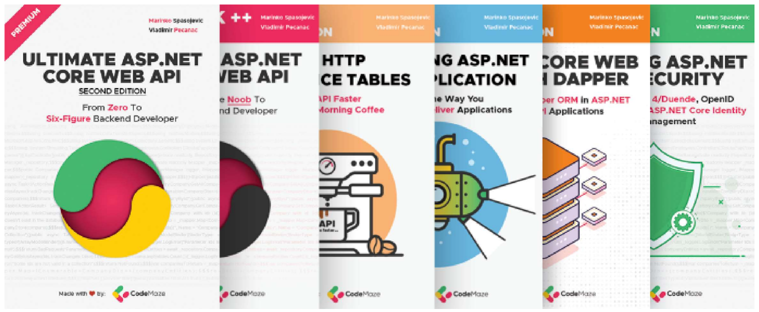
# Integration Testing in ASP.NET Core

Posted by **Marinko Spasojevic** | Updated Date Jan 12, 2022 | **23**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In this article, we are going to learn about Integration Testing in ASP.NET Core. Additionally, we are going to prepare an in-memory database so we don't have to use the real SQL server during integration tests. For that purpose, we are going to use the WebApplicationFactory class.

> To download the source code for this article, you can visit **our GitHub repository**.

For the complete navigation of this series, you can visit **ASP.NET Core Testing**.

Let's move on.

## What is Integration Testing?

**Integration testing ensures that different components inside the application function correctly when working together.** The main difference between integration testing and unit testing is that integration testing often includes application's infrastructure components like database, file system, etc. When we work with unit tests, we mock these mentioned components. But with integration testing, we want to ensure that the whole app is working as expected with all of these components combined together.

## Preparing a new Project for Integration Testing

So, let's see how we can write integration tests in ASP.NET Core.

First, we are going to create a new `xUnit` project named `EmployeesApp.IntegrationTests` for integration testing purposes.

After the project creation, we are going to rename the `UnitTest1.cs` class to `EmployeesControllerIntegrationTests`.

Additionally, **we are going to reference the main project** and install two NuGet packages required for the testing purposes:

- AspNetCore.Mvc.Testing – this package provides the TestServer and an important class `WebApplicationFactory` to help us bootstrap our app in-memory
- Microsoft.EntityFrameworkCore.InMemory – In-memory database provider

Now we can continue on.

## Using WebApplicationFactory class for Creating In-Memory Factory Configuration

The `WebApplicationFactory` class is a factory that we can use to bootstrap an application in memory for functional end-to-end tests. With .NET 6, new templates were introduced without the `Startup` class. This affects the

implementation of `WebApplicationFactory` class compared to what we used to in .NET 5.

So, let's see how we can use the WebApplicationFactory class in .NET 6 to create an in-memory factory configuration.

The first thing we are going to do is to create a new class `TestingWebAppFactory` and modify it:

```
public class TestingWebAppFactory<TEntryPoint> : WebApplicationFac
{
    protected override void ConfigureWebHost(IWebHostBuilder build
    {

    }
}
```

For this to work, we need two namespaces included:

```
using Microsoft.AspNetCore.Hosting;
using Microsoft.AspNetCore.Mvc.Testing;
```

Our class implements the `WebApplicationFactory<Startup>` class and overrides the `ConfigureWebHost` method, which gives us an opportunity to configure the application before it gets built.

But we have a small problem. Our class doesn't recognize the `Program` class even though we have the reference from the main project. That's because in .NET 6 compiler generates the `Program` class behind the scenes as the internal class, thus making it inaccessible in our integration testing project. **So to solve**

**this, we can create a public partial Program class in the Program.cs file** in the main project:

```
app.Run();

public partial class Program { }
```

After this modification, our issue will disappear in the `TestWebAppFactory` class.

