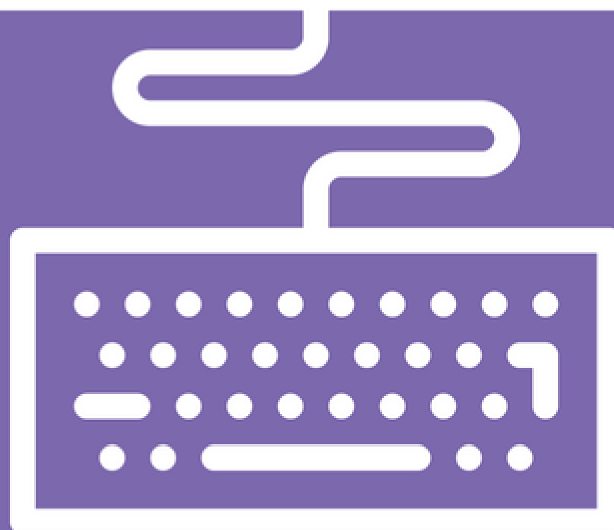
Create your next web application using ASP.NET Core

Practical ASP.NET Core MVC 2.1

Jon Hilton



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Before we start

You're here (hopefully) because you want to cut to the chase and learn how to build a real application using ASP.NET Core MVC.

In order to do that, you're going to need a few things.

Yep, this is the boring but necessary bit but fear not, you'll be writing and running code in no time.

Visual Studio

You don't **have** to use Visual Studio to write ASP.NET Core MVC web apps and in recent years a few alternatives have emerged.

For example, you can write and run .NET Core apps using Visual Studio Code and there's a slightly different version of Visual Studio for the Mac (called... wait for it... "Visual Studio for Mac"!).

But when you're just getting started, Visual Studio (for Windows) remains a common and popular choice and is what we'll be using for the rest of the course.

The good news is there's a free version for you to download and use (with certain caveats, which you may wish to take a look at, but don't need to worry about if you're just learning).

Download

Go to the Visual Studio community homepage and click the **Download VS Community 2017** button and the installer for a fully functional version of Studio will download itself to your computer.

Choose the right options

When you run the installer, it will take a moment to download the actual Visual Studio Installer.

Once that loads, you'll get a handy screen that gives you lots of choices.

For this course, you mainly need the ASP.NET and web development components, but it's nice to know you have choices if you ever decide to get into 3D Games or Mobile Development :-)

It's also worth selecting .NET desktop development, specifically because it will bring in the **SQL Server Express 2016 LocalDB** which you can use as a development database server in the future.

So make sure you've at least ticked the checkbox next to **ASP.NET and web development**, click the Install button and you're all set.

Workloads Individual components Language packs

Web & Cloud (7)

ASP.NET and web development
Build web applications using ASP.NET, ASP.NET Core, HTML/JavaScript, and Containers including Docker support.

Azure development
Azure SDKs, tools, and projects for developing cloud apps, creating resources, and building Containers including...

Python development
Editing, debugging, interactive development and source control for Python.

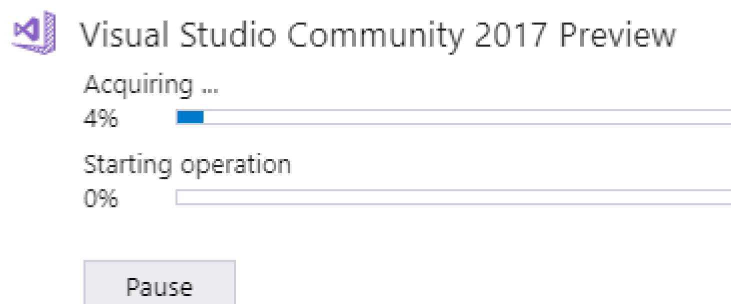
Node.js development
Build scalable network applications using Node.js, an asynchronous event-driven JavaScript runtime.

Summary

Visual Studio core editor
ASP.NET and web development
Included
.NET Framework 4.6.1 development tools
.NET Core 2.0 development tools
ASP.NET and web development tools
Developer Analytics tools
Optional
.NET Framework 4 – 4.6 development tools
Container development tools
Cloud Explorer
.NET profiling tools
Entity Framework 6 tools
Windows Communication Foundation
ASP.NET MVC 4
.NET Framework 4.6.2 development tools
.NET Framework 4.7 development tools
.NET Framework 4.7.1 development tools
.NET Core 1.0 - 1.1 development tools for Web

Just in case it's changed since I took that screenshot **this course has been written using .NET Core 2.1** (and the associated development tools).

If anything doesn't work as you'd expect (and especially if you suspect it's due to an updated version of .NET Core) hit reply to any of the emails from me and let me know.



Sit back and relax while the VS Installer does its thing.

Updating to 2.1

Visual Studio may only give you .NET Core 2.0 out of the box (this is true at the time of writing).

If so, you'll need to install the .NET Core SDK separately in order to target ASP.NET Core 2.1.

Head to https://www.microsoft.com/net/download/windows and click the button to download and install the .NET Core 2.1 SDK.

.NET Core 2.1

.NET Core is a cross-platform version of .NET for building websites, services, and console apps.

Download .NET Core 2.1 SDK (v2.1.300)

A Side Project

Over the course of the next few lessons, we're going to build a Trello clone.

If you're not familiar with Trello, it's basically an online kanban board, useful for managing your work.

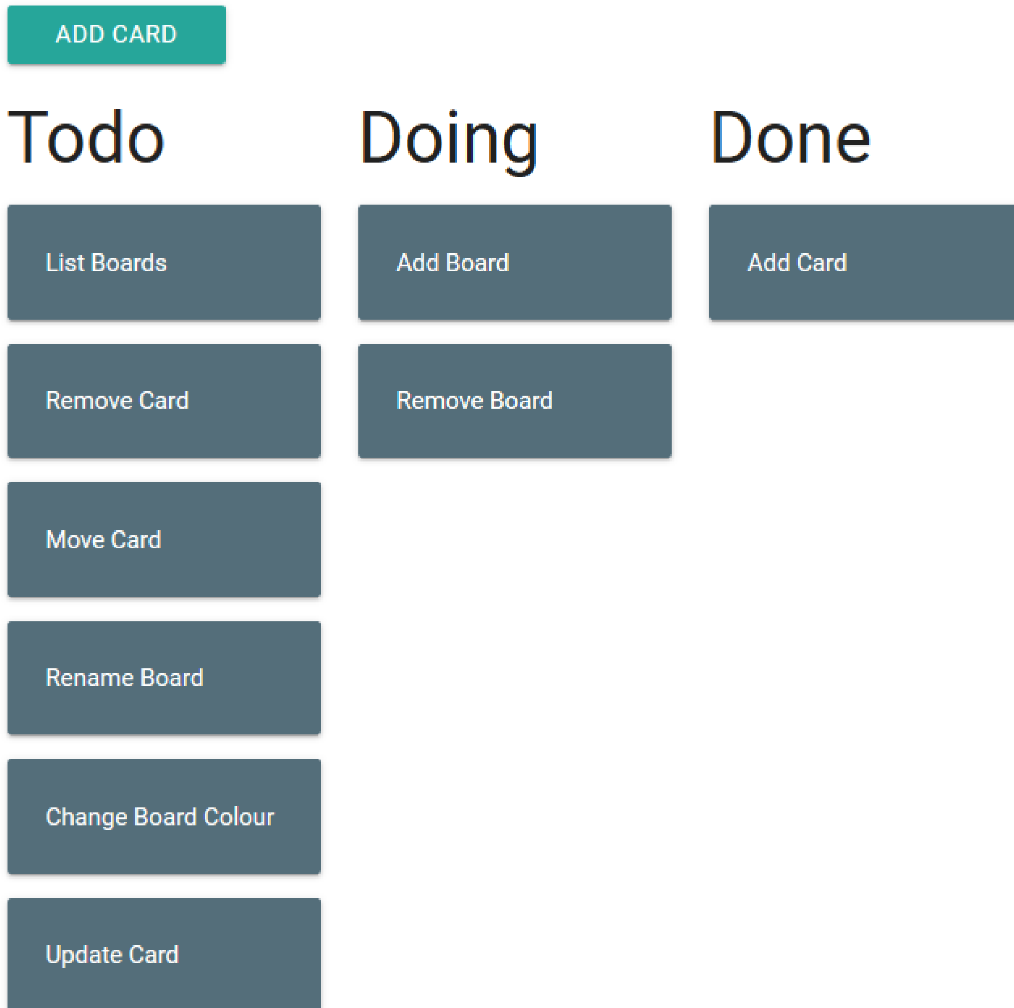
You can create one or more kanban boards.

