RequireUppercase { get; set; } = true;

public bool RequireDigit { get; set; } = true;

}

We can override these options as per our requirements and we need to do that in “Startup.cs” file for ASP.NET Core 5.0 and “Program.cs” file for ASP.NET Core 6.0. For example, if we want to set the “RequiredLength” as 8 characters and “RequireDigit” as false do the following:

**ASP.NET Core 5.0:** go to “Startup.cs” file and re-write the “Services.AddIdentity” method as following:

**Old Code:**

services.AddIdentity<IdentityUser, IdentityRole>().AddEntityFrameworkStores<MVCCoreDbContext>();

**New Code:**

services.AddIdentity<IdentityUser, IdentityRole>(options =>

{

options.Password.RequiredLength = 8;

options.Password.RequireDigit = false;

}).AddEntityFrameworkStores<MVCDbContext>();

**ASP.NET Core 6.0:** go to “Program.cs” file and re-write the “builder.Services.AddIdentity” method as following:

**Old Code:**

builder.Services.AddIdentity<IdentityUser, IdentityRole>().AddEntityFrameworkStores<MVCCoreDbContext>();

**New Code:**

builder.Services.AddIdentity<IdentityUser, IdentityRole>(options =>

{

options.Password.RequiredLength = 8;

options.Password.RequireDigit = false;

}).AddEntityFrameworkStores<MVCCoreDbContext>();

**Step 10:** Implementing “Login Action”, and to do that go to “AccountController” class and add the below 2 Action Methods in the class:

public IActionResult Login()

{

return View();

}

[HttpPost]

public async Task<IActionResult> Login(LoginModel loginModel)

{

if(ModelState.IsValid)

{

var result = await signInManager.PasswordSignInAsync(loginModel.Name, loginModel.Password,

loginModel.RememberMe, false);

if (result.Succeeded)

{

return RedirectToAction("Index", "Home");

}

else

{

ModelState.AddModelError("", "Invalid login credentials.");

}

}

return View(loginModel);

}

Add a View to Login Action method and to do that, right click on Login method in the Controller class, select “Add View”, in the window opened select “Razor View”, click on “Add” button, in the window opened select Template as “Create”, Model Class as “LoginModel (MVCDHProject.Models)” and click on the “Add” button which will create a View with the name “Login.cshtml”. Make any necessary changes to the View (if required) and run it to Login into the application with the user accounts you have registered.

**Providing Login, Register and Logout links:** Let’s provide links for Login and Register if the user is not signed-in and if signed-in, lets display Username and Logout links on the top of every page and to do that do the following:

**i.** Open “\_ViewImports.cshtml” file that is present in “Views” folder and write the below statement in it:

@using Microsoft.AspNetCore.Identity

**ii.** Open “\_Layout.cshtml” file that is present in the “Shared” folder of “Views” folder and write the below statement on top of the file to inject “SignInManager”:

@inject SignInManager<IdentityUser> signInManager

**iii.** In “\_Layout.cshtml” file, we find a “<div>” tag with an un-ordered list containing links for “Home” and “Privacy” Views and with-in that “<ul>” add 1 more “<li>” to the existing 2 “<li>'s” to display a link for Managing Customers:

<li class="nav-item">

<a class="nav-link text-dark" **asp-controller**="Customer" **asp-action**="DisplayCustomers">Customers</a>

</li>

Now after the “</ul>” tag with-in the same “<div>” tag write the below code to add Login, Logout and Register links on the RHS:

<ul class="navbar-nav ml-auto">

@if (signInManager.IsSignedIn(User))

{

<li class="nav-item">

<a class="nav-link text-dark">@User.Identity.Name</a>

</li>

<li class="nav-item">

<a class="nav-link text-dark" **asp-controller**="Account" **asp-action**="Logout">Logout</a>

</li>

}

else

{

<li class="nav-item">

<a class="nav-link text-dark" **asp-controller**="Account" **asp-action**="Register">Register</a>

</li>

<li class="nav-item">

<a class="nav-link text-dark" **asp-controller**="Account" **asp-action**="Login">Login</a>

</li>

}

</ul>

**Step 11:** Implementing Logout Action, and to do that go to “AccountController” class and add the below action method over there:

public async Task<IActionResult> Logout() {

await signInManager.SignOutAsync();

return RedirectToAction("Login");

}

**Authorization:** this refers to the process that determines what a user can do. For example, in a Library Management Application an administrative user can create a document library, add documents, edit documents, and delete them. A non-administrative user working with the library is only authorized to read the documents. Authorization is independent from authentication. However, authorization requires an authentication mechanism. Authentication is the process of ascertaining who a user is. Now let’s implement authorization in our application, so that only logged-in users can perform Edit, Insert and Delete operations on Customer, whereas all other users can View the Customers data. To implement this, we have 2 options:

**Option 1:** Authorize Attribute - by using Authorize attribute we can specify that this action method is accessible only to authorized users and to test that, go to Customer Controller class and on top of “AddCustomer” (Get Method), “EditCustomer” and “DeleteCustomer” add the Authorize attribute as following by importing “Microsoft.AspNetCore.Authorization” namespace:

[Authorize]

public ViewResult AddCustomer()

[Authorize]

public ViewResult EditCustomer(int Custid)

[Authorize]

public RedirectToActionResult DeleteCustomer(int Custid)

**Note:** Now run the application and try to access the above 3 action methods without signing into the application, which will redirect you to Login Page.

Without using Authorize attribute on each action method we can use it directly on the Controller class also, so that all Action methods in the class can be accessed only by Authorizing and in this case if we want to provide Anonymous access to any of the methods in that Controller class we need to use “AllowAnonymous” attribute on those methods.

To test this comment or delete Authorize attribute we used on the 3 action methods and apply the Authorize attribute on Controller class as well as on the top of “DisplayCustomer” and “DisplayCustomers” action methods use “AllowAnonymous” attributes as following:

[Authorize]

public class CustomerController : Controller

[AllowAnonymous]

public ViewResult DisplayCustomers()

[AllowAnonymous]

public ViewResult DisplayCustomer(int Custid)

**Note:** “AllowAnonymous” attribute by passes all authorization statements i.e., if we combine “AllowAnonymous” and “Authorize” attributes, then “Authorize” attribute is ignored. For example, if you apply “AllowAnonymous” at Controller level, any “Authorize” attributes on that Controller’s action methods will be ignored.

**Option 2:** if we want to apply authorization on all the controllers in the project, then without applying it on each and every controller we can do that in “Startup.cs” file for ASP.NET Core 5.0 and “Program.cs” file for ASP.NET Core 6.0 and to do that, first import the 2 namespaces: “Microsoft.AspNetCore.Authorization” and “Microsoft.AspNetCore.Mvc.Authorization”, and re-write the statement “services.AddControllersWithViews()” as below:

**ASP.NET Core 5.0:** go to “Startup.cs” file and re-write the code of “AddControllersWithViews” method that is present under “ConfigureServices” method as below:

**Old Code:**

Services.AddControllersWithViews();

**New Code:**

services.AddControllersWithViews(configure =>

{

var policy = new AuthorizationPolicyBuilder().RequireAuthenticatedUser().Build();

configure.Filters.Add(new AuthorizeFilter(policy));

});

**ASP.NET Core 6.0:** go to “Program.cs” file and re-write the code of “AddControllersWithViews” method that is present above the statement => “var app = builder.Build();” as below:

**Old Code:**

builder.Services.AddControllersWithViews();

**New Code:**

builder.Services.AddControllersWithViews(configure =>

{

var policy = new AuthorizationPolicyBuilder().RequireAuthenticatedUser().Build();

configure.Filters.Add(new AuthorizeFilter(policy));

});

With this change, now any Controller in the project will not run because we enabled Authentication application level i.e., Home Controller, Error Controller and Account Controller also will not run, and to over the problem add “AllowAnonymous” attribute on the top of these 3 Controller classes by importing “Microsoft.AspNetCore.Authorization” namespace:

[AllowAnonymous]

public class HomeController : Controller

[AllowAnonymous]

public class ErrorController : Controller

[AllowAnonymous]

public class AccountController : Controller

**Return URL:** after bringing Authentication into picture if we try to open any of the secured resource it will first open Login View to Login, but after the Login process is completed it will take us to Index action of Home controller but not to the View we have selected and to overcome this problem, when we are being re-directed to Login Page from any secure resource then the “URL” will contain the address of the page to where it has to be redirected after Login, and we find it with the Key-Name “ReturnUrl”, so we can use this “Return-URL” for redirecting back to the original View we requested after a successful Login and to do that make the below changes:

**Step 1:** Go to “LoginModel.cs” and add a new property in LoginModel class to read the Return-URL as below:

public string ReturnUrl { get; set; } = "";

**Step 2:** Go to “Login.cshtml” and read the “ReturnUrl” which is present in the form of “Query String” and to do that, do the following change on the top of the page:

**Old Code:**

@

{

ViewData["Title"] = "Login";

}

**New Code:**

@

{

ViewData["Title"] = "Login";

var returnUrl = @Context.Request.Query["ReturnUrl"];

}

**Step 3:** Now pass the “returnUrl” value to Login’s Post Action Method as a route and to that, change the code of “<form>” tag as following:

**Old Code:**

<form **asp-action**="Login">

**New Code:**

<form **asp-action**="Login" **asp-route-ReturnUrl**="@returnUrl">

**Step 4:** In the Login’s Post Action Method of Account Controller change the code under “Succeeded” condition as below:

**Old Code:**

if (result.Succeeded)

{

return RedirectToAction("Index", "Home");

}

else

{

ModelState.AddModelError("", "Invalid login credentials.");

}

**New Code:**

if (result.Succeeded)

{

if (string.IsNullOrEmpty(loginModel.ReturnUrl))

return RedirectToAction("Index", "Home");

else

return LocalRedirect(loginModel.ReturnUrl);

}

else

{

ModelState.AddModelError("", "Invalid login credentials.");

}

**Note:** Now run the application and watch the difference.

**Email Confirmation:** this is quite an important part of the user registration process. It allows us to verify the registered user is indeed an owner of the provided email.

