# Exercise: MVC Introduction

Problems for exercises and homework for the "Web Dev Basics" course from the official "Applied Programmer" curriculum. In these exercises we will create a very **simple HTTP Server**. We will extend it every time and design it to mimic Microsoft’s IIS.

## Introduce Controllers

Our first task in this exercise is to **create a controller functionality** in our server, which should **route controller** **action methods to responses**. Then, we will create **controller classes** with **actions**:

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### Step 1: Modify Routing Table

If you remember, until now we used **pre-action methods** in the Startup **class** to **modify a response** before it is returned to the browser. We did this, as we needed the **HTTP request** and **response** but now our **controller methods** will obtain the **request** and **directly return a response**.

For this reason, we should **modify our mapping methods** to use the **request data** from the browser and **return a response** through a **function**.

To do this, **modify the methods** in the IRoutingTable **class** like this:

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Note that the three methods now **accept a parameter of type** Request and **return a** Response. This is possible because of the Func<T, T> **delegate**. In this way, the **request** may be **sent to the response function** as a **lambda** **expression**: request => response.

Now **implement the methods** in the RoutingTable **class**. First, our **routes collection** should now change its **type** to **contain a response function** like this:

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As we used the new **keyword** in the **constructor**, it should **stay the same**:

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Then, make the Map(…) **method** of the class **reusable** by the MapGet(…) and MapPost(…) **methods**, which we will implement next. This method should **accept a method** and a **path** and **map them to a response**. Finally, it should **return** the **current** IRoutingTable **instance**. Write the method like this:

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Write the methods for **mapping** "GET" and "POST" **requests**. They should accept a **path** and a **delegate function** and use the Map(…) **method** from above with **different request methods**:

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At the end, **modify** the MatchRequest(Request request) **method** from before. The difference is that it should now **return not only a response**, but the **whole response function** with the **request**. Do it like this:

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Now we have a **routing table**, which allows us to use the **request** **data** when forming a response.

### Step 2: Create Controller Class

To create a **controller functionality**, start by **creating** the Controller **class**, which should be in a **folder** named "Controllers" in the "BasicWebServer.Server" **project**. **Define the class** as abstract, as it won't be instantiated directly:

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Create the **constructor** of the class and **a property** for the **HTTP request**, as our controller actions will use it:

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Then, create a **method**, which **returns responses** with **different response types**, which we have already created:

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Now we have the **base class for all controllers**, which can return **different responses**. We will see how to use it later.

### Step 3: Create Routing Extensions

Before we create controller classes, we should think about how **URL paths** in our app will be **mapped** to the **controller methods**. We want to do the **mapping** in the Startup() **class** of the "BasicWebServer.Demo" **project** like this:

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To do this, we should **add mapping methods** to the **routing table** we have, which should **accept the controller**, a **path** and a **response function**.

Start with creating the RoutingTableExtensions **class**, placed in the "Controllers" **folder**:



Then, implement the MapGet<TController>(…) **method**, which should **extend** the MapGet(…) **method** from the RoutingTable **class**. We often create **extension methods**, as we want to achieve better **separation of concerns** and **single responsibility**.

The MapGet<TController>(…) **method** should accept a **generic parameter of type** Controller and return IRoutingTable:



Also, it should **accept the current routing table instance** to be **extended**, a **path** and a **function**, which **accepts a** **controller** and **returns a response**. Do it like this:

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On the next line, it is important to **add a generic type constraint** for TController to be of **type** Controller:



Then, write the **method implementation**. The method will use the MapGet(…) **method** of the RoutingTable **class**. It should **create a controller instance** of a **given controller type** and **pass it to the method**. For the creation of the controller, we will use a **separate method** – CreateController<TController>(Request request), which we will implement later.

For now, the MapGet<TController>(…) **method body** is the following:



The MapPost<TController>(…) **method** of the RoutingTableExtensions **class** is the **same** as the one for the "GET" **request**. The difference is that it uses the MapPost(…) **method** of the RoutingTable **class**. Write the method like this:

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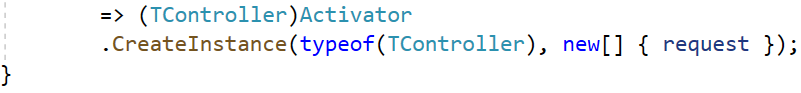
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Now implement the method for **creating a controller of a given type**, which **accepts a request**:



To **create a controller**, we will use the Activator **C# class** with its CreateInstance() **method**. This method **creates an** **instance of the specified type** using the constructor that best matches the specified parameters. It accepts a **controller type** and a params **object**, which we will use to add the **request to our constructor**. When the controller class is **instantiated**, **cast** the result to TController to **set the type** of the variable.

