ASP.NET Core Introduction

ASP.NET Core, MVC, Controllers & Actions,

Creating an ASP.NET Core MVC app

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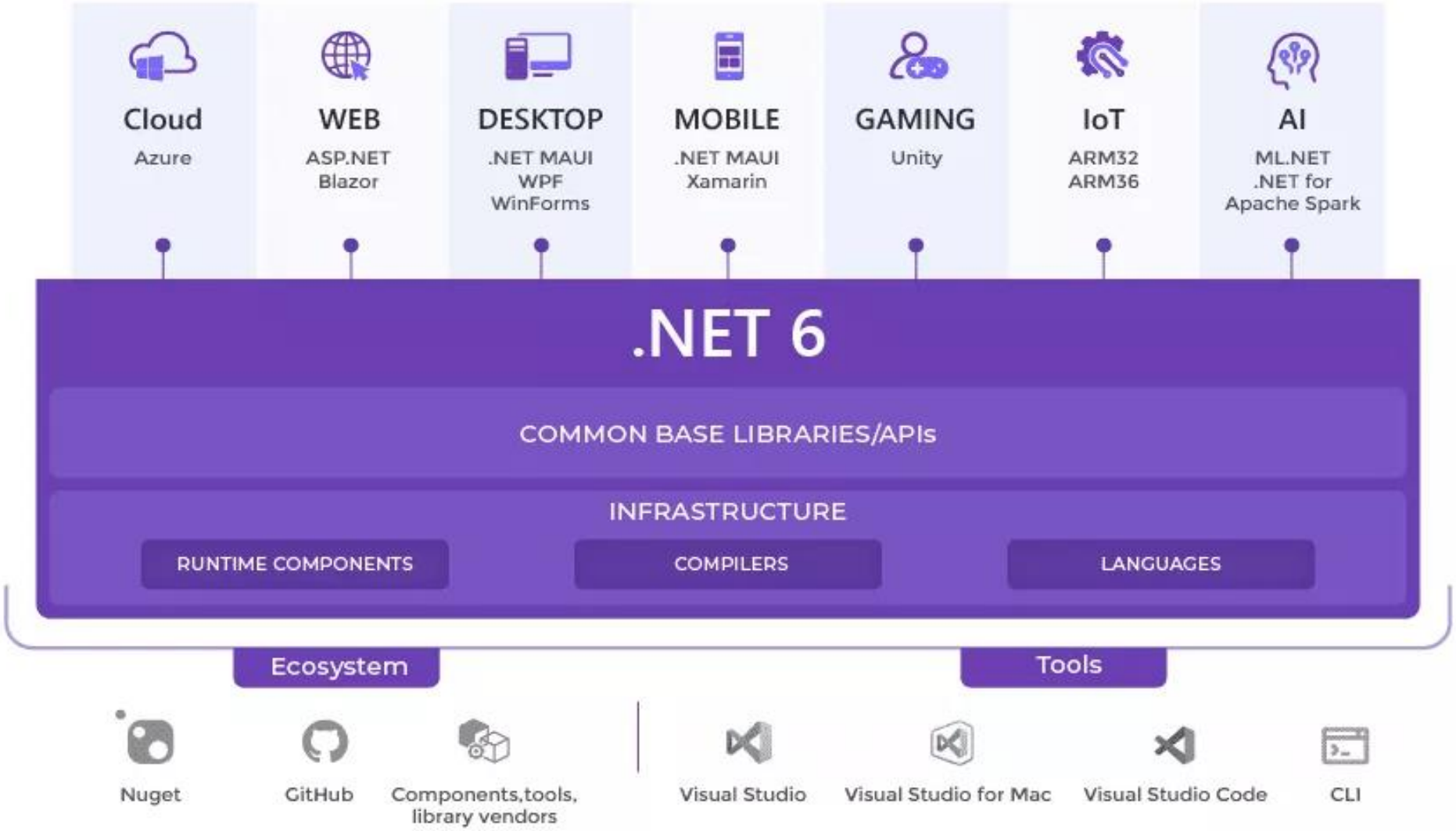
#csharp-web

ASP.NET Core

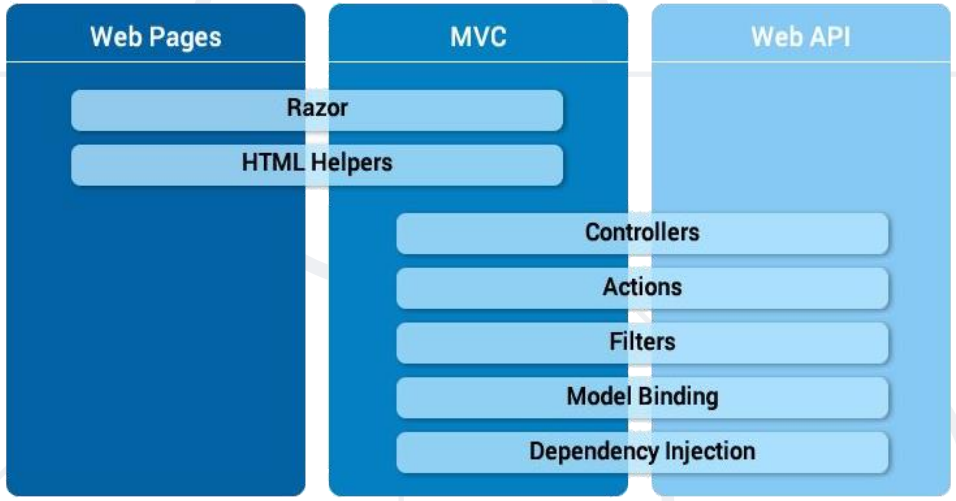
Overview

.NET Core: Bird's Eye View



ASP.NET Core Overview (1)

- **ASP.NET Core** is a cross-platform open-source back-end development framework for C#



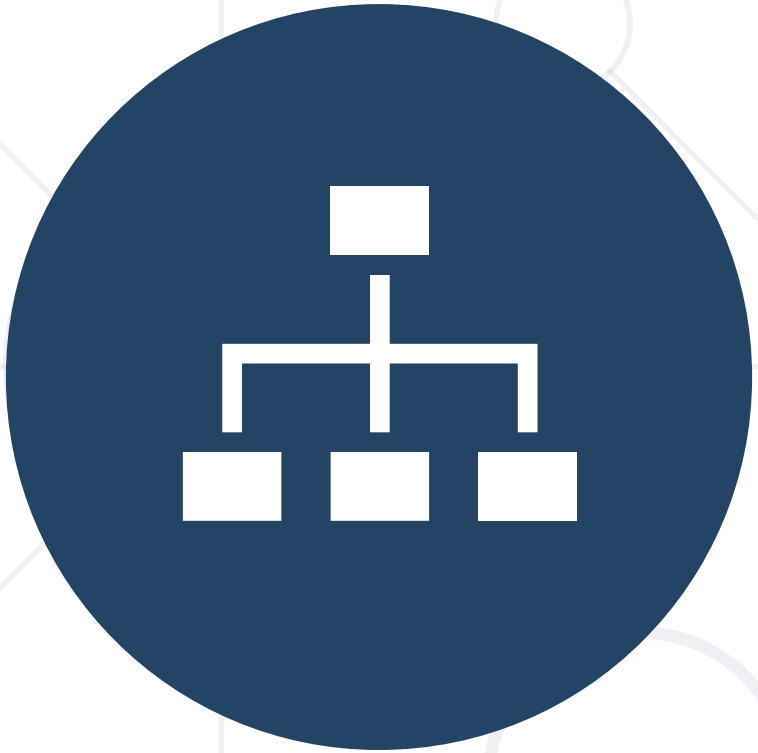
  - ASP.NET Core **Web Pages**: build simple Web apps
  - ASP.NET Core **MVC**: build server-side Web apps
  - ASP.NET Core **Web API**: build Web services and REST APIs

ASP.NET Core Overview (2)

- Great documentation: https://docs.microsoft.com/en-us/aspnet
- **ASP.NET Core** provides
  - Integration of modern client-side frameworks (Angular, React, Blazor, etc.)
  - Development workflows (MVC, WebAPI, Razor Pages, SignalR)
- **ASP.NET Core** applications run both on **.NET Core** and **.NET Framework**

ASP.NET Core Main Features

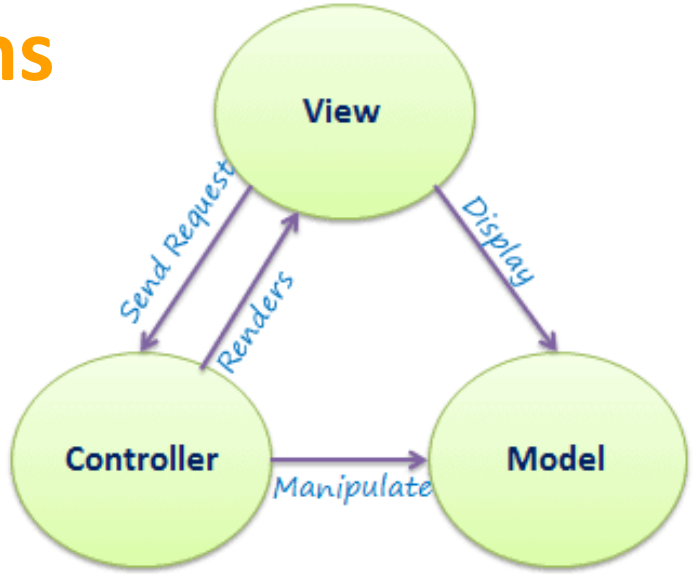
- A **unified framework** for building web UI and web APIs, architected for testability
- Ability to develop and run on **Windows, macOS and Linux**
  - Ability to host on IIS, Nginx, Apache, Docker or self-host in your own process
- Built-in **dependency injection**
- A lightweight, high-performance and modular HTTP request pipeline (**middlewares**)
- **Razor Pages** is a page-based programming model that makes building web UI easier
- **Blazor** lets you use C# in the browser and share server-side and client-side app logic
- **Razor markup** provides syntax for Razor Pages, **MVC** views and Tag Helpers
- Cloud-ready, environment-based configuration system
- Side-by-side app versioning
- Tooling that simplifies modern web development (Visual Studio, VS Code, CLI)