**Why email confirmation is important?**

**Ans:** let’s imagine a scenario where two users with similar email addresses want to register in our application, for example “Rajann” registers first with “rajan@gmail.com” instead of “rajann@gmail.com” which is his actual address and without email confirmation, this registration will execute successfully. Now, “Rajan” comes to registration page and tries to register with his email “rajan@gmail.com” and our application will return an error that the user with that email is already registered. So, thinking that he already has an account, he just resets the password and successfully logs in to the application. We can understand with this now where this could lead, and what problems it could cause.

To overcome this problem, it is a good practice to ask a user to confirm the email after registration and to implement this in our application do the following changes:

**Step 1:** Add a new View in the Shared folder of Views folder with the name “DisplayMessages.cshtml”, to display any information or error messages to the end users, and write the below code in it deleting the existing content:

<h1 class="bg-info text-white">@TempData["Title"]</h1>

<div class="container">

<p class="text-justify text-primary">@TempData["Message"]</p>

</div>

**Step 2:** Go to Register Post Action Method in Account Controller class and re-write the code under the “Succeeded” condition as following:

**Old Code:**

if (result.Succeeded)

{

//Code implemented for an automatic Sign-In after the registration is complete.

await signInManager.SignInAsync(identityUser, false);

return RedirectToAction("Index", "Home");

}

**New Code:**

if (result.Succeeded)

{

//Implementing logic for sending a mail to confirm the Email

var token = await userManager.GenerateEmailConfirmationTokenAsync(identityUser);

var confirmationUrlLink = Url.Action(

"ConfirmEmail", "Account", new { UserId = identityUser.Id, Token = token }, Request.Scheme);

SendMail(identityUser, confirmationUrlLink, "Email Confirmation Link");

TempData["Title"] = "Email Confirmation Link";

TempData["Message"] = "A confirm email link has been sent to your registered mail, click on it to confirm.";

return View("DisplayMessages");

}

**Step 3:** To send an Email from our application, first install “MailKit” package from NuGet Package Manager and then in the Account Controller class import the namespaces “System.Text”, “MimeKit” and “MailKit.Net.Smtp”, and add a new method in the class for sending an Email as following:

public void SendMail(IdentityUser identityUser, string requestLink, string subject)

{

StringBuilder mailBody = new StringBuilder();

mailBody.Append("Hello " + identityUser.UserName + "<br /><br />");

if (subject == "Email Confirmation Link") {

mailBody.Append("Click on the link below to confirm your email:");

}

else if (subject == "Change Password Link") {

mailBody.Append("Click on the link below to reset your password:");

}

mailBody.Append("<br />");

mailBody.Append(requestLink);

mailBody.Append("<br /><br />Regards<br /><br />");

mailBody.Append("Regards");

mailBody.Append("<br /><br />");

mailBody.Append("Customer Support.");

BodyBuilder bodyBuilder = new BodyBuilder();

bodyBuilder.HtmlBody = mailBody.ToString();

MailboxAddress fromAddress = new MailboxAddress("Customer Support", "<Use your Email Id here>");

MailboxAddress toAddress = new MailboxAddress(identityUser.UserName, identityUser.Email);

MimeMessage mailMessage = new MimeMessage();

mailMessage.From.Add(fromAddress);

mailMessage.To.Add(toAddress);

mailMessage.Subject = subject;

mailMessage.Body = bodyBuilder.ToMessageBody();

SmtpClient smtpClient = new SmtpClient();

smtpClient.Connect("smtp.gmail.com", 465, true);

smtpClient.Authenticate("<Use your Email Id here>", "<Generate an App Password and use it here>");

smtpClient.Send(mailMessage);

}

**Note:** to send mails from your Gmail Account first you need to go to “Manage your Google Account” => Select “Security” tab => scroll down to “Signing in to Google” => under that set the “2-Step Verification” property value as “On” and configure it. Now click on “App passwords” option => in the “Select app” Dropdown List, choose => Other (Custom name) and enter some name in the TextBox over there for example “TestApp” and click on Generate button which displays a “16-character Password”, use this password in your application as password for the Email.

**Step 4:** To generate token for Email Confirmation, Change Email and Reset Password, etc. we need to register a default Token Provider in by calling “AddDefaultTokenProviders” method under “Startup.cs” file in ASP.NET Core 5.0 and “Program.cs” file in ASP.NET Core 6.0 as following:

**ASP.NET Core 5.0:** go to “Startup.cs” file and change the code of “services.AddIdentity” method which is present in “ConfigureServices” method as below:

**Old Code:**

services.AddIdentity<IdentityUser, IdentityRole>(options =>

{

options.Password.RequiredLength = 8;

options.Password.RequireDigit = false;

}).AddEntityFrameworkStores<MVCCoreDbContext>();

**New Code:**

services.AddIdentity<IdentityUser, IdentityRole>(options =>

{

options.Password.RequiredLength = 8;

options.Password.RequireDigit = false;

}).AddEntityFrameworkStores<MVCCoreDbContext>().AddDefaultTokenProviders();

**ASP.NET Core 6.0:** go to “Program.cs” file and change the code of “builder.Services.AddIdentity” method which is present above the statement => “var app = builder.Build();” as below:

**Old Code:**

builder.Services.AddIdentity<IdentityUser, IdentityRole>(options =>

{

options.Password.RequiredLength = 8;

options.Password.RequireDigit = false;

}).AddEntityFrameworkStores<MVCCoreDbContext>();

**New Code:**

builder.Services.AddIdentity<IdentityUser, IdentityRole>(options =>

{

options.Password.RequiredLength = 8;

options.Password.RequireDigit = false;

}).AddEntityFrameworkStores<MVCCoreDbContext>().AddDefaultTokenProviders();

After doing all the above changes whenever a new user registers, then a mail is generated and sent to his registered mail with mail confirmation link that contains an Email Confirmation Token and User Id. Token is a unique “ID” value that is generated for email confirmation, change email and change password, to identify the user when he clicks on the link.

**Step 5:** Now with-out confirming the email a user should not be allowed to login into the application and to that, go to Post Action of Login Method which is present in “AccountController” class and add the below code in top of the if condition i.e., inside “if (ModelState.IsValid)” condition:

//Code to check whether Email is confirmed or not

var user = await userManager.FindByNameAsync(loginModel.Name);

if (user != null && (await userManager.CheckPasswordAsync(user, loginModel.Password)) &&

user.EmailConfirmed == false)

{

ModelState.AddModelError("", "Your email is not confirmed.");

return View(loginModel);

}

**Step 6:** Now when the user clicks on the Confirmation Link in his mail it will redirect to “ConfirmEmail” action method of Account Controller class, so let’s define “ConfirmEmail” Action Method in Account Controller as following:

public async Task<IActionResult> ConfirmEmail(string userId, string token)

{

if(userId != null && token != null)

{

var User = await userManager.FindByIdAsync(userId);

if(User != null)

{

var result = await userManager.ConfirmEmailAsync(User, token);

if(result.Succeeded)

{

TempData["Title"] = "Email Confirmation Success.";

TempData["Message"] = "Email confirmation is completed. You can now login into the application.";

return View("DisplayMessages");

}

else

{

StringBuilder Errors = new StringBuilder();

foreach (var Error in result.Errors)

{

Errors.Append(Error.Description + ". ");

}

TempData["Title"] = "Confirmation Email Failure";

TempData["Message"] = Errors.ToString();

return View("DisplayMessages"); }

}

else

{

TempData["Title"] = "Invalid User Id.";

TempData["Message"] = "User Id which is present in confirm email link is in-valid.";

return View("DisplayMessages");

}

}

else

{

TempData["Title"] = "Invalid Email Confirmation Link.";

TempData["Message"] = "Email confirmation link is invalid, either missing the User Id or Confirmation Token.";

return View("DisplayMessages");

}

}

**Implementing Password Reset Functionality:** Now let’s implement password reset functionality in our application and for that, to do the following:

**Step 1:** Go to “Login.cshtml” and add links for Register and Forgot Password, just above the “</form>” tag as below:

<div class="form-group">

New user? <a **asp-action**="Register">Click</a> to register?

