Module 1: Overview

Student Lab Manual

Instructor Edition (Book Title Hidden Style)

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Lab 1: Visual Studio and ASP.NET Core Overview

Introduction

ASP.NET Core is a new open-source and cross-platform framework for building modern cloud-based Web applications using Microsoft .NET Framework. We built it from the ground up to provide an optimized development framework for apps that are either deployed to the cloud or run on-premises. It consists of modular components with minimal overhead, so you retain flexibility while constructing your solutions. You can develop and run your ASP.NET Core applications cross-platform on Windows, Mac and Linux. ASP.NET Core is fully open source on GitHub.

The first preview of ASP.NET 1.0 was released almost 15 years ago. Since then millions of developers have used it to build and run great web applications, and over the years, we have added and evolved many capabilities to it.

With ASP.NET Core, we are making a number of architectural changes that make the core web framework much leaner and more modular. ASP.NET Core is no longer based on System.Web.dll, but is instead based on a set of granular and well factored NuGet packages allowing you to optimize your app to have just what you need. You can reduce the surface area of your application to improve security, reduce your servicing burden, and also to improve performance in a true pay-for-what-you-use model.

ASP.NET Core is built with the needs of modern Web applications in mind, including a unified story for building Web UI and Web APIs that integrate with today's modern client-side frameworks and development workflows. ASP.NET Core is also built to be cloud-ready by introducing environment-based configuration and by providing built-in dependency injection support.

To appeal to a broader audience of developers, ASP.NET CORE supports cross-platform development on Windows, Mac and Linux. The entire ASP.NET CORE stack is open source and encourages community contributions and engagement. ASP.NET CORE comes with a new, agile project system in Visual Studio while also providing a complete command-line interface so that you can develop using the tools of your choice.

In summary, with ASP.NET Core, you gain the following foundational improvements:

- New light-weight and modular HTTP request pipeline
- Ability to host on IIS or self-host in your own process
- Built on .NET Core, which supports true side-by-side app versioning
- Ships entirely as NuGet packages
- Integrated support for creating and using NuGet packages
- Single aligned web stack for Web UI and Web APIs
- Cloud-ready environment-based configuration
- Built-in support for dependency injection
- New tooling that simplifies modern web development
- Build and run cross-platform ASP.NET apps on Windows, Mac and Linux
- Open source and community focused

.NET Core

.NET Core is a modular runtime and library implementation that includes a subset of the .NET Framework. .NET Core consists of a set of libraries, called "CoreFX", and a small, optimized runtime, called "CoreCLR". .NET Core is open-source, so you can follow the progress on the project and contribute to it on GitHub:

- .NET Core Libraries (CoreFX)
- .NET Core Common Language Runtime (CoreCLR)

The CoreCLR runtime (Microsoft.CoreCLR) and CoreFX libraries are distributed via NuGet. The CoreFX libraries are factored as individual NuGet packages according to functionality, named "System.[module]" on nuget.org.

One of the key benefits of .NET Core is its portability. You can package and deploy the CoreCLR with your application, eliminating your application's dependency on an installed version of .NET (for example, .NET Framework on Windows). You can host multiple applications side-by-side using different versions of the CoreCLR, and upgrade them individually, rather than being forced to upgrade all of them simultaneously.

CoreFX has been built as a componentized set of libraries, each requiring the minimum set of library dependencies (for example, System.Collections only depends on System.Runtime, not System.Xml). This approach enables minimal distributions of CoreFX libraries (just the ones you need) within an application, alongside CoreCLR. CoreFX includes collections, console access, diagnostics, IO, Language Integrated Query (LINQ), JavaScript Object Notification (JSON), XML, and regular expression support, just to name a few libraries. Another benefit of CoreFX is that it allows developers to target a single common set of libraries that are supported by multiple platforms.

When .NET Framework first shipped in 2002, it was a single framework, but it did not take long before the .NET Compact Framework shipped, providing a smaller version of .NET Framework designed for mobile devices. Over the years, this exercise was repeated multiple times, so that today there are different flavors of .NET Framework specific to different platforms. Add to this, the further platform reach provided by Mono and Xamarin, which target Linux, Mac, and native iOS and Android devices. For each platform, a separate vertical stack consisting of runtime, framework, and app model is required to develop .NET applications. One of the primary goals of .NET Core is to provide a single, modular, cross-platform version of .NET that works the same across all of these platforms. Since .NET Core is a fully open source project, the Mono community can benefit from CoreFX libraries. .NET Core will not replace Mono, but it will allow the Mono community to reference and share, rather than duplicate, certain common libraries, and to contribute directly to CoreFX, if desired.

In addition to being able to target a variety of different device platforms, there was also pressure from the server side to reduce the overall footprint, and more importantly, surface area, of the .NET Framework. By factoring the CoreFX libraries and allowing individual applications to pull in only those parts of CoreFX, they require (a so-called "pay-for-play" model), server-based applications built with ASP.NET Core to minimize their dependencies. This, in turn, reduces the frequency with which patches and updates to the framework impact these applications, since only changes made to the individual pieces of CoreFX that is used by the application impact the application. A smaller deployment size for the application is a side benefit, and one that makes more of a difference if many applications are deployed side-by-side on a given server.

Objectives

This lab will show you how to:

- Create a new ASP.NET Core application in Visual Studio 2019.
- Compile the application using .NET Core and .NET Framework.
- Work with static files.
- Create custom middleware.
- Use working environments to configure application pipelines.

System Requirements

To complete this lab, you need:

- Visual Studio 2019 or higher
- .NET Core 3.1 (download from https://dot.net)

Estimated Time to Complete This Lab

60-100 minutes

Exercise 1: Create a New ASP.NET Core Application

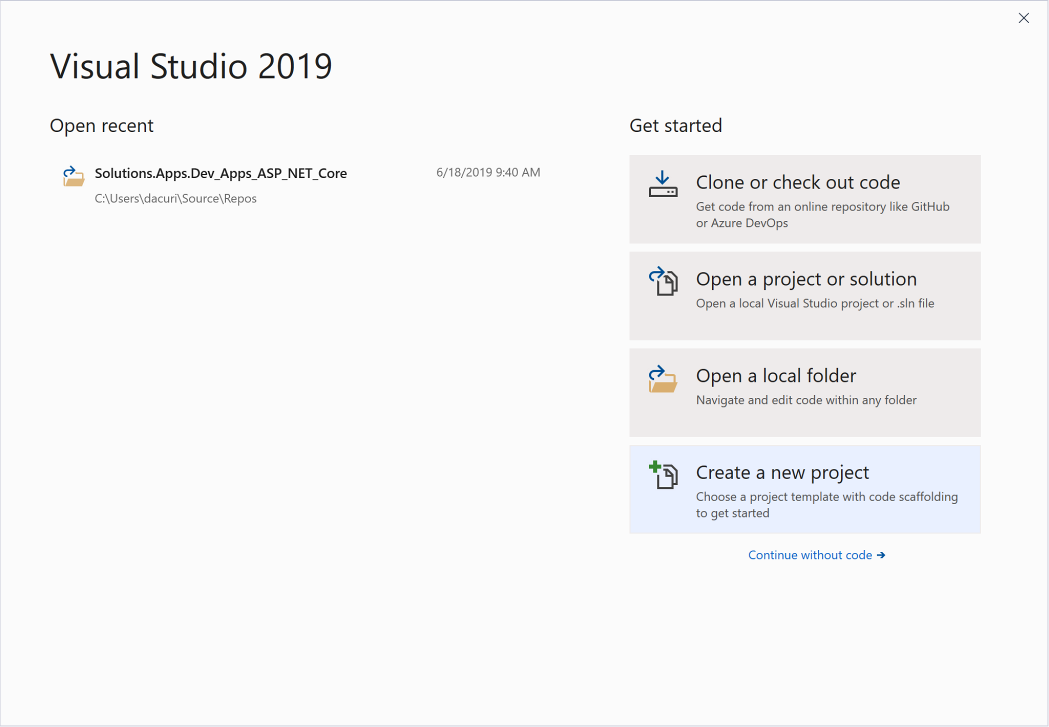
Objectives

In this exercise, you will:

- Create a new ASP.NET Core application in Visual Studio 2019.
- Run the application using different web servers.