The MVC Pattern

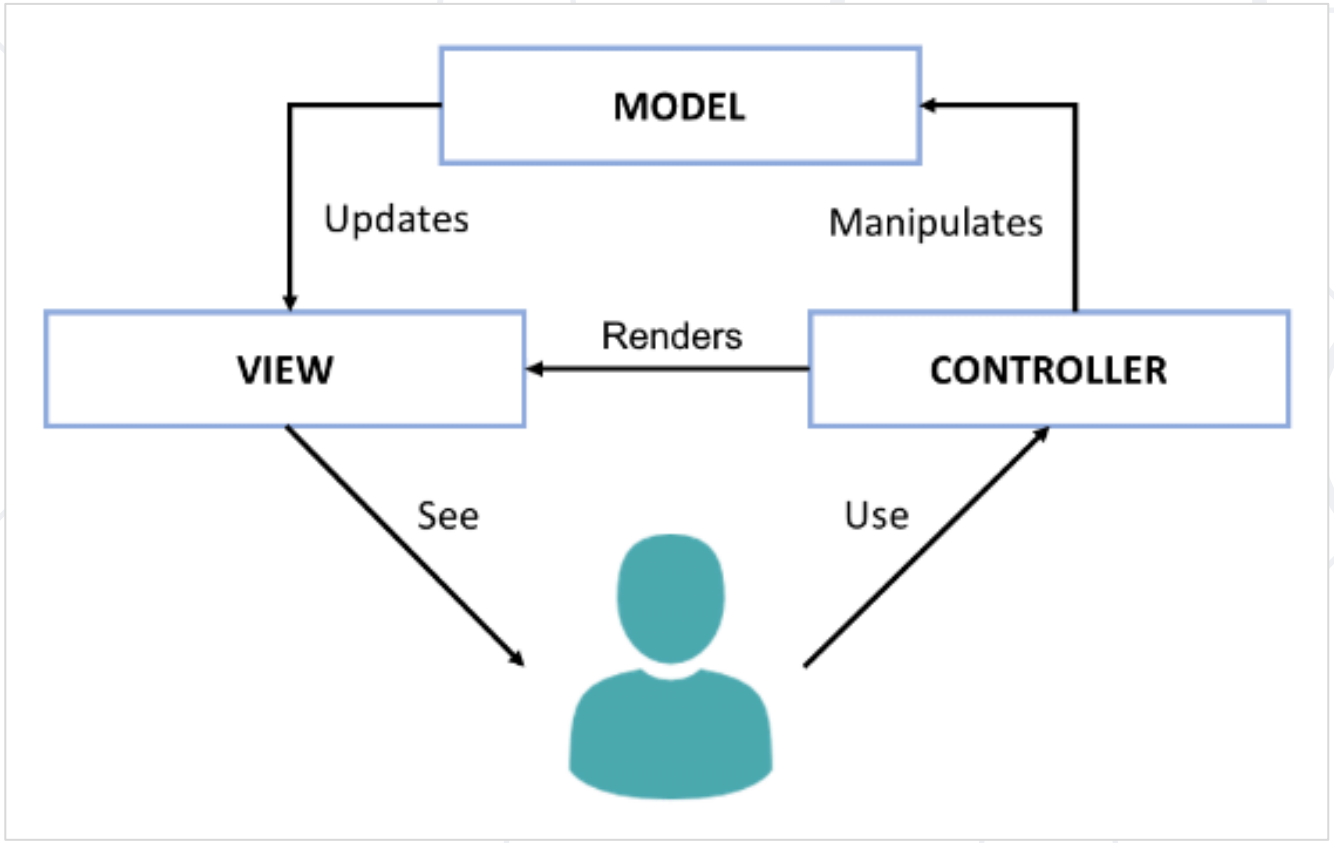
The MVC Pattern

- **Model–View–Controller** (MVC) is a **software architectural pattern**
- Originally formulated in the late 1970s by Trygve Reenskaug as part of the **Smalltalk** (object-oriented programming language)
- **Code reusability** and **separation of concerns**
- Originally developed for **desktop**, then adapted for **internet applications**



The Model-View-Controller (MVC) Pattern

- The **Model-View-Controller** (**MVC**) pattern



- **Controller**
  - Handles user actions
  - Updates the model
  - Renders the view (UI)
- **Model**
  - Holds app data
- **View**
  - Displays the UI, based on the model data

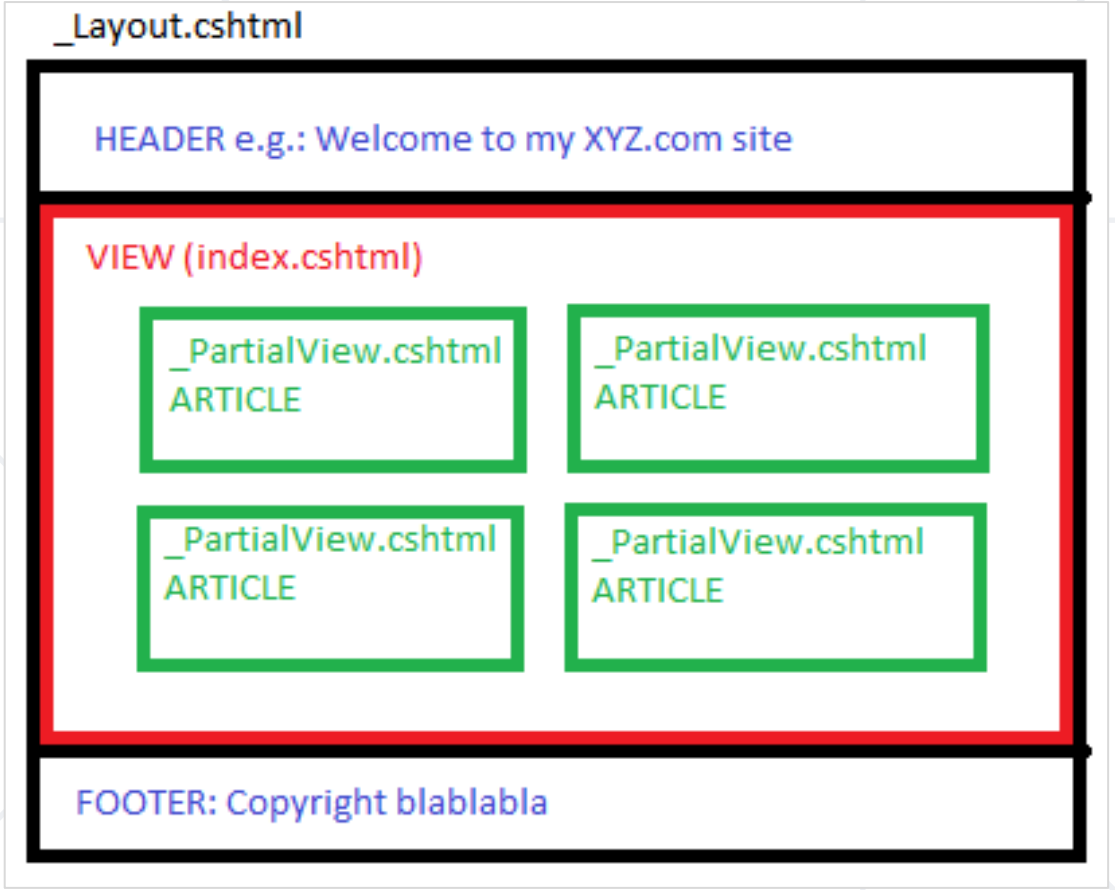
Controller

- The **Controller** in **MVC** represents
  - **Processes user's actions** and produces a response
  - Process the requests with the help of **Views** and **Models**
  - A set of classes that handles
    - Communication from the user
    - Overall application flow
    - Application-specific logic
  - Every **Controller** has one or more "**Actions**"

Controller	Action
AccountController	Login
AccountController	Login
AccountController	LogOff
AccountController	MixPanelApiToken

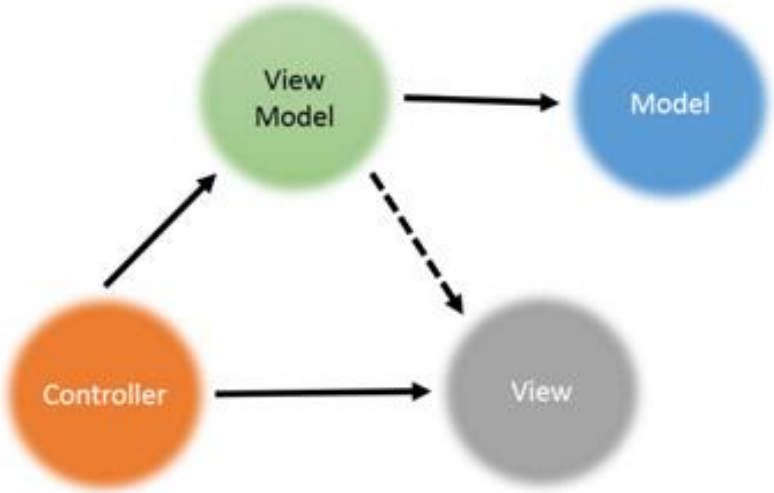
View

- The **View** in **MVC** represents
  - Defines how the application's user interface (**UI**) will be displayed
  - May support **Master Views** (**layouts**) and **Sub-Views** (**partial views** or controls)
  - In Web apps: template to dynamically generate HTML



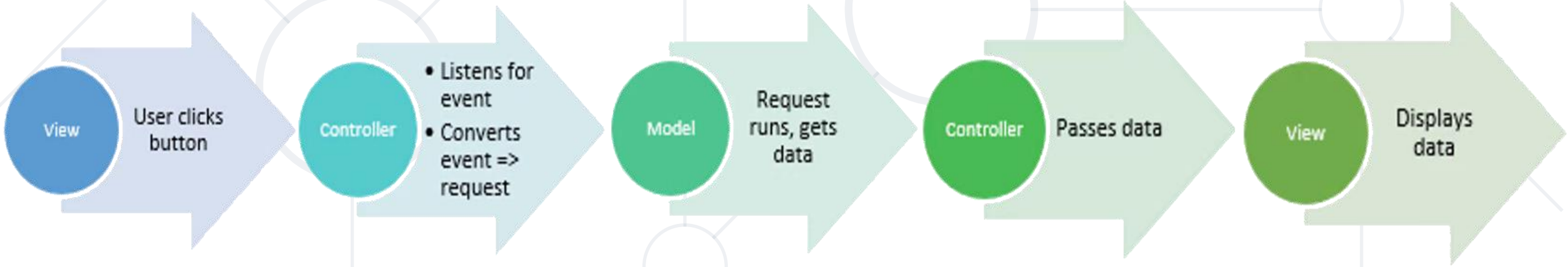
Model

- The **Model** in **MVC** represents
  - A **set of classes** that describes the **data** we display in the UI
  - May contain **data validation rules**
- Two types of models
  - **View model / binding model**
    - Maps the UI of the Web page to C# class
    - Part of the **MVC** architecture
  - **Database model / domain model**
    - Maps database table to C# class (using ORM)



