

Create .NET 5 MVC Application for Ajax Communication

In this blog post you learn to create an MVC application to serve up web pages. On these web pages you can use JavaScript or jQuery to make Ajax calls to a web server that hosts Web API calls.

Asynchronous JavaScript And XML (Ajax) is the cornerstone of communication between your client-side and server-side code. Regardless of whether you use JavaScript, jQuery, Angular, React or any other client-side language, they all use Ajax under the hood to send and receive data from a web server. Using Ajax you can read data from, or send data to, a web server all without reloading the current web page. In other words, you can manipulate the DOM and the data for the web page without having to perform a post-back to the web server that hosts the web page. Ajax gives you a huge speed benefit because there is less data going back and forth across the internet. Once you learn how to interact with Ajax, you will find the concepts apply to whatever front-end language you use.

Ajax Defined

Though Ajax stands for **Asynchronous JavaScript And XML**, the data transmitted can be JSON, XML, HTML, JavaScript, plain text, etc. Regardless of the type of data, Ajax can send and receive it. Ajax uses a built-in object of all modern browsers called XMLHttpRequest. This object is used to exchange data back and forth between your web page and a web server as shown in Figure 1.

Looking at Figure 1 you see an HTML page sends a request for data (1) to a controller in the web server (2). The controller gets that data from data storage medium (3) and from the data model serializes that data as JSON (4) and sends the response back to the HTML page (5). If you now look at Figure 2, you can see both the JavaScript and C# code on the client and the server that corresponds to each of the numbers on Figure 1. Don't worry too much about the code in Figure 2, you are going to learn how to build it in this blog post.

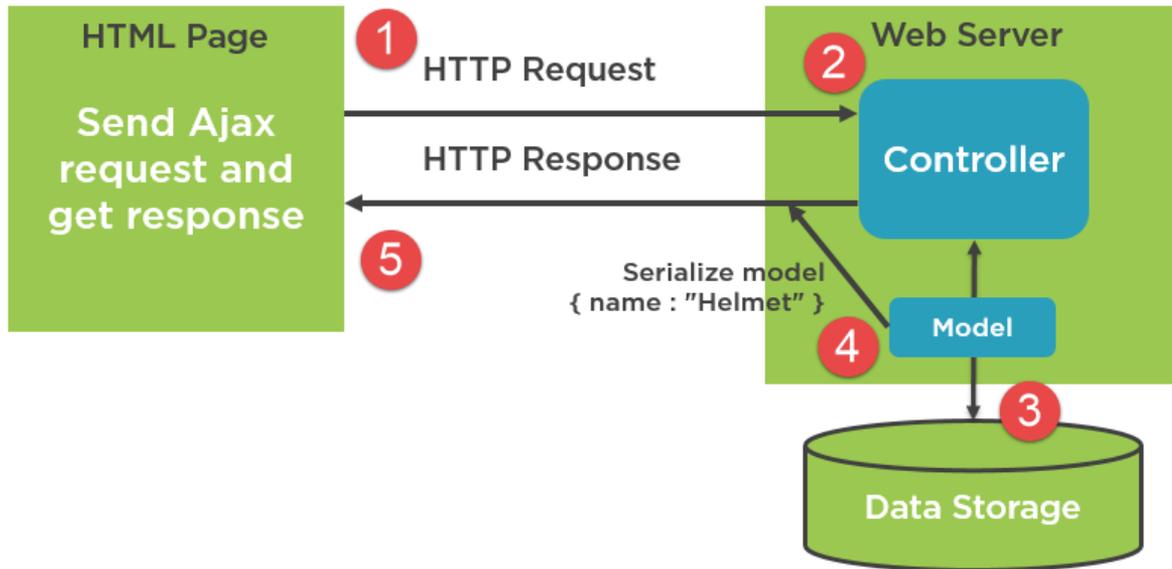


Figure 1: Ajax sends a request for data to a web server and receives data back, all without having to post the entire web page back and forth.

```

function get() {
  let req = new XMLHttpRequest();

  req.onreadystatechange = function () {
    console.log(this); 5
  };

  req.open("GET", URL);

  req.send(); 1
}
    
```

JavaScript on HTML Page

```

[HttpGet]
0 references
public IActionResult Get() {
  List<Product> list = new List<Product>();

  list = _DbContext.Products.ToList(); 3

  return StatusCode(StatusCode.Status200OK, list);
} 4
    
```

C# on Web API Server

Figure 2: The code on the left shows the JavaScript on the web page and the code on the bottom right show the C# code on the Web API server.