Each board can have any number of columns and cards.

A card represents a task/feature you need to work on.

When you add a card it typically starts off in the left column (often called "Todo") and then moves across the board as you work on it.

Here's a sneak peek of where we'll end up.



I should probably say at this point, I'm no UI expert. Thankfully you don't need to be to learn how ASP.NET MVC works.

What are the features?

hint: the clue's in the screenshot ;-)

One of the challenges when building software is that moment, right at the beginning, where you start with a blank piece of paper and no code. It feels like all the work is ahead of you and you're not entirely sure where to start.

This is especially true when you're also trying to learn a new programming language/framework at the same time.

So, before we start (and I promise, the code follows shortly) it's worth breaking this down into what features we want to build.

The smaller the better. What we're aiming for, are features you can build in an hour or so. That way, you get to learn ASP.NET Core whilst seeing your efforts come to fruition in hours, not days or weeks.

There's no better motivator than seeing the application spring to life in front of your eyes.

So, with a little bit of domain knowledge (and studying other examples like Trello for clues) we can start to think about what our users will want/need to do.

The easiest way to do this is to sit down and brainstorm all the possible "tasks" our users are going to want to undertake with an online kanban board application.

- See list of boards
- Add board
- View board
- Add column (to a board)
- Add card (to a board)
- Change card title
- Move card to another column

And of course there are plenty more.

When you come to your own pet projects I highly recommend going through a brainstorming process, where you create a list (just like this one) of the key "things your users want/need to do".

It really helps get your imagination going and gives you a list which you can then prioritise, so you know what to build first.

What's in a name?

> There are only two hard things in Computer Science: cache invalidation and **naming things** *Phil Karlton*

If you've ever found yourself arguing (often with yourself) about what to call that method/class/view then you know how easy it is to get hung up on what something's called.

So more on a whim than for any good reason I've started referring to this Trello clone as **Donatello**.

Depending on your age/interests, your mind has either jumped to the Italian Renaissance sculptor, or the Teenage Mutant Ninja Turtles.

photo credit: W10002 [Wondercon 2016 - Donatello]() via [photopin]() [(license)]()

Either way it doesn't really matter, but that's the name we'll be using in all the code samples etc.

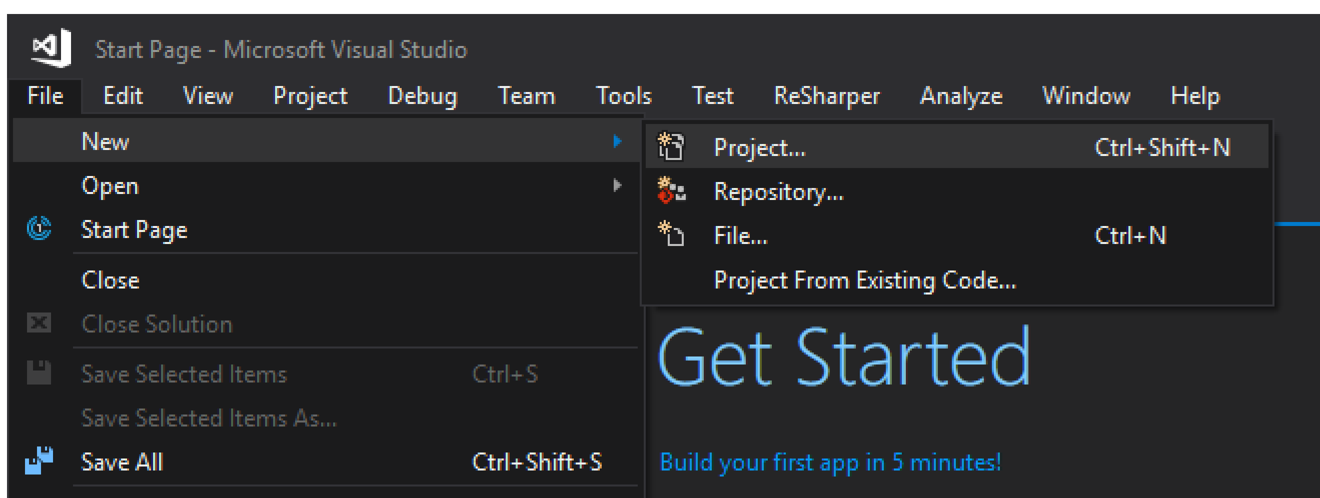
It all starts with a blank screen (project)

We can't build much without a project so let's get that going first.

You'll typically create at least one **project** per application. It provides a means of grouping together all of the code for your application, as well as indicating what third party libraries your project might need (often referenced via the ASP.NET package manager - NuGet).

Visual Studio enables you to have multiple projects for your application which are themselves grouped together within a **solution**.