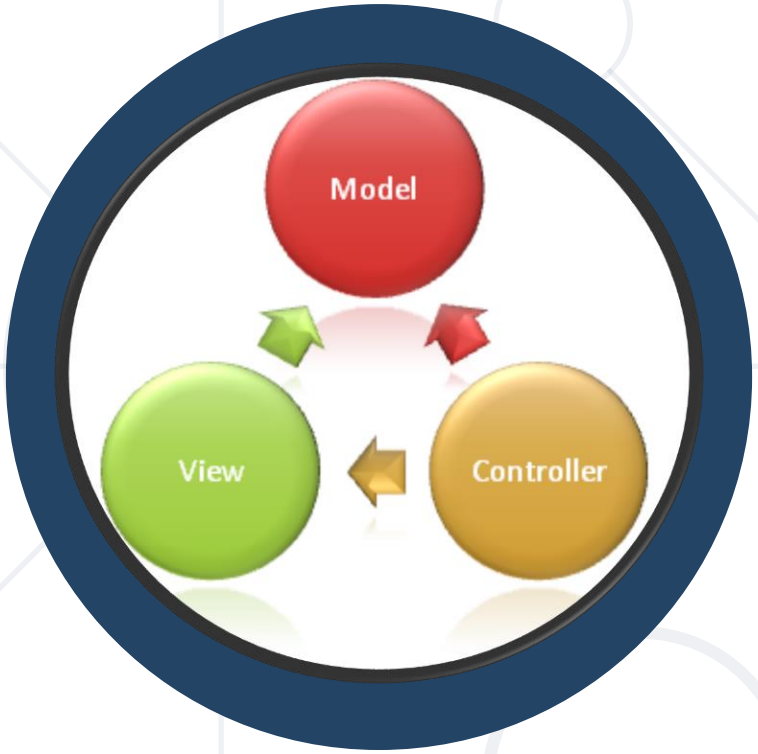
MVC Steps

- Incoming **Request** routed to **Controller**
- **Controller** processes **Request** and creates a **Model** (view model)
  - Controller also selects **appropriate result** (for example: **View**)
- **Model** is passed to the **View**
- **The View** transforms **Model** into appropriate output format (HTML)
- **Response** is rendered (**HTTP Response**)



Web MVC Frameworks

- **Web MVC frameworks** are used to build Web applications
  - It provides the MVC **structure** and **engine** to build Web apps
  - **Controllers** handle HTTP GET / POST requests and render a view
  - **Views** display HTML + CSS, based on the models
  - **Models** hold app data for views, prepared by controllers
- Examples of Web MVC frameworks
  - **ASP.NET Core MVC** (C#), **Spring MVC** (Java), **Express** (JS), **Django** (Python), **Laravel** (PHP), **Ruby on Rails** (Ruby), **Revel** (Go), …



ASP.NET Core MVC

Overview

ASP.NET Core MVC Overview

- **ASP.NET Core MVC** provides features for building web APIs and web apps
  - Uses the **Model-View-Controller (MVC)** design pattern
  - Lightweight, open source, testable, good tooling
  - **Razor** markup for Razor Pages and MVC views
  - RESTful services with **ASP.NET Core Web API**
    - Built-in support for multiple data formats, content negotiation and CORS
  - Achieve high-quality architecture design, optimizing developer work
    - **Convention over Configuration**
  - **Model binding** automatically maps data from HTTP requests
  - **Model validation** with client-side and server-side validation
  - Often combined with **Entity Framework** for **ORM**

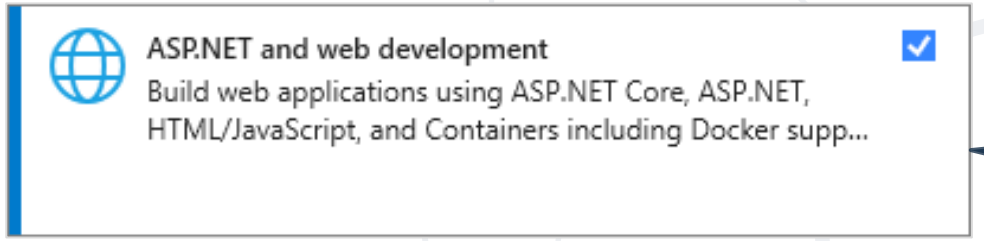
ASP.NET Core MVC Features

- **Routing** for mapping requests
- **Dependency injection** for injecting components at runtime
- Strongly-typed views with the **Razor view engine**
- **Model binding** automatically maps data from HTTP requests
- **Model validation** with client-side and server-side validation
- **Tag helpers** enable server-side code in HTML elements
- Filters, Areas, Middlewares
- Built-in security features
- **Identity** with users and roles
- And many more…

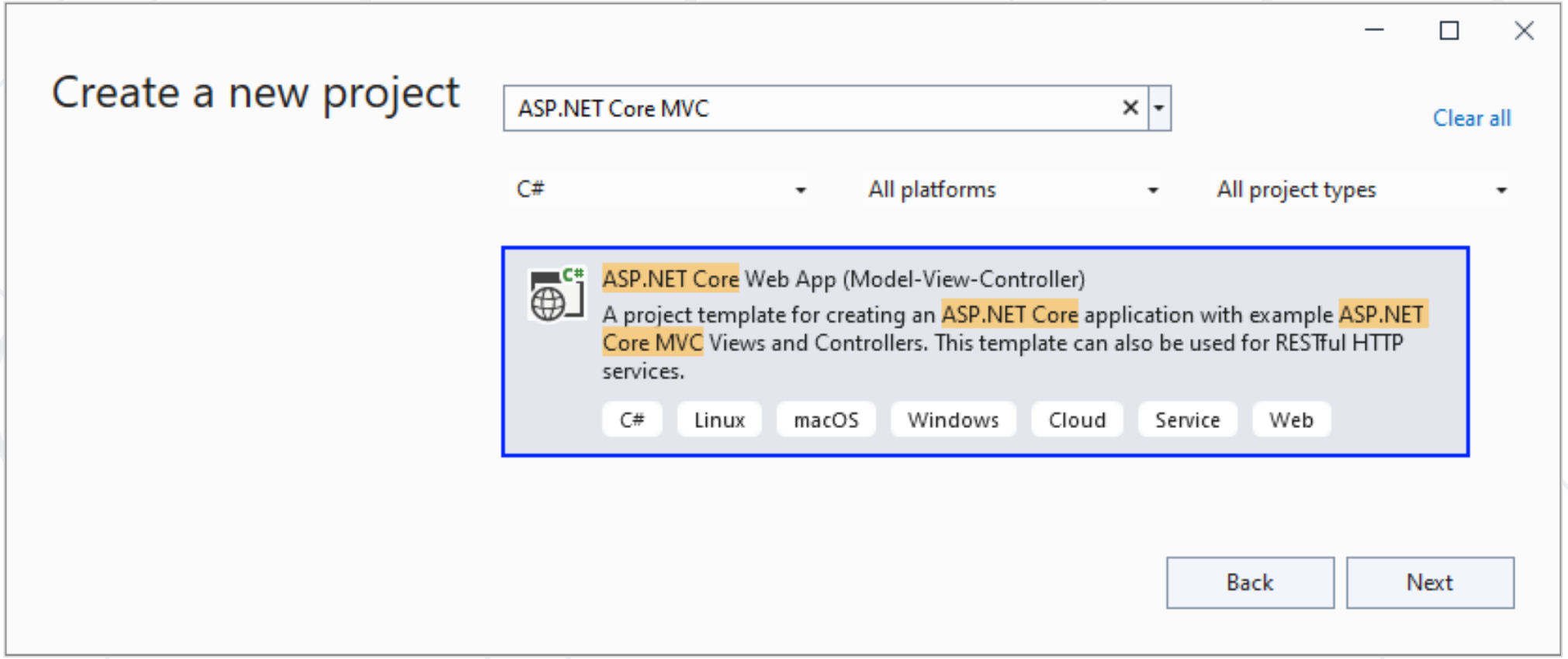
Creating an ASP.NET Core MVC App

Project Setup in Visual Studio. What's Inside?