<br />

Forgot password? - <a **asp-action**="ForgotPassword">Click</a> to reset.

</div>

**Step 2:** Add a new Model class in Model’s folder, naming it as “ChangePasswordModel.cs” and write the below code in the class:

using System.ComponentModel.DataAnnotations;

public class ChangePasswordModel

{

[Required]

[Display(Name = "User Name")]

[RegularExpression("[A-Za-z0-9-.\_@+]\*")]

public string Name { get; set; }

}

**Step 3:** Go to “AccountController” class and write the below Action Methods in the class:

public IActionResult ForgotPassword()

{

return View();

}

[HttpPost]

public async Task<IActionResult> ForgotPassword(ChangePasswordModel model)

{

if(ModelState.IsValid)

{

var User = await userManager.FindByNameAsync(model.Name);

if (User != null && await userManager.IsEmailConfirmedAsync(User))

{

var token = await userManager.GeneratePasswordResetTokenAsync(User);

var confirmationUrlLink = Url.Action("ChangePassword", "Account", new { UserId = User.Id, Token = token },

Request.Scheme);

SendMail(User, confirmationUrlLink, "Change Password Link");

TempData["Title"] = "Change Password Link";

TempData["Message"] = "Change password link has been sent to your mail, click on it and change password.";

return View("DisplayMessages");

}

else

{

TempData["Title"] = "Change Password Mail Generation Failed.";

TempData["Message"] = "Either the Username you have entered is in-valid or your email is not confirmed.";

return View("DisplayMessages");

}

}

return View(model);

}

Now add a View to “ForgotPassword” action method and to do that, choose Razor View in Scaffold Page, click “Add” button, under Template select “Create”, under Model Class select “ChangePasswordModel” and click on “Add” button. Run the View; enter your “Username” to receive a reset password mail. After receiving the mail, user can click on the link to change the password and to perform that we need to define “ResetPassword” Action method.

**Step 4:** Add another Model class in Model’s folder, naming it as “ResetPasswordModel.cs” and write the below code in it:

using System.ComponentModel.DataAnnotations;

public class ResetPasswordModel

{

[Required]

public string UserId { get; set; }

[Required]

public string Token { get; set; }

[Required]

[DataType(DataType.Password)]

public string Password { get; set; }

[Display(Name = "Confirm Password")]

[DataType(DataType.Password)]

[Compare("Password", ErrorMessage = "Confirm password should match with password.")]

public string ConfirmPassword { get; set; }

}

**Step 5:** Go to “AccountController” class and write the below Action Methods in that class:

public IActionResult ChangePassword()

{

return View();

}

[HttpPost]

public async Task<IActionResult> ChangePassword(ResetPasswordModel model)

{

if (ModelState.IsValid)

{

var User = await userManager.FindByIdAsync(model.UserId);

if (User != null)

{

var result = await userManager.ResetPasswordAsync(User, model.Token, model.Password);

if (result.Succeeded)

{

TempData["Title"] = "Reset Password Success";

TempData["Message"] = "Your password has been reset successfully.";

return View("DisplayMessages");

}

else

{

foreach (var Error in result.Errors)

ModelState.AddModelError("", Error.Description);

}

}

else

{

TempData["Title"] = "Invalid User";

TempData["Message"] = "No user exists with the given User Id.";

return View("DisplayMessages");

}

}

return View(model);

}

Now add a View to “ChangePassword” action method, choose Razor View in Scaffold Page, click “Add”, under Template select “Create”, under Model Class select “ResetPasswordModel” and click on “Add” button. This view gets launched when we user clicks on the “Reset Password Email Link” he has received, and that link contains 2 “Query String” values “UserId & Token”, and we need to read the values of them into our page and to do that modify the code on the top of the view as following:

**Old Code:**

@{

ViewData["Title"] = "ResetPassword";

}

**New Code:**

@{

ViewData["Title"] = "ResetPassword";

var UserId = @Context.Request.Query["UserId"];

var Token = @Context.Request.Query["Token"];

}

**Note:** In the current view, it will provide “Textbox’s” for entering “User Id & “Token” values, but we are not going to enter those values because those values came to the View as “Query Strings”, when the user clicks on the link that is sent to his email, so delete the 2 “<div>” tags containing controls for entering “User Id” and “Token”. Now we need to bind “User Id & Token” values we have captured, to the Model in the form of “route-values” and to do those change the code of “<form>” tag as following:

**Old Code:**

<form **asp-action**="ResetPassword">

**New Code:**

<form **asp-action**="ResetPassword" **asp-route-userId**="@UserId" **asp-route-token**="@Token">

**Implementing Open Authentication:** open authentication is a process of adding an option of authenticating a User by using external login providers like Google, Facebook, Microsoft, and Twitter.

**Implementing Google and Facebook Authentication:** to implement Google and Facebook authentication in our application do the following:

**Step 1:** Re-write the code in “Login.cshtml” as following:

@model MVCDHProject.Models.LoginModel

@{

ViewData["Title"] = "Login";

var returnUrl = @Context.Request.Query["ReturnUrl"];

}

<h1>Login With</h1>

<hr />

<div class="row">

<div class="col-md-6">

<h3>NIT Account</h3>

<hr />

<form **asp-action**="Login" **asp-route-ReturnUrl**="@returnUrl">

<div **asp-validation-summary**="ModelOnly" class="text-danger"></div>

<div class="form-group">

<label **asp-for**="Name" class="control-label"></label>

<input **asp-for**="Name" class="form-control" />

<span **asp-validation-for**="Name" class="text-danger"></span>

</div>

<div class="form-group">

<label **asp-for**="Password" class="control-label"></label>

<input **asp-for**="Password" class="form-control" />

<span **asp-validation-for**="Password" class="text-danger"></span>

</div>

<div class="form-group form-check">

<label class="form-check-label">

<input class="form-check-input" **asp-for**="RememberMe" />

@Html.DisplayNameFor(model => model.RememberMe)

</label>

</div>

<div class="form-group">

<input type="submit" value="Login" class="btn btn-primary" />

<input type="reset" value="Reset" class="btn btn-primary" />

</div>

<div class="form-group">

New user? <a **asp-action**="Register">Click</a> to register?

<br />

Forgot password? - <a **asp-action**="ForgotPassword">Click</a> to reset.

</div>

</form>

</div>

<div class="col-md-6">

<h3>Google or Facebook</h3>

<hr />

<form **asp-action**="ExternalLogin" **asp-route-returnUrl**="@returnUrl">

<input type="submit" name="Provider" value="Google" class="btn btn-primary" />

<input type="submit" name="Provider" value="Facebook" class="btn btn-primary" />

</form>

</div>

</div>

@section Scripts {

@{await Html.RenderPartialAsync("\_ValidationScriptsPartial");}

}

**Step 2:** Register our application under Google => to work with Google, first we need to register our application with Google and to do that open the site “console.cloud.google.com” and login with your credentials. Now click on Create Project => in the window opened enter project name as “NIT Customer Management” and click on Create button which creates a new project. Now go to “Navigation Menu” which is present in LHS, on the top and select “APIS and Services” => “Library” => now in the window opened Search for “Google+ Api” which opens a new window, in that click on “Google+ Api” and then click on Enable button.

Now in the LHS top we find “Google+ API” and above it we find “APIs and Services” click on it which displays the options below, select “OAuth consent screen” in LHS and click on Create button => which will display a screen and asks for “App Name”, enter the name as “NIT Customer Management”, Enter the Support Email Id: “<enter your email id here>”, scroll down and enter Developer contact information also with your email id and click on “Save and Continue” button.

Now click on “Credentials” in the LHS and click on “Create Credentials” on the top and select “OAuth Client Id” in the provided list, and then choose “Application Type” as “Web Application”, give a name to it, for example: “NIT Client”, and then under “Authorized Java Script Origins”, click on “+Add URI” option and specify the URI for the home page of our site: https://localhost:port.

**Note:** to get the URI of our site’s home page go to Solution Explorer if our project, right click on the project and select Properties, which opens the project property window and, in that select, “Debug” in LHS and scroll down to the bottom in RHS, select the CheckBox “Enable SSL” which displays the URI, copy, and paste it in Google’s “URI” TextBox. E.g.: https://localhost:YourPortNo

Now under Authorized redirect URIs option click on “+Add URI” option and specify the redirect URI as shown: “YourSiteURI/signin-google” for example: https://localhost:YourPortNo/signin-google and click on the Create button which opens a window and in that it will display Client ID and Client Secret, copy and save them because we need to use those values in our Web Application.