Methods of Communication

While the XMLHttpRequest object is the basis for all Ajax calls, there are actually a few different ways you can utilize this object. Table 1 provides a list of the most common methods in use today.

Technology	Description
JavaScript XMLHttpRequest using Callbacks	This is the most primitive method of Ajax communication.
JavaScript XMLHttpRequest with Promises	You can build your own wrapper around the callbacks and return a Promise.
Fetch API	Most modern browsers support this Promise-based API for Ajax communication.
jQuery using Callbacks	Prior to jQuery 1.5, you used callbacks to respond to Ajax events returned by the underlying XMLHttpRequest object.
jQuery using Promises	From jQuery 1.5 onwards the jQuery team put a Promise-based wrapper around the XMLHttpRequest object so you can use a more streamlined approach to Ajax queries.
jQuery Ajax Shorthand Functions	There are several shorthand functions such as \$.get(), \$.post() that allow you to shorten the syntax for making GET and POST requests of the Web API server.

Table 1: There are several methods you may use to communicate from a web page to a Web API server.

If you are unfamiliar with the terms callbacks and promises, the two sections that follow provide you with a definition and some links on the web to learn more about each.

Callbacks

A **callback** is the object reference (the name) of a function that is passed to another function. That function can then determine if, and when, to invoke (callback) that function. It may call that function after some variable changes state, or maybe after some task is perform. For a nice definition and an example of a callback, check out this blog post: <https://www.freecodecamp.org/news/javascript-callback-functions-what-are-callbacks-in-js-and-how-to-use-them>.

Promises

A **promise** is the result of the completion of an asynchronous operation. The operation may succeed, fail, or be cancelled. Whatever the result, the promise allows us access to the result and any data returned by the operation. For more information see this post: https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Promise. Another great blog post compares callbacks and promises: <https://itnext.io/javascript-promises-vs-rxjs-observables-de5309583ca2>.

Tools You Need

It is recommended you follow along step-by-step with this blog post to build a .NET MVC application to serve up HTML and run your JavaScript and jQuery. For this blog post I am going to use the following technologies.

- Visual Studio Code v1.52.1 or higher
- .NET v5.x or higher
- JavaScript ECMAScript 2015 or higher

If you wish to follow along, download these tools, and install on your computer. At the time of the writing of this blog post, these tools can be retrieved from the following locations.

- VS Code - code.visualstudio.com
- .NET 5 - dotnet.microsoft.com/download

The Web API Application

To communicate with a Web API server, you need to get the sample code from my previous blog post entitled "Create CRUD Web API in .NET 5" which you can find at <https://www.pdsa.com/blog>.

Create a .NET MVC Application

To make calls using Ajax from a web page to a Web API server, you need to run the HTML pages from their own web server. There are several web servers you can use, I am going to use .NET MVC. Create this project by opening VS Code and selecting **Terminal | New Terminal...** from the menu. Click into the terminal window and navigate to a folder where you normally create your development projects. On my machine I am going to use the \Samples folder on my D drive. Run the following commands one at a time in the terminal (substituting your project folder for the first command).

```
CD D:\Samples  
  
dotnet new mvc -n AjaxSample
```

Load the AjaxSample folder in VS Code and wait a few seconds until you see a prompt at the bottom right of your screen asking to add some assets to the project as shown in Figure 3. Answer "Yes" to the prompt to add Required Assets.