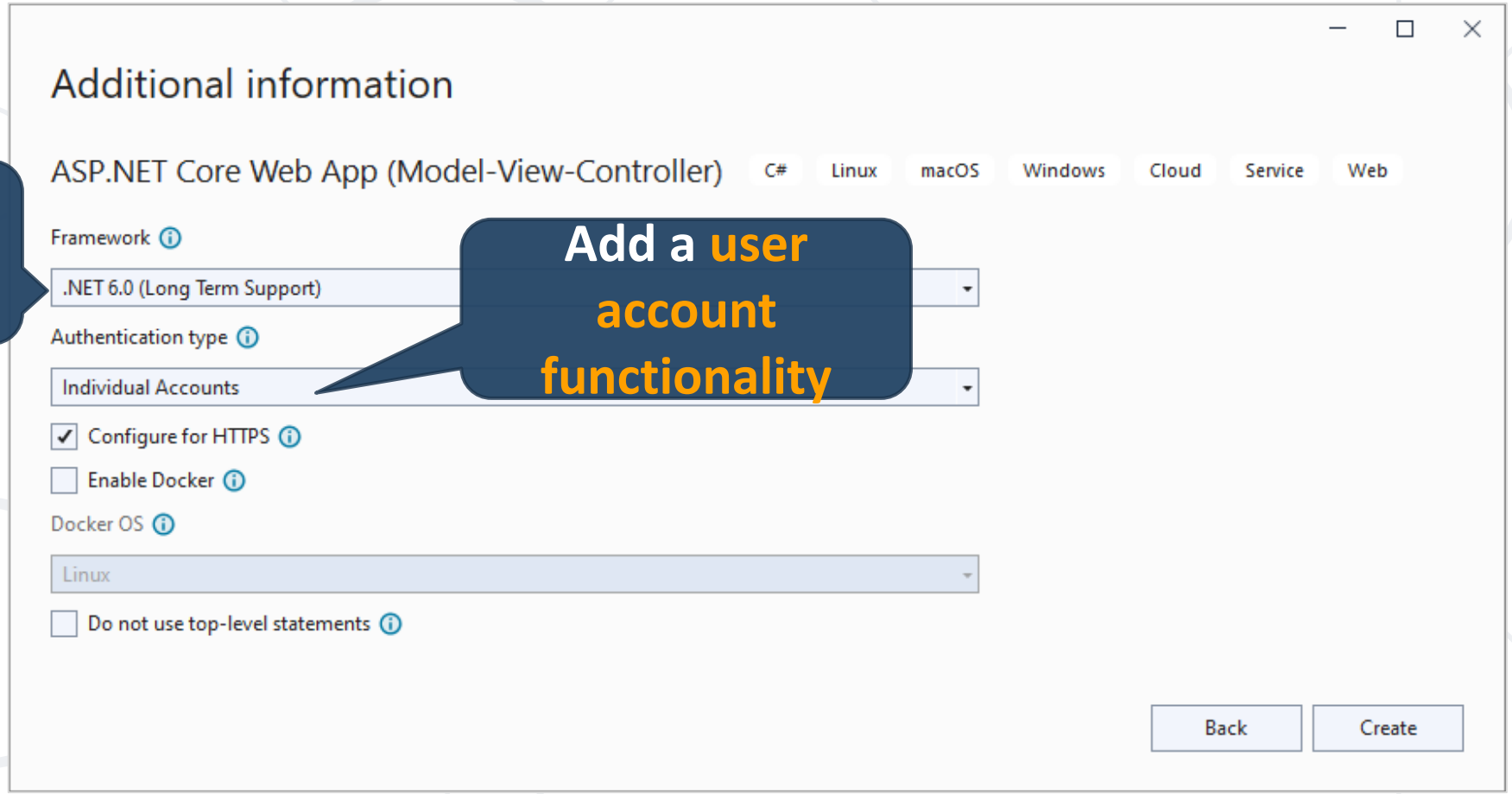
Create ASP.NET Core MVC App Project



Install this in **Visual Studio**!



Create ASP.NET Core MVC App: Choose Template



Choose the .NET version

Add a user account functionality

MVC App: What's Inside?

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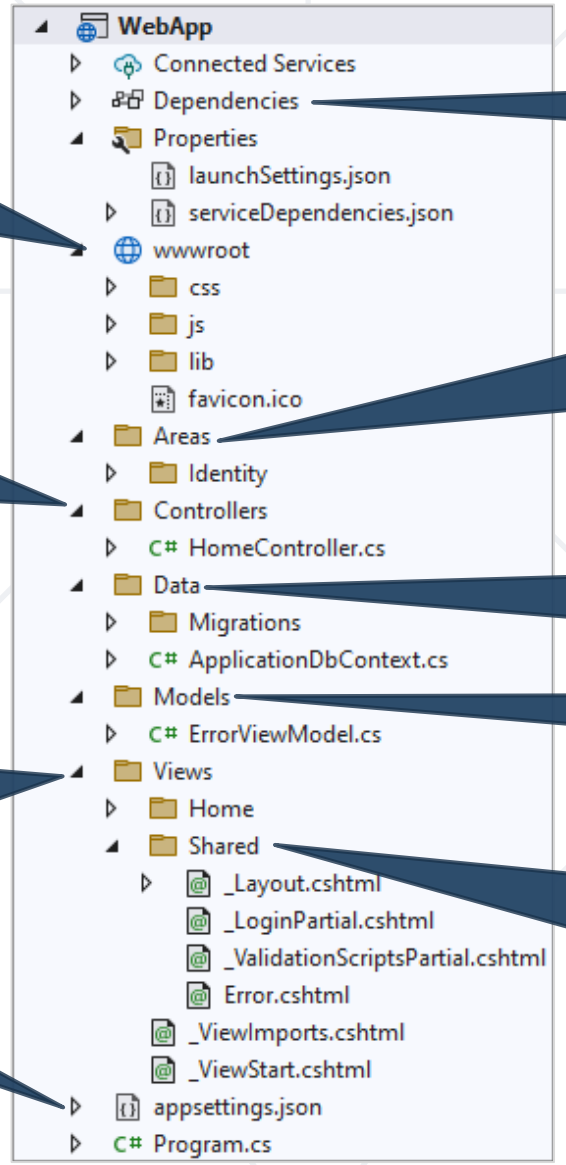
Static files: CSS styles. images, fonts, …

Controller classes holding actions

Views: HTML templates for the pages

App start files



NuGet packages + Projects References

Areas: physically partition a web app in separate units

Data: EF models + DB context + migrations

Models: view models

Shared views: layout for all pages + partial views

Controllers

- MVC controllers hold logic to process user actions
- The URL **/Home/About** invokes **HomeController** → **About()**

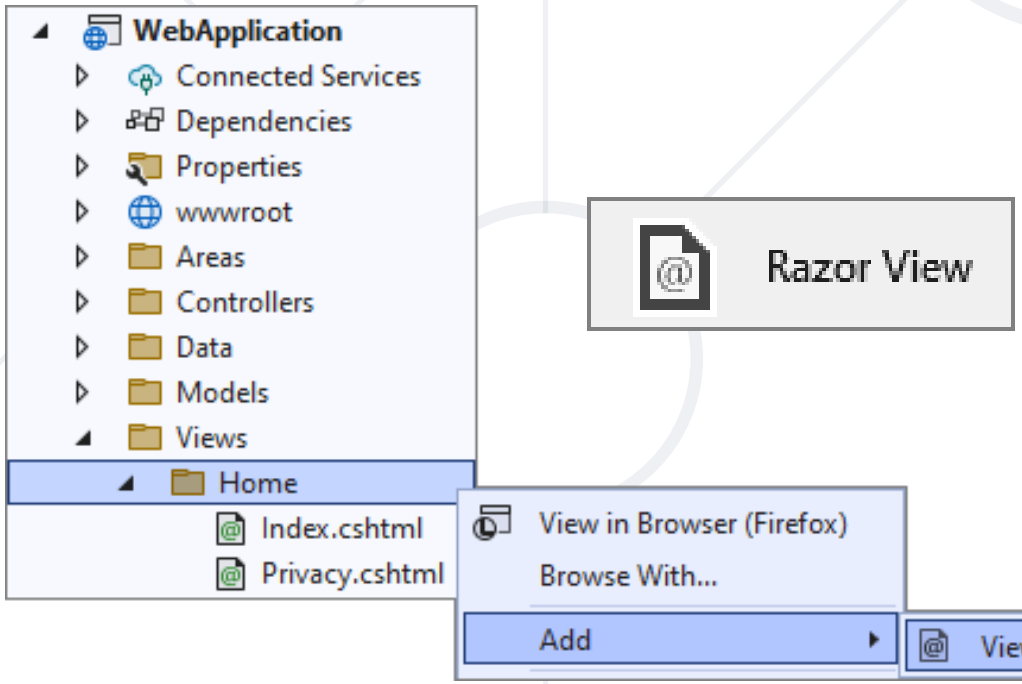
\Controllers\HomeController.cs

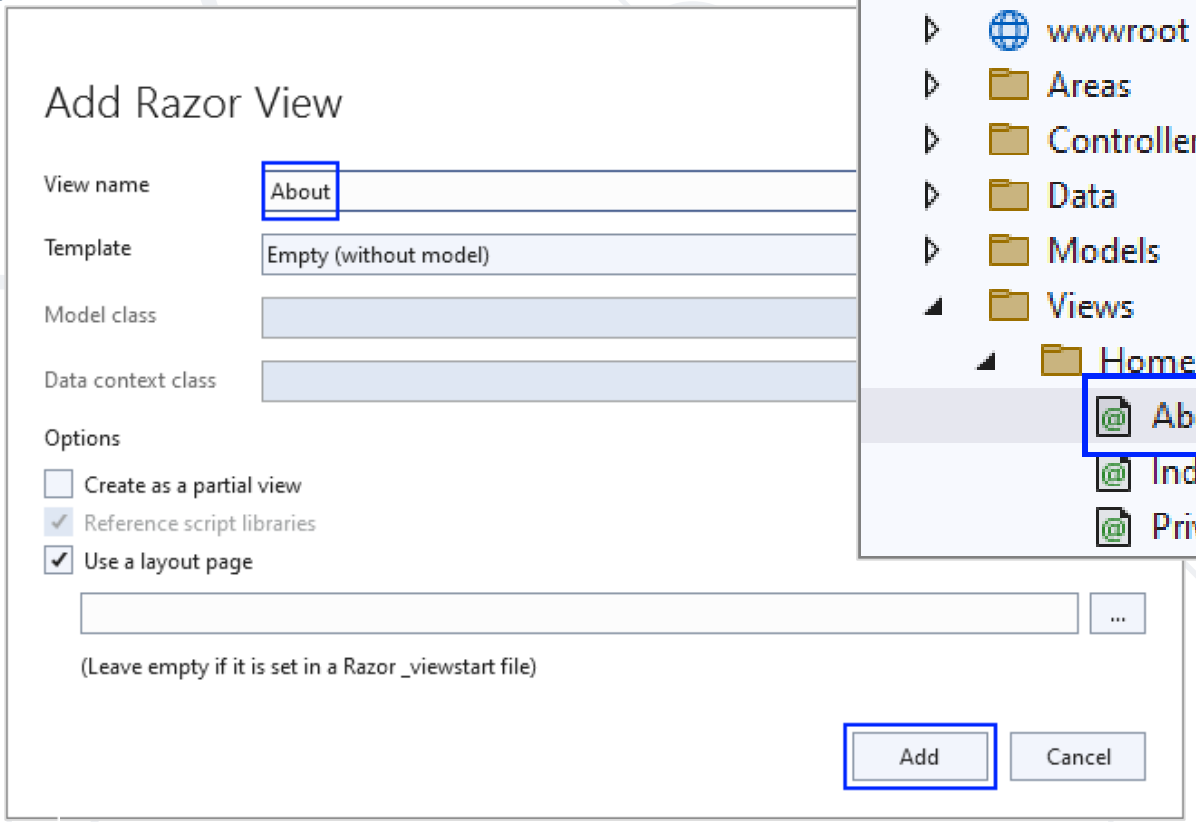
```
public class HomeController : Controller
{
    public ActionResult About()
    {
        ViewBag.Message = "This is an ASP.NET Core MVC app.";
        return View();
    }
}
```