**Step 3:** Registering our application under Facebook => open the site [https://developers.facebook.com](https://developers.facebook.com/) and login with your credentials. Now in the RHS top, click on “MyApps” Menu, which opens a window click on the button “Create App”, which opens another window asking for “Select an app type” => Select “None” Radio Button and click on “Next”, in the window opened enter “Display Name” for our App, as “NIT Customer Management”, enter “App Contact Email”, click on “Create App” button which will create the app and opens “App Dashboard”.

Now in the “App Dashboard” click on the “Setup” button under “Facebook Login”, which will ask to “Select the platform for this app.”, choose “Web” which will ask for site “URL” enter it as shown: “YourSiteURI/signin-facebook”, for example: https://localhost:YourPortNo/signin-facebook and click on “Save”.

Now click on Facebook Login in LHS and under that choose Settings, now on the RHS select the option to configure the client “OAuth Login”, which is already selected “Yes”, so leave the same and under “Valid OAuth Redirect URL’s” enter the URL as “YourSiteURL/signin-facebook” and click on “Save Changes”. Now in the LHS on the top we find another “Settings” option, expand it and under it choose “Basic” which will display “App Id” and “App Secret” in RHS, copy and save because we need to use them in our application.

Now to take your app live we need to provide a privacy policy which should be generated at the following site: [https://www.termsfeed.com](https://www.termsfeed.com/). Login into the site by creating an account, in the window opened select “Private Policy Generator” which opens a window in that choose “Website” and click on Next Step button and fill in the following details:

1. Website URL: https://localhost:YourPortNo/

2. Website Name: NIT Customer Management

3. Entity Type: Individual

4. Country: India

5. State: Telangana

Click on Next Step button and choose the required options (select all the free options), click on Generate a Privacy Policy URL, then click on download button which displays an URL copy it. Now come back to Facebook, under the “Basic” Settings paste the Url in “Privacy Policy URL” TextBox and click on Save Changes button.

Now on the top of the page we find a “Toggle Button” as “In Development” click on it to change the App to “Live”, which opens a window in that choose a Category for your application, for example Education and click on “Switch Mode” Button.

**Step 4:** come back to your project in Visual Studio and install the below 2 packages using NuGet Package Manager:

Microsoft.AspNetCore.Authentication.Google

Microsoft.AspNetCore.Authentication.Facebook

**Step 5:** Go to “Startup.cs” file in ASP.NET Core 5.0 and “Program.cs” file in ASP.NET Core 6.0 and write the below code to include Google and Facebook authentications in our application:

**ASP.NET Core 5.0:** under “ConfigureServices” method of Startup Class write the below code.

services.AddAuthentication()

.AddGoogle(options =>

{

options.ClientId = "<Specify Client Id>";

options.ClientSecret = "<Enter Client Secret>";

})

.AddFacebook(options =>

{

options.AppId = "<Specify App Id>";

options.AppSecret = "<Specify App Secret>";

});

**ASP.NET Core 6.0:** in Program Class write the below code just above the statement => “var app = builder.Build();”.

builder.Services.AddAuthentication()

.AddGoogle(options =>

{

options.ClientId = "<Specify Client Id>";

options.ClientSecret = "<Enter Client Secret>";

})

.AddFacebook(options =>

{

options.AppId = "<Specify App Id>";

options.AppSecret = "<Specify App Secret>";

});

**Step 6:** Now go to “AccountController” class and implement the below Action methods by importing the namespace “System.Security.Claims”:

public IActionResult ExternalLogin(string returnUrl, string Provider)

{

var url = Url.Action("CallBack", "Account", new { ReturnUrl = returnUrl });

var properties = signInManager.ConfigureExternalAuthenticationProperties(Provider, url);

return new ChallengeResult(Provider, properties);

}

public async Task<IActionResult> CallBack(string returnUrl)

{

if (string.IsNullOrEmpty(returnUrl)) {

returnUrl = "~/";

}

LoginModel model = new LoginModel();

var info = await signInManager.GetExternalLoginInfoAsync();

if (info == null)

{

ModelState.AddModelError("", "Error loading external login information.");

return View("Login", model);

}

var signInResult = await signInManager.ExternalLoginSignInAsync(info.LoginProvider, info.ProviderKey, false, true);

if (signInResult.Succeeded)

{

return LocalRedirect(returnUrl);

}

else

{

var email = info.Principal.FindFirstValue(ClaimTypes.Email);

if (email != null)

{

var user = await userManager.FindByEmailAsync(email);

if (user == null)

{

user = new IdentityUser

{

UserName = info.Principal.FindFirstValue(ClaimTypes.Email),

Email = info.Principal.FindFirstValue(ClaimTypes.Email),

PhoneNumber = info.Principal.FindFirstValue(ClaimTypes.MobilePhone),

};

var identityResult = await userManager.CreateAsync(user);

}

await userManager.AddLoginAsync(user, info);

await signInManager.SignInAsync(user, false);

return LocalRedirect(returnUrl);

}

TempData["Title"] = "Error";

TempData["Message"] = "Email claim not recieved from google.";

return RedirectToAction("DisplayMessages");

}

}

**Hosting MVC Core Application on Microsoft Azure**

Open the site “portal.azure.com” and create an account to login into the site. Click on the Subscriptions button on the home screen which opens another window and in that click on “+ Add” button which opens a new window and, in that select, “Azure for Students” and click on “Select Offer” button which opens a new window, click on “Activate” button and provide all the required details.

Now open our project “MVCDHProject” in Visual Studio, then go to Solution Explorer, right click on the project and select the option “Publish” this opens the Publish Window and in that under “Target” choose “Azure” and click next, now under the “Specific Target” choose “Azure App Service (Windows)” and click next, now under the “App Service” we need to create an “App Service Instance” and to do that click on “+ (Create an Azure App Service)” button which opens a window and in that provide the following details:

**Name:** nitcore

**Subscription:** “Choose your subscription plan here”

**Resource Group:** Click on New button beside and enter a name to it, for example “NITRG”.

**Hosting Plan:** Click on New button besides, which opens a window and in that enter the following details:

**Hosting Plan:** NITHP

**Location:** “Choose any location or leave the default”

**Size:** “Choose the size or leave the default”

=> Click on the Ok button

=> Click on the Create button

=> Click on the Finish button

Now in the publish window, it will recognize all the dependencies, and our application right now has a “Database Dependency”, so it will display that in the bottom of the window under “Service Dependencies” option, click on the “+ (Add new service dependency)” button and in the window opened, select “Azure SQL Database” option and click “Next” button, now in the new window opened click on the “+ (Create a SQL Database)” button which opens a new window, provide the following details in it:

**Database name:** Enter a name to the Database or leave the existing name

**Subscription:** Choose your subscription plan here

**Resource Group:** NITRG

**Database Server:** Click on the New button beside and enter the following details in the window opened:

**Database server name:** nitdbserver

**Location:** Choose any location or leave the default

**Administrator username:** NitAdmin

**Administrator password:** NIT2022pwd

=> Click on the Ok button

=> Click on the Create button

=> Click on the Next button which will ask for Connection String details, so enter the following in it:

**Database connection string name:** ConStr

**Database connection username:** NitAdmin

**Database connection password:** NIT2022pwd

=> Click on the Finish button which will finish the configuration, click on the Close button, and close.

Now in the Publish window we find “More actions” dropdown select “Edit” in it which opens a new window and in that on the LHS choose “Settings” and do the following:

* Expand the “Databases” option and check the CheckBox “Use this connection string at runtime”.
* Expand the “Entity Framework Migrations” option and check the CheckBox “Apply this migration on publish”.

=> Click on the Save button which closes the window.

=> In the Publish window click on the Publish button which will upload the site to azure server, which we can now access by using the URL: [https://nitcore.azurewebsites.net](https://nitcore.azurewebsites.net/)

**Entity Framework Core DB First**

This was available in Entity Framework Core also but with a very limited support. To work with DB First, create a new “ASP.NET Core Web App (Model-View-Controller)” Project, naming it as “MVCCoreDBF”, choose “.NET 6.0 (Long Term Support)”, Select the Checkbox “Configure for HTTPS”, Select the Checkbox “Do not use top-level statements” and click on “Create” button.

**Note:** in EF Core we don’t have any designer support for creating DB First project just like what we have in EF 6. So here we need to use Scaffolding commands to generate Model and Context classes.

**To generate Model and Context classes use the below Scaffold command:**

Scaffold-DbContext [ConnectionString] [Provider] [-OutputDir <Name>] [-Tables <Name]

**Step 1:** To use Scaffold Commands and Entity Framework Core for SQL Server first we need to install the below packages using NuGet Package Manager:

Microsoft.EntityFrameworkCore.Tools

Microsoft.EntityFrameworkCore.SqlServer

**Step 2:** Open PMC (Package Manager Console) and write the below code at the “PM” command prompt.

PM>Scaffold-DbContext "Data Source=Server;User Id=Sa;Password=123;Database=MVCDB"

Microsoft.EntityFrameworkCore.SqlServer -OutputDir Models -Tables Student

**Note:** in the Scaffold Command if we don’t use “[-Tables] <Table\_Name>” attribute it will generate Model classes for all the Tables in the Database.