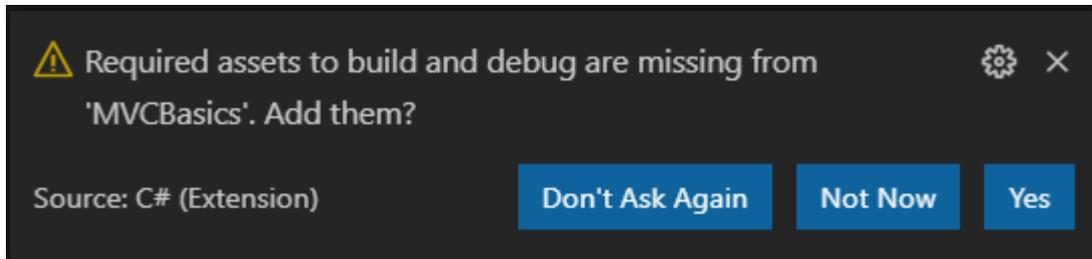


Figure 3: Answer yes when prompted to add required assets.

Open the **Views\Home\Index.cshtml** file and make the file look like the code shown in Listing 1. You are going to add more HTML to this file later, but this small set of HTML provides us with a good starting point.

```
@{
    ViewData["Title"] = "Ajax Samples";
}

<h1>Ajax Samples</h1>
<p>Bring up console window</p>

<button type="button" onclick="get();" >Get Products</button>

@section Scripts {
    <script>
        'use strict';

        const URL = "/resources/products.json";
        //const URL = "http://localhost:5000/api/product";

        function get() {

        }
    </script>
}
```

Listing 1: Add code in the cshtml file to run your web project.

Add a Resources Folder

To start illustrating how to use Ajax, you are going to read data from a .json file stored in the web server. Create a folder under the **AjaxSample\wwwroot** folder named **resources**. Add a new file named **products.json**. Add the data shown in Listing 2 into this new file.

```
[
  {
    "productID": 680,
    "name": "HL Road Frame - Black, 58",
    "productNumber": "FR-R92B-58",
    "color": "Black",
    "standardCost": 1059.31,
    "listPrice": 1431.50
  },
  {
    "productID": 707,
    "name": "Sport-100 Helmet, Red",
    "productNumber": "HL-U509-R",
    "color": "Red",
    "standardCost": 13.08,
    "listPrice": 34.99
  },
  {
    "productID": 709,
    "name": "Mountain Bike Socks, M",
    "productNumber": "SO-B909-M",
    "color": "White",
    "standardCost": 3.3963,
    "listPrice": 9.50
  },
  {
    "productID": 709,
    "name": "Mountain Bike Socks, M",
    "productNumber": "SO-B909-M",
    "color": "White",
    "standardCost": 3.3963,
    "listPrice": 9.50
  },
  {
    "productID": 712,
    "name": "AWC Logo Cap",
    "productNumber": "CA-1098",
    "color": "Multi",
    "standardCost": 6.9223,
    "listPrice": 8.99
  },
  {
    "productID": 821,
    "name": "Touring Front Wheel",
    "productNumber": "FW-T905",
    "color": "Black",
    "standardCost": 96.7964,
    "listPrice": 218.01
  }
]
```

Listing 2: A JSON array of product objects

Change the Port Number

Open the `launchSettings.json` file located under the `\Properties` folder and modify the `applicationUrl` property under the "AjaxSample" property as shown in bold below. Since you are going to be using a Web API server that is running on a different port, and thus a different domain, Cross-Origin Resource Sharing (CORS) needs to have a specific URL that we can whitelist. Change the URL to use port number 3000. Later when you create your Web API server, you are going to use this domain address with CORS to allow calls to travel from one domain to another.

```
"AjaxSample": {
  "commandName": "Project",
  "dotnetRunMessages": "true",
  "launchBrowser": true,
  "applicationUrl": "http://localhost:3000",
  "environmentVariables": {
    "ASPNETCORE_ENVIRONMENT": "Development"
  }
}
```

Try it Out

Run this MVC application and you should see a screen that looks like Figure 4.