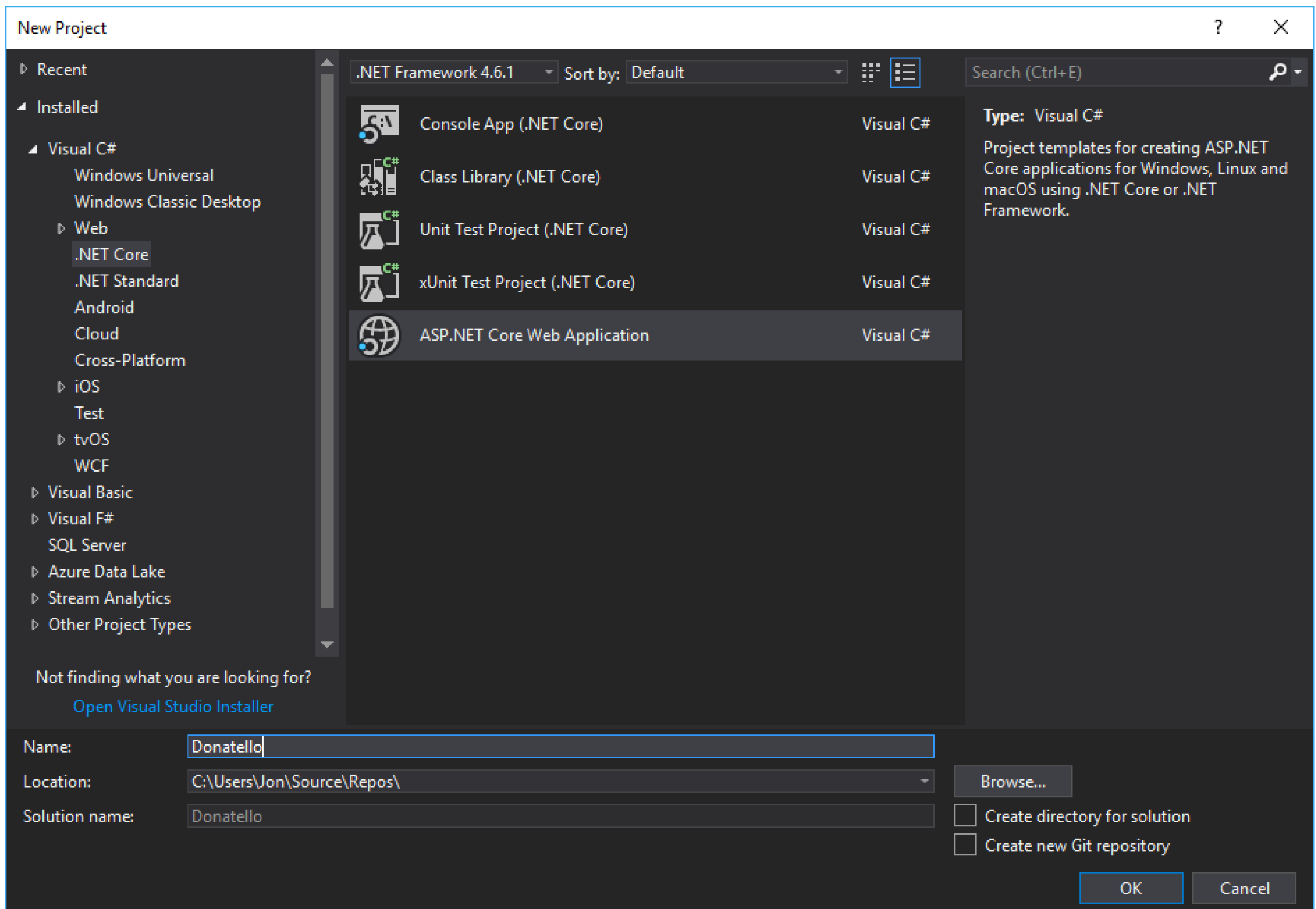
In Visual Studio, click **File -> New -> Project**



You'll find yourself staring at a big ol' list of possibilites.

We need to find the ASP.NET Core project template, typically under **Visual C# -> .NET Core -> ASP.NET Core Web Application**.

Pick a name etc. then click OK.



In case you don't feel you had enough decisions to make in that last window, now you get a whole load more!

New ASP.NET Core Web Application - Donatello

.NET Core | ASP.NET Core 2.1 | Learn more

Empty
API
Web Application
Web Application (Model-View-Controller)
Angular
React.js
React.js and Redux
Razor Class Library

An empty project template for creating an ASP.NET Core application. This template does not have any content in it.

Learn more

Change Authentication

Authentication **No Authentication**

Enable Docker Support

OS: Windows

Requires Docker for Windows

Docker support can also be enabled later Learn more

Configure for HTTPS

OK Cancel

You might want to explore some of these options at a later date. For example, if you're interested in building Single Page Applications (SPAs) on top of ASP.NET Core, you could use one of the starter templates e.g. Angular.

In our case, we want to start with the simplest possible project (so we can add what we need, and nothing else).

Select **Empty** for the web application type.

Also make sure you've got **.NET Core** and **ASP.NET Core 2.1** selected at the top.

At this point we don't want to worry about Authentication and definitely don't want to complicate things by introducing Docker, so you can just hit the **OK** button.

Hello World

It's always a good idea to check that things are working properly, even when your app is as simple as this one.

Hit **CTRL + F5** and you should see your first (and last) Hello World of this course.

You're all set

Now you're all set to get started with the fun bit, building features.

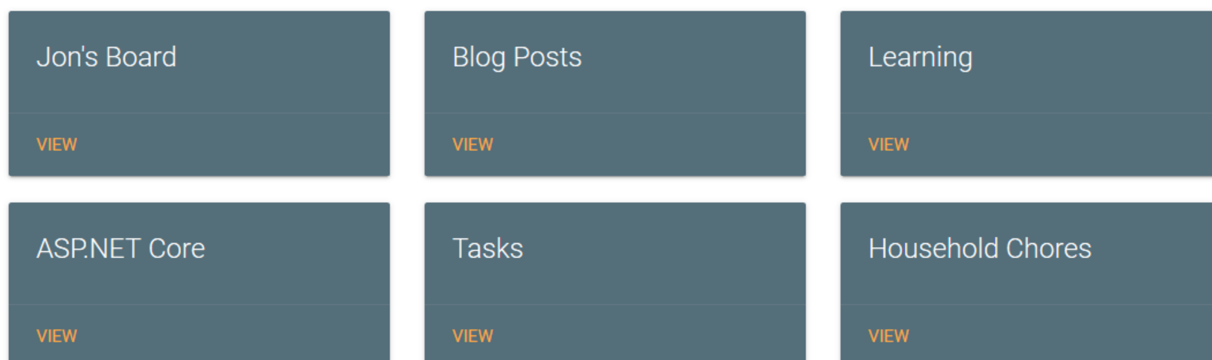
We'll be starting with the list of boards.

The First Feature

So now we know what we're building, we've installed Visual Studio and created our project.

It makes sense to start by implementing the list of kanban boards.

Here's what we're aiming for.



From here our users will be able to navigate to any of the boards (and eventually add more boards).

Before we get too heavy into the details (controllers, views, view models and how they all interact) let's build this boards list view.

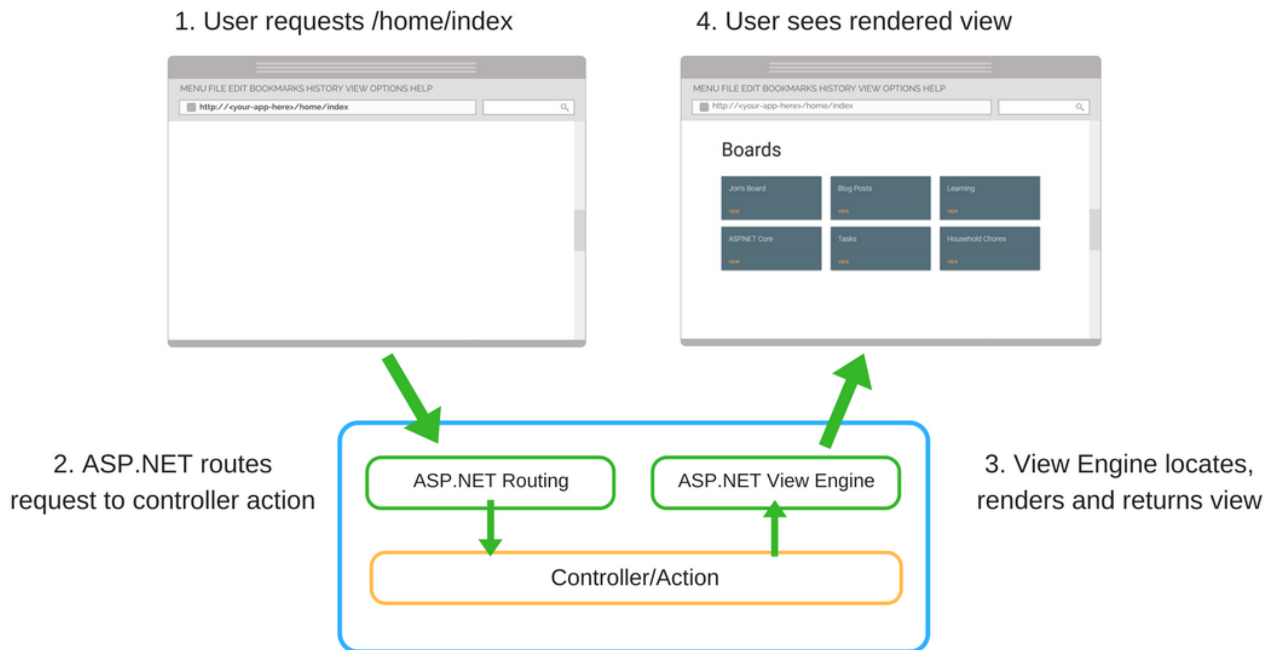
Then once you've got a working example under you belt we can dig into more comprehensive explanations of how (and why) it works, as we add more features.

