EXPERT INSIGHT

Web Development with Blazor

A practical guide to building interactive UIs with C# 12 and .NET 8

Third Edition

Foreword by
Steve Sanderson
Developer/Architect at Microsoft and original creator of Blazor

Jimmy Engström

packt

Web Development with Blazor

Third Edition

A practical guide to building interactive UIs with C# 12 and .NET 8

Jimmy Engström

<packt>

Web Development with Blazor

Third Edition

Senior Publishing Product Manager: Suman Sen
Acquisition Editor – Peer Reviews: Jane Dsouza
Project Editor: Meenakshi Vijay
Content Development Editor: Shazeen Iqbal
Copy Editor: Safis Editing
Technical Editor: Aneri Patel
Proofreader: Safis Editing
Indexer: Tejal Soni
Presentation Designer: Rajesh Shirsath
Developer Relations Marketing Executive: Priyadarshini Sharma

First published: June 2021
Second edition: March 2023
Third Edition: April 2024
Production reference: 1240424

Published by Packt Publishing Ltd.
Grosvenor House
11 St Paul's Square
Birmingham
B3 1RB, UK.

ISBN 978-1-83546-591-2

`www.packt.com`

Foreword

Blazor is the .NET team's effort to create the best modern framework we can for building rich web apps. "Best" could mean a few things, but besides the non-negotiables like being secure and reliable, one meaning we most strongly focus on is developer productivity. By empowering you to use all the tools and techniques of .NET, and through a streamlined and consistent architecture, Blazor aims to free you from incidental complexity, so you ship your web app faster and with more features your users want. This seems to be landing well with the community: even six years into the framework's life, Blazor remains one of the fastest-growing parts of .NET.

Of course, six years is a long time in software! Sometimes it surprises me how long we've been going and how far we've come. The web development industry has reinvented itself a few times during that period. And so Blazor has correspondingly pivoted several times, extending its reach and meeting new needs. Some of the biggest pivots so far have been:

- Initially, Blazor was designed as a framework solely for WebAssembly. However, in a strategic shift, it evolved into a multi-platform UI framework with the introduction of Blazor Server. Blazor Server was officially supported and released before the WebAssembly version, despite the latter being the original focus of development.
- Later, changing from being browser-only to running on native desktop and mobile apps with .NET MAUI. People don't know this but we actually used Blazor in an internal Microsoft desktop app prototype way earlier still, even before Blazor Server existed.
- Most recently in .NET 8, changing from being client-rendered (SPA-like) only to also supporting static **server-side rendering** (**SSR**).

Despite the changing landscape, we've still always kept the same core component programming model, so Blazor app developers can bring forward their skills and code. Our hope is to keep doing so for many years to come, adapting to however the industry evolves.

Blazor is a full, modern framework, so there's potentially a lot to learn. That's why I'm delighted you're reading this book! With this third edition, Jimmy Engström has seamlessly merged everything new into his well-proven teaching structure that has been effective in getting readers going with Blazor. His thoughtful organization and brand-new samples and tutorials explain the range of options, along with the pros and cons of different ways to deliver a web app with .NET. It's not oversimplified, either: as you'll see when you read about innately subtle topics like authentication/authorization or state management, this book genuinely gets into the details you need to know.

Jimmy has been a valued member of the Blazor community for years. I always enjoy catching up with him at the various conferences and community events we participate in around the world and online, and I know other Blazor team members feel the same. I'm confident in his ability to communicate not only how things work, but also why they work as they do, and what backstory has led us to this point. His enthusiasm and knowledge make him an ideal guide as you enter this world.

Reader, I wish you the best of luck with your Blazor projects!

Steve Sanderson,

Developer/Architect at Microsoft and original creator of Blazor

Contributors

About the author

Jimmy Engström has been developing ever since he was 7 years old and got his first computer. He loves to be on the cutting edge of technology, trying new things. When he got wind of Blazor, he immediately realized its potential and adopted it when it was in beta. He has been running Blazor in production since it was launched by Microsoft.

His passion for the .NET industry and community has taken him around the world, speaking about development. Microsoft has recognized this passion by awarding him the Microsoft Most Valuable Professional award 10 years in a row.

I dedicate this book to my mom and dad, who got me my first computer, which got me started with programming.

To my brother, who took the time to teach me how to code, and to my sister, who helped me with my English homework growing up.

I would also like to dedicate the book to my wife, Jessica, who has helped me along the way by both reviewing the book and picking up my slack. Love you! This book would never have been possible without you all! A huge thanks to the reviewers, who have done a tremendous job reviewing the book.

– Jimmy Engström

Since my parents are not fluent in English, here is the same text but in Swedish:

Jag dedikerar den här boken till min mamma och pappa som köpte min första dator, som fick mig att börja programmera. Till min bror som tog sig tiden att lära mig koda och till min syster som hjälpte mig med engelskaläxan när jag växte upp.

Jag vill också dedikera boken till min fru som har hjälpt mig att se över boken och stöttat mig på alla tänkbara sätt. Älskar dig!

Detta hade inte varit möjligt utan er alla.

Ett stort tack till Stacy som sett över boken, du har gjort ett fantastiskt jobb.

– Jimmy Engström

About the reviewer

Stacy Cashmore has been developing solutions since the mid-1990s in various companies and industries ranging from facilitating contract jobbing to allowing consumers to close a mortgage without the help of a financial adviser – with lots in between.

She has a passion for sharing knowledge: using storytelling for sharing her experiences to help teams grow in the ways that they develop software and work together, and performing live coding demonstrations to inspire others to try new technologies.

For her effort in the community, Stacy has been awarded the Microsoft MVP for Developer Technologies since 2020.

I'd like to thank my family for putting up with the time I commit to the development community, and to Jessica Engstrom for convincing me that I had something to offer and to take up speaking and getting involved in the first place.

Join our community on Discord

Join our community's Discord space for discussions with the author and other readers:

`https://packt.link/WebDevBlazor3e`

Table of Contents

Chapter 11: Managing State – Part 2 209

Chapter 15: Moving from, or Combining with, an Existing Site 261

Chapter 16: Going Deeper into WebAssembly 273

Chapter 17: Examining Source Generators 287

Preface

Until now, creating interactive web pages meant using JavaScript. But with Blazor, a framework for creating .NET web applications, developers can easily build interactive and rich web applications using C#. This book will guide you through the most commonly encountered scenarios when starting your journey with Blazor.

Firstly, you'll discover how to leverage the power of Blazor and learn what you can do with **server-side rendering (SSR)**, Blazor Server, Blazor WebAssembly, and Blazor Hybrid. This book will help you overcome some of the common obstacles that developers face by showing you how all of the elements work together practically. As you advance, you'll learn how to create Blazor projects, how Razor syntax works, how to validate forms, and how to create your own components. The book then introduces you to the key concepts involved in web development with Blazor, which you can put into practice immediately.

By the end of this Blazor book, you'll have gained the confidence to create and deploy production-ready Blazor applications.

Who this book is for

The book is for web developers and software developers who want to explore Blazor to learn how to build dynamic web UIs. This book assumes familiarity with C# programming and web development concepts.

What this book covers

Chapter 1, *Hello Blazor*, will teach you the difference between Blazor server and Blazor WebAssembly and the new Static and Streaming SSR. You will get an overview of how the technology works and a brief history of where Blazor comes from. Knowing the structure and differences between the hosting models is essential for understanding the technology.

Chapter 2, *Creating Your First Blazor App*, helps you understand how to install and set up your development environment. You will create your first Blazor app and learn about the structure of the project template.

Chapter 3, *Managing State – Part 1*, teaches you how to create a repository to store your data (blog posts, categories, tags, and comments).

Chapter 4, *Understanding Basic Blazor Components*, digs deeper into components, life cycle events, adding parameters, and sharing parameters between components. You will also create reusable components in this chapter.

Chapter 5, *Creating Advanced Blazor Components*, digs even deeper into components, adding functionality such as child components, cascading parameters, and values, and covering how to use actions and callbacks.

Chapter 6, *Building Forms with Validation*, looks at forms, how to validate forms, and how to build your own validation mechanism. This chapter will cover the most common use cases when handling forms, such as file upload, text, numbers, and triggering code when typing on the keyboard.

Chapter 7, *Creating an API*, looks at creating an API using Minimal API. When using Blazor WebAssembly, we need an API to get data.

Chapter 8, *Authentication and Authorization*, looks at adding authentication and authorization to Blazor and making sure navigation, such as redirecting to a login page, works as expected.

Chapter 9, *Sharing Code and Resources*, teaches you how sharing code between projects. In this chapter, we continue building a shared library that can be packaged as a NuGet package and shared with others.

Chapter 10, *JavaScript Interop*, explores how to leverage JavaScript libraries when using Blazor and make calls from C# to JavaScript. You will also examine how JavaScript can call C# functions in our Blazor app.

Chapter 11, *Managing State – Part 2*, looks into the different ways of managing state (persisting data), such as using LocalStorage or just keeping data in memory using dependency injection. You will also implement real-time updates to your blog post using SignalR.

Chapter 12, *Debugging the Code*, teaches you how to debug your applications and add extended logging to figure out what's wrong with your application. You will not only look at traditional debugging but also at debugging C# code directly from within the web browser.

Chapter 13, *Testing*, looks at automated testing so that you can make sure your components work as they should (and continue to do so). There is no built-in method to test Blazor applications, but there is an excellent community project called bUnit.

Chapter 14, *Deploying to Production*, will take you through the different things you need to think about when running Blazor in production.

Chapter 15, *Moving from, or Combining with, an Existing Site*, will show you how to integrate Blazor into an existing site and combine JavaScript frameworks like Angular or React with Blazor.

Chapter 16, *Going Deeper into WebAssembly*, covers the specific things for Blazor WebAssembly.

Chapter 17, *Examining Source Generators*, covers how Blazor relies heavily on source generators. In this chapter, you will learn how they work and relate to Blazor.

Chapter 18, *Visiting .NET MAUI*, looks at the third hosting model, Blazor Hybrid. Using .NET MAUI, you can build iOS, Android, macOS, Tizen, and Windows applications by leveraging what you have learned in this book.

Chapter 19, *Where to Go from Here*, is a short chapter with a call to action, some resources you can use, and a finale.

To get the most out of this book

I recommend reading the first few chapters to ensure you are up to speed with the basic concepts of Blazor in general. The project we are creating is adapted for real-world use but some parts are left out, such as proper error handing. You should, however, get a good grasp of the building blocks of Blazor.

The book focuses on using Visual Studio 2022; that said, feel free to use whatever version you are comfortable with that supports Blazor.

Software covered in this book	OS requirements
Visual Studio 2022, .NET8	Windows 10 or later, macOS, Linux

If you are using the digital version of this book, we advise you to type the code yourself or access the code via the GitHub repository (link available in the next section). Doing so will help you avoid any potential errors related to the copying and pasting of code.