## Implementation of the ConfigureWebHost Method

After we've fixed our issue, we can implement the `ConfigureWebHost` method:

```
public class TestingWebAppFactory<TEntryPoint> : WebApplicationFac
{
    protected override void ConfigureWebHost(IWebHostBuilder build
    {
        builder.ConfigureServices(services =>
        {
            var descriptor = services.SingleOrDefault(
                d => d.ServiceType ==
                    typeof(DbContextOptions<EmployeeContext>));

            if (descriptor != null)
                services.Remove(descriptor);

            services.AddDbContext<EmployeeContext>(options =>
            {
                options.UseInMemoryDatabase("InMemoryEmployeeTest"
                });

                var sp = services.BuildServiceProvider();
                using (var scope = sp.CreateScope())
                using (var appContext = scope.ServiceProvider.GetRequi
                {
                    try
                    {
                        appContext.Database.EnsureCreated();
                    }
                    catch (Exception ex)
                    {
                        //Log errors or do anything you think it's nee
                        throw;
                    }
                }
            });
        }
    }
```

A couple of things to mention here.

In the `ConfigureWebHost` method, we remove the EmployeeContext registration from the `Program` class.

After that, we add the database context to the service container and instruct it to use the in-memory database instead of the real database.

Finally, we ensure that we seed the data from the `EmployeeContext` class (The same data you inserted into a real SQL Server database at the beginning of this series).

With these preparations in place, we can return to the test class and start writing our tests.

## Integration Testing of the Index Action

In our test class, we can find a single test method with the default name. But let's remove it and start from scratch.

The first thing we have to do is to implement a previously created `TestingWebAppFactory` class:

```
public class EmployeesControllerIntegrationTests : IClassFixture<T
{
    private readonly HttpClient _client;

    public EmployeesControllerIntegrationTests(TestingWebAppFactor
        => _client = factory.CreateClient();
}
```

So, we implement the `TestingWebAppFactory` class with the `IClassFixture` interface and inject it in a constructor, where we create an instance of the `HttpClient`. The `IClassFixture` interface is a decorator which indicates that tests in this class rely on a fixture to run. We can see that the fixture is our `TestingWebAppFactory` class.

Now, let's write our first integration test:

```
[Fact]
public async Task Index_WhenCalled_ReturnsApplicationForm()
{
    var response = await _client.GetAsync("/Employees");

    response.EnsureSuccessStatusCode();

    var responseString = await response.Content.ReadAsStringAsync(

    Assert.Contains("Mark", responseString);
    Assert.Contains("Evelin", responseString);
}
```

We use the `GetAsync` method to call the action on the `/Employees` route, which is the `Index` action, and return a result in a `response` variable. With the `EnsureSuccessStatusCode` method, we verify that the `IsSuccessStatusCode` property is set to true.

If it is false, it means that the request is not successful, and the test will fail.

> To learn more about the HttpClient class and request and response actions, you can read **our tutorial about HttpClient in ASP.NET Core**.

Finally, we serialize our HTTP content to a string with the `ReadAsStringAsync` method and verify that it contains our two employees.

Right now, if we start the test runner, our test will fail due to the migration issue:

`System.InvalidOperationException : Relational-specific methods can only be used when the context is using a relational database provider.`

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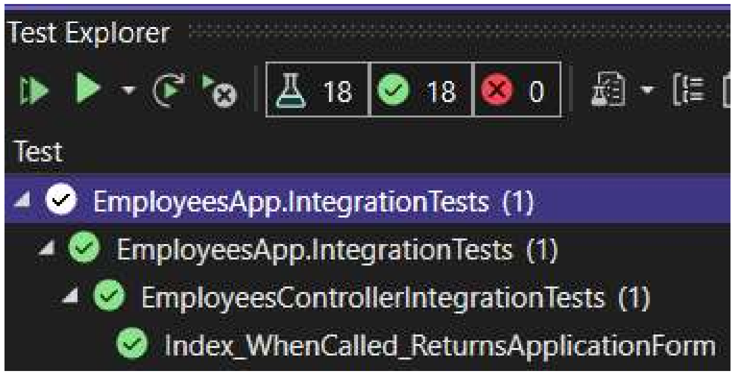
That's because our `MigrationManager` class can execute migrations only with the real SQL server and not with the in-memory one. So to fix this issue, we are going to modify the try block in that class:

```
try
{
    if (appContext.Database.ProviderName != "Microsoft.EntityFrame
        appContext.Database.Migrate();
}
```

Now, we can run our test:



```
EmployeesApp.IntegrationTests (1)
  EmployeesApp.IntegrationTests (1)
    EmployeesControllerIntegrationTests (1)
      Index_WhenCalled_ReturnsApplicationForm
```

We can see that the test passes and that we successfully return our employees from the in-memory database. If you want to make sure that we are really using the in-memory database and not the real one, you can always stop the SQLServer service in the Services window and run the test again.