This might look like a lot to absorb in one sitting but remember you can always come back and go through this again.

A brief introduction to controllers

Whatever you build in ASP.NET MVC you're going to need a controller.

When someone requests a page on your site, their request will be routed to a controller, more specifically an `action` on a controller.



You can think of `actions` as methods or functions.

For example.

```
public class HomeController : Controller
{
    public IActionResult Index()
    {
        return Ok();
    }
}
```

This `Index()` action is just about as simple as a controller action can be.

We'll look at the details of how web requests are routed to controllers later on, but for now, if we were using the default routing setup for an MVC project, you would trigger the `Index` action by opening a browser, and navigating to...

`http://<your-app-here>/home/index`

And, you would get back an empty screen.

`Index()` returns `Ok()` which simply tells our MVC controller to return an HTTP status code of 200 (OK).

A 200 (OK) status code means everything worked, and the request was successful.

Of course, you'd rarely do this in the real world and would be more likely to return some content, or a web page (view).

Create a boards controller

With our rough idea of what controllers look like, we need to create one for when users want to view a list of kanban boards.

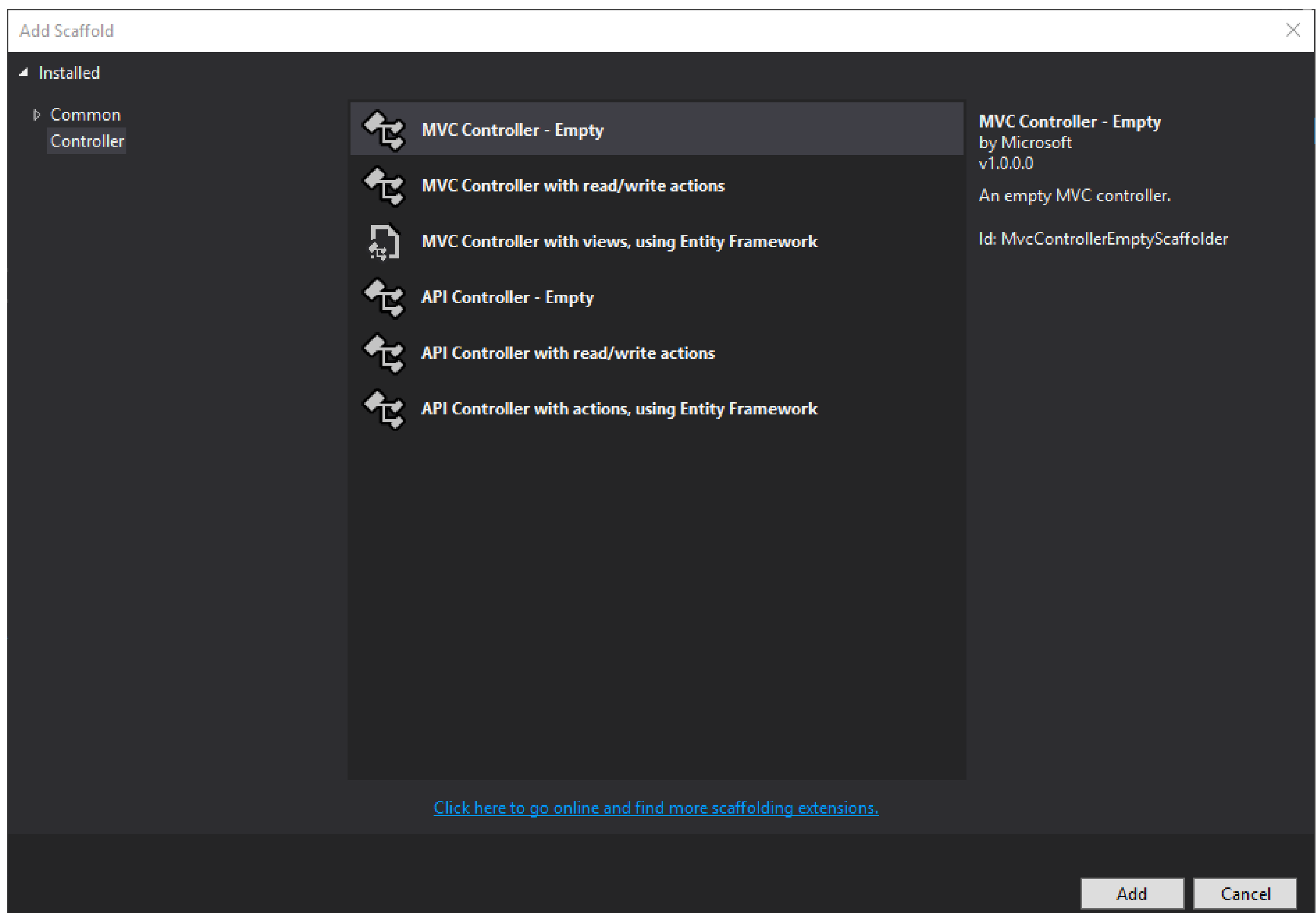
It's standard practice to have a **Controllers** folder, and to put all of your controllers in there.

We'll adopt this convention for now to keep things simple.

In your brand new web application, create a folder called **Controllers** (right-click the Project in Solution Explorer, select **Add -> New Folder**)

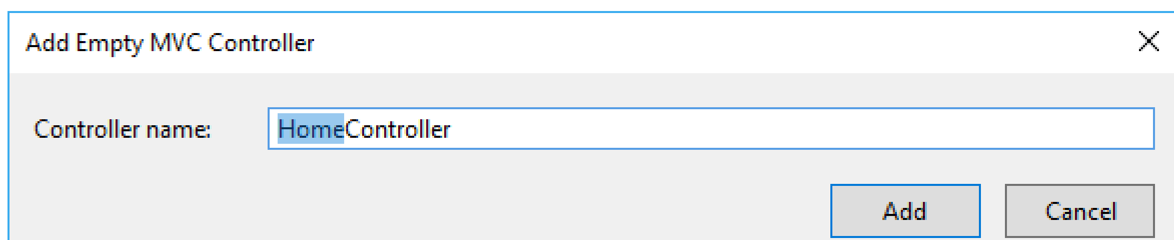
Then right-click on your new folder, and select **Add -> Controller**.

As we've already seen, VS2017 likes giving you choices, here's another one...



We're only interested in MVC controllers for now, and want to write the code ourselves (not let VS do it for us) so we can stick to the first option **MVC Controller - Empty**.

VS will prompt you for a controller name. Call it **Home**.



> **Scaffolding**
>
> The first time you create a controller in a new project Visual Studio might install some NuGet packages and tell you it's scaffolding.
>
> We'll touch on NuGet later in the series, but think of it as the primary Package Manager for .NET (a bit like npm for front-end applications).
>
> When we instructed VS to create a controller, it added a NuGet package that allows it to some "clever" things like automatically generating controllers for us to support basic operations (like writing to and reading from a database).
>
> This is called scaffolding.
>
> For this course we will generally stick to creating "empty" controllers and writing the code ourselves, so that we get a better understanding of how everything works.

After a short while, you should find yourself looking at this controller...