The above statement will generate the Model class with the name “Student” and also generates the Context class with the name “MVCDBContext” as below:

public partial class Student

{

public int Sid { get; set; }

public string Name { get; set; }

public int? Class { get; set; }

public decimal? Fees { get; set; }

public string Photo { get; set; }

public bool? Status { get; set; }

}

public partial class MVCDBContext : DbContext

{

public MVCDBContext()

{

}

public MVCDBContext(DbContextOptions<MVCDBContext> options) : base(options)

{

}

public virtual DbSet<Student> Students { get; set; }

protected override void OnConfiguring(DbContextOptionsBuilder optionsBuilder)

{

if (!optionsBuilder.IsConfigured)

{

#warning To protect potentially sensitive information in your connection string, you should move it out of

source code. You can avoid scaffolding the connection string by using the Name= syntax to read it from

configuration - see https://go.microsoft.com/fwlink/?linkid=2131148. For more guidance on storing

connection strings, see http://go.microsoft.com/fwlink/?LinkId=723263.

optionsBuilder.UseSqlServer("Data Source=Server;Database=MVCDB;User Id=Sa;Password=123");

}

}

protected override void OnModelCreating(ModelBuilder modelBuilder)

{

modelBuilder.HasAnnotation("Relational:Collation", "SQL\_Latin1\_General\_CP1\_CI\_AS");

modelBuilder.Entity<Student>(entity =>

{

entity.HasKey(e => e.Sid).HasName("PK\_\_Student\_\_CA1E5D78E2EF83E9");

entity.ToTable("Student");

entity.Property(e => e.Sid).ValueGeneratedNever();

entity.Property(e => e.Fees).HasColumnType("money");

entity.Property(e => e.Name).HasMaxLength(50).IsUnicode(false);

entity.Property(e => e.Photo).HasMaxLength(100).IsUnicode(false);

entity.Property(e => e.Status).IsRequired().HasDefaultValueSql("((1))");

});

OnModelCreatingPartial(modelBuilder);

}

partial void OnModelCreatingPartial(ModelBuilder modelBuilder);

}

**Step 3:** To define the Controller class, Action methods and Views also let us use Scaffolding and to do that, right click on the Controllers folder, Select Add => Controller and in the window opened select “MVC Controller with views, using Entity Framework” and click Add button, which will open a new window and in that select the “Model cls:” as “Student” and “Data context class:” as “MVCDBContext (MVCCoreDBF.Models)” and click on the “Add” button which will generate the Controller class with all the required action methods and corresponding Views, and the name of the Controller will be “StudentsController”.

**Step 4:** Now go to “Startup” class in case of ASP.NET Core 5.0 or “Program” class in case of ASP.NET Core 6.0 and register the “DBContext” class by calling “AddDbContext” method and to do this first we need to import the namespace “MVCCoreDBF.Models” and write the code.

**ASP.NET Core 5.0:** write the below statement under “ConfigureServices” method of “Startup” class:

services.AddDbContext<MVCDBContext>();

**ASP.NET Core 6.0:** write the below statement under “Program” class just above the statement => “var app = builder.Build();”:

builder.Services.AddDbContext<MVCDBContext>();

Now run the project and watch the output of all the Views, but the problem is with the image i.e., it will not be displayed and in “Add” and “Edit” Views we will not find the option for selecting the image, so we need to now make all the necessary changes for including the Image in Display, New, Edit and Delete Views.

**Step 5:** Create a folder with the name “images” under “wwwroot” folder and copy all the image files of Students into that folder.

**Step 6:** Now make the necessary changes in all the required Views and their corresponding Action methods as following:

**Index View:** go to “Index.cshtml” and replace the code of Photo property with new code as following:

**Old Code:** @Html.DisplayFor(modelItem => item.Photo)

**New Code:** <img src='/images/@item.Photo' width="30" height="30" alt="No Image" />

**Details View:** go to “Details.cshtml” and replace the code of Photo property with new code as following:

**Old Code:** @Html.DisplayFor(model => model.Photo)

**New Code:** <img src='/Images/@Model.Photo' width="200" height="200" alt="No Image" />

**Create View:**go to “Create.cshtml” and replace the code of Photo property with new code as following:

**Old Code:** <input **asp-for**="Photo" class="form-control" />

**New Code:** <input type="file" name="selectedFile" />

**Edit View:** go to “Edit.cshtml” and replace the code of Photo property with new code as following:

**Old Code:** <input **asp-for**="Photo" class="form-control" />

**New Code:** <img src='/images/@Model.Photo' width="100" height="100" alt="No Image" />

<input type="file" name="selectedFile" />

**Note:** in “Create.cshtml” and “Edit.cshtml”, add “enctype” attribute to “<form>” tag which should look as below:

**Create.cshtml:** <form **asp-action**="Create" enctype="multipart/form-data">

**Edit.cshtml:** <form **asp-action**="Edit" enctype="multipart/form-data">

**Delete View:** go to “Delete.cshtml” and replace the code of Photo property with new code as following:

**Old Code:** @Html.DisplayFor(model => model.Photo)

**New Code:** <img src='/images/@Model.Photo' width="100" height="100" alt="No Image" />

Now go to “StudentsController” class, import “System.IO”, “Microsoft.AspNetCore.Http” and “Microsoft.AspNetCore.Hosting” namespaces and make the below changes:

**Re-write the constructor in the class by declaring a new field as following:**

private readonly IWebHostEnvironment \_environment;

public StudentsController(MVCDBContext context, IWebHostEnvironment environment)

{

\_context = context;

\_environment = environment;

}

**Re-write the Post Action method of Create as following:**

public async Task<IActionResult> Create([Bind("Sid,Name,Class,Fees,Photo,Status")] Student student,

IFormFile selectedFile)

{

if (ModelState.IsValid)

{

if (selectedFile != null)

{

string FolderPath = \_environment.WebRootPath + "\\images";

if (!Directory.Exists(FolderPath))

{

Directory.CreateDirectory(FolderPath);

}

string FilePath = FolderPath + "\\" + selectedFile.FileName;

FileStream fs = new FileStream(FilePath, FileMode.Create);

selectedFile.CopyTo(fs);

student.Photo = selectedFile.FileName;

}

student.Status = true;

\_context.Add(student);

await \_context.SaveChangesAsync();

return RedirectToAction(nameof(Index));

}

return View(student);

}

**Re-write the Get Action method of Edit as following:**

public async Task<IActionResult> Edit(int? id)

{

if (id == null || \_context.Students == null)

{

return NotFound();

}

var student = await \_context.Students.FindAsync(id);

if (student == null)

{

return NotFound();

}

if (student.Photo != null)

{

TempData["Photo"] = student.Photo;

}

return View(student);

}

**Re-write the Post Action method of Edit as following:**

public async Task<IActionResult> Edit(int id, [Bind("Sid,Name,Class,Fees,Photo,Status")] Student student,

IFormFile selectedFile)

{

if (id != student.Sid)

{

return NotFound();

}

if (ModelState.IsValid)

{

try

{

if (selectedFile != null)

{

string FolderPath = Path.Combine(\_environment.WebRootPath, "images");

if (!Directory.Exists(FolderPath))

{

Directory.CreateDirectory(FolderPath);

}

string ImagePath = Path.Combine(FolderPath, selectedFile.FileName);

FileStream fs = new FileStream(ImagePath, FileMode.Create);

selectedFile.CopyTo(fs);

student.Photo = selectedFile.FileName;

}

else if (TempData["Photo"] != null)

{

student.Photo = TempData["Photo"].ToString();

}

\_context.Update(student);

await \_context.SaveChangesAsync();

}

catch (DbUpdateConcurrencyException)

{

if (!StudentExists(student.Sid))

{

return NotFound();

}

else

{

throw;

}

}

return RedirectToAction(nameof(Index));

}

return View(student);

}

**Web API Core**

Create a new project of type “ASP.NET Core Web API”, name the project as “CoreWebApiService”, choose Target Framework as “.NET 6.0 (Long-term support)” and check these Checkbox’s “Configure for HTTPS”, “Use controllers (uncheck to use minimal APIs)”, “Enable Open API Support” and “Do not use top-level statements” (this will define Program class with Main method in it and all the code will be defined inside of the Main method).