Using XMLHttpRequest

As mentioned earlier in this blog post, the most fundamental building block of Ajax is the XMLHttpRequest object. Let's now use this object to retrieve the products in the `\resources\projects.json` file in your web server. Open the `index.cshtml` file and modify the empty `get()` function to look like the following code.

```
function get() {
  let req = new XMLHttpRequest();

  req.onreadystatechange = function () {
    console.log(this);
  };

  req.open("GET", URL);

  req.send();
}
```

The code above creates an instance of the XMLHttpRequest object that is built-in to your browser. It assigns a function to the **onreadystatechange** event that fires as

the XMLHttpRequest object performs various operations and reports on the different states in the *readyState* property. The next line of code opens the XMLHttpRequest object and tells it the type of request it is performing and the URL on which to send the type of request. In this case you are performing a GET on the URL pointing to the `/resources/products.json` file. The final line of code; `req.send()`, sends an asynchronous request to the web server to retrieve the `products.json` file.

Try it Out

Save the `index.cshtml` file and restart the debugger. Open the Developer Tools console window in your browser (typically the F12 key). Click on the Get Products button and you should see something that like Figure 4. Depending on the browser you use, the console window may look slightly different.

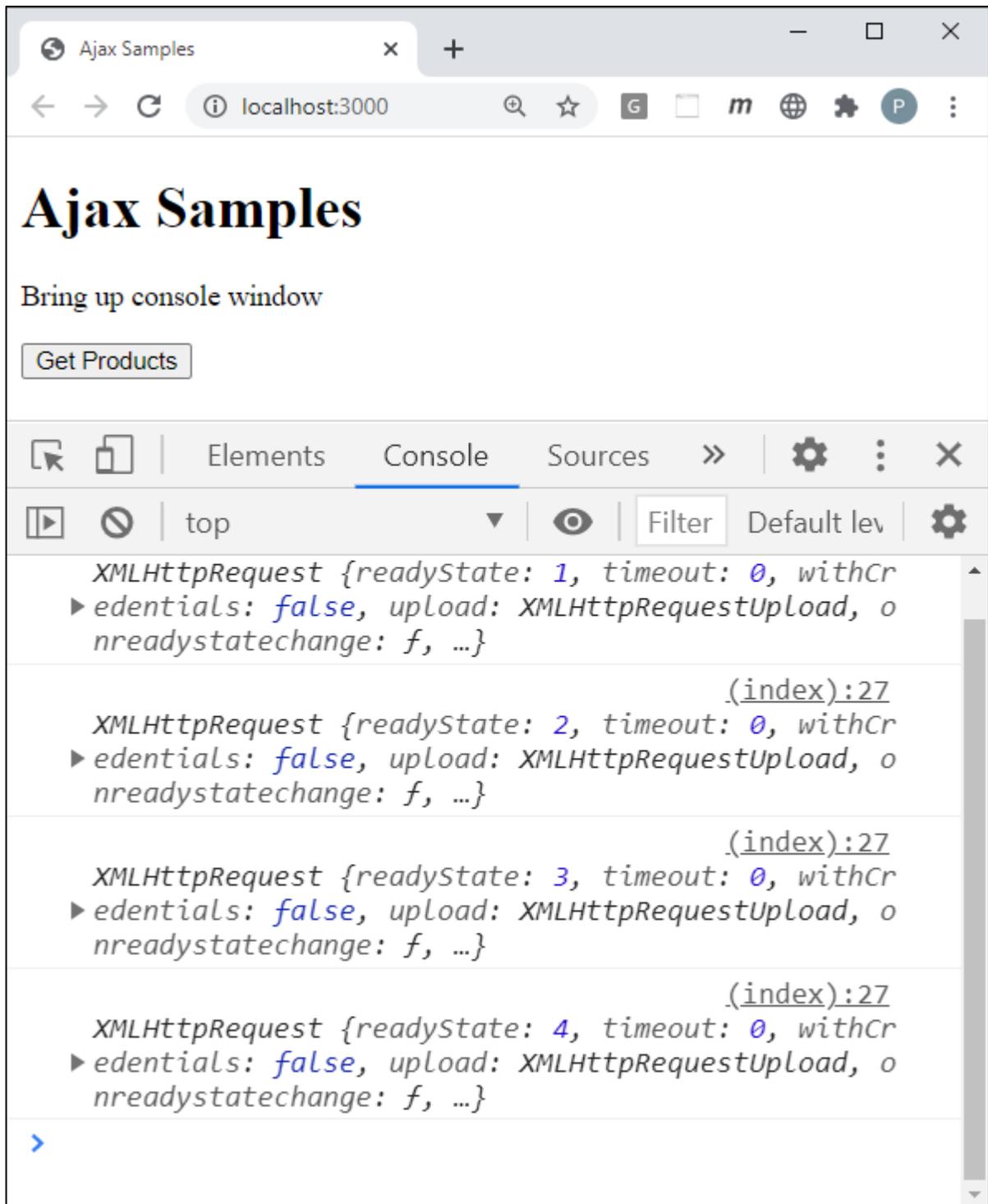


Figure 4: Bring up the Developer Tools on your browser to see the results of your JavaScript.

The XMLHttpRequest readyState Property

As you can see from the developer tools console window you received four different states. As the XMLHttpRequest goes through retrieving the data, it sends some notifications that you are reporting in the function you assigned to the `onreadystatechange` event. An instance of the XMLHttpRequest object is assigned to 'this' within the `onreadystatechange` event. The `readyState` property on the object can have one of five different values.

0 = Unsent

1 = Opened

2 = Headers Received

3 = Loading

4 = Done