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Threading.Tasks;
using Microsoft.AspNetCore.Mvc;

namespace Dontaello.Controllers
{
    public class HomeController : Controller
    {
        public IActionResult Index()
        {
            return View();
        }
    }
}
```

This action differs slightly from the example we looked at, can you see what's changed?

Yep, gone is the `return Ok()` line, and in its place we return a View.

Create a boards list view

Generally speaking, we're going to be using views to display content in our application.

Views let you use standard HTML elements to render your app and mix in dynamic content (for example, from a database) with these standard HTML elements.

> **A word on MVC Conventions**
>
> ASP.NET Core MVC comes with some default "out of the box" conventions.

> These defaults cover things like where to look for your controllers and views.
>
> By default ASP.NET Core MVC will expect your views to live in a folder called....
>
> ... Views (bet you didn't see that coming).
>
> It also looks at your controller and action names.
>
> `Views\<controller-name>\<action-name>`
>
> In our case...
>
> ```
> public class HomeController : Controller
> {
>  public IActionResult Index()
>  {
>      return View();
>  }
> }
> ```
>
> ... MVC will try to locate a view called **Index.cshtml** in the **Views\Home** folder.
>
> `Views\Home\Index`

Create a new folder at the root of your project and call it **Views**.

Then right-click on the **Views** folder and select **Add -> Folder** and add a "sub folder" called **Home**.

Finally, right-click on the **Home** folder and select **Add -> View**.

More VS choices now await you.

Add MVC View

View name: Index

Template: Empty (without model)

Model class:

Options:

Create as a partial view

Reference script libraries

Use a layout page:

(Leave empty if it is set in a Razor _viewstart file)

Add Cancel

For the most part we can stick with the defaults here.

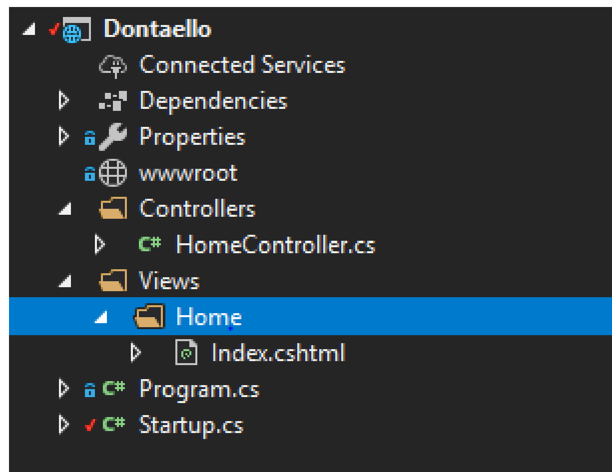
The key bit is to make sure your View name is **Index**, so that MVC can locate it.

We'll cover layout pages shortly but for now, leave **Use a layout page** ticked, and the textbox below it empty.

Hit **Add** and you'll see the default "new view template" content.

```
@{
    ViewData["Title"] = "Index";
}

<h2>Index</h2>
```

Your new view appears in Solution Explorer (this is a good time to check it's in the right folder, otherwise MVC might not be able to find it).



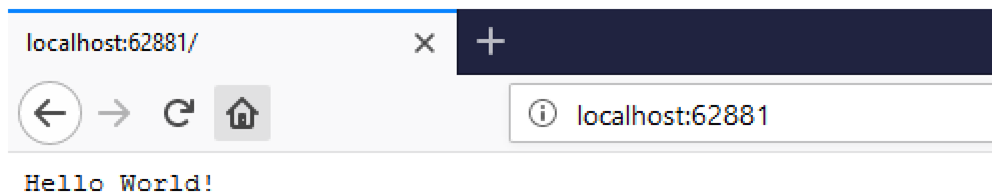
Never too early to check your work

Before we continue...

What do you expect to see if you hit **CTRL+F5** to run your application?

Your shiny new Index page, and the word **Index**?

Give it a go and see.



Hmmm, so we're still seeing our original hello world.

Where is that text coming from? and why aren't we seeing our shiny new view?

The answers lie in **startup.cs**.

Hello Startup.cs

Startup.cs is at the heart of any ASP.NET Core application.

It is the "go-to" place to set up your application, including things like security, routing, whether or not to enable MVC.

Take a moment to figure out where that pesky "Hello World!" is coming from...

```
app.Run(async (context) =>
{
    await context.Response.WriteAsync("Hello World!");
});
```

Yep, there it is, in the **Configure** method.

This is the simplest web application you could possibly write in ASP.NET Core, it simply returns "Hello World!", no matter what URL you visit.

The thing is our application doesn't actually know that we want to use MVC and isn't configured to use any of the MVC features such as controllers, views etc.

If we'd chosen one of the other project templates when we created our project some of the following steps would have been done for us.

It can be a useful time saver to use one of ASP.NET Core's starter projects but it also comes at a cost, namely the fact that you get a load of other stuff in your project that you may or may not need.

Plus it's quite useful to understand how to do this yourself, should you ever need to modify an existing project.

Enter MVC

To enable MVC in our application, we need to do two things.

The first bit is done in the **ConfigureServices** method.

Yours is probably empty right now, so go ahead and add this line...

```
public void ConfigureServices(IServiceCollection services)
{
    services.AddMvc();
}
```

ASP.NET Core MVC relies on various built-in services to work correctly, this line ensures they are all registered and available to our application.

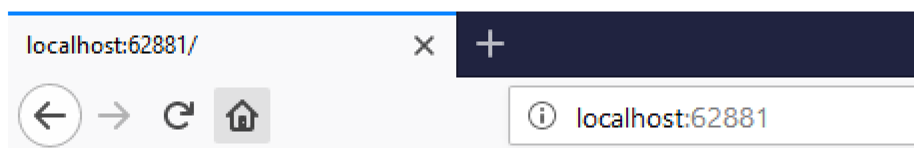
Then we need to tell our app to go ahead and use MVC (with default routing options) by adding `app.UseMvcWithDefaultRoute()` to the **Configure** method.

```
public void Configure(
    IApplicationBuilder app, IHostingEnvironment env)
{
    if (env.IsDevelopment())
    {
        app.UseDeveloperExceptionPage();
    }

    app.UseMvcWithDefaultRoute();