Task 1: Create the Visual Studio Solution

1. Open Visual Studio 2019.
2. Select **Create a new project**



Visual Studio 2019

Open recent

Solutions.Apps.Dev_Apps_ASP_NET_Core 6/18/2019 9:40 AM
C:\Users\dacuri\Source\Repos

Get started

Clone or check out code
Get code from an online repository like GitHub or Azure DevOps

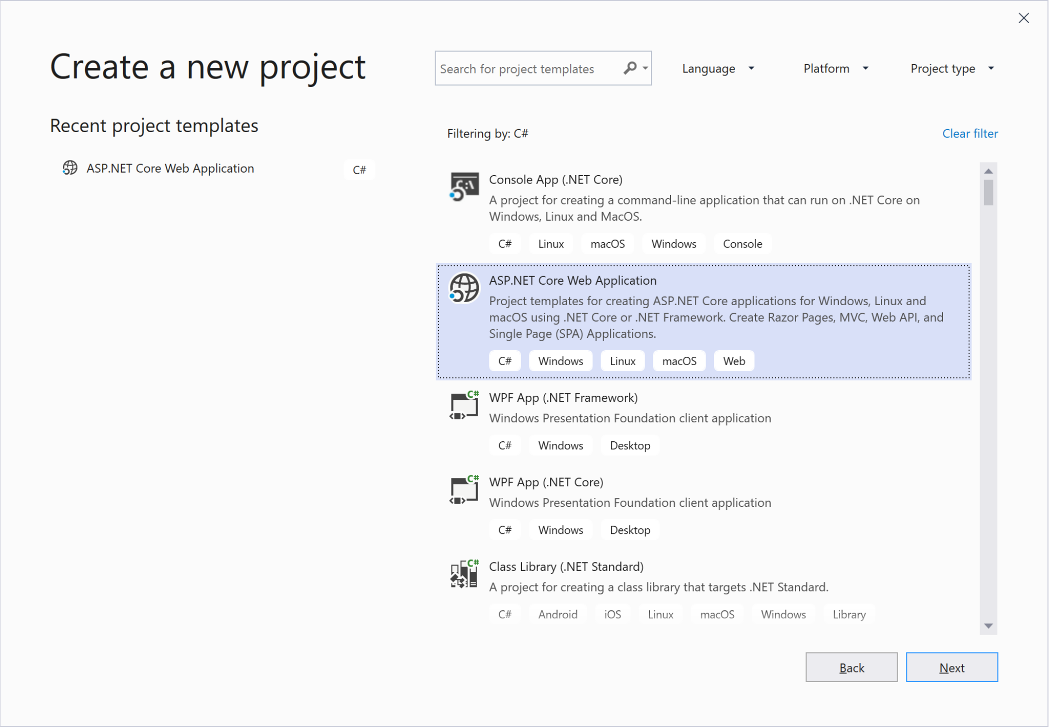
Open a project or solution
Open a local Visual Studio project or .sln file

Open a local folder
Navigate and edit code within any folder

Create a new project
Choose a project template with code scaffolding to get started

Continue without code →

3. Choose **ASP.NET Core Web Application** (with the C# language).



Create a new project

Recent project templates

ASP.NET Core Web Application C#

Filtering by: C#

Console App (.NET Core)
A project for creating a command-line application that can run on .NET Core on Windows, Linux and MacOS.

ASP.NET Core Web Application
Project templates for creating ASP.NET Core applications for Windows, Linux and macOS using .NET Core or .NET Framework. Create Razor Pages, MVC, Web API, and Single Page (SPA) Applications.

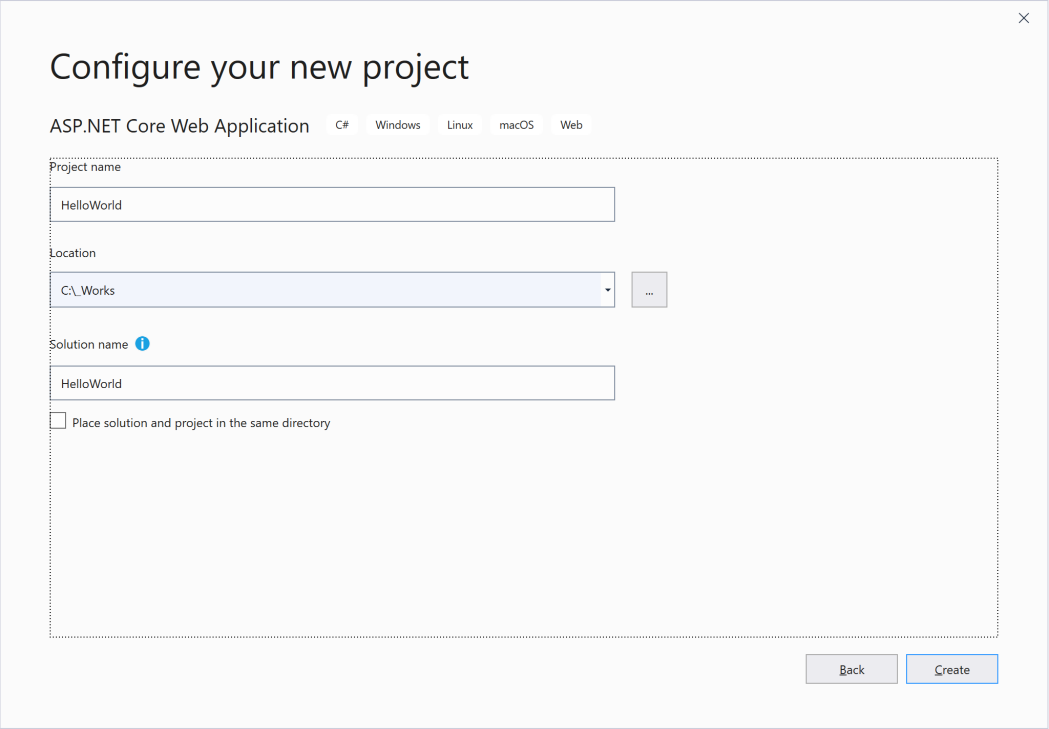
WPF App (.NET Framework)
Windows Presentation Foundation client application

WPF App (.NET Core)
Windows Presentation Foundation client application

Class Library (.NET Standard)
A project for creating a class library that targets .NET Standard.

Search for project templates
Language
Platform
Project type
Clear filter
C# Linux macOS Windows Console
C# Windows Linux macOS Web
C# Windows Desktop
C# Windows Desktop
C# Android iOS Linux macOS Windows Library
Back
Next

4. Name the project *HelloWorld*, and change the location as per your own preferences. Leave the check box for **Place solution and project in the same directory**, unchecked. Click **Create**.