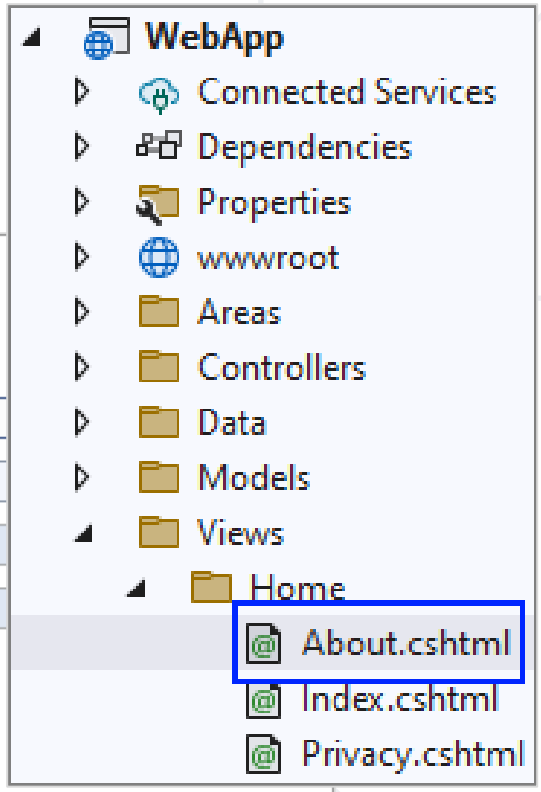
Renders
\Views\Home\About.cshtml

Views (1)

- **Views** render the **HTML code** for the invoked action
- Create **About.cshtml** view







Views (2)

- ASP.NET MVC uses **Razor** view engine
- Views combine HTML with C# code

\Views\Home\About.cshtml

```
@{
  ViewBag.Title = "About";
}

<h2>@ViewBag.Title</h2>
<h3>@ViewBag.Message</h3>

<p>Use this area to provide additional information.</p>
```

@ { … } inserts C# code block

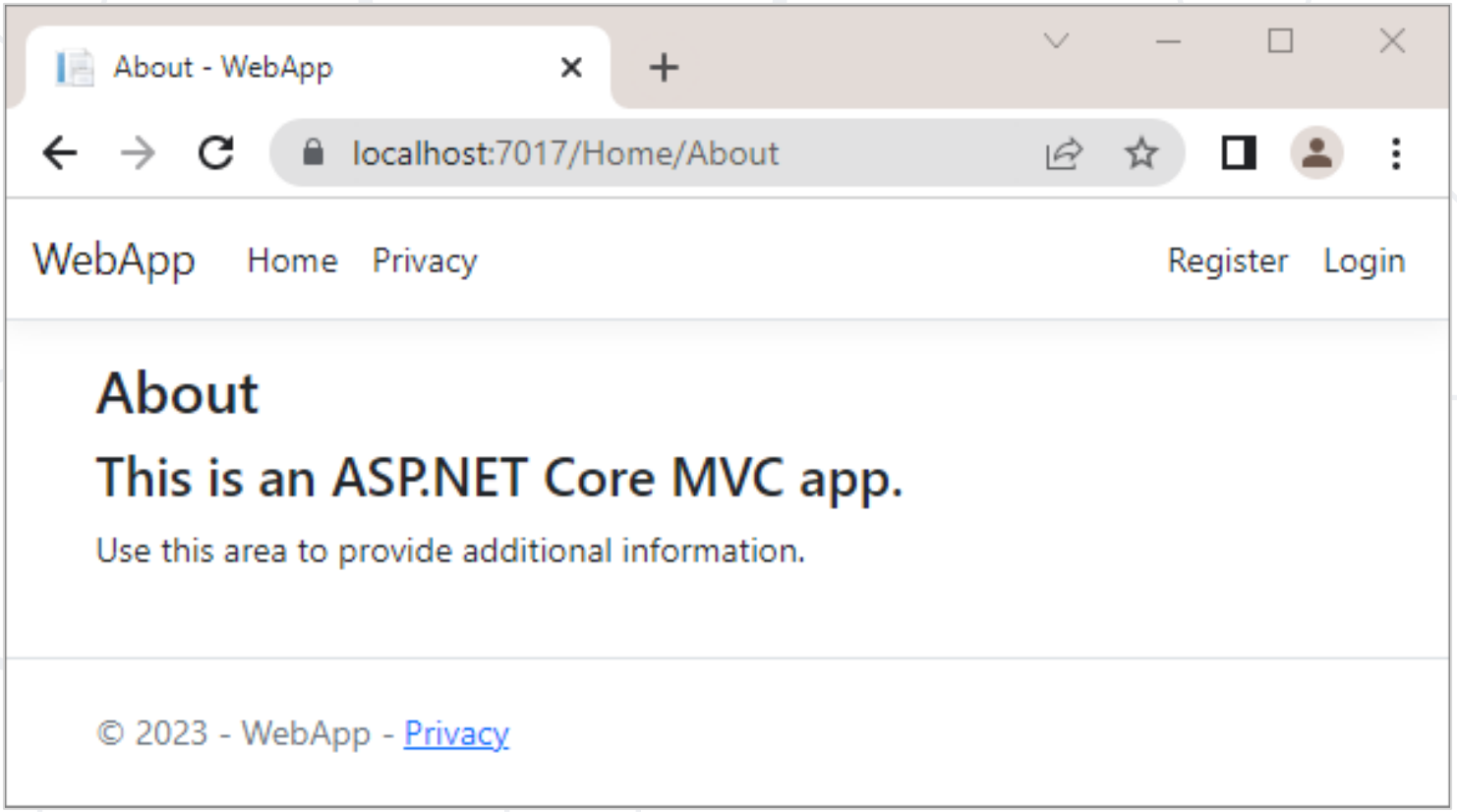
@Something
prints a C# variable

Everything else is HTML code

The "About" Page in the Browser

- Run the app, by pressing **[Ctrl + F5]**
  - Open the "**About**" page on https://localhost:44364/Home/About

The **port number** is auto-generated



Controllers and Actions

Controllers

- All controllers should be in the "**Controllers**" folder
- Controller naming standard should be **{name}Controller**
- Every controller should inherit the **Controller** class
  - Access to **Request**, **Response**, **HttpContext**, **RouteData**, **TempData**, etc.
- Routes select Controllers in every request

```
\Controllers\UsersController.cs
```

```
public class UsersController : Controller
{
  public IActionResult All() => View();
}
```

Mapped to URL "/Users/All"

Actions

- **Actions** are the ultimate **Request** destination
  - Public controller methods
  - Non-static
  - No return value restrictions
- Actions typically return an **IActionResult**

```
public IActionResult Details(int id)
{
    var viewModel = this.dataService.GetById(id).To<DetailsViewModel>();
    return this.View(viewModel);
}
```

Action Results (1)

- **Action result** == controller's response to a browser request
  - Represent various **HTTP status codes**
- Inherit from the base **`ActionResult`** class

```
public IActionResult Index()
{
    return Json(_dataService.GetData());
}
```

```
public IActionResult GetFile()
{
    return File(fileStream, mimeType, fileName);
}
```

```
private const string AppVersion = "v.1.0.0";

public IActionResult Version()
{
    return Content(AppVersion);
}
```

```
public IActionResult LoginConfirm(string username,
    string password)
{
    return Redirect("/Home/Index");
}
```

Action Results (2)

Name	Framework Behavior	Helping Method
`StatusCodeResult`	Returns an HTTP Response Result with given Status	`StatusCode()` / `Ok()` `BadRequest()` / `NotFound()`
`JsonResult`	Returns data in JSON format	`Json()`
`RedirectResult`	Redirects the client to a new URL	`Redirect()` / `RedirectPermanent()`
`RedirectToRouteResult`	Redirect to another action, or another controller's action	`RedirectToRoute()` / `RedirectToAction()`
`ViewResult` `PartialViewResult`	Response is the responsibility of a view engine	`View()` / `PartialView()`
`ContentResult`	Returns a string literal	`Content()`
`EmptyResult`	No response, no content-type header	
`FileContentResult` `FilePathResult` `FileStreamResult`	Return the contents of a file	`File()` / `PhysicalFile()`

Action Selectors

- ActionName(string name)
- AcceptVerbs
  - HttpPost
  - HttpGet
  - HttpDelete
  - HttpOptions
  - …
- NonAction
- RequireHttps
- etc.

```
public class UsersController : Controller
{
    [ActionName("UserLogin")]
    [HttpPost]
    [RequireHttps]
    public IActionResult Login(
        string username, string password)
    {
        return Content("Logged in!");
    }
}
```

Selectors' order doesn't matter

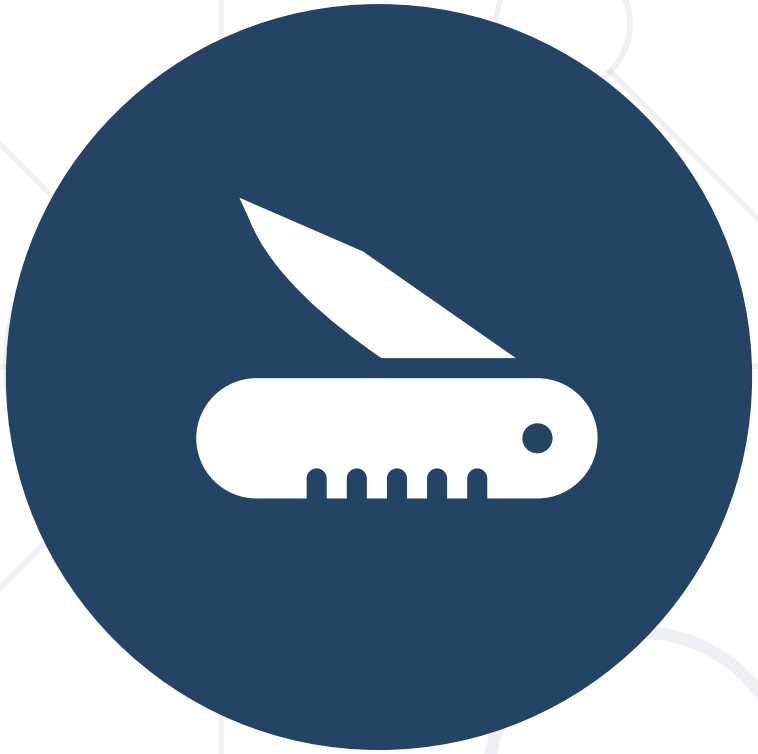
Action Parameters

- **ASP.NET Core** maps the **data** from the **HTTP request** to action parameters in few ways
  - **Routing engine** can pass parameters to actions
    - **Routing pattern**: `Users/{username}`
  - URL query string can contain parameters
    - `/Users/ByUsername?username=NikolayIT`
  - HTTP post data can also contain parameters

http://localhost/Users/Niki

http://localhost/Users/ByUsername?username=NikolayIT

```
public IActionResult
    ByUsername(string username)
{
    return Content(username);
}
```