**Let’s create an API Service that uses XML as Data Source and to do that follow the below process:**

**Step 1:** add an XML File in the project naming it as “Customer.xml” and write the below code in it:

<Customers>

<Customer>

<Custid>101</Custid>

<Name>Scott</Name>

<Balance>25000</Balance>

<City>Hyderabad</City>

<Status>True</Status>

</Customer>

<Customer>

<Custid>102</Custid>

<Name>Smith</Name>

<Balance>35000</Balance>

<City>Kolkata</City>

<Status>True</Status>

</Customer>

<Customer>

<Custid>103</Custid>

<Name>David</Name>

<Balance>45000</Balance>

<City>Bengaluru</City>

<Status>True</Status>

</Customer>

<Customer>

<Custid>104</Custid>

<Name>Sofia</Name>

<Balance>55000</Balance>

<City>Mumbai</City>

<Status>True</Status>

</Customer>

</Customers>

**Step 2:** Add a new folder under the project naming it as “Models” and then under the folder add a class naming it as “Customer” and write the below code in it:

public class Customer

{

public int Custid { get; set; }

public string Name { get; set; }

public decimal? Balance { get; set; }

public string City { get; set; }

public bool Status { get; set; }

}

**Step 3:** Add an interface in the Models folder naming it as “ICustomerDAL” so that DAL Class implementation can use Dependency Injection Pattern, and write the below code in the interface:

public interface ICustomerDAL

{

List<Customer> Customers\_Select();

Customer Customer\_Select(int Custid);

void Customer\_Insert(Customer customer);

void Customer\_Update(Customer customer);

void Customer\_Delete(int Custid);

}

**Step 4:** Add a class in the Models folder naming it as “CustomerXmlDAL”, and right now we are implementing the DAL class logic to work with XML Data Source, and to do that write the below code in the class:

using System.Data;

public class CustomerXmlDAL : ICustomerDAL

{

DataSet ds;

public CustomerXmlDAL()

{

ds = new DataSet();

ds.ReadXml("Customer.xml");

ds.Tables[0].PrimaryKey = new DataColumn[] { ds.Tables[0].Columns["Custid"] };

}

public List<Customer> Customers\_Select()

{

List<Customer> Customers = new List<Customer>();

foreach (DataRow dr in ds.Tables[0].Rows)

{

Customer obj = new Customer

{

Custid = Convert.ToInt32(dr["Custid"]),

Name = (string)dr["Name"],

Balance = Convert.ToDecimal(dr["Balance"]),

City = (string)dr["City"],

Status = Convert.ToBoolean(dr["Status"])

};

Customers.Add(obj);

}

return Customers;

}

public Customer Customer\_Select(int Custid)

{

DataRow dr = ds.Tables[0].Rows.Find(Custid);

if (dr != null)

{

Customer obj = new Customer

{

Custid = Convert.ToInt32(dr["Custid"]),

Name = (string)dr["Name"],

Balance = Convert.ToDecimal(dr["Balance"]),

City = (string)dr["City"],

Status = Convert.ToBoolean(dr["Status"])

};

return obj;

}

return null;

}

public void Customer\_Insert(Customer customer)

{

DataRow dr = ds.Tables[0].NewRow();

dr[0] = customer.Custid;

dr[1] = customer.Name;

dr[2] = customer.Balance;

dr[3] = customer.City;

dr[4] = customer.Status;

ds.Tables[0].Rows.Add(dr);

ds.WriteXml("Customer.xml");

}

public void Customer\_Update(Customer customer)

{

DataRow dr = ds.Tables[0].Rows.Find(customer.Custid);

int Index = ds.Tables[0].Rows.IndexOf(dr);

ds.Tables[0].Rows[Index]["Name"] = customer.Name;

ds.Tables[0].Rows[Index]["Balance"] = customer.Balance;

ds.Tables[0].Rows[Index]["City"] = customer.City;

ds.Tables[0].Rows[Index]["Status"] = customer.Status;

ds.WriteXml("Customer.xml");

}

public void Customer\_Delete(int Custid)

{

DataRow dr = ds.Tables[0].Rows.Find(Custid);

int Index = ds.Tables[0].Rows.IndexOf(dr);

ds.Tables[0].Rows[Index].Delete();

ds.WriteXml("Customer.xml");

}

}

**Step 5:** Go to “Startup.cs” file in case ASP.Net Core 5.0 and Program.cs file in case of ASP.NET Core 6.0 and write the below statement by importing “CoreWebApiService.Models” namespace:

**ASP.NET Core 5.0** => go to ConfigureServices method in Startup class and write the below statement over there:

services.AddScoped<ICustomerDAL, CustomerXmlDAL>();

**ASP.NET Core 6.0** => go to Main method in Program class and write the below statement just above the statement “var app = builder.Build();”:

builder.Services.AddScoped<ICustomerDAL, CustomerXmlDAL>();

**Step 6:** Add an “ApiController” in the Controllers folder and to do that right click on the “Controllers” folder, select Add => Controller, in the window opened select API in LHS and then on the RHS select “API Controller - Empty”, click Add button, name the class as “CustomerController” and write the below code in the class:

using System.Net;

using System.Net.Http;

using CoreWebApiService.Models;

[Route("api/[controller]")]

[ApiController]

public class CustomerController : ControllerBase

{

private readonly ICustomerDAL dal;

public CustomerController(ICustomerDAL dal)

{

this.dal = dal;

}

[HttpGet]

public List<Customer> GetCustomers()

{

return dal.Customers\_Select();

}

[HttpGet("{Custid}")]

public Customer GetCustomer(int Custid)

{

return dal.Customer\_Select(Custid);

}

[HttpPost]

public HttpResponseMessage Post(Customer c)

{

dal.Customer\_Insert(c);

return new HttpResponseMessage(HttpStatusCode.Created);

}

[HttpPut]

public HttpResponseMessage Put(Customer c)

{

Customer customer = dal.Customer\_Select(c.Custid);

if (customer != null)

{

dal.Customer\_Update(c);

return new HttpResponseMessage(HttpStatusCode.OK);

}

else

{

return new HttpResponseMessage(HttpStatusCode.NotFound);

}

}

[HttpDelete("{Custid}")]

public HttpResponseMessage Delete(int Custid)

{

Customer customer = dal.Customer\_Select(Custid);

if (customer != null)

{

dal.Customer\_Delete(Custid);

return new HttpResponseMessage(HttpStatusCode.OK);

}

else

{

return new HttpResponseMessage(HttpStatusCode.NotFound);

}

}

}

To test Web API Core, we are provided with a built-in tool known as “Swagger”, so we don’t require using any web debugging tools like Postman or Fiddler etc. Run the “APIController” we have defined and test all the functionalities by using Swagger.

**Consuming our Core API Service in an MVC Controller using JQuery-Ajax with-in the Same Project:** add a new Controller in the current project and it should be an “MVC Controller”, naming it as “HomeController” and add a View to the default Index action method and write the below code in it:

<html xmlns="http://www.w3.org/1999/xhtml">

<head>

<title></title>

<script src="https://code.jquery.com/jquery-3.6.1.min.js"

integrity="sha256-o88AwQnZB+VDvE9tvIXrMQaPlFFSUTR+nldQm1LuPXQ=" crossorigin="anonymous"></script>

<script>

$(document).ready(function() {

GetCustomers();

});

function GetCustomers() {

$.ajax({

url: 'http://localhost/CoreWebApiService/api/Customer',

type: 'GET',

dataType: 'json',

success: function (Customers) {

$("#tblCustomers tbody").empty();

$("#tblCustomers").append("<tr><td><input id='custid' type='text' style='width: 50px'/></td><td><input id='name' type='text' /></td><td><input id='balance' type='text' /></td><td><input id='city' type='text' /></td><td align='center'><input id='status' type='checkbox' /></td><td align='center'><input type='button' id='insert' value='Insert' onclick='AddCustomer()' /></td></tr>");

$.each(Customers, function (index, Customer) {

$("#tblCustomers").append(BuildCustomerRow(Customer));

});

},

error: function (request) {

HandleException(request);

}

});

}

function BuildCustomerRow(Customer) {

var NewRow = "<tr>" + "<td align='center'>" + Customer.custid + "</td>" +

"<td><input type='text' class='input-name' value='" + Customer.name + "'/></td>" +

"<td><input type='text' class='input-balance' value='" + Customer.balance + "'/></td>" +

"<td><input type='text' class='input-city' value='" + Customer.city + "'/></td>";

if (Customer.status == true)

NewRow += "<td align='center'><input class='input-status' type = 'checkbox' checked /></td>";

else

NewRow += "<td align='center'><input class='input-status' type = 'checkbox' /></td>";

NewRow += "<td><button type='button' onclick='UpdateCustomer(this);' data-custid='" +

Customer.custid + "'>Update</button>";

NewRow += "<button type='button' onclick='DeleteCustomer(this);' data-custid='" +

Customer.custid + "'>Delete</button>";

NewRow += "</td></tr>";

return NewRow;

}

function HandleException(request) {

var msg = "";

msg += "Code: " + request.status + "\n";

msg += "Text: " + request.statusText + "\n";

if (request.responseJSON != null) {

msg += "Message" + request.responseJSON.Message + "\n";

}

alert(msg);