I would love for you to share your progress while reading this book or in Blazor development in general. Tweet me at `@EngstromJimmy`.

I hope you have as much fun reading this book as I had writing it.

Download the example code files

The code bundle for the book is hosted on GitHub at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition`. We also have other code bundles from our rich catalog of books and videos available at `https://github.com/PacktPublishing/`. Check them out!

Download the color images

We also provide a PDF file that has color images of the screenshots/diagrams used in this book. You can download it here: `https://packt.link/gbp/9781835465912`.

Conventions used

There are a number of text conventions used throughout this book.

`CodeInText`: Indicates code words in text, database table names, folder names, filenames, file extensions, pathnames, dummy URLs, user input, and Twitter handles. For example; "`EditForm` will create an `EditContext` instance as a cascading value so that all the components you put inside of `EditForm` will access the same `EditContext`."

A block of code is set as follows:

```
public void ConfigureServices(IServiceCollection services)
{
    services.AddRazorPages();
    services.AddServerSideBlazor();
    services.AddSingleton<WeatherForecastService>();
}
```

Any command-line input or output is written as follows:

```
dotnet new blazorserver -o BlazorServerSideApp
cd Data
```

Bold: Indicates a new term, an important word, or words that you see on the screen, for example, in menus or dialog boxes, also appear in the text like this. For example: "Select **Blazor Server App** from the search results and press **Next**."

Warnings or important notes appear like this.

Tips and tricks appear like this.

Get in touch

Feedback from our readers is always welcome.

General feedback: Email `feedback@packtpub.com`, and mention the book's title in the subject of your message. If you have questions about any aspect of this book, please email us at `questions@packtpub.com`.

Errata: Although we have taken every care to ensure the accuracy of our content, mistakes do happen. If you have found a mistake in this book, we would be grateful if you would report this to us. Please visit, `http://www.packtpub.com/submit-errata`, selecting your book, clicking on the Errata Submission Form link, and entering the details.

Piracy: If you come across any illegal copies of our works in any form on the Internet, we would be grateful if you would provide us with the location address or website name. Please contact us at `copyright@packtpub.com` with a link to the material.

If you are interested in becoming an author: If there is a topic that you have expertise in and you are interested in either writing or contributing to a book, please visit `http://authors.packtpub.com`.

Share your thoughts

Once you've read *Web Development with Blazor*, we'd love to hear your thoughts! Please `click here to go straight to the Amazon review page` for this book and share your feedback.

Your review is important to us and the tech community and will help us make sure we're delivering excellent quality content.

Download a free PDF copy of this book

Thanks for purchasing this book!

Do you like to read on the go but are unable to carry your print books everywhere?

Is your eBook purchase not compatible with the device of your choice?

Don't worry, now with every Packt book you get a DRM-free PDF version of that book at no cost.

Read anywhere, any place, on any device. Search, copy, and paste code from your favorite technical books directly into your application.

The perks don't stop there, you can get exclusive access to discounts, newsletters, and great free content in your inbox daily.

Follow these simple steps to get the benefits:

1. Scan the QR code or visit the link below:

`https://packt.link/free-ebook/9781835465912`

2. Submit your proof of purchase.
3. That's it! We'll send your free PDF and other benefits to your email directly.

1

Hello Blazor

Thank you for picking up your copy of *Web Development with Blazor*. This book intends to get you started as quickly and smoothly as possible, chapter by chapter, without you having to read this book from cover to cover before getting your Blazor on.

This book will start by guiding you through the most common scenarios you'll come across when you begin your journey with Blazor and will also dive into a few more advanced scenarios later on. This book aims to show you what Blazor is – Blazor Server, Blazor WebAssembly, Blazor Hybrid, and on top of that, the new **Server-Side Rendering** (**SSR**) – and how it all works practically to help you avoid traps.

This is the book's third edition; much has happened since the first edition. .NET 6 and .NET 7 were released, and for the second edition, I updated the content to reflect the changes and the new functionality we got.

This edition has been updated to include all the new things in .NET 8, and let me tell you, that is a lot.

I do Blazor presentations all over the world, and there are common questions that I get asked a lot. Without going into too much detail, they are often related to download size or time when it comes to Blazor WebAssembly and continuous connection to Blazor Server. In .NET 8, we can leverage a new mode, SSR, that solves all of these problems in one swift blow. Okay, maybe not all problems, but we are well on our way to solving them. A common belief is that Blazor is WebAssembly, but WebAssembly is just one way of running Blazor. Many books, workshops, and blog posts on Blazor focus heavily on WebAssembly.

This book will cover Blazor WebAssembly, Blazor Server, Blazor Hybrid, and SSR. There are a few differences between the different ways of running Blazor; I will point them out as we go along.

This first chapter will explore where Blazor came from, what technologies made Blazor possible, and the different ways of running Blazor. We will also touch on which type (Blazor WebAssembly, Blazor Server, or Blazor Hybrid) is best for you.

In this chapter, we will cover the following topics:

- Why Blazor?
- Preceding Blazor
- Introducing WebAssembly
- Introducing .NET 8
- Introducing Blazor

Technical requirements

It is recommended that you have some knowledge of .NET before you start, as this book is aimed at .NET developers who want to utilize their skills to make interactive web applications. However, it's more than possible that you will pick up a few .NET tricks if you are new to the world of .NET.

Why Blazor?

Not that long ago, I got asked by a random person on Facebook if I work with Blazor.

I said, "Yes, yes I do".

He then continued with a long remark telling me Blazor would never beat Angular, React, or Vue.

I see these kinds of remarks quite often, and it's essential to understand that beating other **Single-Page Application** (**SPA**) frameworks has never been the goal. This is not *Highlander*, and there can be more than one.

Learning web development has previously been pretty tough. Not only do we need to know ASP.NET for the server but we also need to learn an SPA framework like React, Angular, or Vue.

But it doesn't end there. We also need to learn npm, Bower, and Parcel, as well as JavaScript or TypeScript.

We need to understand transpiling and build that into our development pipeline. This is, of course, just the tip of the iceberg; depending on the technology, we need to explore other rabbit holes.

Blazor is an excellent choice for .NET developers to write interactive web applications without needing to learn (or keep up with) everything we just mentioned. We can leverage our existing C# knowledge and the packages we use and share code between the server and client.

I usually say, "Blazor removes all the things I hate about web development." I guess the saying should be, "Blazor *can* remove all the things I hate about web development." With Blazor, it is still possible to do JavaScript interop and use JavaScript frameworks or other SPA frameworks from within Blazor, but we don't have to.

Blazor has opened a door where I can feel productive and confident I am creating a great user experience for my users, with my existing C# knowledge.

Preceding Blazor

You probably didn't get this book to read about **JavaScript**, but it helps to remember that we came from a pre-Blazor time. I recall that time – the dark times. Many of the concepts used in Blazor are not that far from those used in many JavaScript frameworks, so I will start with a brief overview of where we came from.

As developers, we have many different platforms we can develop for, including desktop, mobile, games, the cloud (or server side), AI, and even IoT. All these platforms have a lot of different languages to choose from, but there is, of course, one more platform: the apps that run inside the browser.

I have been a web developer for a long time, and I've seen code move from the server to run within the browser. It has changed the way we develop our apps. Frameworks such as Angular, React, Aurelia, and Vue have changed the web from reloading the whole page to updating small parts on the fly. This *new* on-the-fly update method has enabled pages to load quicker, as the perceived load time has been lowered (not necessarily the whole page load).

But for many developers, this is an entirely new skill set – that is, switching between a server (most likely C#, if you are reading this book) to a frontend developed in JavaScript. Data objects are written in C# in the backend and then serialized into JSON, sent via an API, and then deserialized into another object written in JavaScript in the frontend.

JavaScript used to work differently in different browsers, which jQuery tried to solve by having a common API that was translated into something the web browser could understand. Now, the differences between different web browsers are much more minor, which has rendered jQuery obsolete in many cases.

JavaScript differs slightly from other languages since it is not object-oriented or typed, for example. In 2010, Anders Hejlsberg (known for being C#, Delphi, and Turbo Pascal's original language designer) started working on **TypeScript**. This object-oriented language can be compiled/transpiled into JavaScript.

You can use Typescript with Angular, React, Aurelia, and Vue, but in the end, it is JavaScript that will run the actual code. Simply put, to create interactive web applications today using JavaScript/TypeScript, you need to switch between languages and choose and keep up with different frameworks.

In this book, we will look at this in another way. Even though we will talk about JavaScript, our primary focus will be on developing interactive web applications mainly using C#.

Now, we know a bit about the history of JavaScript. JavaScript is no longer the only language that can run within a browser, thanks to WebAssembly, which we will cover in the next section.

Introducing WebAssembly

In this section, we will look at how **WebAssembly** works. One way of running Blazor is by using WebAssembly, but for now, let's focus on what WebAssembly is.

WebAssembly is a binary instruction format that is compiled and, therefore, smaller. It is designed for native speeds, which means that when it comes to speed, it is closer to C++ than it is to JavaScript. When loading JavaScript, the JavaScript files (or inline JavaScript) are downloaded, parsed, optimized, and JIT-compiled; most of those steps are not needed for WebAssembly.

WebAssembly has a very strict security model that protects users from buggy or malicious code. It runs within a sandbox and cannot escape that sandbox without going through the appropriate APIs. Suppose you want to communicate outside WebAssembly, for example, by changing the **Document Object Model** (**DOM**) or downloading a file from the web. In that case, you will need to do that with JavaScript interop (more on that later; don't worry – Blazor will solve this for us).

Let's look at some code to get a bit more familiar with WebAssembly.

In this section, we will create an app that sums two numbers and returns the result, written in C (to be honest, this is about the level of C I'm comfortable with).

We can compile C into WebAssembly but it requires the installation of some tooling so we will not do this all the way. The point here is just to give us a feeling of how WebAssembly works under the hood. Consider this code:

```
int main() {
  return 1+2;
}
```

The result of this will be the number 3.

WebAssembly is a stack machine language, which means that it uses a stack to perform its operations.

Consider this code:

```
1+2
```

Most compilers will optimize the code and return 3.

But let's assume that all the instructions should be executed. This is the way WebAssembly would do things:

1. It will start by pushing 1 onto the stack (`instruction: i32.const 1`), followed by pushing 2 onto the stack (`instruction: i32.const 2`). At this point, the stack contains 1 and 2.
2. Then, we must execute the add instruction (`i32.add`), which will pop (`get`) the two top values (1 and 2) from the stack, add them up, and push the new value onto the stack (3).

This demo shows that we can build WebAssembly from C code. Even though we never need to go to this level to understand WebAssembly (Blazor handles all of that for us), we will use C code and other libraries compiled into WebAssembly later in the book (*Chapter 16*, *Going Deeper into WebAssembly*).

OTHER LANGUAGES

Generally, it is only low-level languages that can be compiled into WebAssembly (such as C or Rust). However, there are a plethora of languages that can run on top of WebAssembly. Here is a great collection of some of these languages: `https://github.com/appcypher/awesome-wasm-langs`.