    // removed app.Run line
}
```

Whilst we're here we can remove the lines that called `app.Run` as this is now redundant, MVC will take over our application and start serving content using controllers and views, no need for Hello World anymore.

Now try running your application again.

Tada, you should be looking at our amazing home page.



Index

What if it doesn't work?

Whenever you build anything using a framework like ASP.NET MVC things can (and do) go wrong.

The most likely issue you might see here is this one...

An unhandled exception occurred while processing the request.

InvalidOperationException: The view 'Index' was not found. The following locations were searched:
/Views/Home/Index.cshtml
/Views/Shared/Index.cshtml

Microsoft.AspNetCore.Mvc.ViewEngines.ViewEngineResult.EnsureSuccessful(IEnumerable<string> originalLocations)

Stack Query Cookies Headers

InvalidOperationException: The view 'Index' was not found. The following locations were searched: /Views/Home/Index.cshtml /Views/Shared/Index.cshtml

Microsoft.AspNetCore.Mvc.ViewEngines.ViewEngineResult.EnsureSuccessful(IEnumerable<string> originalLocations)
Microsoft.AspNetCore.Mvc.ViewResult+<ExecuteResultAsync>d__26.MoveNext()
System.Runtime.ExceptionServices.ExceptionDispatchInfo.Throw()
System.Runtime.CompilerServices.TaskAwaiter.HandleNonSuccessAndDebuggerNotification(Task task)
Microsoft.AspNetCore.Mvc.Internal.ResourceInvoker+<InvokeResultAsync>d__19.MoveNext()
System.Runtime.ExceptionServices.ExceptionDispatchInfo.Throw()

You'll get this if ASP.NET can't locate your view for some reason.

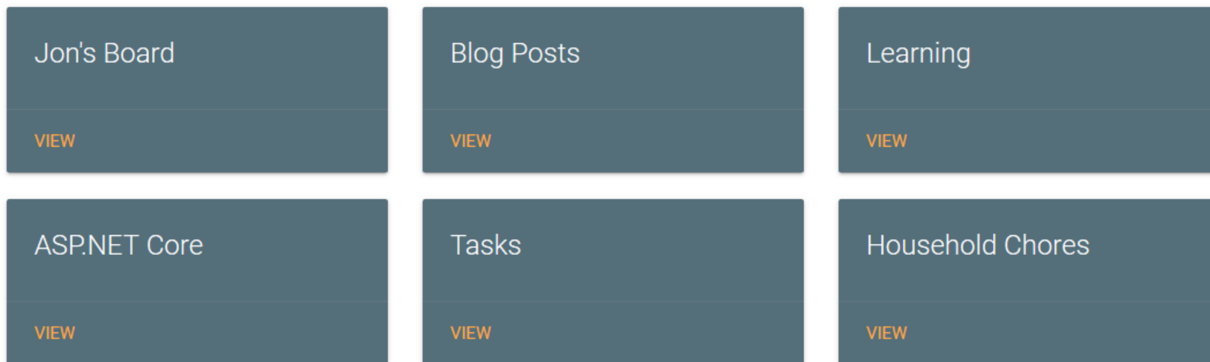
As error messages go this is actually pretty useful and tells you exactly where to look.

If you do encounter it, go ahead and check the folders mentioned to see if your view is in there.

Chances are, the view you thought you added is either in the wrong folder or has the wrong name.

But what about that list of Kanban boards?

Here's a reminder of what we're aiming for with this first feature.



And here's where we've got to.

- Configured our app to use MVC (with default routing)
- Added a very simple **controller**, with one **action** that returns a **view**
- Created the relevant view
- Removed the "boilerplate" hello world code
- Checked everything worked as expected

That last bit is crucial. No matter how small the step you've just taken, testing what you've got so far is always worth doing.

Occasionally (OK, a lot of the time) things don't work as you might expect, and the longer you delay testing, the more you have to backtrack to work out what caused your app to stop working!

Introducing the ViewModel

We've done pretty well up to this point in our exploration of MVC.

In fact, we've touched on the C (controllers) and the V (our basic view), which just leaves us with the M (model).

Specifically, we're going to create our first **ViewModel**.

We will cover the difference between Models and ViewModels in a subsequent lesson, but for now, you can think of the ViewModel as the place where your data goes so that it can be returned from your controller to your view.

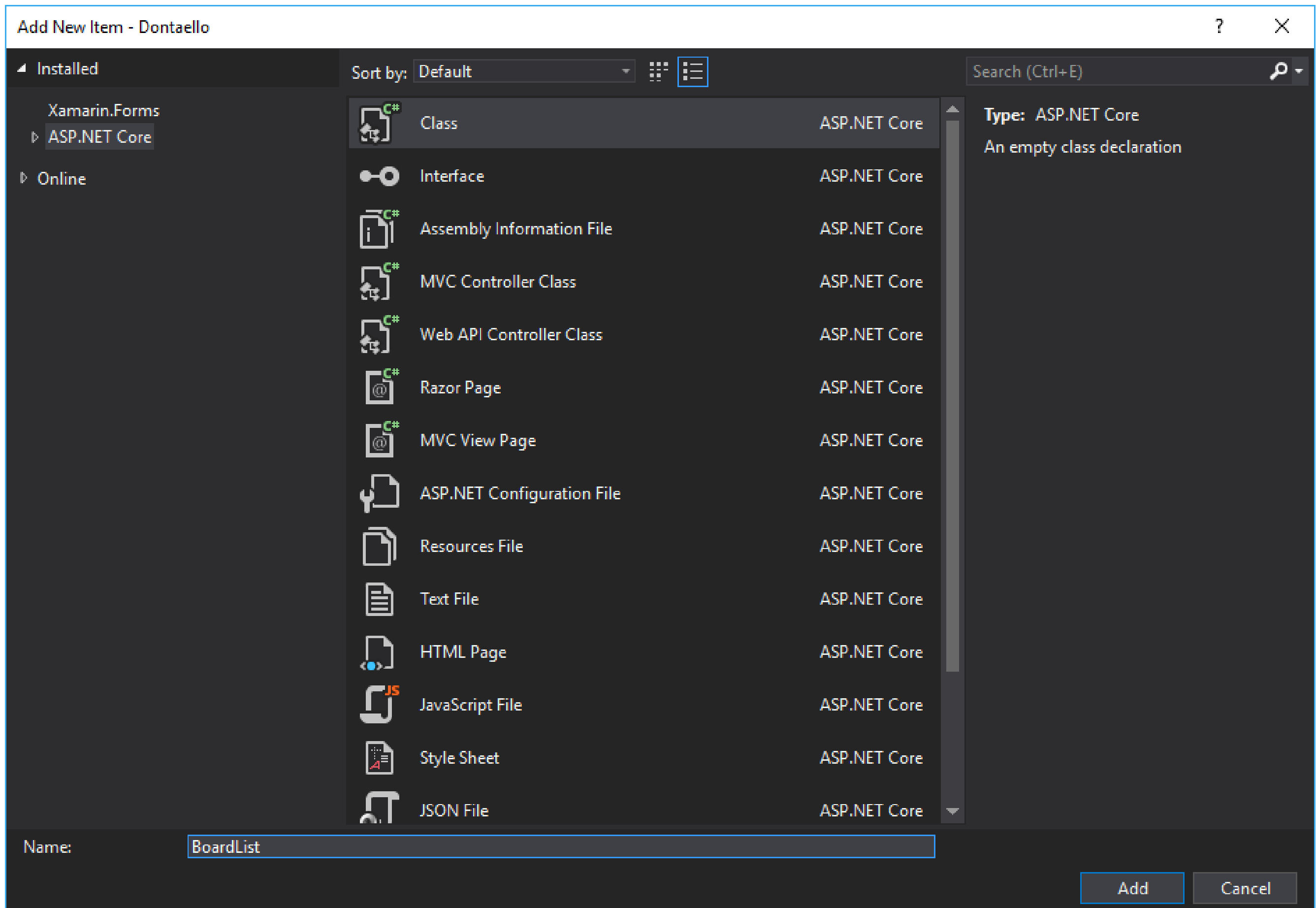
Your view can then show the contents of a ViewModel using some simple binding syntax (which you're about to see).

First up we'll create a folder for our ViewModels.

Add a new folder to the root of your project, called **ViewModels**.

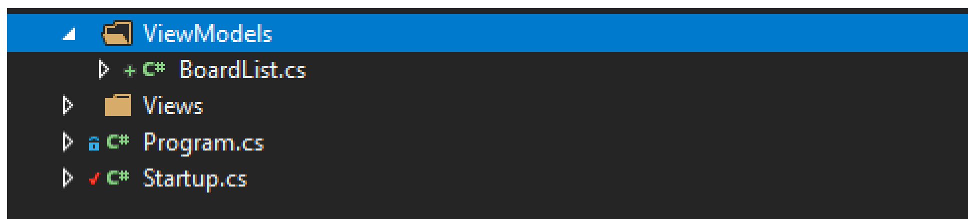
Then right-click and select **Add -> Class**.

Strangely, Visual Studio is still determined to give you choices at this point (even though we were quite clear that we wanted a new class).



Select **ASP.NET Core** from the menu on the left, and **Class** from the pane on the right.

Name it **BoardList.cs** and hit **Add**.



Create the first version of a Board List ViewModel

So what does our ViewModel need to contain?

Well, we know we want a list of kanban boards so a list would be a good starting point.

And we know we want something to represent a "board" in this context.

So let's create that `Board` class first.

We can add a `Board` nested class to the `BoardList` class in **BoardList.cs**.

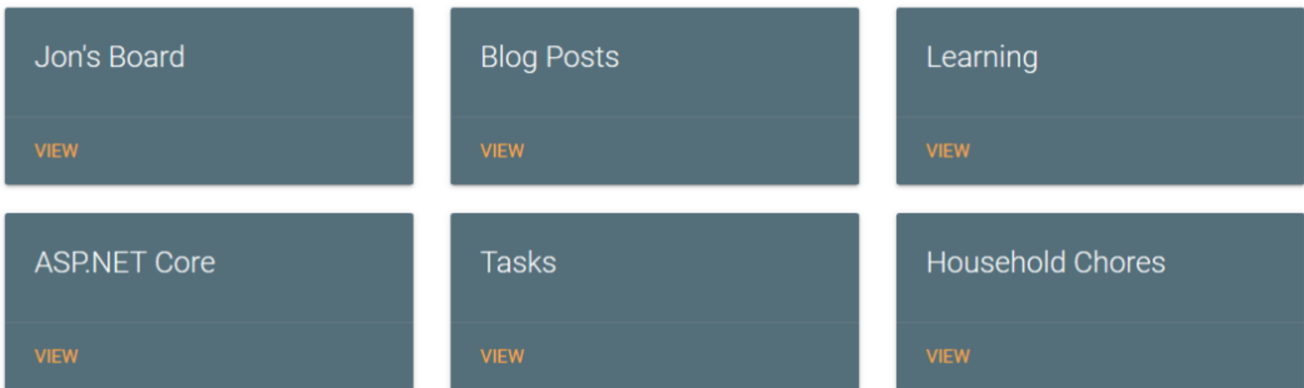
```
public class BoardList
{
    public class Board
    {