Configure your new project

ASP.NET Core Web Application C# Windows Linux macOS Web

Project name: HelloWorld

Location: C:_Works

Solution name: HelloWorld

□ Place solution and project in the same directory

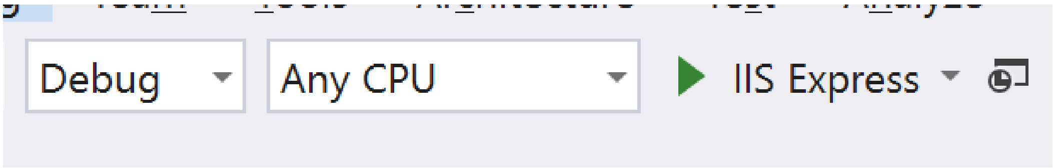
5. Choose **Web Application (Model-View-Controller)** template and from drop downs select .NET Core / **ASP.NET Core 3.1**.

Make sure **Authentication** is set as "No Authentication" and to uncheck **Enable Docker Support**.

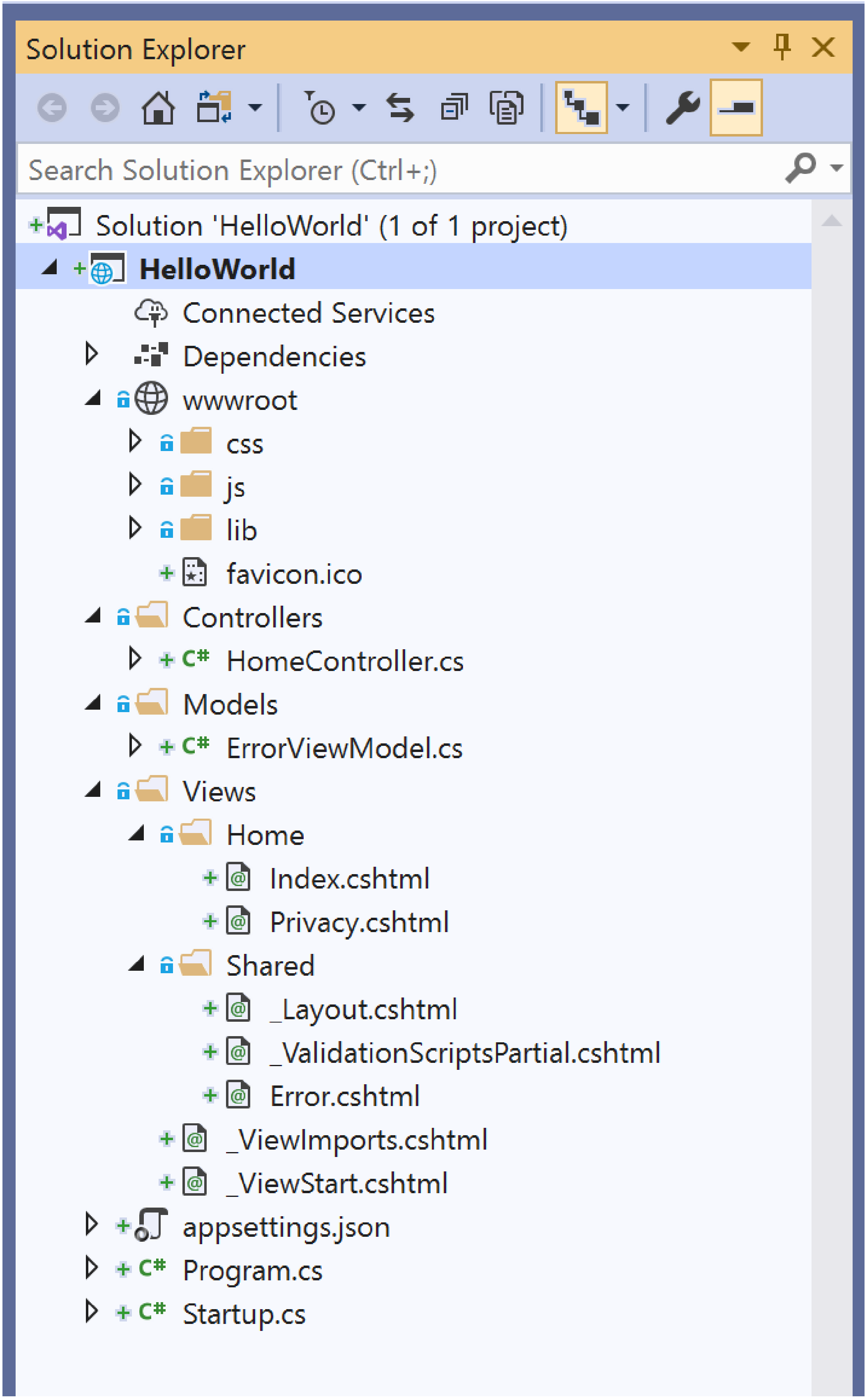
6. Click **Create**. Visual Studio will take a few seconds to restore NuGet packages and setup a project.
7. Build the application to ensure everything compiles well. (Build > Build Solution)

Task 2: Run the Application on Different Web Servers

1. Run the application using **IIS Express**. Go to different application views.



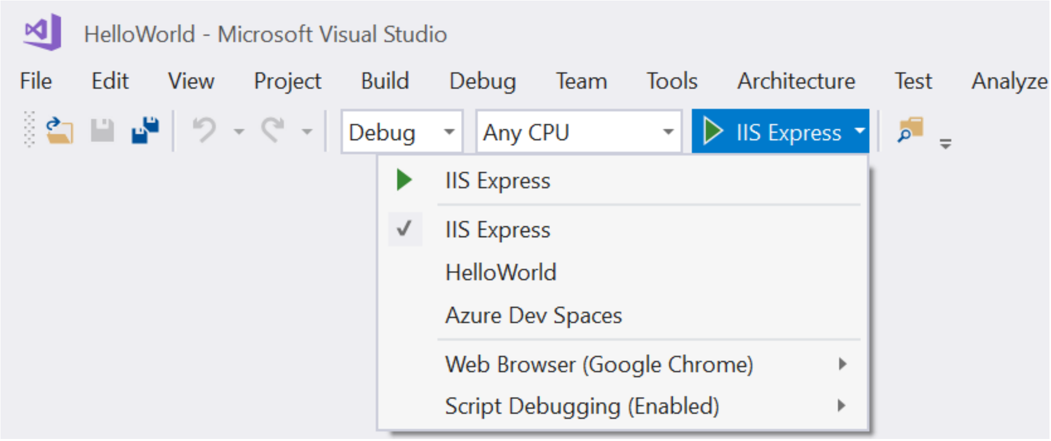
2. Take some time to review the following aspects of the project:
   - Project file (*.csproj)
   - wwwroot folder
   - Client-side dependencies
   - Controllers, Models, ViewModels, and Views folders
   - appsettings.json
   - Startup.cs