Once the `readyState` property is equal to the value 4, the call is complete. If the call is successful the data returned from the Ajax call is available in the `this.response` property. The `response` property returns an array of product objects that looks like the data shown in Listing 2. If you want to just retrieve the array of product objects, and not each state, modify the `get()` function to look like the following:

```
function get() {
    let req = new XMLHttpRequest();

    req.onreadystatechange = function () {
        if (this.readyState === XMLHttpRequest.DONE &&
            this.status === 200) {
            console.log(this.response);
        }
    };

    req.open("GET", URL);

    req.send();
}
```

In the above code you check the value of the `readyState` property to see if it is equal to the constant `DONE`. You should also check the `status` property to see if the call was successful. A successful call should set the `status` property to a value between 200 and 399. A value of 400 and higher signifies an error occurred with the Ajax call.

Add a displayResponse Function

Instead of writing a bunch of `console.log()` statements within the `onreadystatechange` event function, create a function named `displayResponse()`. In this function you can then write any calls you want such as those shown below.

```
function displayResponse(resp) {
    console.log(resp);
    console.log("");
    console.log("responseText: " + resp.responseText);
    console.log("status: " + resp.status.toString());
    console.log("statusText: " + resp.statusText);
}
```

Modify the `get()` function to call the `displayResponse()` function when the status is equal to 200.

```
function get() {
    let req = new XMLHttpRequest();
    req.onreadystatechange = function () {
        if (this.readyState === XMLHttpRequest.DONE &&
            this.status === 200) {
            displayResponse(this);
        }
    };
    req.open("GET", URL);
    req.send();
}
```

Try it Out

Save all the changes within VS Code, restart the debugger, then go back to your browser and click on the Get Products button again. In the console window you should see the product data, plus the additional status property values.