Write the CreateController<TController>(Request request) **method** like this:



This method will use the **constructor** from the Controller **class**. It will also **set the request**, which will be used later:

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Now we have the **full controller functionality** implemented. We should just **add the controller classes**.

### Step 4: Create Controllers with Actions

Now we will create our first controller– the HomeController, which will use **methods** to return **responses**.

With the **new routing**, we should **map**, for example, "/" to the Index() **method** of the HomeController **class** in the Main() **method** like this:

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**Create** the HomeController **class** and we will see later how to **map paths** to its **actions**.

#### HomeController Class

Go to the "BasicWebServer.Demo" **project** and **create a folder** named "Controllers". In the folder, create a **new class** HomeController, which should **inherit the base** Controller **class** and **use its constructor**:

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##### Index() Method

Then, **create** an Index() **method** – it should **return** a TextResponse by using the Text(string text) **method** of the Controller **class** like this:



Try the **controller method** in the **browser**. Don't forget to **map the path to the controller action**, as shown above, and include the "BasicWebServer.Server.Controllers" **namespace** in the Startup **class** to use the routing extensions.

The TextResponse should be **returned to the browser**:

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Go to the HomeController **class** and **implement the missing methods**.

##### Redirect() Method

First, let's create the **mapping** for a "GET" **request** to "/Redirect" in the Startup **class**. It should **invoke** the Redirect() **method** of the HomeController **class** like this:

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**Implement** the Redirect() **method in the** HomeController – it should **redirect** to the <https://softuni.org/> **site**:

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**Run the app** in the browser and go to "/Redirect" – you should be **redirected** to the **SoftUni's site**:

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##### Html() Method

Create the **mapping** for a "GET" **request** to "/HTML" in the Startup **class** – it should **invoke** the Html() **method** of the HomeController **class**:

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Write the Html() **method**, which should only **display the form** with the **name** and **age** to be filled in. Get the **form constant field** from the Startup **class** and **place it** **in this class**. Then, **use it in the method** like this:

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Visit "/HTML" in the browser – the **HTML form** with **name** and **age** should be displayed:

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##### HtmlFormPost() Method

The next **method** we should create is HtmlFormPost(), which should **get the name and age** from the **request** **form** and **return** a TextResponse.

Clear the Startup **class** from the AddFormDataAction(…) **method** and make a "POST" request to "/HTML" to invoke the HtmlFormPost() **method**:

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Implement the HomeController action as shown below. In the HtmlFormPost() **method** we will **get the form data directly** from the **request**, as we have access to it.

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**Test the method** in the browser. Go to "/HTML", **fill in data** in the **form** and **submit it**. The result should be the following:

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##### Content() Method

Go on with the Content() **method**, which should only **return the form** with the [Download] **button**.

The **mapping** in the Startup **class** is the following:

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Get the **form field** from the Startup **class** and **use** it:

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**Run the app** and go to "/Content" – you should see the [Download Sites Content] **button**:

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##### DownloadContent() Method

Next, we should **map** the "POST" **request** of "/Content" to the DownloadContent() **method**:

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The DownloadContent() should get the **HTML content** from **sites** and **add it to a text file,** which will be **downloaded**. Until now, this was done by the DownloadSitesAsTextFile(string fileName, string[] urls) and DownloadWebSiteContent(string url) methods in the Startup **class**. **Move** them to the HomeController **class** together with the FileName **property**:

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Use the **methods** and the **property** in the **controller action** like this:

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As you see, the DownloadContent(…) method **invokes other methods** to **download the sites HTML content**. Now it should **return** a FileResponse with the **file name**:



**Try out the file downloading** in the browser. Go to "/Content", **click on the button** and the "content.txt" **file** should be **downloaded**:

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##### Cookies() Method

Next, implement the Cookies() **method**, which should **set the cookies** when "/Cookies" is accessed. Add the **mapping** in the Startup **class** like this:

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We have already implemented the **cookie functionality** in the Startup **class** and you know that we needed to **add the cookies to the HTML response** before it is returned to the browser.

To do this, we will **modify** the Html(string html) **method** of the Controller **class** to accept a CookieCollection and **add each cookie to the response**. Then, an **HTML response** should be returned like this:

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Then, let's go back to the HomeController **class** and **implement** the Cookie() **method**. **Copy the cookie functionality** **logic** from the Startup **class** and **modify it**. The method should look like this:

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Note that we invoke the Html(…) **method** with **cookies** when we want them to be **added to the response** (when they are set for the first time or they are missing). Otherwise, we just send a **pure HTML response content**.

**Examine the cookies** in the browser by **accessing** "/Cookies" at least twice:

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Note that the **session cookie is created** with other cookies because of the AddSession() **method** in the HttpServer **class**.