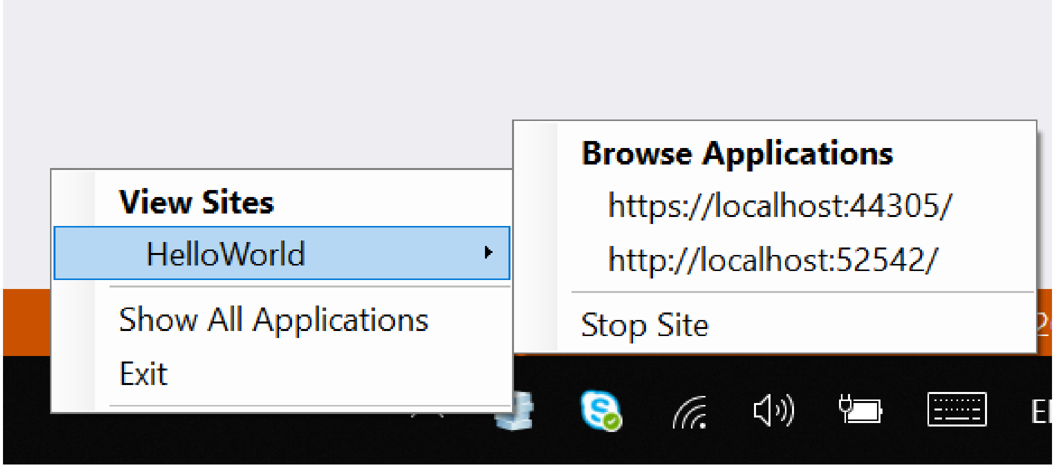
```
Solution 'HelloWorld' (1 of 1 project)
  HelloWorld
    Connected Services
    Dependencies
    wwwroot
      css
      js
      lib
      favicon.ico
    Controllers
      HomeController.cs
    Models
      ErrorViewModel.cs
    Views
      Home
        Index.cshtml
        Privacy.cshtml
      Shared
        _Layout.cshtml
        _ValidationScriptsPartial.cshtml
        Error.cshtml
      _ViewImports.cshtml
      _ViewStart.cshtml
    appsettings.json
    Program.cs
    Startup.cs
```

3. Now that you are a bit more familiar with ASP.NET Core project template and files involved, let us try to run the application using other web servers: using Kestrel and IIS Express.

4. Choose **IIS Express** as the hosting server in Visual Studio and run the application.



5. Visual Studio will deploy your app to IIS Express, which servers as a reverse proxy to Kestrel.

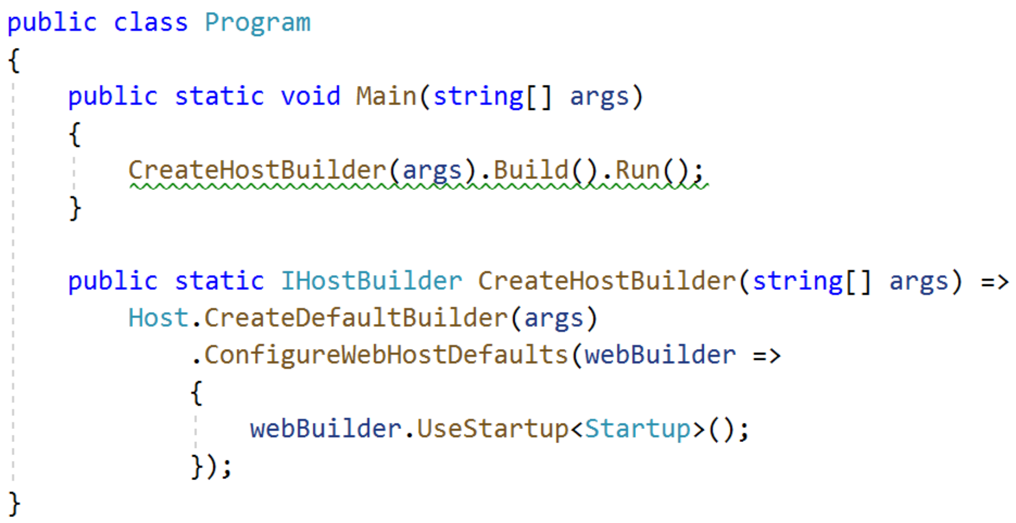


```
ASP.NET Core is completely decoupled from the web server environment that hosts
the application. ASP.NET Core supports hosting in IIS and IIS Express, and
self-hosting scenarios using the Kestrel and WebListener HTTP servers.
Additionally, developers and third party software vendors can create custom
servers to host their ASP.NET Core apps.

The default web host for ASP.NET apps developed using Visual Studio is IIS
Express functioning as a reverse proxy server for Kestrel. The
"Microsoft.AspNetCore.Server.Kestrel" and
"Microsoft.AspNetCore.Server.IISIntegration" dependencies are included by
default, even with the Empty Web Site template. Visual Studio provides support
for multiple profiles, associated with IIS Express. You can manage these
profiles and their settings in the Debug tab of your web application project's
Properties menu or from the launchSettings.json file.
```

6. Open **Program.cs** to see how webhost is configured.

   ASP.NET Core apps require a host in which to execute. This is typically done in your app's entry point: **public static void Main** (located in a Program.cs file).



```
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>();
            });
}
```

   What is the difference between a host and a server?

   The host is responsible for application startup and lifetime management. The server is responsible for accepting HTTP requests. Part of the host's responsibility includes ensuring the application's services and the server are available and properly configured. You can think of the host as being a wrapper around the server. The host is configured to use a particular server; the server is unaware of its host.

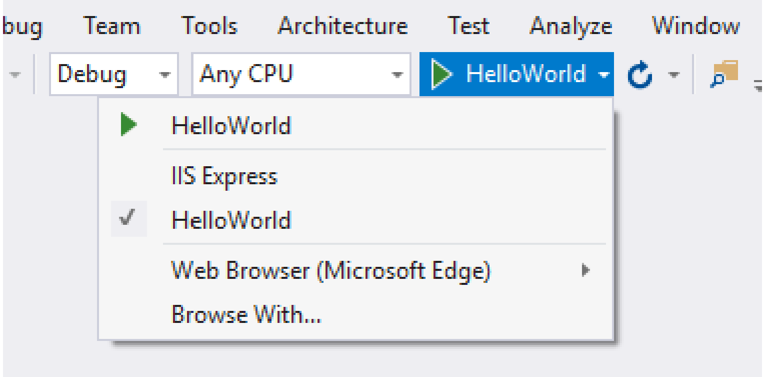
   Note: If the app should work with IIS, the UseIISIntegration method should be called as part of building the host. Note that this does not configure a server, like UseKestrel does. To use IIS with ASP.NET Core, you must specify both UseKestrel and UseIISIntegration. Kestrel is designed to be run behind a proxy and should not be deployed directly facing the Internet. UseIISIntegration specifies IIS as the reverse proxy server.

   In ASP.NET Core 3.1, the UseIISIntegration extension method on Generic Host Builder is called automatically when you run with IIS.

   ASP.NET Core project templates use Kestrel by default. In Program.cs, the template code calls CreateDefaultBuilder, which calls UseKestrel behind the scenes.