}

var Customer = {

custid: 0,

name: "",

balance: 0,

city: "",

status: false

}

function AddCustomer() {

var obj = Customer;

obj.custid = $("#custid").val();

obj.name = $("#name").val();

obj.balance = $("#balance").val();

obj.city = $("#city").val();

obj.status = $("#status").is(":checked");

var options = {};

options.url = "http://localhost/CoreWebApiService/api/Customer";

options.type = "POST";

options.contentType = "application/json";

options.dataType = "json";

options.data = JSON.stringify(obj);

options.success = function () {

GetCustomers();

$("#divMsgs").html("Insert operations is successful.");

}

options.error = function () {

$("#divMsgs").html("Error while performing insert operation!");

}

$.ajax(options);

}

function UpdateCustomer(button) {

var obj = Customer;

obj.custid = $(button).data("custid");

obj.name = $(".input-name", $(button).parent().parent()).val();

obj.balance = $(".input-balance", $(button).parent().parent()).val();

obj.city = $(".input-city", $(button).parent().parent()).val();

obj.status = $(".input-status", $(button).parent().parent()).is(":checked");

var options = {};

options.url = "http://localhost/CoreWebApiService/api/customer";

options.type = "PUT";

options.contentType = "application/json";

options.dataType = "json";

options.data = JSON.stringify(obj);

options.success = function () {

GetCustomers();

$("#divMsgs").html("Update operations is successful.");

}

options.error = function () {

$("#divMsgs").html("Error while performing update operation!");

}

$.ajax(options);

}

function DeleteCustomer(button) {

$.ajax({

url: 'http://localhost/CoreWebApiService/api/customer/' + $(button).data("custid"),

type: 'DELETE',

dataType: 'json',

success: function () {

GetCustomers();

$("#divMsgs").html("Delete operations is successful.");

},

error: function () {

$("#divMsgs").html("Error while performing delete operation!");

}

});

}

</script>

</head>

<body style="background-color:cornflowerblue">

<form>

<table align="center" id="tblCustomers" border="1">

<thead>

<tr>

<th>Custid</th>

<th>Name</th>

<th>Balance</th>

<th>City</th>

<th>Status</th>

<th>Actions</th>

</tr>

</thead>

<tbody></tbody>

</table>

<br />

<div id="divMsgs" style="color:red"></div>

</form>

</body>

</html>

Right now, our project is a “WebApiProject” so we can run only “ApiControllers” whereas if we want to run our “MVCController” do the following:

**Step 1:** go to “Startup.cs” file in ASP.NET Core 5.0 or “Program.cs” file in ASP.Net Core 6.0 and change the method call “AddControllers” as “AddControllersWithViews” as below:

**ASP.NET Core 5.0:** go to ConfigureServices method in Startup class and do the below change:

**Old Code** => services.AddControllers();

**New Code** => services.AddControllersWithViews();

**ASP.NET Core 6.0:** go to Program class and do the below change:

**Old Code** => builder.Services.AddControllers();

**New Code** => builder.Services.AddControllersWithViews();

**Step 2:** also change the “EndPoint” configuration code as below:

**ASP.NET Core 5.0:**

**Old Code:**

app.UseEndpoints(endpoints =>

{

endpoints.MapControllers();

});

**New Code:**

app.UseEndpoints(endpoints =>

{

endpoints.MapControllerRoute(

name: "default",

pattern: "{controller=Home}/{action=Index}/{id?}"

);

endpoints.MapControllers();

});

**ASP.NET Core 6.0:** add this code just above the method call “app.MapControllers();”:

app.MapControllerRoute(

name: "default",

pattern: "{controller=Home}/{action=Index}/{id?}");

**Step 3:** host the “API Service on IIS” and then run the project using “IIS Web Server”.

**Step 4:** Go to “Web.config” file in the project and there we find a node “<system.webServer>” and under that we find “<handlers>” node, write the below statement inside of that <handlers> node:

<remove name="WebDAV" />

* Now under “<system.webServer>” node if you find “<modules>” node, add the below statement inside of it:

<remove name="WebDAVModule" />

* If you don’t find “<modules>” node, then write the below statements:

<modules><remove name="WebDAVModule" /></modules>

**Step 5:** run the “HomeController’s - Index” action method and test all the functionalities.

**Consuming our API Service in an MVC Controller using JQuery Ajax from Another Project:** If we want to consume an “API Service” from other projects first we need to enable “CORS” in our “API Service Project” and to do that make the below changes:

**ASP.NET Core 5.0** => go to “ConfigureServices” method of “Startup.cs” file and add “Cors Service” as below:

services.AddCors();

**ASP.NET Core 6.0** => go to “Program.cs” file and add “Cors Service” just above the statement “var app = builder.Build();”:

Builder.Services.AddCors();

**ASP.NET Core 5.0** => go to “Configure” method of “Startup.cs” file and add “Cors Middleware” as below (write this statement after “app.UseRouting();”) statement:

app.UseCors(options =>

{

options.AllowAnyOrigin();

options.AllowAnyMethod();

options.AllowAnyHeader();

});

**ASP.NET Core 6.0** => go to “Program.cs” file and add “Cors Middleware” just below the statement “var app = builder.Build();”:

app.UseCors(options =>

{

options.AllowAnyOrigin();

options.AllowAnyMethod();

options.AllowAnyHeader();

});

Now create a new “ASP.NET Core Web App (Model-View-Controller)” project naming it as “CoreWebApiConsumer1”. Add a Controller in the project naming it as “TestApiController”, add a View to the default “Index” action method, copy the whole code of “Index View” present in “HomeController” of our previous project i.e., “CoreWebApiService”, paste it in “Index View” of the current project and run it.

**Consuming our API Service in an MVC Controller using C# Code from Another Project:** In the above case we have seen how to consume an API Service in an MVC Project using JQuery AJAX, whereas if we want to consume it from Action Methods of an MVC Controller using C#, do the following.

**Step 1:** Create a “ASP.NET Core Web App (Model-View-Controller)” project naming it as “CoreWebApiConsumer2”, add a new class in the Models folder naming it as “Customer” and write the below code in the class:

public class Customer

{

public int Custid { get; set; }

public string Name { get; set; }

public decimal? Balance { get; set; }

public string City { get; set; }

public bool Status { get; set; }

}

**Step 2:** Install “Microsoft.AspNet.WebApi.Client” library using NuGet Package Manager.

**Step 3:** Add a Controller in the project naming it as “TestApiController”, delete all the existing code in the class and write the below code in the class:

using System.Net.Http;

using Newtonsoft.Json;

using CoreWebApiConsumer2.Models;

public class TestApiController : Controller

{

HttpClient client = new HttpClient();

String serviceUri = "http://localhost/CoreWebApiService/api/";

public async Task<IActionResult> DisplayCustomers()

{

List<Customer> customers = new List<Customer>();

client.BaseAddress = new Uri(serviceUri);

HttpResponseMessage response = await client.GetAsync("Customer");

if (response.IsSuccessStatusCode)

{

string result = response.Content.ReadAsStringAsync().Result;

customers = JsonConvert.DeserializeObject<List<Customer>>(result);

}

return View(customers);

}

public async Task<IActionResult> DisplayCustomer(int Custid)

{

Customer customer = new Customer();

client.BaseAddress = new Uri(serviceUri);

HttpResponseMessage response = await client.GetAsync("Customer/" + Custid);

if (response.IsSuccessStatusCode)

{

string result = response.Content.ReadAsStringAsync().Result;

customer = JsonConvert.DeserializeObject<Customer>(result);

}

return View(customer);

}

public IActionResult AddCustomer()

{

Customer customer = new Customer();

return View(customer);

}

[HttpPost]

public async Task<IActionResult> AddCustomer(Customer customer)

{

client.BaseAddress = new Uri(serviceUri);

HttpResponseMessage response = await client.PostAsJsonAsync("Customer", customer);

if (response.IsSuccessStatusCode)

return RedirectToAction("DisplayCustomers");

else

return View();

}

public async Task<IActionResult> EditCustomer(int Custid)

{

Customer customer = new Customer();

client.BaseAddress = new Uri(serviceUri);

HttpResponseMessage response = await client.GetAsync("Customer/" + Custid);

if (response.IsSuccessStatusCode)

{

string result = response.Content.ReadAsStringAsync().Result;

customer = JsonConvert.DeserializeObject<Customer>(result);

}

return View(customer);

}

public async Task<IActionResult> UpdateCustomer(Customer customer)

{

client.BaseAddress = new Uri(serviceUri);

HttpResponseMessage response = await client.PutAsJsonAsync("Customer", customer);

if (response.IsSuccessStatusCode)

return RedirectToAction("DisplayCustomers");

else

return View("EditCustomer");

}

public async Task<IActionResult> DeleteCustomer(int Custid)

{

client.BaseAddress = new Uri(serviceUri);

HttpResponseMessage response = await client.DeleteAsync("Customer/" + Custid);

if (!response.IsSuccessStatusCode)