WebAssembly is super performant (near-native speeds) – so performant that game engines have already adopted this technology for that very reason. Unity, as well as Unreal Engine, can be compiled into WebAssembly.

Here are a couple of examples of games running on top of WebAssembly:

- **Angry Bots (Unity)**: `https://beta.unity3d.com/jonas/AngryBots/`
- **Doom**: `https://wasm.continuation-labs.com/d3demo/`

This is a great list of different WebAssembly projects: `https://github.com/mbasso/awesome-wasm`.

This section touched the surface of how WebAssembly works; in most cases, you won't need to know much more. We will dive into how Blazor uses this technology later in this chapter.

To write Blazor apps, we can leverage the power of .NET 8, which we'll look at next.

Introducing .NET 8

.NET is a platform developed by Microsoft for building different types of applications, including web, mobile, and desktop applications. The .NET team has been working hard on tightening everything up for us developers for years. They have been making everything simpler, smaller, cross-platform, and open source – not to mention easier to utilize your existing knowledge of .NET development.

.NET Core was a step toward a more unified .NET. It allowed Microsoft to re-envision the whole .NET platform, build it in a completely new way, and make it run on even more platforms.

There were three different types of .NET runtimes:

- .NET Framework (full .NET)
- .NET Core
- Mono/Xamarin

Different runtimes had different capabilities and performances. This also meant that creating a .NET Core app (for example) had different tooling and frameworks that needed to be installed.

.NET 5 was the start of our journey toward one single .NET. With this unified toolchain, the experience of creating, running, and so on became the same across all the different project types. "Framework" and "Core" were dropped from the name. .NET 5 is still modular in a similar way to what we are used to, so we do not have to worry that merging all the different .NET versions is going to result in a bloated .NET.

Thanks to the .NET platform, you will be able to reach all the platforms we talked about at the beginning of this chapter (web, desktop, mobile, games, the cloud (or server side), AI, and even IoT) using only C# and with the same tooling.

Blazor has been around for a while now. In .NET Core 3, the first version of Blazor Server was released, and at Microsoft Build in 2020, Microsoft released Blazor WebAssembly.

In .NET 5, we got a lot of new components for Blazor – pre-rendering and CSS isolation to name a couple of things. Don't worry; we will go through all these things throughout the book.

In .NET 6, we got even more functionality, like Hot Reload, co-located JavaScript, new components, and much more, all of which we will explore throughout the book.

In .NET 7, we got even more enhancements for Blazor developers. We got performance improvements and get/set/after modifiers, among other things.

In November 2023, Microsoft released .NET 8, and with that, everything changed. During development, this new way of developing Blazor apps was called "Blazor United," which is a name they now have updated to simply Blazor. This is the new way of creating Blazor applications and it is an awesome way. But let's save something for later chapters as well.

.NET 8 brought us performance improvements, native Define, better source generators, and so much more. It is also an LTS (Long-Term Support) version.

Looking at the enhancements and number of features, I can only conclude that Microsoft believes in Blazor, and so do I.

Now that you know about some of the surrounding technologies, in the next section, it's time to introduce the main character of this book: Blazor.

Introducing Blazor

Blazor is an open-source web UI framework. That's a lot of buzzwords in the same sentence, but simply put, it means that you can create interactive web applications using HTML, CSS, and C# with full support for bindings, events, forms and validation, dependency injection, debugging, and much more, with Blazor. We will take a look at these in this book.

In 2017, Steve Sanderson (well-known for creating the Knockout JavaScript framework and who works for the ASP.NET team at Microsoft) was about to do a session called *Web Apps can't really do *that*, can they?* at the developer conference NDC Oslo.

But Steve wanted to show a cool demo, so he thought, *Would it be possible to run C# in WebAssembly?* He found an old inactive project on GitHub called *Dot Net Anywhere*, which was written in C and used tools (similar to what we just did) to compile the C code into WebAssembly.

He got a simple console app running in the browser. This would have been a fantastic demo for most people, but Steve wanted to take it further. He thought, *Is it possible to create a simple web framework on top of this?*, and went on to see if he could also get the tooling working.

When it was time for his session, he had a working sample to create a new project, create a to-do list with great tooling support, and run the project in the browser.

Damian Edwards (the .NET team) and David Fowler (the .NET team) were also at the NDC conference. Steve showed them what he was about to demo, and they described the event as their heads exploded and their jaws dropped.

And that's how the prototype of Blazor came into existence.

The name Blazor comes from a combination of **Browser** and **Razor** (which is the technology used to combine code and HTML). Adding an *L* made the name sound better, but other than that, it has no real meaning or acronym.

There are a few different flavors of Blazor, including Blazor Server, Blazor WebAssembly, Blazor Hybrid (using .NET MAUI), and Server-Side Rendering.

The different versions have some pros and cons, all of which I will cover in the upcoming sections and chapters.

Blazor Server

Blazor Server uses SignalR to communicate between the client and the server, as shown in the following diagram:

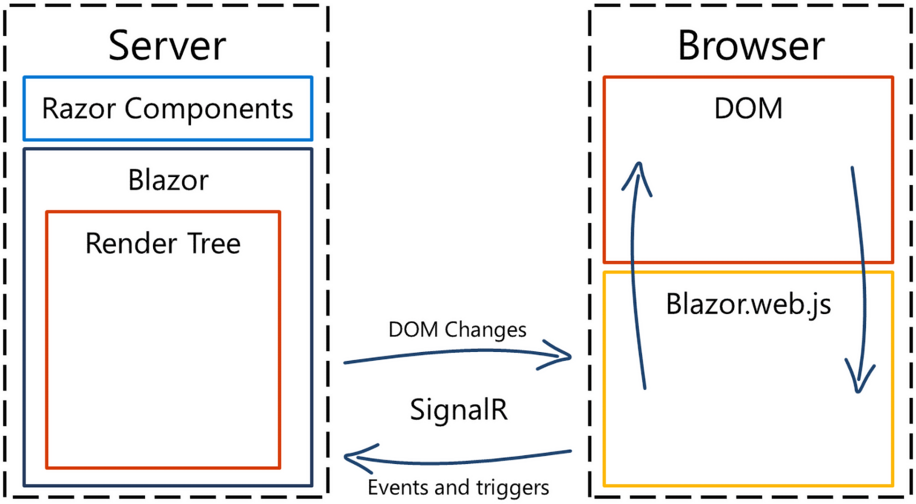


Figure 1.1: Overview of Blazor Server

SignalR is an open-source, real-time communication library that will create a connection between the client and the server. SignalR can use many different means of transporting data and automatically selects the best transport protocol based on your server and client capabilities. SignalR will always try to use WebSockets, which is a transport protocol built into HTML5. If WebSockets is not enabled, it will gracefully fall back to another protocol.

Blazor is built with reusable UI elements called **components** (more on components in *Chapter 4*, *Understanding Basic Blazor Components*). Each component contains C# code and markup. A component can include other components. You can use Razor syntax to mix markup and C# code or do everything in C# if you wish. The components can be updated by user interaction (pressing a button) or triggers (such as a timer).

The components are rendered into a render tree, a binary representation of the DOM containing object states and any properties or values. The render tree will keep track of any changes compared to the previous render tree, and then send only the things that changed over SignalR using a binary format to update the DOM.

JavaScript will receive the changes on the client side and update the page accordingly. If we compare this to traditional ASP.NET, we only render the component itself, not the entire page, and we only send over the actual changes to the DOM, not the whole page.

There are advantages to Blazor Server:

- It contains just enough code to establish that the connection is downloaded to the client, so the site has a small footprint, which makes the site startup really fast.
- Since everything is rendered on the server, Blazor Server is more SEO-friendly.
- Since we are running on the server, the app can fully utilize the server's capabilities.
- The site will work on older web browsers that don't support WebAssembly.
- The code runs on the server and stays on the server; there is no way to decompile the code.
- Since the code is executed on your server (or in the cloud), you can make direct calls to services and databases within your organization.

There are, of course, some disadvantages to Blazor Server as well:

- You need to always be connected to the server since the rendering is done on the server. If you have a bad internet connection, the site might not work. The big difference compared to a non-Blazor Server site is that a non-Blazor Server site can deliver a page and then disconnect until it requests another page. With Blazor, that connection (SignalR) must always be connected (minor disconnections are okay).
- There is no offline/**PWA** (**Progressive Web App**) mode since it needs to be connected.
- Every click or page update must do a round trip to the server, which might result in higher latency. It is important to remember that Blazor Server will only send the changed data. I have not experienced any slow response times personally.
- Since we have to have a connection to the server, the load on that server increases and makes scaling difficult. To solve this problem, you can use the Azure SignalR hub to handle the constant connections and let your server concentrate on delivering content.
- Each connection stores the information in the server's memory, increasing memory use and making load balancing more difficult.
- To be able to run Blazor Server, you have to host it on an ASP.NET Core-enabled server.

At my workplace, we already had a large site, so we decided to use Blazor Server for our projects. We had a customer portal and an internal CRM tool, and our approach was to take one component at a time and convert it into a Blazor component.

We quickly realized that, in most cases, it was faster to remake the component in Blazor rather than continue to use ASP.NET MVC and add functionality. The **User Experience** (**UX**) for the end-user became even better as we converted.

The pages loaded faster. We could reload parts of the page as we needed instead of the whole page, and so on.

We found that Blazor introduced a new problem: the pages became *too* fast. Our users didn't understand whether data had been saved because *nothing happened*; things *did* happen, but too fast for the users to notice. Suddenly, we had to think more about UX and how to inform the user that something had changed. This is, of course, a very positive side effect of Blazor.

Blazor Server is not the only way to run Blazor – you can also run it on the client (in the web browser) using WebAssembly.

Blazor WebAssembly

There is another option: instead of running Blazor on a server, you can run it inside your web browser using WebAssembly.

The Mono runtime is a tool that lets you run programs made with C# and other .NET languages on various operating systems, not just Windows.

Microsoft has taken the Mono runtime (which is written in C) and compiled that into WebAssembly.