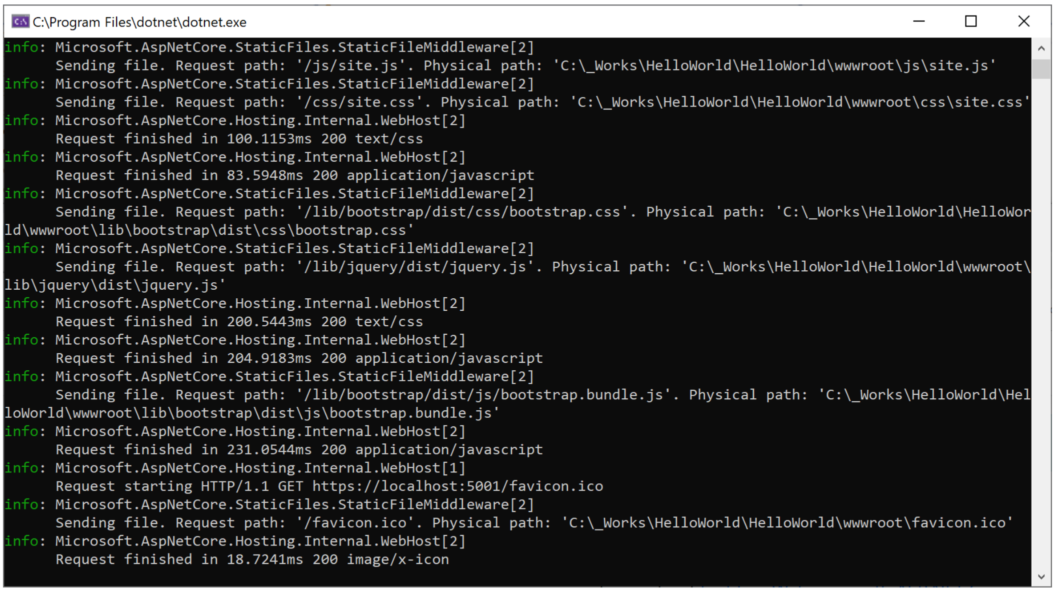
   UseKestrel and UseIISIntegration are very different actions. IIS is only used as a reverse proxy. UseKestrel creates the web server and hosts the code. UseIISIntegration specifies IIS as the reverse proxy server.

1. After, run the application again using *HelloWorld* option.



> ***Note:*** *If you see this message, click "yes."*
>
> *Then click yes.*

It should show the following window. The application is now self-hosted and will remain active if this process is not shut down.


C:\Program Files\dotnet\dotnet.exe

```
info: Microsoft.AspNetCore.StaticFiles.StaticFileMiddleware[2]
      Sending file. Request path: '/js/site.js'. Physical path: 'C:\_Works\HelloWorld\HelloWorld\wwwroot\js\site.js'
info: Microsoft.AspNetCore.StaticFiles.StaticFileMiddleware[2]
      Sending file. Request path: '/css/site.css'. Physical path: 'C:\_Works\HelloWorld\HelloWorld\wwwroot\css\site.css'
info: Microsoft.AspNetCore.Hosting.Internal.WebHost[2]
      Request finished in 100.1153ms 200 text/css
info: Microsoft.AspNetCore.Hosting.Internal.WebHost[2]
      Request finished in 83.5948ms 200 application/javascript
info: Microsoft.AspNetCore.StaticFiles.StaticFileMiddleware[2]
      Sending file. Request path: '/lib/bootstrap/dist/css/bootstrap.css'. Physical path: 'C:\_Works\HelloWorld\HelloWor
ld\wwwroot\lib\bootstrap\dist\css\bootstrap.css'
info: Microsoft.AspNetCore.StaticFiles.StaticFileMiddleware[2]
      Sending file. Request path: '/lib/jquery/dist/jquery.js'. Physical path: 'C:\_Works\HelloWorld\HelloWorld\wwwroot\
lib\jquery\dist\jquery.js'
info: Microsoft.AspNetCore.Hosting.Internal.WebHost[2]
      Request finished in 200.5443ms 200 text/css
info: Microsoft.AspNetCore.Hosting.Internal.WebHost[2]
      Request finished in 204.9183ms 200 application/javascript
info: Microsoft.AspNetCore.StaticFiles.StaticFileMiddleware[2]
      Sending file. Request path: '/lib/bootstrap/dist/js/bootstrap.bundle.js'. Physical path: 'C:\_Works\HelloWorld\Hel
loWorld\wwwroot\lib\bootstrap\dist\js\bootstrap.bundle.js'
info: Microsoft.AspNetCore.Hosting.Internal.WebHost[2]
      Request finished in 231.0544ms 200 application/javascript
info: Microsoft.AspNetCore.Hosting.Internal.WebHost[1]
      Request starting HTTP/1.1 GET https://localhost:5001/favicon.ico
info: Microsoft.AspNetCore.StaticFiles.StaticFileMiddleware[2]
      Sending file. Request path: '/favicon.ico'. Physical path: 'C:\_Works\HelloWorld\HelloWorld\wwwroot\favicon.ico'
info: Microsoft.AspNetCore.Hosting.Internal.WebHost[2]
      Request finished in 18.7241ms 200 image/x-icon
```

Now, instead of IIS Express – we are directly using Kestrel as web server to host the app.

2. Press **Ctrl + C** to shut down the server.

   We've now finished creating an ASP.NET Core Web Application!

Exercise 2: Middleware

Introduction

Middleware are components that are assembled into an application pipeline to handle requests and responses. Each component can choose whether to pass the request on to the next component in the pipeline, and can perform certain actions before and after the next component in the pipeline. Request delegates are used to build this request pipeline, which are then used to handle each incoming HTTP request to your application.

Request delegates are configured using Run, Map, and Use extension methods on the IApplicationBuilder type that is passed into the Configure method in the Startup class. An individual request delegate can be specified in-line as an anonymous method, or it can be defined in a reusable class. These reusable classes are middleware, or middleware components. Each middleware component in the request pipeline is responsible for invoking the next component in the chain, or can opt to short-circuit the chain if appropriate.

Objectives

In this exercise, you will:

- Create a custom middleware
- Use extension methods for built-in Static Files middleware

Task 1: Create a Custom Middleware

1. Create a new **ASP.NET Core Web Application**, with the **Empty** template. And name the project *Middleware* - detailed steps are below:

    - Create a new project with the type of **ASP.NET Core Web Application** (like you've done in the previous exercises.)
    - Name the project *Middleware*, and then click **Create**.
    - Choose **Empty** under ASP.NET Core templates. Leave other settings to

      ```
      default state. Click **Create**.
      ```

    - Run the application to check that it works. It should show "**Hello World!**" text in the

      ```
      browser.
      ```

2. Navigate to **Startup.cs** and replace **Configure( )** method with the following code:

    ```
    public void Configure(IApplicationBuilder app, IHostingEnvironment env)
    {
        app.Run(async (context) =>
        {
            await context.Response.WriteAsync("Hello World! ");
        });

        app.Run(async (context) =>
        {
            await context.Response.WriteAsync("2nd middleware in the pipeline!");
        });
    }
    ```

3. When you run the application, it still only shows a single Hello World statement. **Why is the 2nd middleware not executed?**

    It is important to realize that the request delegate as written in the first middleware, uses **app.Run()** and will terminate the pipeline, regardless of other calls to app.Run() that you may include. Therefore, only the first delegate ("Hello, World!") will be run and displayed.

You must chain multiple request delegates together making a different call to app.Use(), with a **next** parameter representing the next delegate in the pipeline. Note that just because you are calling “**next**” does not mean you cannot perform actions both before and after the next delegate.