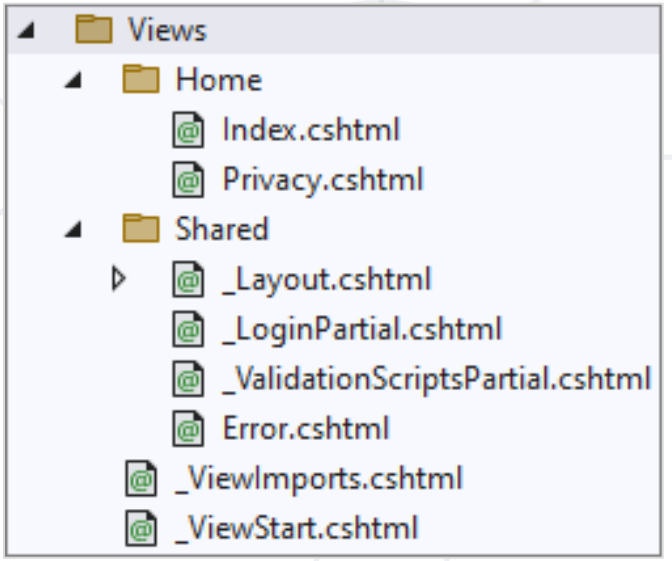


Views and Razor View Engine

Passing Data to a View

Views

- **Views** render the **HTML code** for the invoked action
- View naming standard is **{ActionName}.cshtml**
- Views should be placed in folder "**/Views/{ControllerName}**"
- A lot of **view engines** available
  - View engines execute code and provide HTML
  - Provide a lot of helpers to easily generate HTML
  - The most popular is **Razor View Engine**

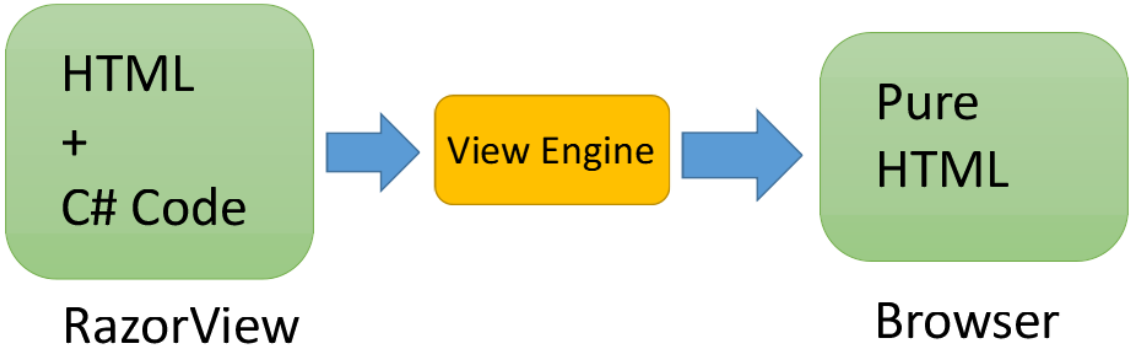


Razor View Engine

- **Razor** is a markup syntax which helps us write **HTML** and **server-side code** using **C#**
- **Razor View Engine**: use **Razor** with **MVC** to produce HTML
  - **Code blocks** start with a **@** character and don't require explicit closing

```
<div>
    @{
        for (int count = 0; count < 3; count++)
        {
            <p>Count is: @count</p>
        }

        string[] nameArray = { "Mandy", "Peter" };
        foreach (var name in nameArray)
        {
            <p>Your name is: @name</p>
        }
    }
</div>
```



Count is: 0

Count is: 1

Count is: 2

Your name is: Mandy

Your name is: Peter

Razor View Engine: Example

- **HTML** mixed with **C#** code (**@** switches to C#):

```
<div class="row">
  @foreach(var article in Model)
  {
    <article>
      <h2>@article.Title</h2>
      <p>@article.Content</p>
      <small>--@article.Author.FullName</small>
    </article>
  }
</div>
```

C# foreach

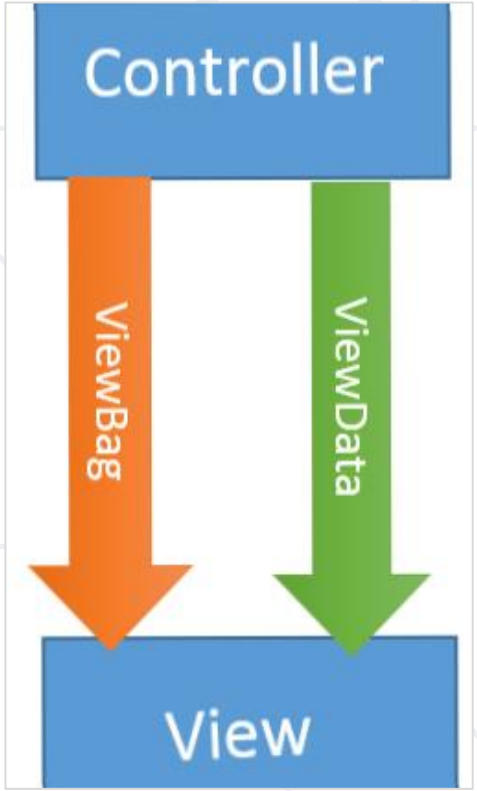
C# code

HTML Syntax

C# code

Passing Data to a View – Weakly Typed

- With `ViewBag` (`dynamic` type):
  - Action: `ViewBag.Message = "Hello!";`
  - View: `@ViewBag.Message`
- With `ViewData` (dictionary)
  - Action: `ViewData["message"] = "Hello!";`
  - View: `@ViewData["message"]`



ViewBag – Example

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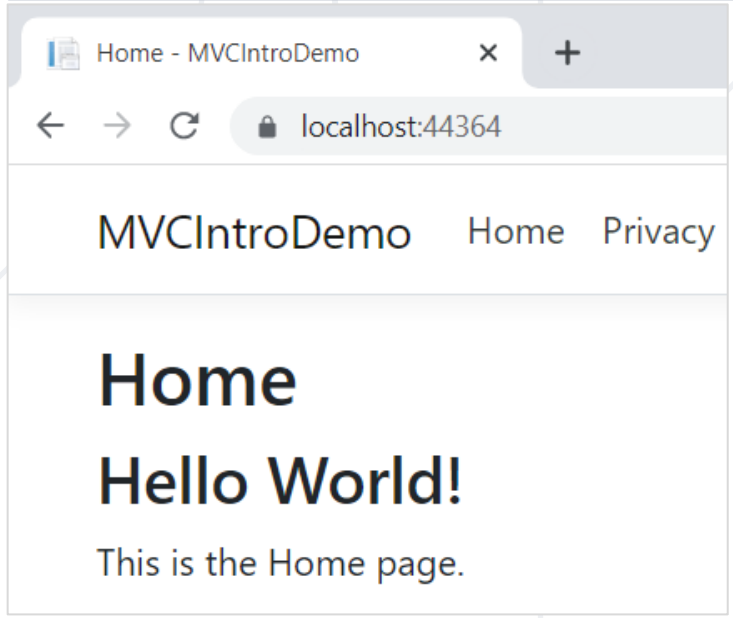
\Controllers\HomeController.cs

```
public IActionResult Index()
{
    ViewBag.Message = "Hello World!";
    return View();
}
```



@{ … } inserts C# code block

@Something prints a C# variable

Everything else is HTML code

\Views\Home\Index.cshtml

```
@{
    ViewBag.Title = "Home";
}

<h2>@ViewBag.Title</h2>
<h3>@ViewBag.Message</h3>

<p>This is the Home page.</p>
```

Passing Data to a View – Strongly Typed – Example

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\Controllers\CustomerController.cs

```
public IActionResult Show()
{
    CustomerViewModel customer =
        new CustomerViewModel()
    {
        Name = "Pesho",
        Age = 20
    };

    return View(customer);
}
```

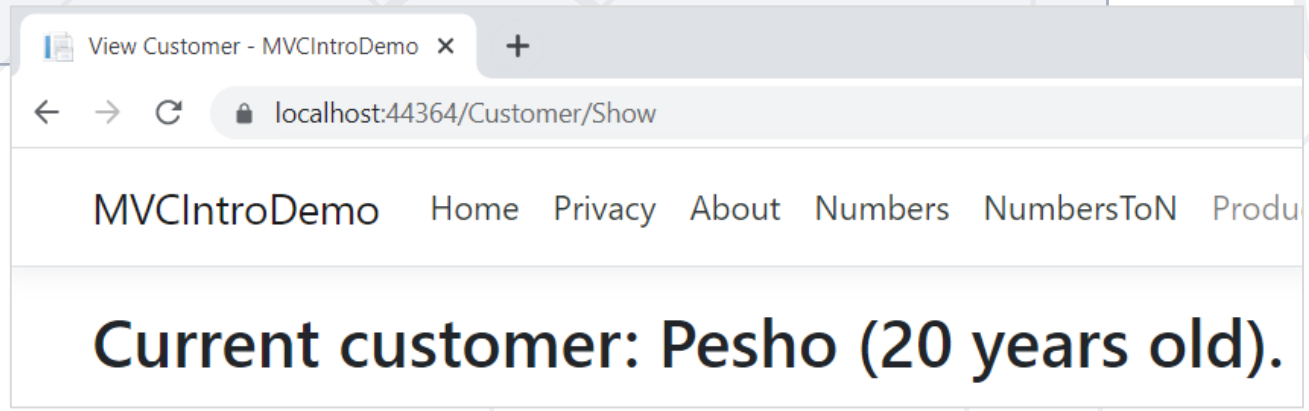
\Models\CustomerViewModel.cs

```
public class CustomerViewModel
{
    public string Name { get; set; }
    public int Age { get; set; }
}
```

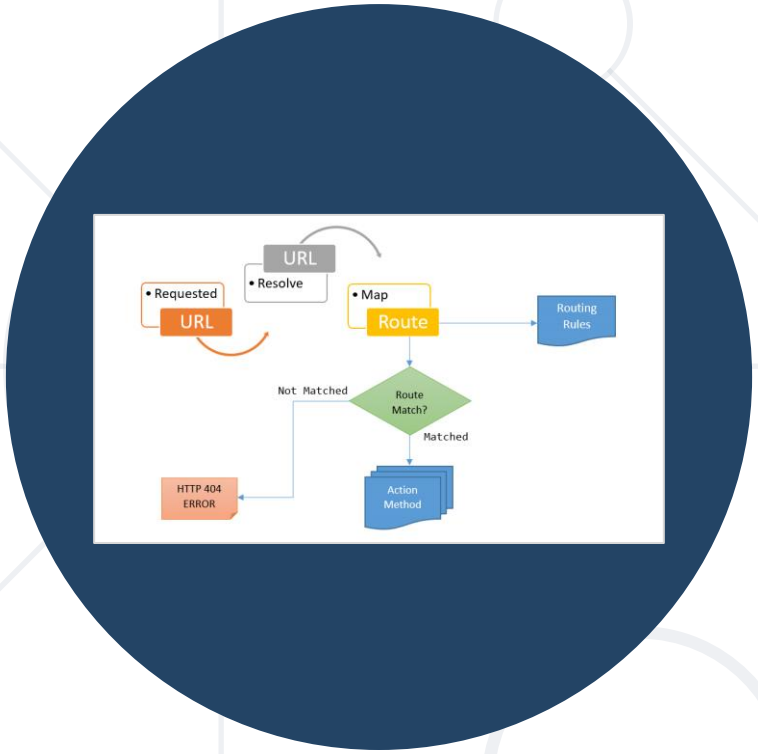
The @model directive makes the model available to the view