The WebAssembly version of Blazor works very similarly to the server version, as shown in the following diagram. We have moved everything off the server, and it is now running within our web browser:

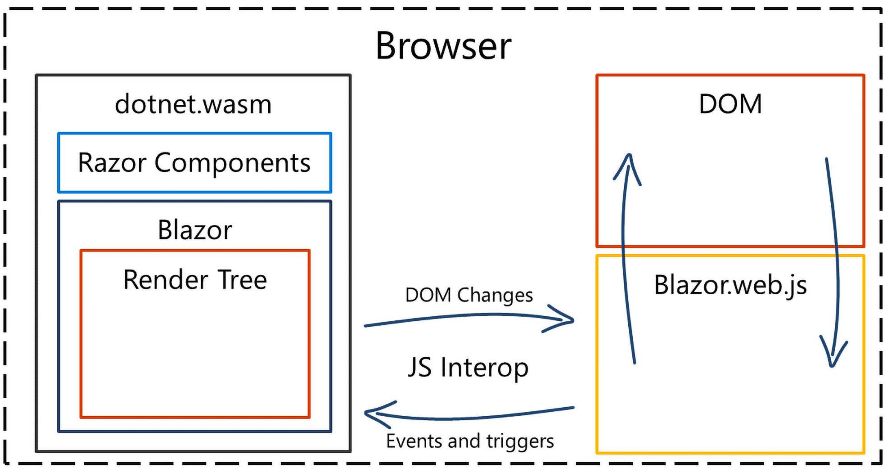


Figure 1.2: Overview of Blazor WebAssembly

A render tree is still created, and instead of running the Razor pages on the server, they are now running inside our web browser. Instead of SignalR, since WebAssembly doesn't have direct DOM access, Blazor updates the DOM with direct JavaScript interop.

The Mono runtime that's compiled into WebAssembly is called **dotnet.wasm**. The page contains a small piece of JavaScript that will make sure to load `dotnet.wasm`. Then, it will download `blazor.boot.json`, a JSON file containing all the files the application needs to run, as well as the application's entry point.

If we look at the default sample site that is created when we start a new Blazor project in Visual Studio, the `Blazor.boot.json` file contains 63 dependencies that need to be downloaded. All the dependencies get downloaded and the app boots up.

As we mentioned previously, `dotnet.wasm` is the mono runtime that's compiled into WebAssembly. It runs .NET DLLs – the ones you have written and the ones from .NET Framework (which is needed to run your app) – in your browser.

When I first heard of this, I got a bit of a bad taste. It's running the whole .NET runtime in my browser?! But then, after a while, I realized how amazing that is. You can run any .NET Standard DLLs in your web browser.

In the next chapter, we will look at exactly what happens and in what order code gets executed when a WebAssembly app boots up.

There are, of course, some advantages of Blazor WebAssembly:

- Since the code runs in the browser, creating a **PWA** is easy.
- It does not require a connection to the server. Blazor WebAssembly will work offline.
- Since we're not running anything on the server, we can use any backend server or file share (no need for a .NET-compatible server in the backend).
- No round trips mean that you can update the screen faster (that is why there are game engines that use WebAssembly).

There are some disadvantages to Blazor WebAssembly as well:

- Even if we compare it to other large sites, the footprint of Blazor WebAssembly is large and there are a large number of files to download.
- To access any on-site resources, you will need to create a Web API to access them. You cannot access the database directly.

- The code runs in the browser, meaning it can be decompiled. All app developers are used to this, but it is perhaps not as common for web developers.

I wanted to put WebAssembly to the test! When I was seven years old, I got my first computer, a Sinclair ZX Spectrum. I remember that I sat down and wrote the following:

```
10 PRINT "Jimmy"
20 GOTO 10
```

That was *my* code; I made the computer write my name on the screen over and over!

That was when I decided that I wanted to become a developer to make computers do stuff.

After becoming a developer, I wanted to revisit my childhood and decided I wanted to build a ZX Spectrum emulator. In many ways, the emulator has become my test project instead of a simple *Hello World* when I encounter new technology. I've had it running on a Gadgeteer, Xbox One, and even a HoloLens (to name a few platforms/devices).

But is it possible to run my emulator in Blazor?

It took me only a couple of hours to get the emulator working with Blazor WebAssembly by leveraging my already built .NET Standard DLL; I only had to write the code specific to this implementation, such as the keyboard and graphics. This is one of the reasons Blazor (both Server and WebAssembly) is so powerful: it can run libraries that have already been made. Not only can you leverage your knowledge of C# but you can also take advantage of the large ecosystem and .NET community.

> You can find the emulator here: `http://zxbox.com`. This is one of my favorite projects to work on, as I keep finding ways to optimize and improve the emulator.

Building interactive web applications used to only be possible with JavaScript. Now, we know we can use Blazor WebAssembly and Blazor Server, but which one of these new options is the best?

Blazor WebAssembly versus Blazor Server

Which one should we choose? The answer is, as always, it depends. You have seen the advantages and disadvantages of both.

If you have a current site that you want to port over to Blazor, I recommend going for the server side; once you have ported it, you can make a new decision as to whether you want to go for WebAssembly as well. This way, it is easy to port parts of the site, and the debugging experience is better with Blazor Server.

Suppose your site runs on a mobile browser or another unreliable internet connection. In that case, you might consider going for an offline-capable (PWA) scenario with Blazor WebAssembly since Blazor Server needs a constant connection.

The startup time for WebAssembly is a bit slow, but there are ways to combine the two hosting models to have the best of both worlds. We will cover this in *Chapter 16*, *Going Deeper into WebAssembly*.

There is no silver bullet when it comes to this question, but read up on the advantages and disadvantages and see how they affect your project and use cases.

With .NET 8, we have more opportunities to mix and match the different technologies, so the question becomes less relevant since we can choose to have one specific component running Blazor Server and another running Blazor WebAssembly (more on that later in this chapter).

We can run Blazor server-side and on the client, but what about desktop and mobile apps?

Blazor Hybrid/.NET MAUI

.NET MAUI is a cross-platform application framework. The name comes from **.NET Multi-platform App UI** and is the next version of Xamarin. We can use traditional XAML code to create our cross-platform application just as with Xamarin. However, .NET MAUI also targets desktop operating systems that will enable running our Blazor app on Windows and even macOS.

.NET MAUI has its own template that enables us to run Blazor inside of a .NET MAUI application using a Blazor WebView. This is called Blazor Hybrid. Blazor Hybrid works in a similar way to the other hosting models (Blazor Server and Blazor WebAssembly). It has a render tree and updates the Blazor WebView, which is a browser component in .NET MAUI. This is a bit oversimplified perhaps but we have a whole chapter on Blazor Hybrid (*Chapter 18*, *Visiting .NET MAUI*). Using Blazor Hybrid, we also get access to native APIs (not only Web APIs), making it possible to take our application to another level.

We will take a look at .NET MAUI in *Chapter 18*, *Visiting .NET MAUI*.

Sometimes we don't need interactive components, we just need to render some content and be done. In .NET 8, we have a new way of doing that.

Server-Side Rendering (SSR)

Server-side rendering is the new kid on the Blazor block. It makes it possible to use the Razor syntax to build web pages that are rendered server-side just like MVC or Razor Pages. This is called Static Server-side Rendering. It has some additional features that will keep scrolling in the previous position even though the whole page is reloaded, which is called enhanced form navigation. This will only render static pages, with no interactivity (with a few exceptions). There is also something called streaming rendering that will load the page even faster. This mode is called streaming server-side rendering. During long-running tasks, streaming rendering will first send the HTML it has and then update the DOM once the long-running task is complete, giving it a more interactive feeling.

But sometimes we want interactivity, and choosing between Blazor Server or Blazor WebAssembly can be a bit hard. But what if I told you we don't have to choose anymore? We can mix it up.

The feature formerly known as Blazor United

This next feature was called "Blazor United" when Microsoft first spoke of it but is now simply part of Blazor, not an extra feature. I still want to mention the name because the community still uses it, and chances are you might have heard it and are wondering why I am not mentioning it.

It is a really cool feature: we can pick and choose what components will run using SSR and what components will use Blazor Server, Blazor WebAssembly, or (hope you are sitting down for this) a mix of the two. Previously, we had to choose one of the two (Blazor Server or Blazor WebAssembly), but now we can combine the technologies to get the best of both worlds. We can now tell each component how we want it to render and we can mix and match throughout the site. The new "auto" feature means the first time our users visit the site, they will run Blazor Server. This is to get a quick connection and get data to the user as quickly as possible. In the background, the WebAssembly version is downloaded and cached so the next time they visit the site, it will use the cached Blazor WebAssembly version. If the WebAssembly version can be downloaded and started within 100 milliseconds, it will load only the WebAssembly version. If it takes longer, it will start up Blazor Server and download in the background. This is one of the ways we can speed up the download speed of our Blazor site. We can combine all of these technologies, pre-render the content on the server using Static Server-side Rendering, make the site interactive using Blazor Server (using SignalR), and then switch over to Blazor WebAssembly without the "long" download time.

Summary

In this chapter, we discussed how Blazor was created and its underlying technologies, such as SignalR and WebAssembly. You also learned about the render tree and how the DOM gets updated to give you an understanding of how Blazor works under the hood.

We got an overview of the different technologies you can use with Blazor, such as server-side (Blazor Server), client-side (WebAssembly), desktop, and mobile (Blazor Hybrid). This overview should have helped you decide what technology to choose for your next project.

We talked about why Blazor is a good choice for .NET developers.

We looked at SSR and (according to me) the most exciting feature in .NET 8 for Blazor, what was known as Blazor United.

In the upcoming chapters, I will walk you through various scenarios to equip you with the knowledge to handle everything from upgrading an old/existing site and creating a new server-side site to creating a new WebAssembly site.

In the next chapter, we'll get our hands dirty by configuring our development environment and creating and examining our first Blazor app.

Further reading

As a .NET developer, you might be interested in Uno Platform (`https://platform.uno/`), which makes it possible to create a UI in XAML and deploy it to many different platforms, including WebAssembly.

If you want to see how the ZX Spectrum emulator is built, you can download the source code here: `https://github.com/EngstromJimmy/ZXSpectrum`.

Join our community on Discord

Join our community's Discord space for discussions with the author and other readers:

`https://packt.link/WebDevBlazor3e`

2

Creating Your First Blazor App

In this chapter, we will set up our development environment so that we can start developing Blazor apps. We will create our first Blazor app and go through the project structure.

By the end of this chapter, you will have a working development environment and have created a Blazor App that can run a mix of streaming server-side rendering, Blazor Server, and Blazor WebAssembly.

In this chapter, we will cover the following:

- Setting up your development environment
- Creating our first Blazor application
- Using the command line
- Figuring out the project structure

Technical requirements

We will create a new project (a blog engine) and will continue working on that project throughout the book.

You can find the source code for this chapter's result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter02`.

Setting up your development environment

In this book, the focus will be on Windows development, and any screenshots are going to be from Visual Studio (unless stated otherwise). But since .NET 8 is cross-platform, we will go through how to set up your development environment on Windows, macOS, and Linux.

The go-to link for all the platforms can be found at `https://visualstudio.microsoft.com/`.

We can download Visual Studio or Visual Studio Code from the web page.

Windows

On Windows, we have many different options for developing Blazor applications. Visual Studio 2022 is the most powerful tool we can use.

There are three different editions, which are as follows:

- Community 2022
- Professional 2022
- Enterprise 2022

In short, the Community Edition is free, while the others cost money. The Community Edition does have some limitations, and we can compare the different editions here: `https://visualstudio.microsoft.com/vs/compare/`.