4. Let us replace the **Configure()** method code with the following:

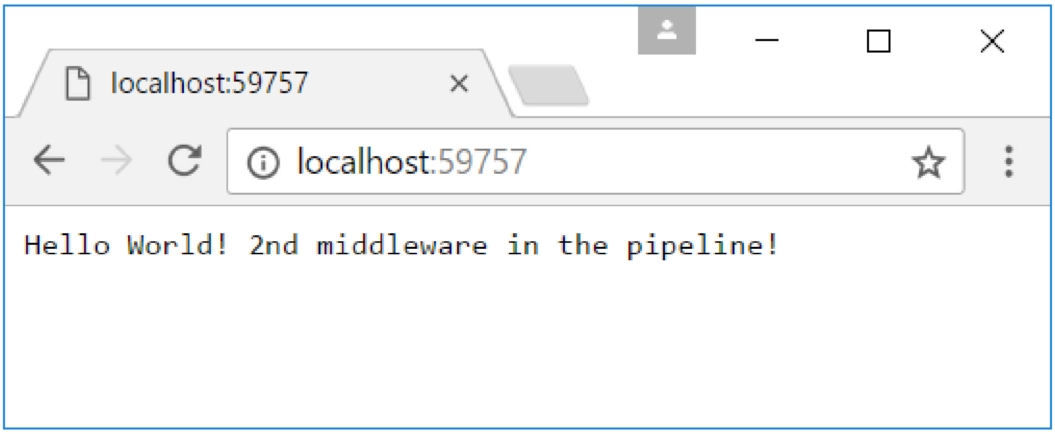
```
public void Configure(IApplicationBuilder app, IHostingEnvironment env)
{
    app.Use(async (context, next) =>
    {
        await context.Response.WriteAsync("Hello World! ");
        await next.Invoke();
    });

    app.Run(async (context) =>
    {
        await context.Response.WriteAsync("2nd middleware in the pipeline!");
    });
}
```

Note: You configure the HTTP pipeline using the extensions **Run, Map**, and **Use**. By convention, the Run method is simply a shorthand way of adding middleware to the pipeline that does not call any other middleware (that is, it will not call a next request delegate). Thus, Run should only be called at the end of your pipeline. Run is a convention, and some middleware components may expose their own Run[Middleware] methods that should only run at the end of the pipeline.

In the above code, the first middleware uses **Use** and the terminating middleware uses **Run**.

5. Run the application now. It should show both text lines in the browser.



```
Hello World! 2nd middleware in the pipeline!
```

We’ve just finished writing some in-line middleware!

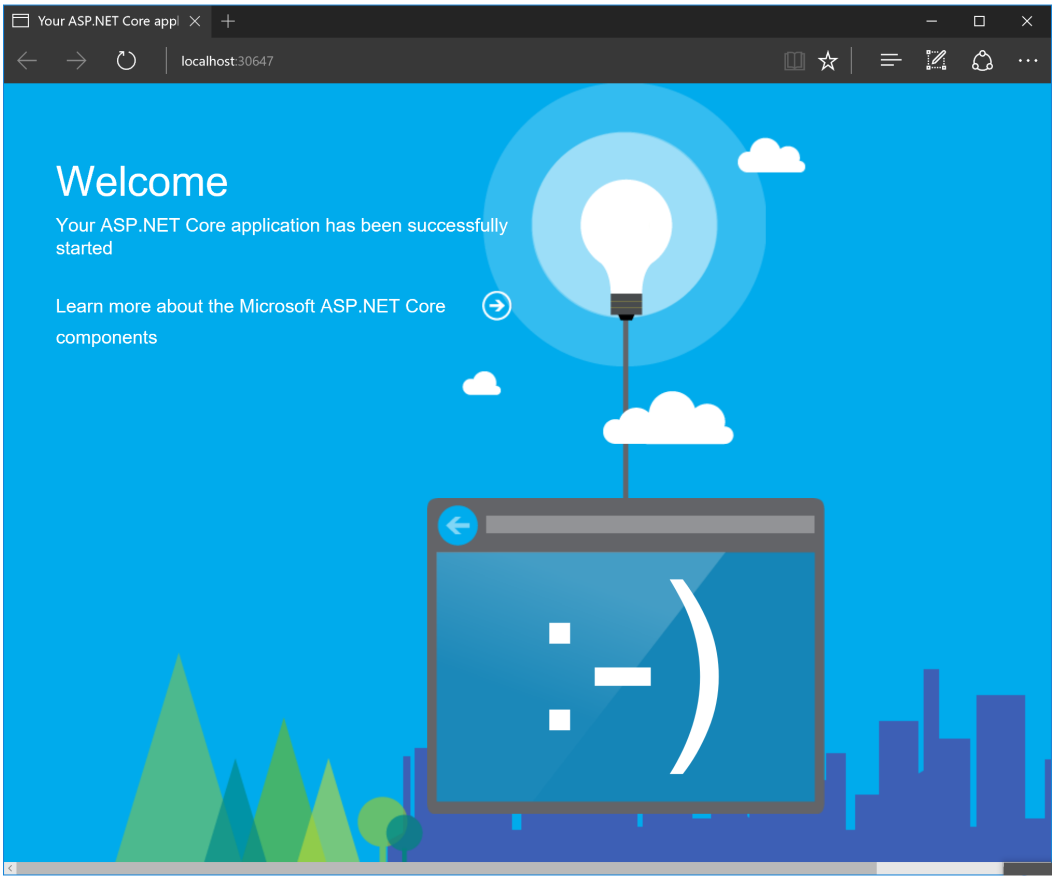
Task 2: Use Built-in Middleware

You have created in-line middleware so far. Let us use the **Static File** built-in middleware in ASP.NET Core.

1. Go to **Startup.cs**, and add the following line at the start of the **Configure()** method:

```
app.UseWelcomePage();
```

2. Running the application now should show a Welcome page, like below.



Welcome

Your ASP.NET Core application has been successfully started

Learn more about the Microsoft ASP.NET Core components

Important: The order in which you arrange your **Use[Middleware]** statements in your application's Configure method is very important. Be sure you have a good understanding of how your application's request pipeline will behave in various scenarios.

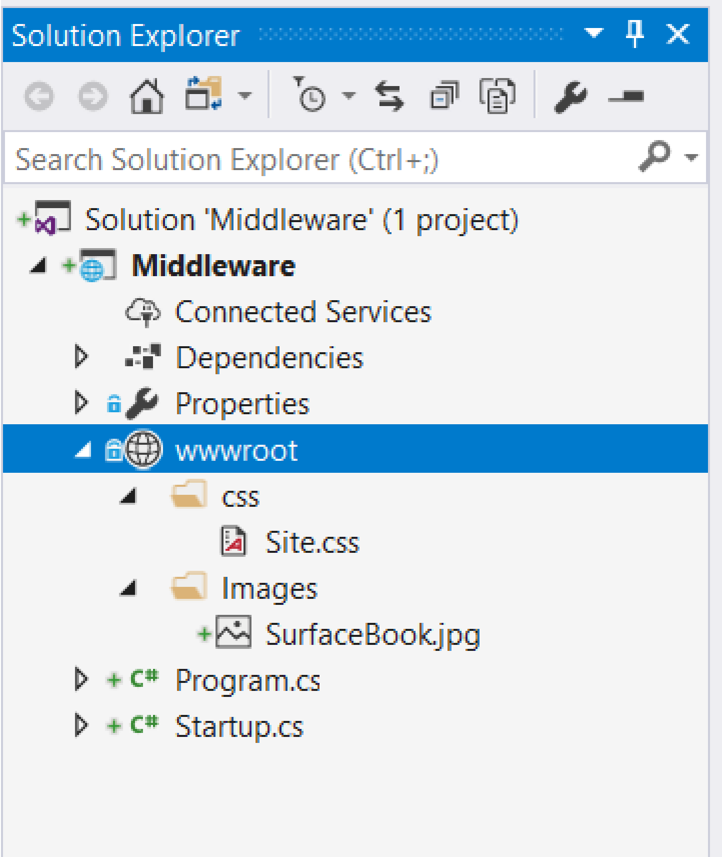
We've just successfully used a built-in middleware component!