Excellent!

Now, we can continue towards the integration testing of both `Create` actions.

## Integration Testing of the Create (GET) Action in ASP.NET Core

Before we continue with testing, let's open the `Create.cshtml` file, from the `Views\Employees` folder, and modify it by changing the `h4` tag (just to have more than one word to test):

```
<h4>Please provide a new employee data</h4>
```

Great.

Now we are ready to write our test code.

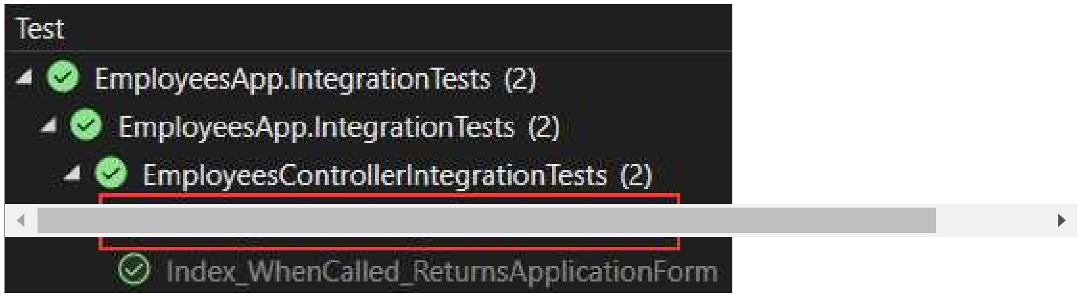
We want to verify when the Create (GET) action executes, it returns a create form:

```
[Fact]
public async Task Create_WhenCalled_ReturnsCreateForm()
{
    var response = await _client.GetAsync("/Employees/Create");

    response.EnsureSuccessStatusCode();
```

```
        var responseString = await response.Content.ReadAsStringAsync(

        Assert.Contains("Please provide a new employee data", response
    }
```



Test
EmployeesApp.IntegrationTests (2)
EmployeesApp.IntegrationTests (2)
EmployeesControllerIntegrationTests (2)
Index_WhenCalled_ReturnsApplicationForm

And it does.

## Testing the Create (POST) Action

To continue, we are going to write some integration testing code for the POST action. For the first test method, we are going to verify that our action returns a view with an appropriate error message when the model, sent from the `Create` page, is invalid. And yes, in a **previous article**, we had test methods for the invalid model, but without an HTTP request.

That said, let's write the test code:

```
    [Fact]
    public async Task Create_SentWrongModel_ReturnsViewWithErrorMessag
    {
        var postRequest = new HttpRequestMessage(HttpMethod.Post, "/Em

        var formModel = new Dictionary<string, string>
        {
            { "Name", "New Employee" },
            { "Age", "25" }
        };

        postRequest.Content = new FormUrlEncodedContent(formModel);

        var response = await _client.SendAsync(postRequest);

        response.EnsureSuccessStatusCode();

        var responseString = await response.Content.ReadAsStringAsync(

        Assert.Contains("Account number is required", responseString);
    }
```

We create a post request and the `formModel` object as a dictionary, which consists of the elements that we have on the Create page. Of course, we didn't provide all the elements, the `AccountNumber` is missing, because we want to send invalid data.

[illegible]
request with the `SendAsync` method and ensure that the response is successful.