For this book, we can use any of these versions. Take the following steps:

1. Download Visual Studio 2022 from `https://visualstudio.microsoft.com/vs/`. Choose the version that is right for you.
2. Install Visual Studio and, during the installation, make sure to select **ASP.NET and web development**, as shown in *Figure 2.1*:

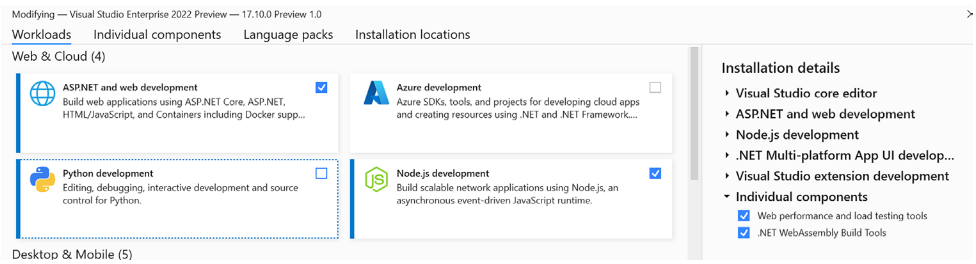


Figure 2.1: Visual Studio 2022 installation on Windows

3. To the right is a list of all the components that will be installed. Check **.NET WebAssembly Build Tools**. There might be a .NET6 or .NET 7 version in the list as well but we want the one without a version number.

We can also use Visual Studio Code to develop Blazor on Windows, but we won't discuss the installation process for Windows.

macOS and Linux (or Windows)

Visual Studio Code is cross-platform, which means we can use it on Linux, macOS, or Windows.

The different versions are available at `https://code.visualstudio.com/Download`.

Once installed, we also need to add two extensions:

1. Open Visual Studio Code and open the extension panel by pressing *Shift* + *command* + *X* on macOS or *Ctrl* + *Shift* + *X on Linux and Windows*.
2. Search for `C# Dev Kit for Visual Studio Code` and click **Install**. You might need a Microsoft account to install C# Dev Kit.
3. Search for `JavaScript Debugger (Nightly)` and click **Install**.

There are other IDEs that are cross-platform as well, like JetBrains Rider for example, that some prefer.

Now that everything is set up, let's create our first app.

Creating our first Blazor application

Throughout the book, we will create a blog engine. There won't be a lot of business logic that you'll have to learn; the app is simple to understand but will touch base on many of the technologies and areas you will be faced with when building a Blazor app.

> I had an opportunity to discuss the project with Steve Sanderson (creator of Blazor) and Dan Roth (program manager for ASP.NET). We came to the conclusion that this is going to showcase the most important features of Blazor.

The project will allow visitors to read blog posts and post comments. It will also have an admin site where we can write a blog post, which will be password-protected.

We will create an app that leverages Blazor Server, Blazor WebAssembly, and streaming server-side rendering.

> IMPORTANT NOTE
>
> This guide will use Visual Studio 2022 from now on, but other platforms have similar ways of creating projects.

Exploring the templates

In .NET 8, Microsoft reduced the amount of templates we have access to. We will explore them further in *Chapter 4*, *Understanding Basic Blazor Components*. This chapter will give you a quick overview.

In .NET 7, we had different templates depending on whether we wanted sample code, but in .NET 8 we only have two. We also have one Blazor Hybrid template (.NET MAUI), but we will return to it in *Chapter 18*, *Visiting .NET MAUI*.

Blazor Web App

The **Blazor Web App** template gives us a Blazor app. Once we have selected this template, we get options for how we want our app to run. We can configure our app with sample code or without. We can choose whether our app should support interactive components and what type of interactivity we want. We can also choose whether we want to specify the rendering mode per component or for the full app. So, right away, we don't need to choose whether or not we want to choose Blazor Server or Blazor WebAssembly; we can mix and match.

If we add sample pages, we get a couple of components to see what a Blazor app looks like and some basic setup and menu structure. It also contains code for adding Bootstrap, Isolated CSS, and things like that (see *Chapter 9*, *Sharing Code and Resources*).

This is the template we will use in the book to better understand how things go together.

Blazor WebAssembly Standalone App

The **Blazor WebAssembly Standalone App** template gives us (as the name implies) a Blazor WebAssembly standalone app. Here, we can choose whether we want to have sample pages as well. It contains a couple of components to see what a Blazor app looks like and some basic setup and menu structure. It also contains code for adding Bootstrap, isolated CSS, and things like that (see *Chapter 9*, *Sharing Code and Resources*). So why do we have this one? Well, the Blazor Web App is dependent on server rendering technologies in one way or another. If you want to be able to run your app from a file share, GitHub Pages, or Azure Static Web Apps (to name a few), this is the template for you.

Creating a Blazor web application

To start, we will create a Blazor Server application and play around with it:

1. Start Visual Studio 2022, and you will see the following screen:

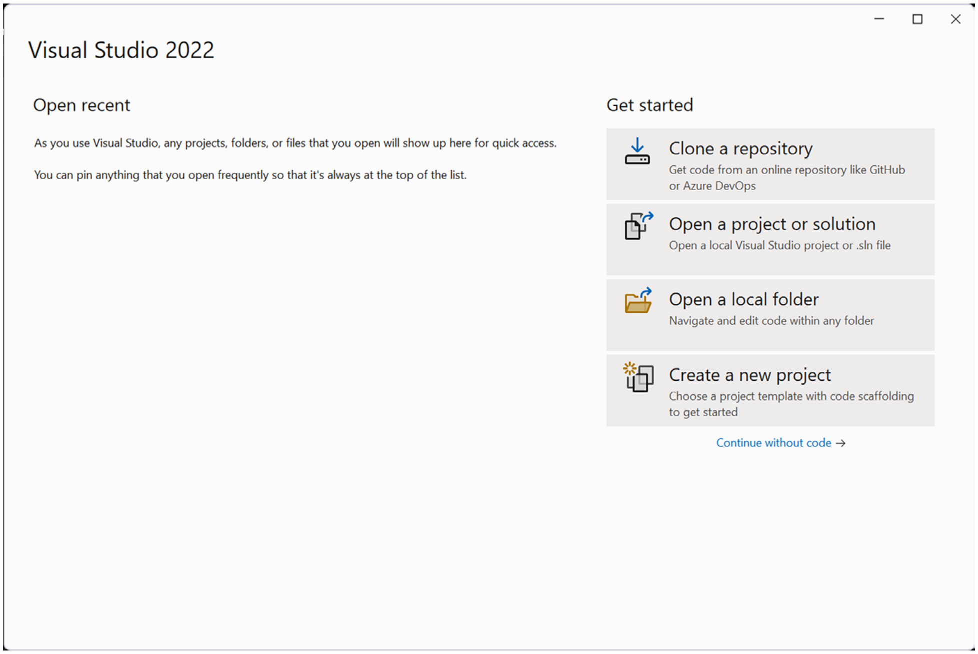


Figure 2.2: Visual Studio startup screen

2. Click **Create a new project**, and in the search bar, type `blazor`.

3. You will get a list of different templates – this is a mix of .NET 7 and .NET 8 templates. Now we need to select the template for our project. Select **Blazor Web App** from the search results and click **Next**:

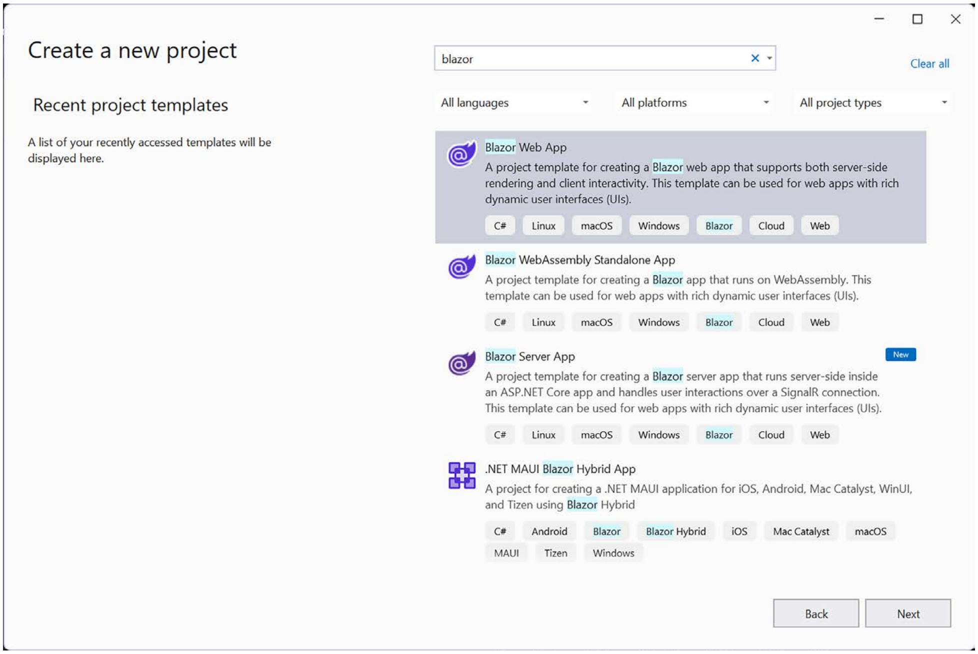


Figure 2.3: The Visual Studio Create a new project screen

4. Now name the project (this is the hardest part of any project, but fear not, I have done that already!). Name the application `BlazorWebApp`. Change the solution name to `MyBlog` and click **Next**:

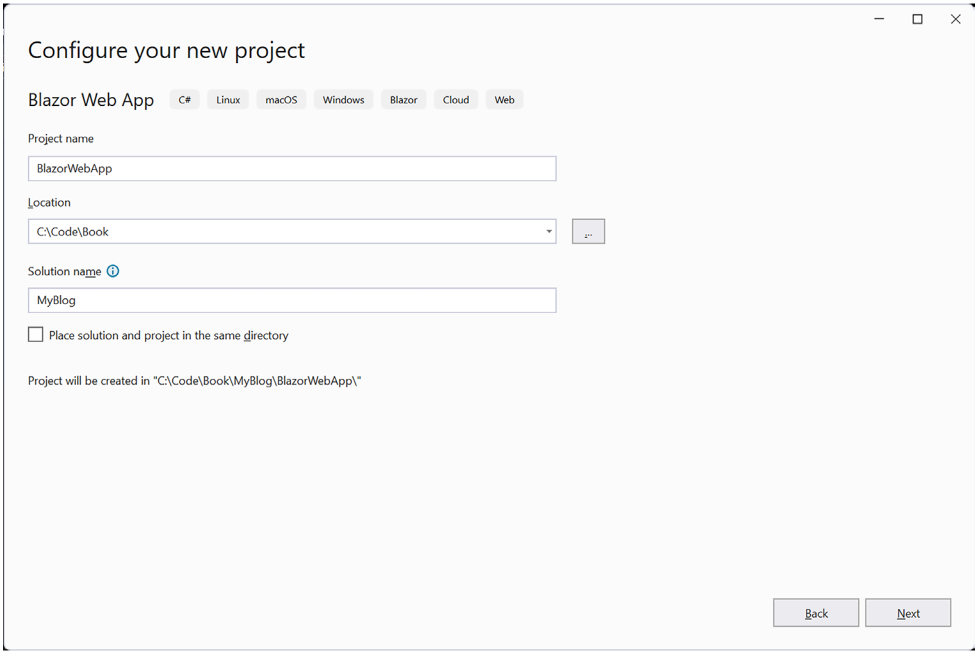


Figure 2.4: The Visual Studio Configure your new project screen

5. Next, choose what kind of Blazor app we should create. Select **.NET 8.0 (Long Term Support)** from the dropdown menu. Set **Authentication type** to **None**. Check **Configure** for HTTPS. Set Interactive render mode to **Auto (Server and Webassembly)** and **Interactivity location** to **Per page/component**.