Get Product Data from JavaScript

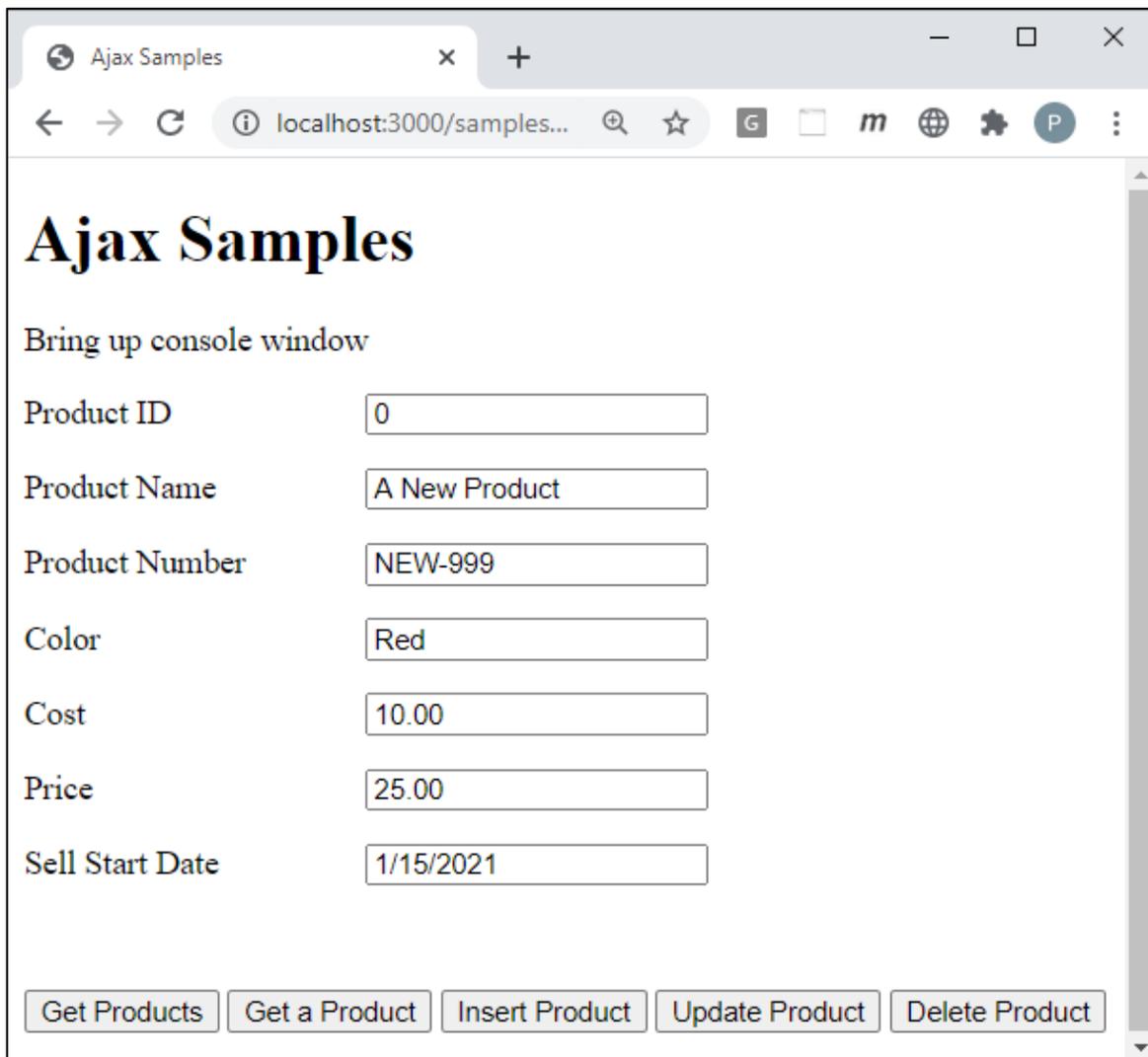
Leave the Web API project running and go back to the `index.cshtml` page in your web server and modify the constant URL to look like the following.

```
const URL = "http://localhost:5000/api/product";
```

Save the changes to the index.cshtml page, restart the debugger, and go to the browser. Click the Get Products button and in the console window you should now see product data retrieved from the Product table in the AdventureWorksLT database.

Add Web Form to Submit Product Data

Let's now finish up the index.cshtml page to allow you to enter Product data using a form. Look a Figure 5 to see what this page is going to look like.



The screenshot shows a web browser window titled "Ajax Samples" with the address bar at "localhost:3000/samples...". The page content includes a heading "Ajax Samples" and a link "Bring up console window". Below this is a form with the following fields and values:

Product ID	<input type="text" value="0"/>
Product Name	<input type="text" value="A New Product"/>
Product Number	<input type="text" value="NEW-999"/>
Color	<input type="text" value="Red"/>
Cost	<input type="text" value="10.00"/>
Price	<input type="text" value="25.00"/>
Sell Start Date	<input type="text" value="1/15/2021"/>

At the bottom of the form are five buttons: "Get Products", "Get a Product", "Insert Product", "Update Product", and "Delete Product".