    }
}
```

> **Nested classes**
>
> Depending on your experience of C#, this might look a little strange.
>
> You've probably seen a few classes, but not necessarily many nested like this (where one class lives inside another).
>
> All it really means is that this class is always referenced in relation to its parent.
>
> So if you were to try and create a new instance of `Board` from somewhere else in your application, you'd need to use its full name like this...
>
> ```
> var board = new BoardList.Board();
> ```
>
> You don't have to nest your classes like this but I find it helps to be explicit, in this case being very clear that this `Board` class is intrinsically linked to our ViewModel and not for general consumption elsewhere in our app.

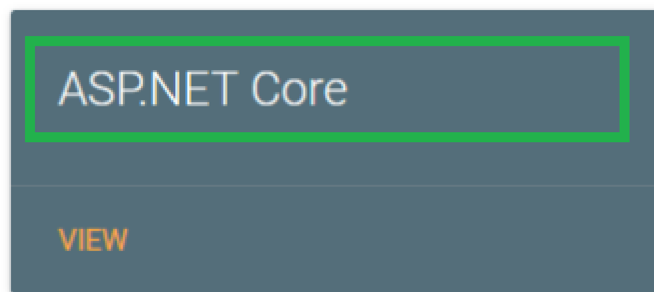
As far as we're concerned, this ViewModel is only ever going to be used for this one feature/view (a list of kanban boards).

For that reason we don't need to go crazy and add loads of properties to our ViewModel that we don't need.

Remember this image of what we're aiming for?



If you think of each "Board" being represented by an instance of our `Board` class, what does it need?



Well for now just a title really e.g. **ASP.NET Core**.

So go ahead and add a `Title` property to the `Board` class.

```
public class BoardList
{
    public class Board
    {
        public string Title { get; set; }
    }

}
```

Now what about that list I mentioned? If we want our ViewModel to contain one or more of these "Board" representations, we'll need a list to put them in.

```
public class BoardList
{
    public List<Board> Boards { get; set; } = new List<Board>();

    // Board class definition omitted for brevity...

}
```

Add that to the top of your `BoardList` class and you're good to go.

> **Object reference not set to an instance of an object**

> You don't have to include the end of that line...
>
> ```
> = new List<Board>();
> ```
>
> But if you don't, the list will be `null` to start with.
>
> This will likely catch you out later. If you subsequently try to add items to the list without making the above call (to "new up" or "instantiate" the list) you'll get a Null Reference Exception.
>
> It's easier all round if you take this defensive step to instantiate the list now.
>
> Your future self will thank you!

Back to the controller

That's our ViewModel defined, so how can we return an instance of it to our view?

We need to revisit our controller action.

Open up **HomeController.cs** and take a look at the `Index` action.

```
public class HomeController : Controller
{
    public IActionResult Index()
    {
        return View();
    }
}
```

So far we've just returned a View (using the default conventions that MVC uses to locate views).

But we can also return an ViewModel alongside our View.

To do so we'll need to create a new instance of our `BoardList` ViewModel and pass it in the call to `return View();`.

```
public IActionResult Index()
{
    var model = new BoardList();

    var board = new BoardList.Board();
    board.Title = "Jon's Board";

    model.Boards.Add(board);