6. Check **Include sample pages**. Uncheck **Do not use top-level statements.** Uncheck **Enlist in .NET Aspire orchestration** and click **Create**:

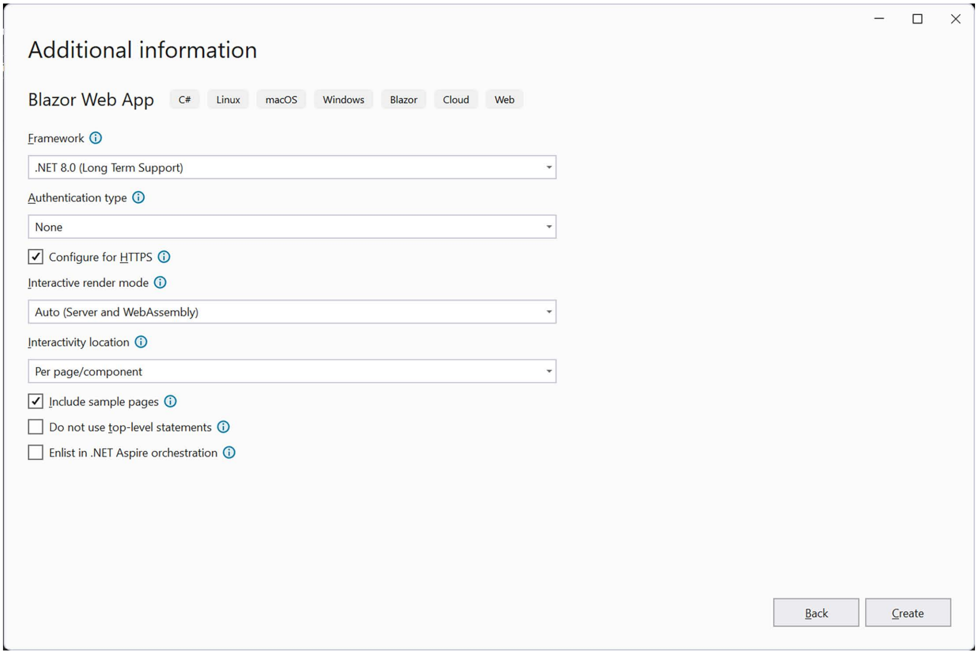


Figure 2.5: Visual Studio screen for creating a new Blazor app

7. Now run the app by pressing **Ctrl** + **F5** (we can also find it under the menu **Debug** | **Start without debugging**).

Congratulations! You have just created your first Blazor web application. The site should look something like in *Figure 2.6*:

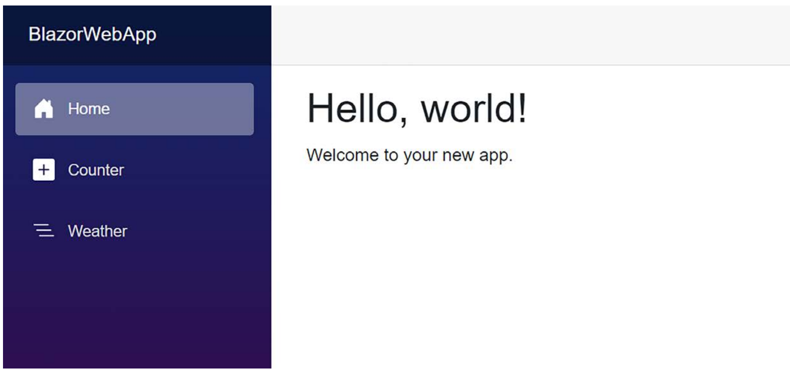


Figure 2.6: A new Blazor Web App

Explore the site a bit, navigate to **Counter** and **Weather** to get a feeling for the load times, and see what the sample application does.

The different pages have different ways of running. The Counter page is interactive and uses auto render mode. This means if loading the WebAssembly version takes longer than 100 milliseconds, the web will first start up a SignalR connection that will load the component fast. In the background, the WebAssembly version is downloaded and cached. The next time the user visits our site, it will use the cached version and load much faster.

The browser downloads the page, some CSS, and then `blazor.web.js`, which is responsible for setting up the site. In some cases, it's a SignalR connection back to the server, and in some, it's starting up WebAssembly.

The Counter page is configured as `RenderMode:Auto`, which means it will first render with Blazor Server and then any following requests will update with WebAssembly. As soon as you switch to the Counter page, a bunch of files will get downloaded in the background.

In this case, when the page gets downloaded, it will trigger a download of the necessary JavaScript files. Then, `blazor.boot.json` gets downloaded. *Figure 2.13* shows an example of part of `blazor.boot.json`:


```json
{
    "mainAssemblyName": "BlazorWebApp.Client",
    "resources": {
        "hash": "sha256-z3KiOqbXc8OgmK/910prUscNCoohMgnE2UN2pN7Jlzw=",
        "jsModuleNative": {
            "dotnet.native.8.0.2.deknxu92gu.js": "sha256-gPMK16QWoJSTxorlZJqcVtbBRTniIQWlLsJN2O4cJHg="
        },
        "jsModuleRuntime": {
            "dotnet.runtime.8.0.2.8j60y5zbay.js": "sha256-54KSaoOArNfygQbV+r4B5y3ys53v2tnvFIyZcZiUmi0="
        },
        "wasmNative": {
            "dotnet.native.wasm": "sha256-C2P+OTYZAJlmqo6rc4heqwvIVVsXIF8MAxC6WRe96Eg="
        },
        "icu": {
            "icudt_CJK.dat": "sha256-SZLtQnRc0JkwqHab0VUVP7T3uBPSeYzxzDnpxPpUnHk=",
            "icudt_EFIGS.dat": "sha256-8fItetYY8kQ0ww6oxwTLiT3oXlBwHKumbeP2pRF4yTc=",
            "icudt_no_CJK.dat": "sha256-L7sV7NEYP37/Qr2FPCePo5cJqRgTXRwGHuwF5Q+0Nfs="
        },
        "assembly": {
            "Microsoft.AspNetCore.Authorization.wasm": "sha256-xpsdU9uDJz5t2/e+ZH5CkB8nfZeCmSo9PqwquQX4B2U=",
            "Microsoft.AspNetCore.Components.wasm": "sha256-buD5cBBc62HWdCjvn6Z3Zo39W90qvd5Wk6QfHoBzWqw=",
            "Microsoft.AspNetCore.Components.Forms.wasm": "sha256-K/+6c3zlmAc3Y2qud/ksu/AexTbQpjbOhmTw03Ttg7E=",
            "Microsoft.AspNetCore.Components.Web.wasm": "sha256-485U1bL1Di+N+F1YkF/nGkY7S4uizJqRQ3xuV0ZX7Qg=",
            "Microsoft.AspNetCore.Components.WebAssembly.wasm": "sha256-A+PtISAkUO4WdDfhiOL5C2xve/IW90FjL/NccwdoQdE=",
            "Microsoft.AspNetCore.Metadata.wasm": "sha256-azMjpHKCROY2+Go/fNQAXceu5fXqk9s0CqSDiQvyPXc=",
```


Figure 2.7: Part of the blazor.boot.json file

The most important thing `blazor.boot.json` contains is the entry assembly, which is the name of the DLL the browser should start executing. It also includes all the framework DLLs the app needs to run. Now, our app knows what it needs to start up. In previous versions of .NET, the files were DLL files. In .NET 8, we download `.wasmfiles`.

By default, Blazor will use `Webcil`, which is a payload format. `Webcil` will package the DLLs. Some providers have turned off support for DLL files, and anti-virus programs have issues with DLL files, so this is an awesome update.

JavaScript will then download all the resources mentioned in `blazor.boot.json`: this is a mix of your code compiled to a .NET Standard DLL, Microsoft .NET Framework code, and any community or third-party DLLs you might use. The JavaScript then downloads `dotnet.native.wasm`, the Mono runtime compiled to WebAssembly, which will start booting up your app.

Now, we have the base for our project. Throughout this book, we will use Visual Studio, but there are other ways to run your Blazor site, such as using the command line. The command line is a super powerful tool, and in the next section, we will take a look at how to set up a project using the command line.

Using the command line

With .NET 5, we got a super powerful tool called `dotnet.exe`. Developers who have used .NET Core before will already be familiar with the tool, but with .NET 5, it is no longer exclusively for .NET Core developers.

It can do many things Visual Studio can do, for example, creating projects, adding and creating NuGet packages, and much more. In the following example, we will create a Blazor Server and a Blazor WebAssembly project using the **dotnet** command.

Creating projects using the command line

The following steps are to demonstrate the power of using the command line. We will not use this project later in the book, so if you don't want to try it, go ahead and skip this section. The CLI is cross-platform, so this can be used on Linux and macOS as well.

To create a solution with a Blazor app, you can do the following:

```
dotnet new blazor -o BlazorWebApp
```

We will not go deeper into the CLI in this book but know that it is a great way to create projects, add packages, and much, much more.

NOTE: THE .NET CLI

The idea is that you should be able to do everything from the command line. If you prefer working with the command line, you should check out the .NET CLI; you can read more about the .NET CLI here: `https://docs.microsoft.com/en-us/dotnet/core/tools/`.

Let's go back to the Blazor template, which has added a lot of files for us. In the next section, we will look at what Visual Studio has generated for us.

Figuring out the project structure

Visual Studio will generate two projects: `Blazor App`, which is the server project, and `BlazorWebApp.Client`, which is where we put our WebAssembly components.

Now, it's time to look at the different files and how they may differ in different projects. Take a look at the code in the two projects we just created (in the *Creating our first Blazor app* section) while we go through them.

Program.cs (BlazorWebApp project)

`Program.cs` is the first class that gets called. So, let's start looking at that one.