Figure 5: Add input fields for each product property to insert or update.

Add Some Global Styles

The MVC application already has the bootstrap CSS framework, so many styles are already there for us to use. However, go to the `\wwwroot\css` folder and open the **site.css** file and add just a couple of styles as shown in Listing 3 to the site.css file.

```
form .row label {
    display: inline-block !important;
    min-width: 10em !important;
}

.infoMessage {
    font-weight: bold;
}

.errorMessage {
    font-weight: bold;
    background-color: red;
    color: white;
}
```

Listing 3: Add some global styles to help make the form like nice.

Add a Product Form

In the `index.cshtml` file delete the button within the `<body>` but leave the `<h1>` and the `<p>` tags.

```
<button type="button" onclick="get();" >Get Products</button>
```

Add the code shown in Listing 4 just below the `<h1>` and the `<p>` tag to your index page.

```
<form>
  <div class="row">
    <label for="productID">Product ID</label>
    <input id="productID" name="productID"
      type="text" value="0" />
  </div>
  <div class="row">
    <label for="name">Product Name</label>
    <input id="name" name="name" type="text"
      value="A New Product" />
  </div>
  <div class="row">
    <label for="productNumber">Product Number</label>
    <input id="productNumber" name="productNumber"
      type="text" value="NEW-999" />
  </div>
  <div class="row">
    <label for="color">Color</label>
    <input id="color" name="color" type="text"
      value="Red" />
  </div>
  <div class="row">
    <label for="standardCost">Cost</label>
    <input id="standardCost" name="standardCost"
      type="number" value="10.00" />
  </div>
  <div class="row">
    <label for="listPrice">Price</label>
    <input id="listPrice" name="listPrice"
      type="number" value="25.00" />
  </div>
  <div class="row">
    <label for="sellStartDate">Sell Start Date</label>
    <input id="sellStartDate" name="sellStartDate"
      type="text" value="1/15/2021" />
  </div>
  <div class="row">
    <label id="message" class="infoMessage"></label>
  </div>
  <div class="row">
    <label id="error" class="errorMessage"></label>
  </div>
  <div class="row">
    <button type="button" onclick="get();" >
      Get Products
    </button>
    <button type="button" onclick="getProduct();" >
      Get a Product
    </button>
    <button type="button" onclick="insertProduct();" >
      Insert Product
    </button>
    <button type="button" onclick="updateProduct();" >
      Update Product
    </button>
    <button type="button" onclick="deleteProduct();" >

```

```
        Delete Product
    </button>
</div>
</form>
```

Listing 4: Add a <form> tag and input fields to allow the user to input product data.

Modify Script on Page

You added more buttons in the index page, so you need to add functions to correspond to each button's click event. Modify the code in the <script> tag to look like Listing 5.

```
<script>
    'use strict';

    const URL = "http://localhost:5000/api/product";

    function get() {
        let req = new XMLHttpRequest();
        req.onreadystatechange = function () {
            if (this.readyState === XMLHttpRequest.DONE &&
                this.status === 200) {
                console.log(this.response);
                displayMessage("Products Retrieved");
            }
        };
        req.open("GET", URL);
        req.send();
    }

    function getProduct() {

    }

    function insertProduct() {

    }

    function updateProduct() {

    }

    function deleteProduct() {

    }
</script>
```

Listing 5: Add CRUD functions to product page.

Add Helper Functions into Scripts Folder

As with most applications, you are going to have some generic functions that you can reuse on many web pages. To make them easy to reuse create a `ajax-common.js` file into which you may place these functions. You then put this file into a folder that you can reference from any page(s) that need them. Create a file named **ajax-common.js** in the `\wwwroot\js` folder. Into this file create three functions; `getValue()`, `setValue()` and `handleAjaxError()`.