    return View(model);
}
```

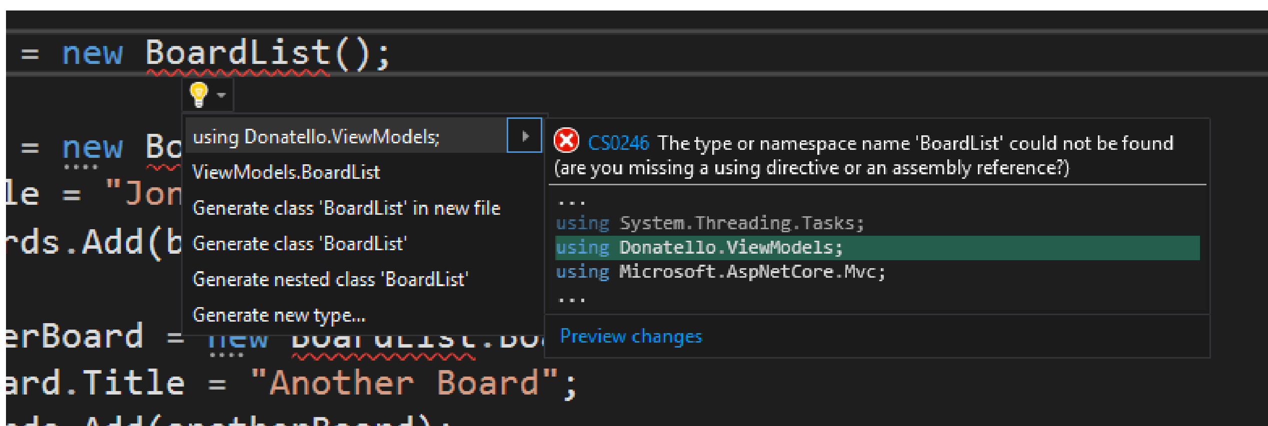
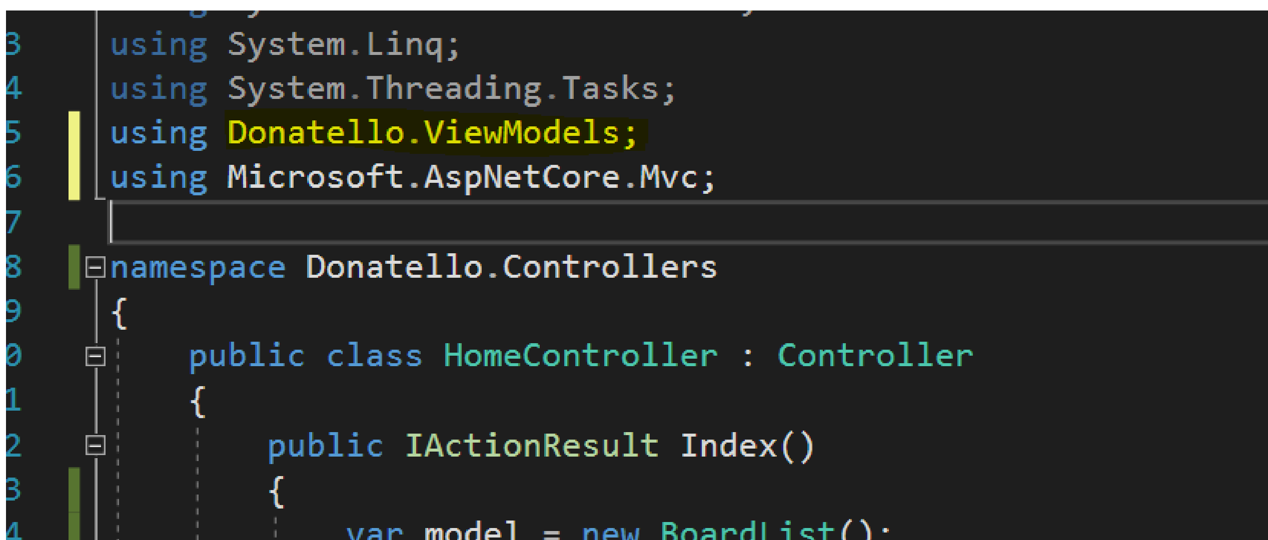
First up, we create a new instance of our `BoardList` ViewModel.

Then we create a new `Board` instance.

We can then set the title of that new `Board` instance before adding it to the list.

Finally we can return the resulting ViewModel alongside our View.

Did you get a red squiggly line when you added this code to your controller? Read on to find out why and how to fix it...

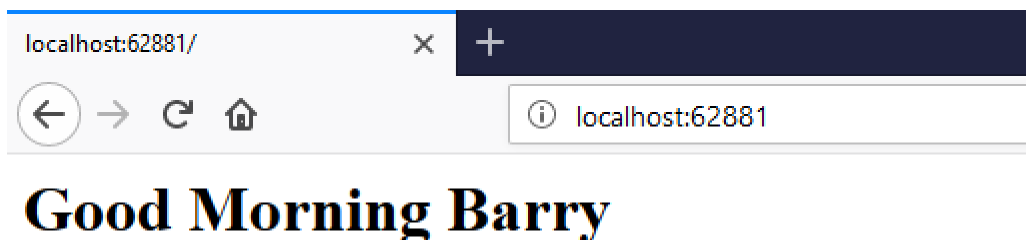
> **Namespaces**
>
> If you add this code to your own controller, chances are Visual Studio will underline any references to `BoardList` with a squiggly red line.
>
> This is VS pointing out that you haven't really told it where your `BoardList` class lives, or how to reference it in this controller class.
>
> If you hover over the offending code (`BoardList`), you'll see a handy explanation, plus a link to **Show potential fixes** (or you can press **CTRL+.**).
>
> 
>
>
> Select the first option and VS will add your ViewModel's namespace to the list of referenced namespaces at the top of the controller class.
>
> 
>
>
> The red squiggle disappears and now you can continue to reference any classes in that ViewModels namespace without VS complaining.

Show data in the view (using Razor)

Finally, we have something to show for all our efforts.

Well almost, we just need to make it visible.

To make this "Board List" (albeit only one board right now) visible, we need to display the contents of the ViewModel in our View.

> By default, MVC views use something called **Razor** to show content in our views.
>
> The **Razor** syntax enables us to bind parts of our HTML markup to the data contained within our ViewModel. This lets us mix our "static" text (headings, paragraphs etc.) and "static" markup (HTML tags such as DIVs etc.) with dynamic data from our ViewModel.
>
> For example, if you had this HTML ...
>
> ```
> <h1>Good Morning</h1>
> ```
>
> ... and a property on your ViewModel called `FirstName`.
>
> MVC could "render" the first name in that heading using this syntax...
>
> ```
> <h1>Good Morning @Model.FirstName</h1>
> ```
>
> Which would render this... (assuming `FirstName` is set to Barry!).
>
> 
>

First up, we need to tell our **View** which **ViewModel** we're going to be using.

Add this line to the very top of **Index.cshtml**.

```
@model Donatello.ViewModels.BoardList

// rest of index.cshtml here...
```

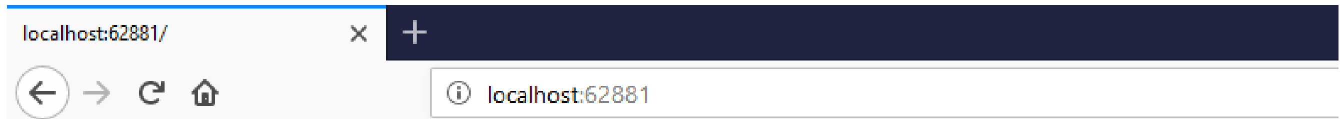
With that in place, Visual Studio springs into life and gives you Intellisense whenever you reference your ViewModel in the view.

This means you don't have to guess (or remember) what you named your properties on your ViewModel, because Visual Studio will help you out by showing you what's available.

Underneath the `<h2>Index</h2>` line, add this...

```
@foreach(var board in Model.Boards)
{
    @board.Title
}
```

Then hit **CTRL+F5** to see what we've got.



Well we're not going to win any design awards for this one, but it's a start.

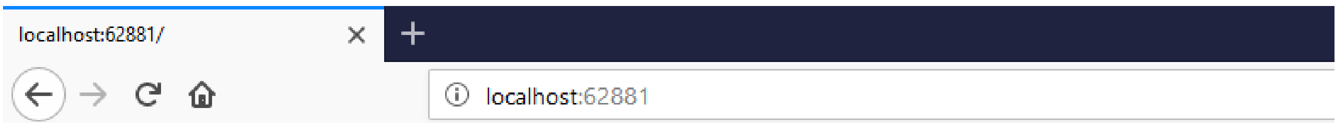
The Razor syntax above loops over each board in our Model.Boards list and then spits out the board's title.

Before we go any further let's add another board to our list, just to prove this works as we think it should.

Head back to **HomeController.cs** and add another board to your list.

```
public IActionResult Index()
{
    var model = new BoardList();

    var board = new BoardList.Board();
    board.Title = "Jon's Board";
    model.Boards.Add(board);

    // add this...
    var anotherBoard = new BoardList.Board();
    anotherBoard.Title = "Another Board";
    model.Boards.Add(anotherBoard);

    return View(model);
}
```

Then run your app again and you should see two "boards" in all their plain text glory.



Index

Jon's BoardAnother Board

It works!

So we have our list of boards, returned as a ViewModel from a Controller and rendered in a View.

But it looks, well let's be honest, a bit ugly.

This is where this free sample of Practical ASP.NET Core MVC ends.

If you purchase the full book, your very next step will be to make this page look a little closer to the example we saw earlier and bring in a CSS framework to do all the heavy lifting.

From there we'll move on to make things a bit more "real". You'll see how to store the kanban board data in a database (using Entity Framework Core) and make it possible for users to add/move cards etc

Next we'll take a moment to make this look a little closer to the example we saw earlier and bring in a CSS framework to do all the heavy lifting.