##### Session() Method

**Map** the "/Session" to the Session() **method** like this:

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Now you should **implement** the Session() **method**, which **adds a session cookie to the response** (if the session doesn't exist) and **returns a text**. Get the **session functionality** from the Startup **class** and **remove it from there**. The Session() **method** should be the following:

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Look at the session data by accessing "/Session":

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Now we have implemented all the **actions** from the HomeController **class**, **cleaned up** the Startup **class** and **mapped paths to the controller methods**. **Run** the app, **navigate to different pages** and make sure that all functionalities of the app are **working correctly**.

#### UsersController Class

In the previous exercise we implemented the **login**, **user profile** and **logout functionalities**. Now we will create a separate **controller** for them, called UsersController, as they are connected to the user. The controller will have **actions** for the above functionalities.

Now create the UsersController **class** in the "Controllers" **folder**. It should **inherit the base** Controller **class**:

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##### Login() Method

The Login() **method** should return the **login** **form** when a "GET" **request** is send to "/Login". Create the mapping in the Startup like this:

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Copy the **login form** from the Startup **class** and **write the method** to return it like this:

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Go to "/Login" in the browser and you should see the **login form**:

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##### LogInUser() Method

The LogInUser() method is invoked on a "POST" request to "/Login" and implements the login functionality:

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Copy the logic for the LogInUser() **method** from the LoginAction(…) method in the Startup class. You need to change it a little bit – now we won't return the login form when login is unsuccessful but will directly return a RedirectResponse to "/Login".

Do it as shown below. Don't forget to get the Username and Password **constant** **fields** from the Startup **class**, as well:

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Note that we invoke the Html(…) **method** with a CookieCollection when we want to **add cookies to the** **response**.

Try the "**login**" **functionality**. Go to "/Login", **submit the form** with **valid** **and invalid data**. Make sure the functionality has the **correct behavior**:

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##### Logout() Method

A "GET" request to "/Logout" should **invoke** the Logout() **method**:

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The Logout() **method** **logic** is the same from before. Get it from the LogoutAction(…) **method** in the Startup **class** and **write the controller action** like this:

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Test the logout functionality:

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##### GetUserData() Method

The last method of the UsersController **class** is invoked when the user accesses "/UserProfile".

The GetUserData() method is shown below. If the user is **not logged-in**, they should be **redirected** to "/Login". Otherwise, they should **see the user data**, e.g. username. Do it like this:

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Go to "/UserProfile" and **try out** the page with a **logged-in user**:

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When the user is **not logged-in**, they should be **redirected** to the "Login" **page**.

Note that the access to the "User Profile" **page** depends only on the **session** – if it is **deleted**, the user may stay **logged-in the app**, but they **won't see the user data** until they log in again:

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You can **fix this by yourself**. Remember that the aim of this is to show the **user info always** when the user is **logged** in the app.

Now we have implemented the UsersController with its **actions for login**, **logout** and **user profile**. **Run** the app, **navigate to different pages** and make sure that all functionalities of the controller are **working correctly**.

### Step 5: Clear Solution

It is a good idea to **delete the pre-render action functionality** from our **server** as we don't use it anymore. To do this, first go to the HttpServer **class** and **remove the following lines** from the Start() **method**:

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Then, **clean** the Response class:

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Clean the ContentResponse **class**, too:

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Now clean the HtmlResponse and TextResponse **classes**, as well:

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We also did a lot of **cleaning** of the Startup **class**. However, make sure that it looks as shown below and **doesn't have** **useless properties or methods**:

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Now you can go on with adding the **views functionality** to the server.

## Introduce Views

As you know, for the "/HTML" and "/Content" **paths** we returned **HTML forms**, which were just strings in our HomeController **class**. In the UsersController, we have the same case with the **login form** on "/Login". In this task, we will **move the HTML forms** to .cshtml files (views), which will be found and used by the **controller actions**.

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### Step 1: Create View Response

To **return a view**, we will need to **create a new response class**. Create the ViewResponse **class**, which should **inherit the** ContentResponse **class**:



Add a **constant field** for the "/" **path separator**, as we are going to need it, and **create a constructor**, which should **accept** a **view name** and a **controller name** and **use the base constructor**:

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As you can see, we **pass an empty string** to the **base response class** – we do it, as we **do not have the content** of the **body** yet. We should **read the view file** and get it first.

To get the **HTML** from our **views**, we will need the **full path to them**. By **convention**, each **view** has the .cshtml **file** **extension** and is **accessed** on "…/Views/{controllerName}/{viewName}.cshtml".