\Views\Customer\Show.cshtml

```
@model CustomerViewModel

@{ViewBag.Title = "View Customer";}

<h2>Current customer: @Model.Name
    (@Model.Age years old).</h2>
```



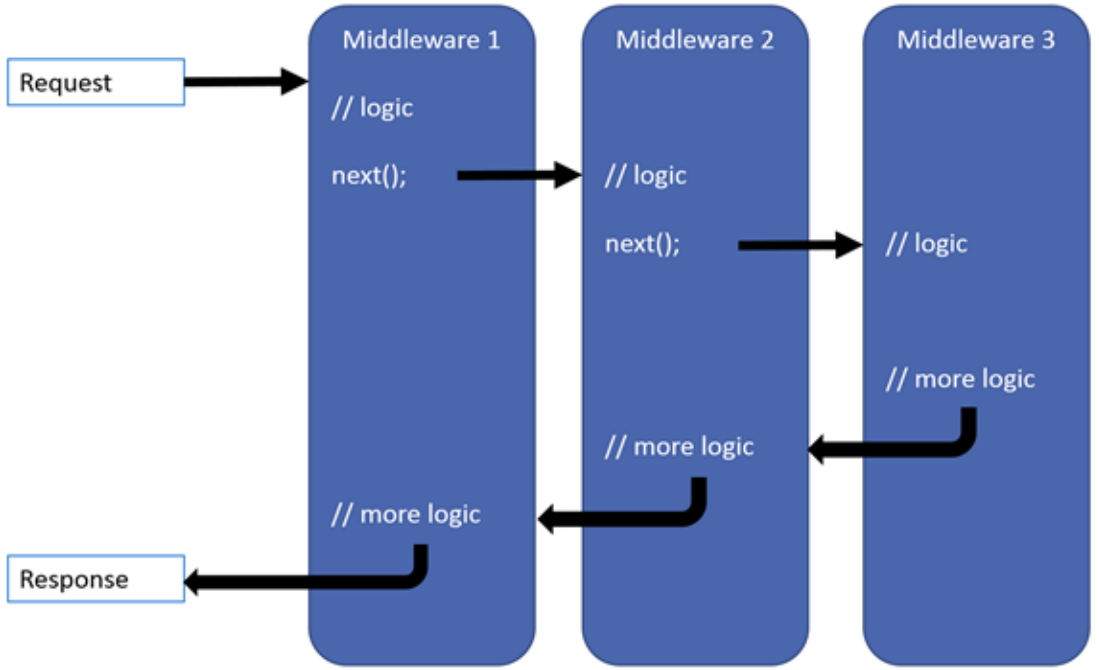
@Model.Property prints a model property



ASP.NET Core MVC Routing

ASP.NET Core MVC Routing

- **ASP.NET Core MVC** uses a **middleware** for **Routing** on client requests
  - **Routes** describe how request URL paths should be mapped to **Controller Actions**
  - There are 2 types of Action routing
    - Conventional
    - Attribute



Conventional Routing (Used by Default)

- Called **Conventional** because it establishes a **convention** for URL paths

```
routes.MapControllerRoute(
        name: "default",
        template: "{controller=Home}/{action=Index}/{id?}"
);
```

- Will match a route like "**/Cats/Show/1**"
- Will extract the route values

```
{
  controller = "Cats",
  action = "Show",
  id = "1"
}
```

Static Files

Static Files

- **Static files** are a necessity for a web application to work
  - Files such as HTML, CSS, JS and different Assets can be served directly to Clients with **ASP.NET Core**

```
app.UseStaticFiles();
```

This will tell the ASP.NET Core App to serve the static files in the "wwwroot" directory

Dependency Injection

Overview

What is Dependency Injection?

- **Dependency injection** injects objects at **runtime**
  - **Register** some service class in the **Program** class

```
services.AddTransient<DataService>();
```

  - Later, **inject** the registered class in your controllers

```
public class ProductController : Controller
{
  public ProductController(DataService ds) {
    // Use the injected object "ds"
  }
}
```

Model Binding

Model Binding (1)

- **Model binding** in ASP.NET Core MVC maps data from **HTTP requests** to **action method parameters**
  - The parameters may be primitive types or complex types
  - Implemented abstractly, paving the way for reusability in different apps
- The framework binds request data to action parameters by **name**
  - The value of each parameter will be searched, using the **parameter name**
  - **Classes** are mapped using the names of the **public settable properties**

Model Binding (2)

- **Model binding** can look through several **data sources** per Request
  - **Form values** – POST Request parameters
  - **Route values** – The set of Route values provided by the Routing
  - **Query strings** – The query string parameters in the URL
  - Even in headers, cookies, session, etc. in custom model binders
  - Data from these sources are stored as **name-value** pairs
- The framework checks each of the data sources for a parameter value
  - If there is no parameter in the data source, the next in order is checked
  - The data sources are checked in the **order** specified above

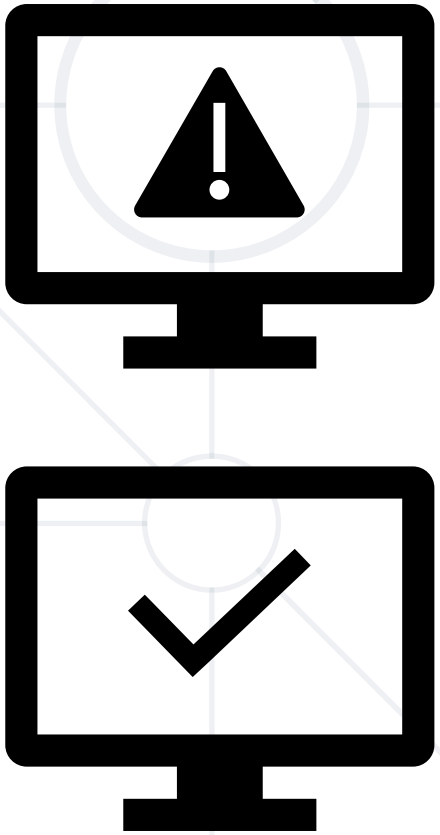
Model Binding (3)

- If binding **fails**, the framework does **not** throw an **error**
  - Every action, accepting **user input**, should check if binding was successful
  - This is done through the `ModelState.IsValid` property
- Each entry in the **controller**'s `ModelState` property is a `ModelStateEntry`
  - Each `ModelStateEntry` contains an `Errors` property
  - It's rarely necessary to query this collection, though
- Default **Model binding** works great for most development scenarios
  - It is also extensible, and you can customize the built-in behavior