Add `getValue()` Helper Function

Each time you want to retrieve data from an input field using JavaScript you use the `document.getElementById("productID").value` for example. This is a lot of typing for each field, so add a simple helper function within the `ajax-common.js` file to perform this service for us.

```
function getValue(id) {  
    return document.getElementById(id).value;  
}
```

Add `setValue()` Helper Function

To place data into an input field using JavaScript you use the code `document.getElementById("productID").value = "data"`. This is a lot of typing for each field, so add a simple helper function within the `ajax-common.js` file to perform this service for us.

```
function setValue(id, value) {  
    document.getElementById(id).value = value;  
}
```

Add `displayMessage()` Helper Function

In the `<form>` you added to the index page is a `<label>` with an id of *message* where you can display informational messages to the user. Create a function named `displayMessage()` in the `ajax-common.js` file to which you can pass a message to display as shown in the following code.

```
function displayMessage(msg) {
    document.getElementById("message").innerHTML = msg;
}
```

Add displayError() Helper Function

In the <form> you added to the index page is a <label> with an id of *error* where you can display error information to the user. Create a function named `displayError()` in the `ajax-common.js` file to which you can pass an error object to display as shown in the following code.

```
function displayError(error) {
    document.getElementById("error").innerHTML =
        JSON.stringify(error);
}
```

Add handleAjaxError() Helper Function

Ajax errors can generally be handled by a common piece of code as shown in Listing 6. Add this function into the `ajax-common.js` file. Don't worry about what it does for now, you learn more about this function in a later blog post.

```
function handleAjaxError(error) {
    displayError(error);

    switch (error.status) {
        case 404:
            console.log(error.responseText);
            break;
        case 500:
            console.log(error.responseText);
            break;
        default:
            console.log(error);
            break;
    }
}
```

Listing 6: Create a common error handler for Ajax errors.

Add Product Helper Functions

Just like you have common functions for any page, you are going to have some functions that just deal with the product data. Add a file into the `\wwwroot\js` folder named **product.js**. Add three functions into this file named `getFromInput()`, `setInput()` and `clearInput()`.

Add `getFromInput()` Helper Function

Create a method called `getFromInput()` to create a product object. This product object should have the exact same property names as the C# entity class you created in the Web API project. The property names can be camel-case because you added the code in the Startup class to convert the names from camel-case to pascal case.

```
function getFromInput() {
  return {
    "productID": getValue("productID"),
    "name": getValue("name"),
    "productNumber": getValue("productNumber"),
    "color": getValue("color"),
    "standardCost": getValue("standardCost"),
    "listPrice": getValue("listPrice"),
    "sellStartDate": new Date(getValue("sellStartDate"))
  };
}
```

Add `setInput()` Helper Function

When a product is returned from the Web API, you need to place each property in the product class into each input field. Create a function called `setInput()` in the `product.js` file to perform this operation.

```
function setInput(product) {
  setValue("productID", product.productID);
  setValue("name", product.name);
  setValue("productNumber", product.productNumber);
  setValue("color", product.color);
  setValue("standardCost", product.standardCost);
  setValue("listPrice", product.listPrice);
  setValue("sellStartDate", product.sellStartDate);
}
```

Add clearInput() Helper Function

After deleting a product, or if you wish to clear the data before the user begins to add a new product, create a function called clearInput() to set each input field to a default value.

```
function clearInput() {
    setValue("productID", "0");
    setValue("name", "");
    setValue("productNumber", "");
    setValue("color", "");
    setValue("standardCost", "0");
    setValue("listPrice", "0");
    setValue("sellStartDate", new Date().toLocaleDateString());
}
```

Reference Scripts from Index Page

To use these .js files on your pages, you need to reference them using a <script> tag. Add two <script> tags shown in the code below just before the <script> tag in the index page.

```
<script src="/js/ajax-common.js"></script>
<script src="/js/product.js"></script>
```

Summary

In this blog post you built a web server to serve web pages and JSON files. You learned the basics of writing Ajax code using the XMLHttpRequest object that is built-in to all browsers for communicating between a web page to a web server.

Sample Code

You can download the complete sample code at my <https://github.com/PaulDSheriff/BlogPosts> page.