The `Program.cs` file looks like this:

```
var builder = WebApplication.CreateBuilder(args);

// Add services to the container.
builder.Services.AddRazorComponents()
    .AddInteractiveServerComponents()
    .AddInteractiveWebAssemblyComponents();

var app = builder.Build();

// Configure the HTTP request pipeline.
if (app.Environment.IsDevelopment())
{
    app.UseWebAssemblyDebugging();
}
```

```
else
{
    app.UseExceptionHandler("/Error", createScopeForErrors: true);
    // The default HSTS value is 30 days. You may want to change this for
production scenarios, see https://aka.ms/aspnetcore-hsts.
    app.UseHsts();
}

app.UseHttpsRedirection();

app.UseStaticFiles();
app.UseAntiforgery();

app.MapRazorComponents<App>()
    .AddInteractiveServerRenderMode()
    .AddInteractiveWebAssemblyRenderMode()
    .AddAdditionalAssemblies(typeof(Counter).Assembly);

app.Run();
```

In .NET 6, Microsoft removed the `Startup.cs` file and put all the startup code in `Program.cs`. It also uses top-level statements, which makes the code a bit less bloated.

There are a few things worthy of mentioning here. The Program class starts with adding all the dependencies we need in our application. In this case, we add `RazorComponent`, which enables us to run Razor components. Then, we add `InteractiveServerComponents`, giving us access to all the objects we need to run Blazor Server. Since we selected the auto render mode, we also get access to Blazor WebAssembly by adding `InteractiveWebAssemblyComponents`.

It also configures **HTTP Strict Transport Security** (**HSTS**), forcing your application to use HTTPS, and will make sure that your users don't use any untrusted resources or certificates. We also ensure that the site redirects to HTTPS to secure the site.

`UseStaticFiles` enables downloading static files such as CSS or images.

`UseAntiforgery` is a method that adds anti-forgery middleware to the application pipeline, providing a layer of security against **Cross-Site Request Forgery** (**CSRF** or **XSRF**) attacks.

These types of attacks occur when a malicious web app influences the interaction between a client browser and a web app that trusts that browser, often leading to unwanted actions being performed without the user's consent.

The different `Use*` methods add request delegates to the request pipeline or middleware pipeline. Each request delegate (`ExceptionHandler`, `HttpRedirection`, `StaticFiles`, and so on) is called consecutively from the top to the bottom in the order they are added in `Program.cs` and back again.

This is why the exception handler is the first one to be added.

If there is an exception in any of the request delegates that follow, the exception handler will still be able to handle it (since the request travels back through the pipeline), as shown in *Figure 2.15*:

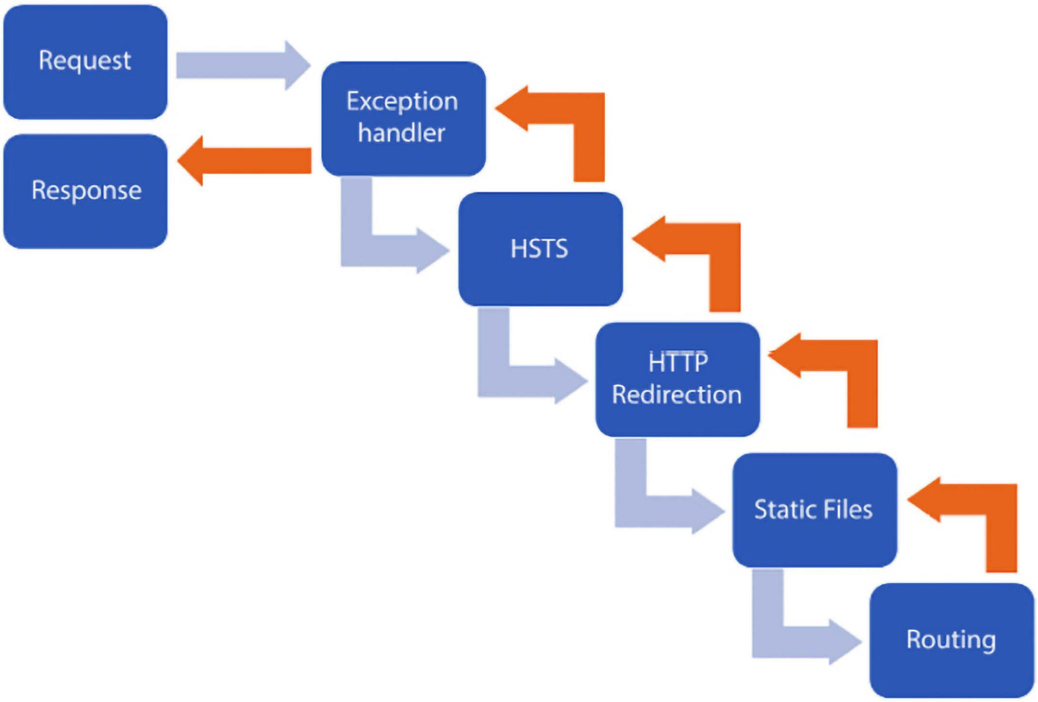


Figure 2.8: The request middleware pipeline

If any of these request delegates handle the request in the case of a static file, for example, there is no need to involve routing, and the remaining request delegates will not get called. Sometimes, it is essential to add the request delegates in the correct order; for example, we want to run authentication early in the pipeline to make sure that users can't access things they shouldn't.

NOTE:

There is more information about this here if you want to dig even deeper: `https://docs.microsoft.com/en-us/aspnet/core/fundamentals/middleware/?view=aspnetcore-8.0`.

At the end of the class, we map Razor components to the `App` component. We add the different render modes and additional assemblies – in this case, the `BlazorWebApp.Client` project, which is our WebAssembly project.

Program.cs (BlazorWebApp.Client)

The `program.cs` located in the Blazor WebAssembly project doesn't contain many things.

It looks like this:

```
var builder = WebAssemblyHostBuilder.CreateDefault(args);

await builder.Build().RunAsync();
```

It simply sets up a host builder and uses the default configuration.

App (BlazorWebApp)

The next thing that happens is that the `App` component runs.

It looks like this:

```
<!DOCTYPE html>
<html lang="en">

<head>
    <meta charset="utf-8" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0"
/>
    <base href="/" />
    <link rel="stylesheet" href="bootstrap/bootstrap.min.css" />
    <link rel="stylesheet" href="app.css" />
    <link rel="stylesheet" href="BlazorWebApp.styles.css" />
    <link rel="icon" type="image/png" href="favicon.png" />
    <HeadOutlet />
```

```
</head>

<body>
    <Routes />
    <script src="_framework/blazor.web.js"></script>
</body>
</html>
```

Let's go through it and see what we can learn. It starts with `html`, `doctype`, and a `head` tag. The `head` tag contains meta tags and **stylesheets** (**CSS**). The `base` tag is so the application finds the appropriate files. If we are, for example, hosting our application in a subfolder (like on GitHub Pages) we need to modify the `base` tag to reflect that. The `HeadOutlet` component is for us to add things like page titles from within our code (we will return to that in *Chapter 5*, *Creating Advanced Blazor Components*).

The `Routes` component is the component that handles all the routing, which we will take a look at next. And last but not least, we have the JavaScript that makes all of this possible.

Routes

The `Routes` component is the one that handles all the routing. It looks like this:

```
<Router AppAssembly="@typeof(Program).Assembly"
AdditionalAssemblies="new[] { typeof(Client._Imports).Assembly }">
    <Found Context="routeData">
        <RouteView RouteData="@routeData" DefaultLayout="@typeof(Layout.
MainLayout)" />
        <FocusOnNavigate RouteData="@routeData" Selector="h1" />
    </Found>
</Router>
```

This file handles the routing, finding the suitable component to show (based on the `@page` directive). It shows an error message if the route can't be found. In *Chapter 8*, *Authentication and Authorization*, we will make changes to this file when we implement authentication.

The `Routes` component also includes a default layout. We can override the layout per component, but usually, you'll have one layout page for your site. In this case, the default layout is called `MainLayout`.

The `FocusOnNavigate` will set the focus on a specific element once we have navigated/loaded a new component/route – in this case, `H1`.

MainLayout

`MainLayout`, which we can find in the shared folder, contains the default layout for all components when viewed as a page. The `MainLayout` contains a couple of `div` tags, one for the sidebar and one for the main content:

```
@inherits LayoutComponentBase
<div class="page">
    <div class="sidebar">
        <NavMenu />
    </div>

    <main>
        <div class="top-row px-4">
            <a href="https://learn.microsoft.com/aspnet/core/" target="_
blank">About</a>
        </div>

        <article class="content px-4">
            @Body
        </article>
    </main>
</div>

<div id="blazor-error-ui">
    An unhandled error has occurred.
    <a href="" class="reload">Reload</a>
    <a class="dismiss">X</a>
</div>
```

The only things you need in this document are `@inherits LayoutComponentBase` and `@Body`; the rest is just Bootstrap.

> Bootstrap is one of the most popular CSS frameworks for developing responsive and mobile-first websites.
>
> We can find a reference to Bootstrap in the `App.Razor` file.
>
> It was created by and for Twitter/X. You can read more about Bootstrap here: `https://getbootstrap.com/`.

The `@inherits` directive inherits from `LayoutComponentBase`, which contains all the code to use a layout. `@Body` is where the component will be rendered (when viewed as a page).

It also contains the default error UI for Blazor.

At the top of the layout, you can see `<NavMenu>`, a Razor component. It is located in the `Components/Layout` folder and looks like this:

```
<div class="top-row ps-3 navbar navbar-dark">
    <div class="container-fluid">
        <a class="navbar-brand" href="">BlazorWebApp</a>
    </div>
</div>

<input type="checkbox" title="Navigation menu" class="navbar-toggler" />

<div class="nav-scrollable" onclick="document.querySelector('.navbar-
toggler').click()">
    <nav class="flex-column">
        <div class="nav-item px-3">
            <NavLink class="nav-link" href="" Match="NavLinkMatch.All">
                <span class="bi bi-house-door-fill-nav-menu" aria-
hidden="true"></span> Home
            </NavLink>
        </div>

        <div class="nav-item px-3">
            <NavLink class="nav-link" href="counter">
                <span class="bi bi-plus-square-fill-nav-menu" aria-
hidden="true"></span> Counter
            </NavLink>
        </div>

        <div class="nav-item px-3">
            <NavLink class="nav-link" href="weather">
                <span class="bi bi-list-nested-nav-menu" aria-
hidden="true"></span> Weather
            </NavLink>
        </div>
```

```
    </nav>
</div>
```

It contains the left-side menu and is a standard Bootstrap menu. It also has three menu items and logic for a hamburger menu (if viewed on a phone). This type of nav menu is usually done with JavaScript, but this one is done solely with CSS and C#.

You will find another component, `NavLink`, which is built into the framework. It will render an anchor tag but will also check the current route. If you are currently on the same route/URL as the nav link, it will automatically add a CSS class called `active` to the tag.

We will run into a couple more built-in components that will help us along the way. There are also some pages in the template, but we will leave them for now and go through them in the next chapter when we go into components.

CSS

In the `Components/Layout` folder, there are two CSS files: : `NavMenu.razor.css` and `MainLayout.razor.css`.