That's why we will check whether the **view name** **contains the path separator** and, if not, **construct the name to be in format** "{controllerName}/{viewName}":

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On the next step, we should **get the full path** to the **view** by **adding the path** to the "Views" **folder before** and the .cshtml **extension after** the **view name**:

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Finally, we should **read the view file content** as a **text** and **add it to the response body**:

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### Step 2: Modify Controller to Return View

Go to the Controller **class** of the **server project** and **add a method** to return a ViewResponse. We will use **reflection** to do this in the best way.

The View() **method** should **accept a view name**, which should be taken with the [CallerMemberName] **attribute**, which allows you to obtain the method or property name of the **caller** to the method. Then, the method should **return** a ViewResponse with the **view name** and the **controller name**:



The GetControllerName() **method** **gets the** **controller name**, without the "**Controller**" part (for example "**HomeController**" 🡪 "**Home**"):

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Now the **controllers** can **return a view**. Let's see how to use them.

### Step 3: Create Views and Modify Controller Actions

First, go to the HomeController **class** and look at the methods, which **return HTML content** – Html() and Content(). **Modify** them to **return** a ViewResponse like this:

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Now go to the UsersController and make the Login() **method** return a **view** in the same way:

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Then, let's create the **views** they will use.

Start with creating a "Views" **folder** in the "BasicWebServer.Demo" **project**, where we will **store our views**. In this folder, create a **new one** with the **name of the controller** and **add** **two** .cshtml **files**, named after the **actions**, which use them.

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The **file** **structure** should be the following for now:

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Get the **HTML form** from the HtmlForm **field** in the HomeController **class** and **add it** to the Html.cshtml **file**. The **view** should look like this:

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Do the same with the DownloadForm **field** and the Content.cshtml **view** **file**:

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Do the same with the **view** for the Login() **method** of the UsersController. The **file structure** and the **view** should look as shown below. Don't forget to **remove** the LoginForm **property** from the UsersController **class**:

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Now you have **all the views** you need in the right folders.

### Step 4: Modify the .csproj File

Before we try the **view functionality**, we need to **modify** the .csproj **file** of the "BasicWebServer.Demo" **project**. To **access** that file, **double-click** on the **project name** in the Solution Explorer:



To use the **views**, we need them to be **copied** to the "net5.0" **folder** of **our project**, where the .dll **files** are. To do this, **add** the following lines:

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When you **run the app**, you will see that the "Views" **folder** **with** **its files** is copied to the "net5.0" **folder**, where the app searches for the views:

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### Step 5: Try Controllers with Views

**Run the demo app** and **navigate** to "/HTML", "/Content" and "/Login" – the **HTML forms should appear**:

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Note that if you have any problems, you should check first if you have a **mistake in naming** – it happens often.

## Introduce Models

We have already implemented **controllers** and **views** in our server. To create a full **MVC** **structure** we should **implement** **models** and **use them in views and controllers**.

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### Step 1: Modify ViewResponse Class

In order to **use models in the views**, we should **modify** the ViewResponse **class**. First, it should **accept a model object** in the **constructor** with a **default value** NULL and later check if we have a **model coming from the controller**:

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With the PopulateModel(string viewContent, object model) we will **modify the content** from the **view**. Get the **model properties** with their **name** and **values** like this:

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Each **model property** in our view will be **surrounded** by **two opening curly brackets** and **two closing curly brackets** like this: "{{Name}}". That's why we need to **get each property value** and **put it on its place** in the **view content**:

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At the end, **return the modified view content** to the method:

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### Step 2: Create Model and View

As our **views can now use model data**, we will **create a model with properties** for **name** and **age**. Create a "Models" **folder** in the "BasicWebServer.Demo" **project** and **create the** FormViewModel **model class** in it:

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Next, **create a view**, which uses these **properties** to **display a message with the model data**. Name the view "HtmlFormPost.cshtml" and place it in the "/Models/Home" **folder**, as we will **invoke** it from the HtmlFormPost() **method** in the HomeController **class**:

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The **view** should have the **model properties** **surrounded** by **curly brackets** and should look like this:



Use the **view** and the **model** in a **controller action**.

### Step 3: Modify Controller Method to Return View with Model

First, go to the Controller **class** and create a View(…) **method**, which **accepts a model** and a **view name** and returns a ViewResponse:

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Use the above method in the HtmlFormPost() **method** of the HomeController **class**. Until now, we returned a TextResponse with the **name** and **age values** from the **request**. Now we will create a FormViewModel with this **data** and **pass it to the view**:

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### Step 4: Try Controller with View and Model

**Run** the demo app and **navigate** to "/HTML". Enter some **valid data** in the **form fields**:

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**Click** on the [Save] **button** to **submit the form**. Now you should see the **returned view** with the **form data** you submitted:

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Now you have a **working MVC architecture** in your server.