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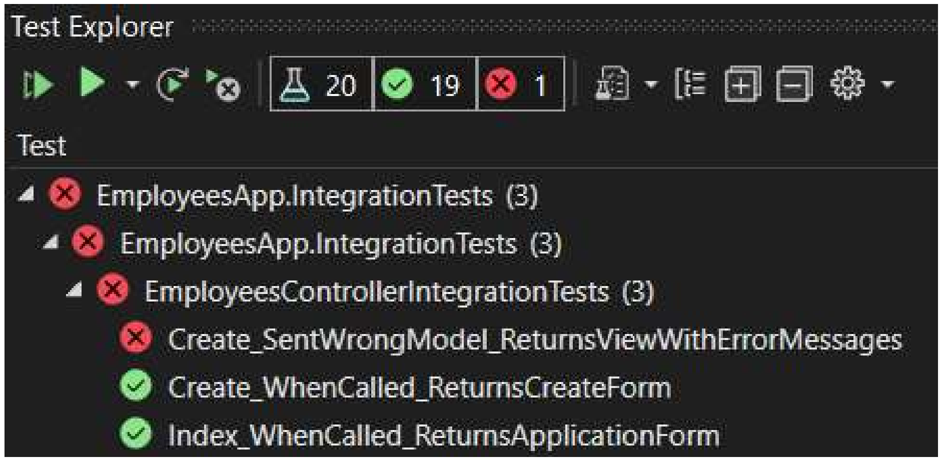
Finally, we serialize our response and make assertion verification.

If we take a look at the `Employee` model class, we are going to see that if the `AccountNumber` is not provided the error message should appear on the form:

```
[Required(ErrorMessage = "Account number is required")]
public string AccountNumber { get; set; }
```

That is exactly what we verify in our test method.

Now, we can run the Test Explorer:



```
EmployeesApp.IntegrationTests (3)
  EmployeesApp.IntegrationTests (3)
    EmployeesControllerIntegrationTests (3)
      Create_SentWrongModel_ReturnsViewWithErrorMessages
      Create_WhenCalled_ReturnsCreateForm
      Index_WhenCalled_ReturnsApplicationForm
```

Well, this test fails. But, there is nothing wrong with the code, the test code is good, just for some reason we are getting the 400 Bad Request message.

Why is that?

## The ValidateAntiForgeryToken Attribute Causing Integration Test to Fail

If we open our controller and take a look at the Create (POST) action, we can see the **ValidateAntiForgeryToken** attribute. So, our action expects the anti-forgery token to be provided but we are not doing that, thus the test fails. For now (just as a temporary solution) we are going to comment out that attribute and run the test again.

Now, the test passes. As we said this is just a temporary solution. There are a couple of steps required to configure the Anti-Forgery token in our testing code and in the next article we are going to show you how to do that step by step. For now, let's just continue with another test while the `ValidateAntiForgeryToken` is commented out.

## Testing Successful POST Request

Let's write the final test in this article, where we verify that the Create action returns the Index view if the POST request is successful:

```
[Fact]
public async Task Create_WhenPOSTExecuted_ReturnsToIndexViewWithCr
{
    var postRequest = new HttpRequestMessage(HttpMethod.Post, "/Em

    var formModel = new Dictionary<string, string>
    {
        { "Name", "New Employee" },
        { "Age", "25" },
        { "AccountNumber", "214-5874986532-21" }
    };

    postRequest.Content = new FormUrlEncodedContent(formModel);

    var response = await _client.SendAsync(postRequest);

    response.EnsureSuccessStatusCode();

    var responseString = await response.Content.ReadAsStringAsync(
        Assert.Contains("New Employee", responseString);
        Assert.Contains("214-5874986532-21", responseString);
    }
```

So, this code is not too much different from the previous one, except we send a valid `formModel` object with the request and the assertion part. Basically, once the POST request is finished successfully, the `Create` method should redirect us to the `Index` method. There, we can find all the employees including the created one. You can always debug your test code and inspect the `responseString` variable to visually confirm that response is the `Index` page with a new employee.

Once we run the Test Explorer the test will pass.

## Conclusion

In this article, we have learned about integration testing in the ASP.NET Core. We have created an In-Memory database to use it during tests instead of the real database server. Additionally, we have learned how to test our Index action and how to write integration tests for the Create actions as well. This testing methodology could be applied to other actions as well (PUT, Delete…).

Finally, we have seen the problem with the anti-forgery token and **in the next article**, we are going to learn how to solve that problem by introducing several new functionalities to our code.

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