ModelState.AddModelError("", "Delete action resulted in an error");

return RedirectToAction("DisplayCustomers");

}

}

**Step 4:** Add Views to “DisplayCustomers”, “DisplayCustomer”, “AddCustomers” and “EditCustomer” actions methods and write the below code over there:

**DisplayCustomers.CShtml:**

@model IEnumerable<Customer>

<h2 style="text-align:center;background-color:yellowgreen;color:red">Customer Details</h2>

<table border="1" align="center" class="table-condensed">

<tr>

<th>@Html.DisplayNameFor(C => C.Custid)</th>

<th>@Html.DisplayNameFor(C => C.Name)</th>

<th>@Html.DisplayNameFor(C => C.Balance)</th>

<th>@Html.DisplayNameFor(C => C.City)</th>

<th>@Html.DisplayNameFor(C => C.Status)</th>

<th>Actions</th>

</tr>

@foreach (Customer customer in Model)

{

<tr>

<td align="center">@Html.DisplayFor(C => customer.Custid)</td>

<td>@Html.DisplayFor(C => customer.Name)</td>

<td>@Html.DisplayFor(C => customer.Balance)</td>

<td>@Html.DisplayFor(C => customer.City)</td>

<td align="center">@Html.DisplayFor(C => customer.Status)</td>

<td>

<a **asp-action**="DisplayCustomer" **asp-route-Custid**="@customer.Custid">View</a> &nbsp;

<a **asp-action**="EditCustomer" **asp-route-Custid**="@customer.Custid">Edit</a> &nbsp;

<a **asp-action**="DeleteCustomer" **asp-route-Custid**="@customer.Custid"

onclick="return confirm('Are you sure of deleting the record?')">Delete</a>

</td>

</tr>

}

<tr><td colspan="6" align="center"><a **asp-action**="AddCustomer">Add New Customer</a></td></tr>

</table>

**DisplayCustomer.cshtml:**

@model Customer

<h2 style="text-align:center;background-color:yellowgreen;color:red">Customer Details</h2>

<table border="1" align="center">

<tr><td>Custid: </td><td>@Model.Custid</td></tr>

<tr><td>Name: </td><td>@Model.Name</td></tr>

<tr><td>Balance: </td><td>@Model.Balance</td></tr>

<tr><td>City: </td><td>@Model.City</td></tr>

<tr><td>Status: </td><td>@Model.Status</td></tr>

</table>

<div style="text-align:center">

<a **asp-action**="DisplayCustomers" align="center">Back to Customer Details</a>

</div>

**AddCustomer.cshtml:**

@model Customer

<form **asp-controller**="TestApi" **asp-action**="AddCustomer" method="post">

<div><label **asp-for**="Custid"></label><br /><input **asp-for**="Custid" /></div>

<div><label **asp-for**="Name"></label><br /><input **asp-for**="Name" /></div>

<div><label **asp-for**="Balance"></label><br /><input **asp-for**="Balance" /></div>

<div><label **asp-for**="City"></label><br /><input **asp-for**="City" /></div>

<div><label **asp-for**="Status"></label><br /><input **asp-for**="Status" /></div>

<div>

<input type="submit" value="Save" />

<input type="reset" value="Reset" />

</div>

</form>

<div>

<a **asp-action**="DisplayCustomers" align="center">Back to Customer Details</a>

</div>

**EditCustomer.cshtml:**

@model Customer

<form **asp-controller**="TestApi" **asp-action**="UpdateCustomer" method="post">

<div><label **asp-for**="Custid"></label><br /><input **asp-for**="Custid" readonly /></div>

<div><label **asp-for**="Name"></label><br /><input **asp-for**="Name" /></div>

<div><label **asp-for**="Balance"></label><br /><input **asp-for**="Balance" /></div>

<div><label **asp-for**="City"></label><br /><input **asp-for**="City" /></div>

<div><label **asp-for**="Status"></label><br /><input **asp-for**="Status" /></div>

<div>

<input type="submit" value="Update" />

<input type="reset" value="Reset" />

</div>

</form>

<div>

<a **asp-action**="DisplayCustomers" align="center">Back to Customer Details</a>

</div>

**Integrating Angular into MVC Core Projects**

**Step 1:** Visit the site <https://nodejs.org/en/> and install the latest version of node, which will also install the tool “npm (Node Package Manager)” on our machines. After installation is completed, open “Windows Command Prompt”, and use the below commands to check the versions of “node” and “npm”.

**Checking the version of node:** node -v

**Checking the version of npm:** npm -v

**Step 2:** Install “Type Script” and “Angular CLI” by using the below commands on Windows Command Prompt:

**Installing Type Script:** npm install -g typescript

**Installing Angular CLI:** npm install -g @angular/cli

**Step 3:** Create a new “ASP.NET Core Web App (Model-View-Controller)” project naming it as “AngularInMVCCore”. Add a new folder under the project naming it as “Angular”, right click on the new folder and select “Open Folder in File Explorer”, this opens a window, in that window in the Path TextBox, enter “cmd” and hit enter which will open Windows Command Prompt pointing to the folder location and, in this folder, we are going to create an Angular Project with the help of “Angular CLI” using the command “ng new <Project Name>”, for example:

**<drive>:\<Personal Folder>\AngularInMVCCore\AngularInMVCCore\Angular>** ng new FirstProject

This command when executed will ask for adding Angular Routing, choose “No”, and then it will ask which Style Sheet Format you would like to use, choose “CSS”. This will install Angular in the “FirstProject” folder which is created under “Angular” folder.

**Now change to the new folder by using “cd FirstProject” which will change us to:**

**<drive>:\<Personal Folder>\AngularInMVCCore\AngularInMVCCore\Angular\FirstProject>**

**If you want to run the Angular Project and test it use the below command and hit enter:**

**<drive>:\<Personal Folder>\AngularInMVCCore\AngularInMVCCore\Angular\FirstProject>** ng s -o

This will open browser and displays the output, and right now this output is coming from “app.component.html” file which is present under “FirstProject” we have created and to check that go to “Visual Studio” and under “Angular” Folder we find the project Folder i.e., “FirstProject” and under that we will find “src” folder and under that we find “app” folder which will contain the file “app.component.html”, open it, delete the whole content in it and write the below code over there:

<h1>Hello World</h1>

Now come back to Command Prompt and run the project again by using “ng s -o” command, which will display the modified output i.e., “Hello World”.

**Step 4:** To integrate Angular with MVC we need to do some changes in “angular.json” file of “FirstProject” which is the configuration file of the project. By default when we build an Angular Project it will generate output files in “dist/FirstProject” folder which is created under the “FirstProject” folder but if we want to integrate Angular with MVC they should be stored under “wwwroot” folder, so we need to create a folder under “wwwroot” with the name “AngularScripts” and then storing the generated build files into that folder and to do that change the location of Output Path Directory in “angular.json” file as following:

**Old Value =>** "outputPath": "dist/FirstProject"

**New Value =>** "outputPath": "../../wwwroot/AngularScripts"

By default every output file that is generated by Angular will be having an “hash key” suffixed to it and that “hash key” value will be changing whenever we make a modification in “Angular Project” so we need to copy the new files every time in to our MVC Project Code and to avoid this we can ask the compiler not to generate an hash value so that the file names will not be changing whenever we make modifications and to do that change the “outputHashing” attribute value to “none” in “angular.json” file which is “all” by default, as following:

**Old Value =>** "outputHashing": "all"

**New Value =>** "outputHashing": "none"

Now save the changes, go to Command Prompt, and then build the project using “ng build -watch” command as following:

**<drive>:\<Personal Folder>\AngularInMVCCore\AngularInMVCCore\Angular\FirstProject>** ng build --watch

**Note:** This will add a new folder under “wwwroot” folder with the name “AngularScripts” and this happens when we build the project for the first time.

Now add a new Controller in Controllers folder naming it as “TestAngular” and add a View to the Index action method, delete the whole content in the file, and then under the “AngularScripts” folder we will find a file “index.html”, open it, copy the whole content in that file and paste it in to our “Index.cshtml” file. Now in the copied code under “<body>” tag we find 3 “<script>” tags that refers to the files “runtime.js”, “polyfills.js” and “main.js” of “AngularScripts” folder.

Right now, we copied the code of “index.html” present in “AngularScirpts” to “Index.cshtml” file, which is present in a different folder, so we need to update the path of those scripts files for pointing them to “AngularScripts” folder as following:

**Existing Code:** **Modified Code:**

<script src="runtime.js" defer></script> => <script src="~/AngularScripts/runtime.js" defer></script>

<script src="polyfills.js" defer></script> => <script src="~/AngularScripts/polyfills.js" defer></script>

<script src="main.js" defer></script> => <script src="~/AngularScripts/main.js" defer></script>

Now run the “TestAngular” controller and invoke the “Index” action method which will execute the angular code and display’s the output here, so whenever we make changes in the “Angular” Project re-compile it and run “Index.cshtml” again.