Task 3: Use Static Files Middleware

Now let's look at using statics files:

1. Add the **wwwroot** folder. (Right-click on the project file **Middleware > Add > New Folder**).
2. Under **wwwroot** - create the two subfolders **css** and **Images**.
3. Within the **wwwroot** subfolders (css, Images) - add the assets from the Asset folder.
   - Right-click **css > Add > Existing Item**
   - Right-click **Images > Add > Existing Item**

   When you're done, the folder structure should look like the following:



4. Comment out the Welcome Page middleware statement below:

```
//app.UseWelcomePage();
```

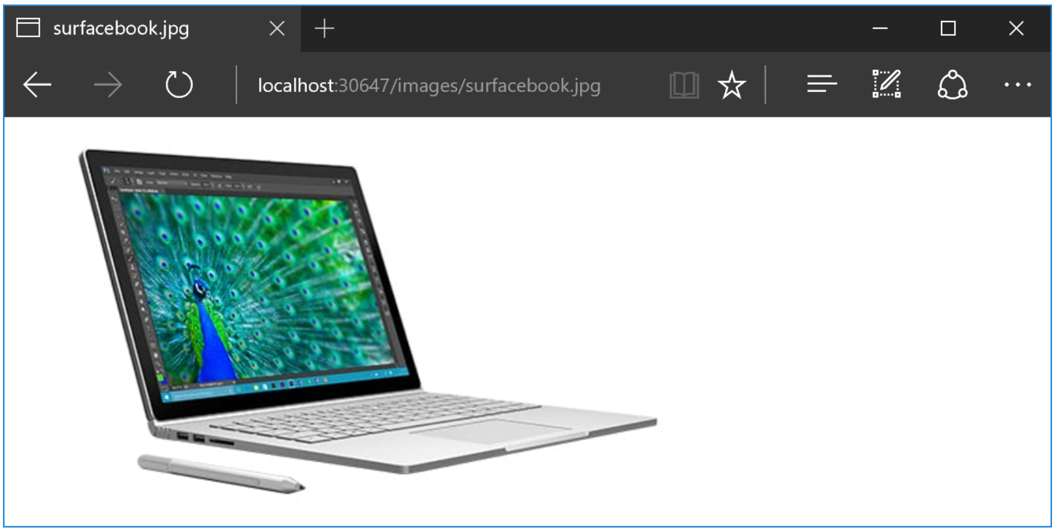
5. Add the following line to the start of the **Configure()** method:

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

6. Run the application and go to:

   http://localhost:[YOUR LOCALHOST PORT]/images/surfacebook.jpg

   It will show an **image** of Surface Book.



7. Similarly, going to the following URL will let you download the CSS file:

   http://localhost:[YOUR LOCALHOST PORT]/css/site.css

   Using the **app.UseStaticFiles()** middleware has enabled access to all of the static files in the wwwroot folder.

8. Now let's restrict access to parts of the static folder. Comment out the existing **UseStaticFiles()** middleware component and replace with the following middleware:

```
//app.UseStaticFiles();

app.UseStaticFiles(new StaticFileOptions
{
    FileProvider = new PhysicalFileProvider($@"{env.WebRootPath}\Images"),
    RequestPath = new PathString("/img")
});
```

   And add the following using statements for the above code:

```
using Microsoft.Extensions.FileProviders;
```

9. Build and start your web app.

   It will now let you access the image using http://localhost:[YOUR LOCALHOST PORT]/img/surfacebook.jpg. However, it will not let you directly download other static files in **wwwroot** folder.

   Note: If you can still access those files, try opening the Edge browser in private/incognito mode via *Ctrl* + *Shift* + *P*. It might be cached in the browser.

We've successfully enabled use of our static files in the wwwroot folder, and then restricted access to parts of it!

Exercise 3: Working Environments

Introduction

ASP.NET Core introduces improved support for controlling application behavior across multiple environments, such as development, staging, and production. Environment variables are used to indicate which environment the application is running in, allowing the app to be configured appropriately.

ASP.NET Core references a particular environment variable to describe the environment, the application is currently running in. This variable can be set to any value you like, but three values are used by convention: *Development*, *Staging*, and *Production*. You will find these values used in the samples and templates provided with ASP.NET Core.

Objectives

In this exercise, you will:

- Configure different pipelines for development and production working environments.

Task 1: Create a New Application Pipeline for Development Environment

1. Let's continue with our *Middleware* project.

   Create a **ConfigureDevelopment()** method in the **Startup** class in **Startup.cs**. Place this above the existing **Configure()** method. It should look something like the code below:

   ```
   public void ConfigureDevelopment(IApplicationBuilder app)
   {
   }

   public void Configure(IApplicationBuilder app, IHostingEnvironment env)
   {
       // Existing method:
       // Middleware code excluded for brevity
   }
   ```

```
**Note:** In addition to using an entirely separate Startup class based on the
current environment, you can also adjust how the application is configured
within a **Startup** class.

The **Configure()** and **ConfigureServices()** methods support
environment-specific versions similar to the Startup class itself, of the form
**Configure** and **Configure[Environment]Services()**.

If you define a method **ConfigureDevelopment()** it will be called instead of
**Configure()** when the **environment** is set to **development**. Likewise,
**ConfigureDevelopmentServices()** would be called instead of
**ConfigureServices()** in the same environment.
```

1. It makes sense to give unrestricted access to static files in the **Development** and environments. And we'll want to use the Welcome page in this environment as well.

   Add the following two statements to the **ConfigureDevelopment( )** method:

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

3. Remove the welcome-page and static files middleware from the regular **Configure( )** method.

4. Modify first middleware's text to "*Hello World, from Production! <br/>*".

5. After all of the above actions, **Startup.cs** class should look like below:

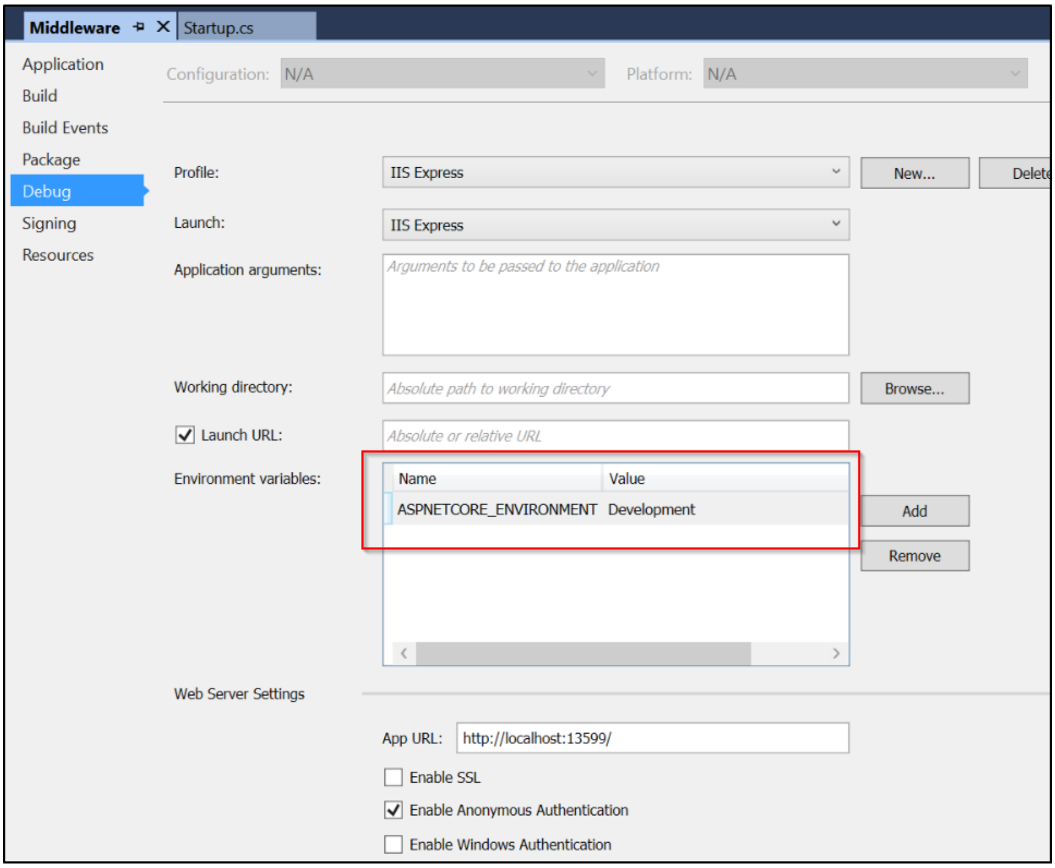
```
public class Startup
{
    public void ConfigureServices(IServiceCollection services)
    {
    }

    public void ConfigureDevelopment(IApplicationBuilder app)
    {
        app.UseStaticFiles();
        app.UseWelcomePage();
    }

    public void Configure(IApplicationBuilder app, IHostingEnvironment env)
    {
        app.Use(async (context, next) =>
        {
            await context.Response.WriteAsync("Hello World, from Production!<br/>");
            await next.Invoke();
        });

        app.Run(async (context) =>
        {
            await context.Response.WriteAsync("2nd middleware in the pipeline!");
        });
    }
}
```

6. Go to project properties (right-click **Middleware > Properties**). Then go to the **Debug** tab. See that the ASPNETCORE_ENVIRONMENT variable value is set to **Development**.



Configuration: N/A

Platform: N/A

Profile: IIS Express

Launch: IIS Express

Application arguments: Arguments to be passed to the application

Working directory: Absolute path to working directory

☑ Launch URL: Absolute or relative URL

Environment variables:

Name	Value
ASPNETCORE_ENVIRONMENT	Development

App URL: http://localhost:13599/

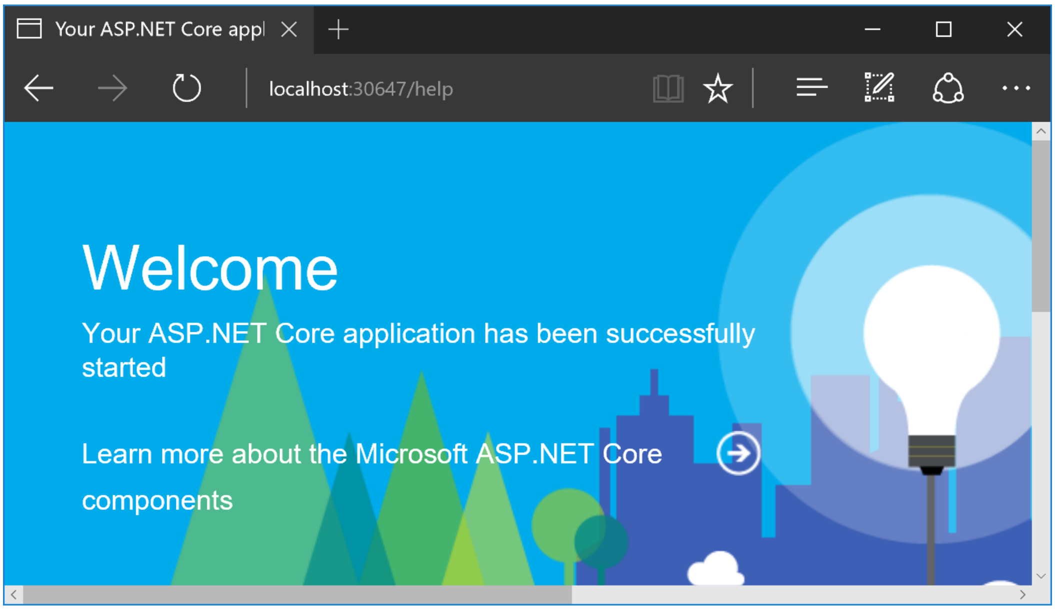
□ Enable SSL

☑ Enable Anonymous Authentication

□ Enable Windows Authentication

7. Run the application. Navigate to any static file URL. As you can see, you have unrestricted access to all static contents.

   Navigating to any other URL (such as http://localhost:[YOUR LOCALHOST PORT]/help) in the application will show the **welcome** page.



localhost:30647/help

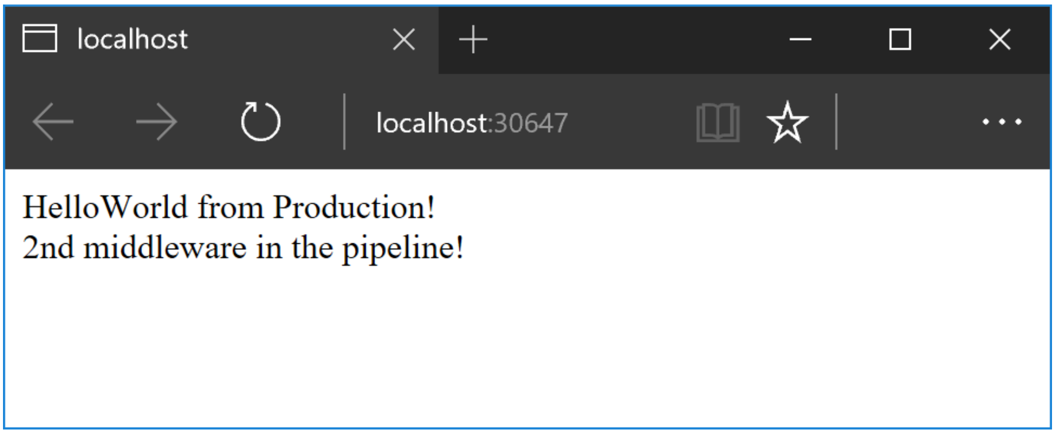
Welcome

Your ASP.NET Core application has been successfully started

Learn more about the Microsoft ASP.NET Core components

8. Go back to project properties in Visual Studio. Set *ASPNETCORE_ENVIRONMENT* variable to **Production**.

9. Run the application again. Since there is no dedicated **ConfigureProduction( )** method, it will run **Configure( )** method to configure to application pipeline.



HelloWorld from Production!
2nd middleware in the pipeline!

We've just configured different pipelines for two different environments - the *development* and *production* environments! ===