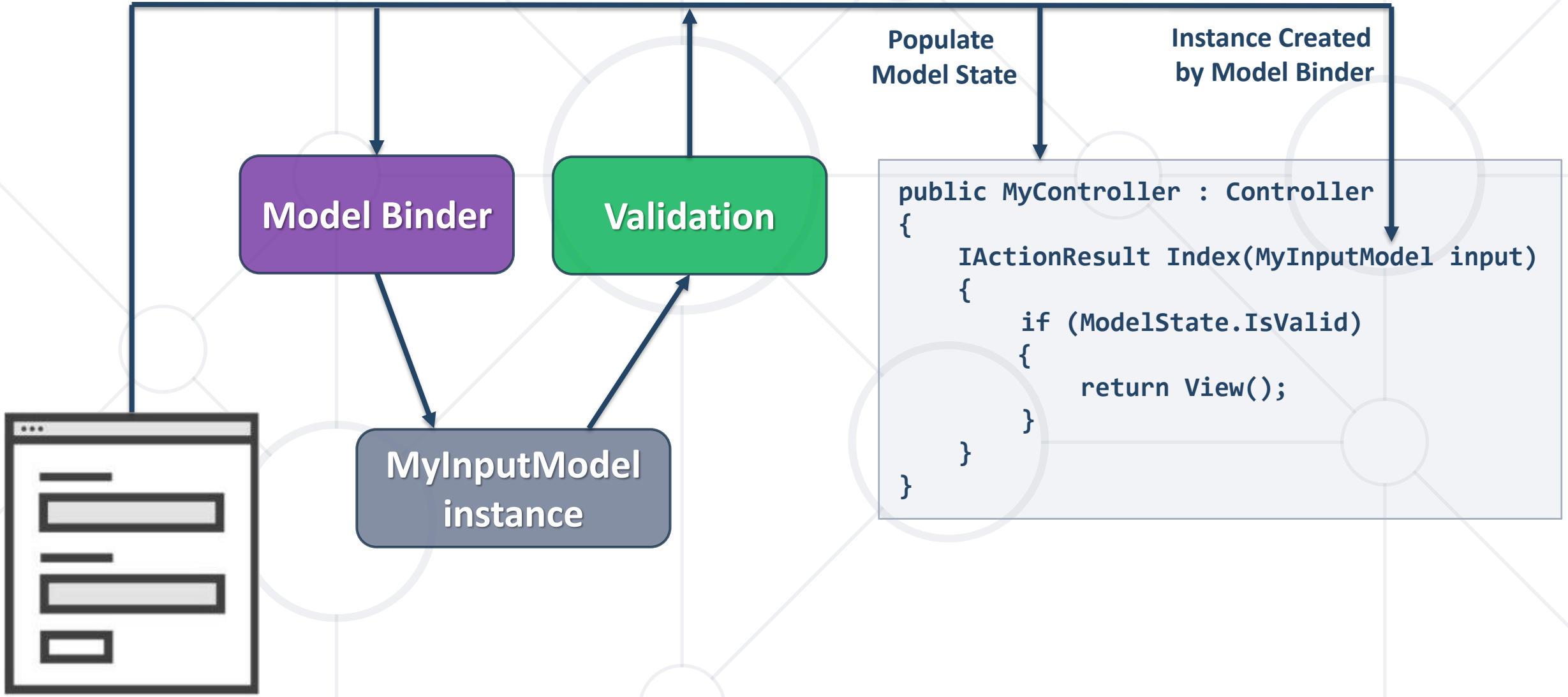
ModelState

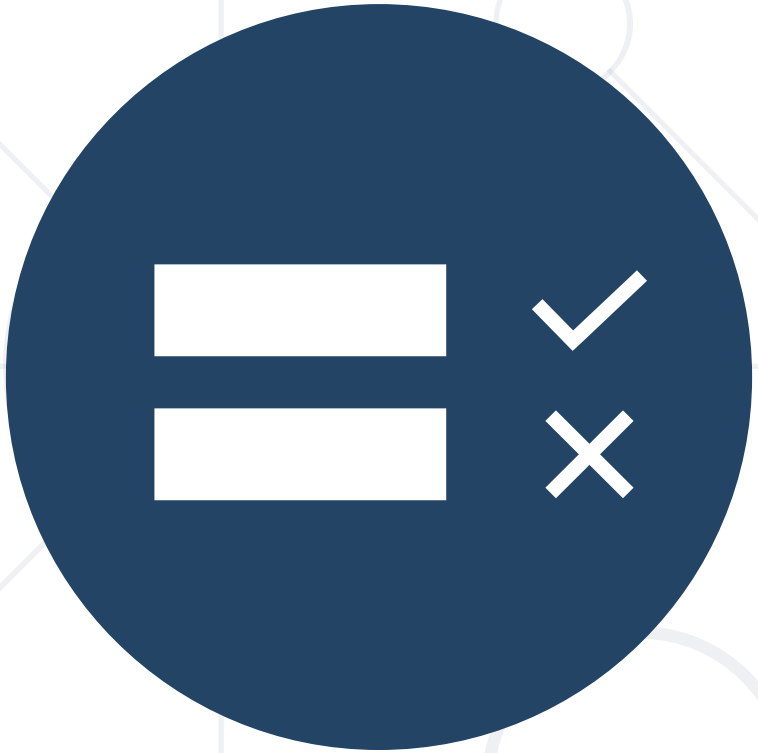
- You can easily **iterate** over the errors in the **ModelState**

```
public class UsersController : Controller
{
    public IActionResult Register(RegisterUserBindingModel model)
    {
        if(!ModelState.IsValid)
        {
            foreach (var error in ModelState.Values.SelectMany(v => v.Errors))
            {
                DoSomething(error);
            }

            // TODO: Return Error Page
        }

        return Ok("Success!");
    }
}
```



Incoming Request to MVC





Model Validation

Model Validation (1)

- **Validation** is absolutely necessary before persisting data
  - There may be potential security threats
  - There may be malformed data (**type**, **size**, **data constraints**)
- In **ASP.NET Core MVC**, validation happens both on **client** and **server**

```
@model RegisterViewModel

<form asp-controller="Demo" asp-action="RegisterValidation" method="post">
    <div asp-validation-summary="ModelOnly"></div>
    Email: <input asp-for="Email"/><br />
    <span asp-validation-for="Email"></span><br />
    <div asp-validation-summary="ModelOnly"></div>
    Password: <input asp-for="Password" /><br />
    <span asp-validation-for="Password"></span><br />
    <button type="submit">Register</button>
</form>
```

```
public class RegisterViewModel
{
    [Required]
    [EmailAddress]
    [Display(Name = "Email Address")]
    0 references
    public string Email { get; set; } = null!;

    [Required]
    [DataType(DataType.Password)]
    0 references
    public string Password { get; set; } = null!;
}
```

Model Validation (2)

- .NET provides us with an abstracted validation through **attributes**
  - Some attributes configure model validation by **constraint**
    - Similar to validation on **database fields**
  - Other apply patterns to data to enforce **business rules**
    - **Credit Cards**, **Phone Numbers**, **Email Addresses** etc.
- Validation attributes make enforcing these requirements simple
  - They are specified at the **property** or **parameter** level

```
[Required]
[StringLength(100)]
0 references
public string Title { get; set; } = null!;
```

```
[Range(0, 999.99)]
0 references
public decimal Price { get; set; }
```

```
public IActionResult SaveUser(
    [Required, EmailAddress] string Email,
    [Required, StringLength(1000)] string Username)
```

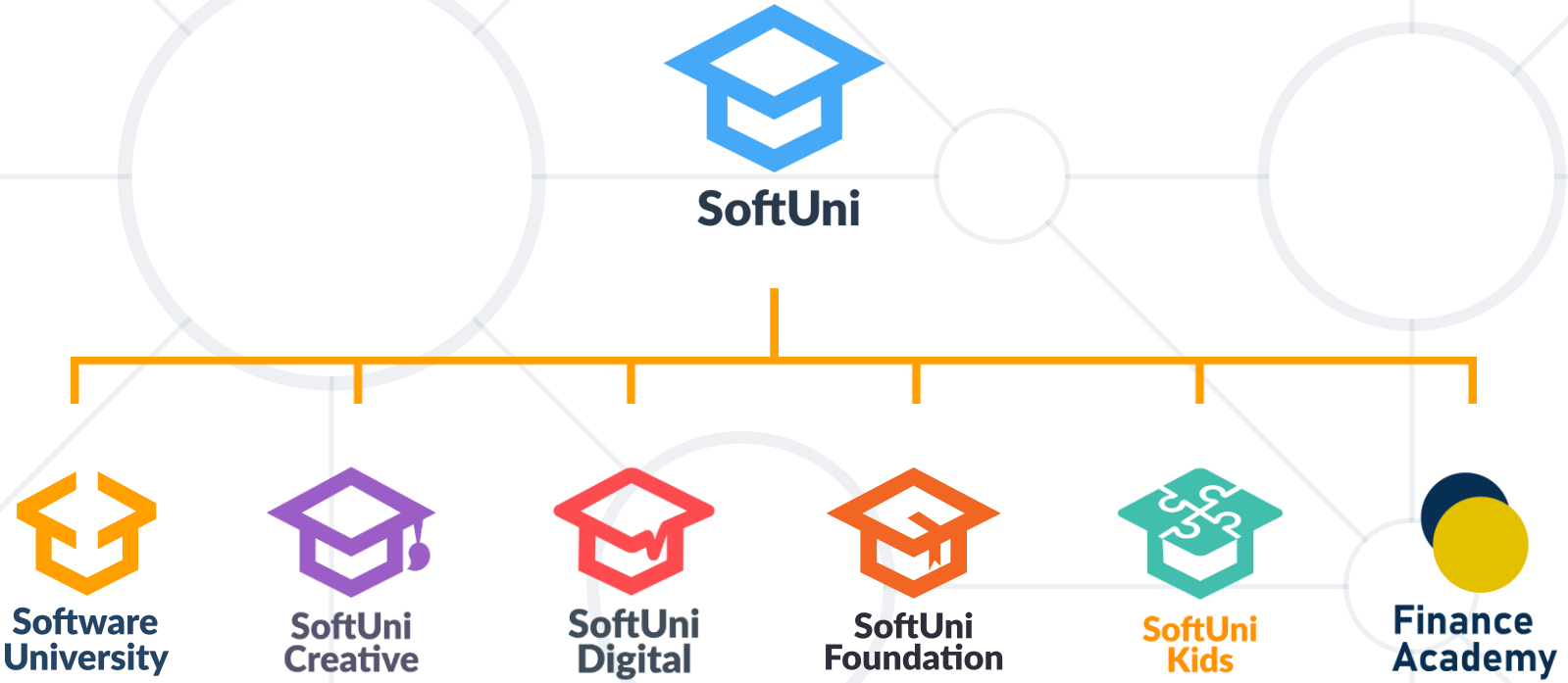
Model Validation (3)

Attribute	Description
[CreditCard]	Validates the property has a credit card format
[Compare]	Validates 2 properties in a model match. (Useful for password confirmation)
[EmailAddress]	Validates the property has an email format
[Phone]	Validates the property has a telephone format
[Range]	Validates the property value falls within the given range
[RegularExpression]	Validates the data matches the specified regular expression
[Required]	Makes the property required. Value cannot be null
[StringLength]	Validates that a string property has at most the given maximum length
[Url]	Validates the property has a URL format

Summary

- **ASP.NET Core** is a great platform for developing Web apps
- MVC **Controllers** and **Actions**
- MVC **Views** and **Razor**
- **Routing**
- **Static Files**
- Dependency Injection
- **Model Binding** and **Model Validation**

Questions?



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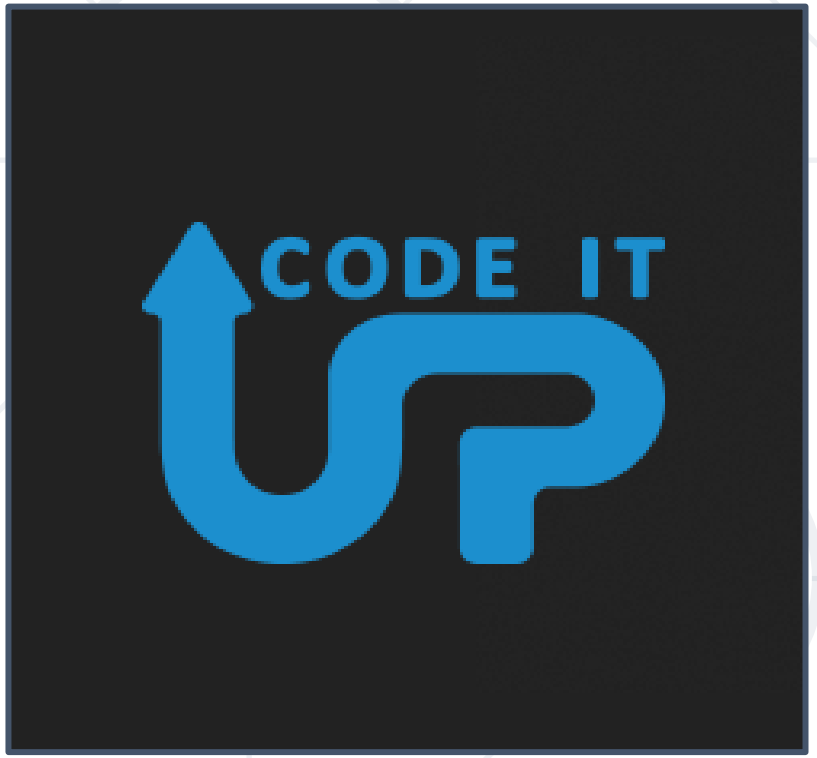

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