These files are CSS styles that affect only the specific component (the first part of the name). We will return to a concept called isolated CSS in *Chapter 9*, *Sharing Code and Resources*.

Summary

In this chapter, we got the development environment up and running, and we created our first Blazor app. We learned in what order classes, components, and layouts are called, making it easier to follow the code.

In the next chapter, we will take a break from Blazor to look at managing state and set up a repository to store our blog posts.

3

Managing State – Part 1

In this chapter, we will start looking at managing state. There is also a continuation of this chapter in *Chapter 11*, *Managing State – Part 2*.

There are many different ways of managing state or persisting data. As soon as we leave a component, the state is gone. If we click the counter button from the sample pages, see the counter count up and then navigate away, we don't know how many times we'll need to click the counter button and have to start over. You can't imagine how many times I have clicked that counter button over the years. It is such a simple yet powerful demo of Blazor and was a part of Steve's original demo back in 2017.

To get started quickly, I have split this chapter in two. In this chapter, we are focusing on data access, and we will come back to more state management in the second part. Since this book focuses on Blazor, we will not explore how to connect to databases but create simple JSON storage instead.

> In the first edition, we used Entity Framework to connect to a database, but there were people who were not used to working with Entity Framework, and they got stuck pretty fast. Using Entity Framework is a book all in itself, so I have opted not to include that in this book to remove any added complexity.

In the repo on GitHub, you can find more examples of storing data in databases such as `RavenDB` or `MSSQL`.

We will use a common pattern called the **repository pattern**.

We will also create an API to access the data from the JSON repository.

By the end of this chapter, you will have learned how to create a JSON repository and an API.

We will cover the following main topics:

- Creating a data project
- Adding the API to Blazor

Technical requirements

Make sure you have followed the previous chapters or use the `Chapter02` folder on GitHub as the starting point.

You can find the source code for this chapter's result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter03`.

Creating a data project

There are many ways of persisting data: document databases, relational databases, and files, to name a few. To avoid complexity in the book, we will use the simplest way of creating blog posts for our project by storing them as JSON in a folder.

To save our blog posts, we will use JSON files stored in a folder, and to do so, we need to create a new project.

Creating a new project

We can create a new project from within Visual Studio (to be honest, that's how I would do it), but to get to know the .NET CLI, let's do it from the command line instead.

To create a new project, follow these steps:

1. Open a PowerShell prompt.
2. Navigate to the `MyBlog` folder.
3. Create a class library (`classlib`) by typing the following command:

   ```
   dotnet new classlib -o Data
   ```

   The `dotnet` tool should now have created a folder called `Data`.

4. We also need to create a project where we can put our models:

   ```
   dotnet new classlib -o Data.Models
   ```

5. Add the new projects to our solution by running the following command:

   ```
   dotnet sln add Data
   ```

```
dotnet sln add Data.Models
```

It will look for any solution in the current folder.

We call the projects `Data` and `Data.Models` so their purpose will be easy to understand and they will be easy to find.

The default project has a `class1.cs` file – feel free to delete the file.

The next step is to create data classes to store our information.

Creating data classes

Now we need to create a class for our blog post. To do that, we will go back to Visual Studio:

1. Open the `MyBlog` solution in Visual Studio (if it is not already open).

   We should now have a new project called `Data` in our solution. We might get a popup asking if we want to reload the solution; click **Reload** if so.

2. Right-click on the `Data.Models` project and select **Add** | **Class**. Name the class `BlogPost.cs` and click **Add**.
3. Right-click on the `Data.Models` project and select **Add** | **Class**. Name the class `Category.cs` and click **Add**.
4. Right-click on the `Data.Models` project and select **Add** | **Class**. Name the class `Tag.cs` and click **Add**.
5. Right-click on the `Data.Models` project and select **Add** | **Class**. Name the class `Comment.cs` and click **Add**.
6. Open `Category.cs` and replace the content with the following code:

```
namespace Data.Models;
public class Category
{
      public string? Id { get; set; }
      public string Name { get; set; } = string.Empty;
}
```

   The `Category` class contains `Id` and `Name`. It might seem strange that the `Id` property is a string, but this is because we will support multiple data storage types, including MSSQL, RavenDB, and JSON. A string is a great datatype to support all of these. `Id` is also nullable, so if we create a new category, we send in null as an `Id`.

7. Open `Tag.cs` and replace the content with the following code:

```
namespace Data.Models;
public class Tag
{
    public string? Id { get; set; }
    public string Name { get; set; } = string.Empty;
}
```

   The `Tag` class contains an `Id` and `Name`.

8. Open `Comment.cs` and replace the content with the following code:

```
namespace Data.Models;

public class Comment
{
    public string? Id { get; set; }
    public required string BlogPostId { get; set; }
    public DateTime Date { get; set; }
    public string Text { get; set; } = string.Empty;
    public string Name { get; set; } = string.Empty;
}
```

9. The `comment` class could be part of the `Blogpost` class, but to use the same classes for different database types, we add comments as a separate entity referencing the blog post.
10. Open `BlogPost.cs` and replace the content with the following code:

```
namespace Data.Models;
public class BlogPost
{
    public string? Id { get; set; }
    public string Title { get; set; } = string.Empty;
    public string Text { get; set; } = string.Empty;
    public DateTime PublishDate { get; set; }
    public Category? Category { get; set; }
    public List<Tag> Tags { get; set; } = new();
}
```

In this class, we define the content of our blog post. We need an `Id` to identify the blog post, a title, some text (the article), and the publishing date. We also have a `Category` property in the class, which is of the `Category` type. In this case, a blog post can have only one category, and a blog post can contain zero or more tags. We define the `Tag` property with `List<Tag>`.

We have now created a couple of classes that we will use. I have kept the complexity of these classes to a minimum since we are here to learn about Blazor.

Next, we will create a way to store and retrieve the blog post information.

Creating an interface

In this section, we will create an API.

We will create one API that has direct database access and one that will retrieve data through a Web API.

In *Chapter 7*, *Creating an API*, we will get back to creating the Web API. Why are we creating two APIs?

We are not creating two APIs; we are creating a service with direct database access and a client that goes over the web and then uses direct database access. But we will use the same interface for both scenarios, making it possible to use one on the server and the other on the client.

In a real-world application, it would make more sense to access all the data in one way, not use both. But the point is to show that it is possible to mix and match and pick what is right for your scenario.

We will start with the API with direct database access:

1. Right-click on the `Data.Models` project, select **Add** | **New Folder**, and name it `Interfaces`.
2. Right-click on the `Interfaces` folder and select **Add** | **Class**.
3. In the list of different templates, select **Interface** and name it `IBlogApi.cs`.
4. Open `IBlogApi.cs` and replace its content with the following:

```
namespace Data.Models.Interfaces;
public interface IBlogApi
{
    Task<int> GetBlogPostCountAsync();
    Task<List<BlogPost>> GetBlogPostsAsync(int numberofposts, int
startindex);
```

```
    Task<List<Category>> GetCategoriesAsync();
    Task<List<Tag>> GetTagsAsync();
    Task<List<Comment>> GetCommentsAsync(string blogPostId);
    Task<BlogPost?> GetBlogPostAsync(string id);
    Task<Category?> GetCategoryAsync(string id);
    Task<Tag?> GetTagAsync(string id);
    Task<BlogPost?> SaveBlogPostAsync(BlogPost item);
    Task<Category?> SaveCategoryAsync(Category item);
    Task<Tag?> SaveTagAsync(Tag item);
    Task<Comment?> SaveCommentAsync(Comment item);
    Task DeleteBlogPostAsync(string id);
    Task DeleteCategoryAsync(string id);
    Task DeleteTagAsync(string id);
    Task DeleteCommentAsync(string id);
}
```

5. Alright, so here's the deal with this `IBlogApi` thing. It's basically our cheat sheet for handling all the blog stuff, like posts, comments, tags, and categories. Need to grab some posts or zap one out of existence? This interface is your go-to. It's all about making our lives easier when we're coding the blog, and keeping things tidy and straightforward.

   Now, we have an interface for the API with the methods we need to list blog posts, tags, and categories, as well as to save (create/update) and delete them. Next, let's implement the interface.

Implementing the interface

The idea is to create a class that stores our blog posts, tags, comments, and categories as JSON files on our file system. We will start with implementing the direct access implementation. This is the one we can use when accessing information directly from the database and not through a Web API. We will use the direct access implementation when running our components on the server and accessing the database and our Web API will also use it to access the database, but we will come back to that in *Chapter 7, Creating an API*.

To implement the interface for the direct database access implementation, follow these steps:

1. First, to be able to access our data models, we need to add a reference to our `Data` models. Expand the `Data` project and right-click on the **Dependencies** node. Select **Add Project reference** and check the `Data.Models` project. Click **OK**.

2. Right-click on the **Dependencies** node once again, but select **Manage NuGet Packages**. In the **Browse** tab, search for `Microsoft.Extensions.Options` and click **Install**.
3. We need a class to hold our settings.

   In the `Data` project, add a new class called `BlogApiJsonDirectAccessSetting.cs` and replace its content with:

```
namespace Data;
public class BlogApiJsonDirectAccessSetting
{
    public string BlogPostsFolder { get; set; } = string.Empty;
    public string CategoriesFolder { get; set; } = string.Empty;
    public string TagsFolder { get; set; } = string.Empty;
    public string CommentsFolder { get; set; } = string.Empty;
    public string DataPath { get; set; } = string.Empty;
}
```

4. This is the class where we hold our settings and the folders we will be using for storing our JSON files. `IOptions` is configured in `program` during the configuration of dependencies and is injected into all the classes that ask for a specific type.
5. Next, we need to create a class for our API. Right-click on the `Data` project, select **Add | Class**, and name the class `BlogApiJsonDirectAccess.cs`.
6. Open `BlogApiJsonDirectAccess.cs` and replace the code with the following:

```
using Data.Models.Interfaces;
using Microsoft.Extensions.Options;
using System.Text.Json;
using Data.Models;
namespace Data;
public class BlogApiJsonDirectAccess: IBlogApi
{
}
```

   This is the start of our JSON direct access class. It references the `IBlogAPI` and we will implement each method the interface wants.

   The error list should contain many errors since we haven't implemented the methods yet. We are inheriting from the `IBlogApi`, so we know what methods to expose.

7. To be able to read settings, we also add a way to inject `IOptions`. By getting the settings this way, we don't have to add any code – it can come from a database, a settings file, or even be hard coded.

   This is my favorite way to get settings because this part of the code itself doesn't know how to do it – instead, we add all our configurations using dependency injection.

   Add the following code to the `BlogApiJsonDirectAccess` class:

```
    BlogApiJsonDirectAccessSetting _settings;
    public BlogApiJsonDirectAccess(
IOptions<BlogApiJsonDirectAccessSetting> option)
    {
        _settings = option.Value;

        ManageDataPaths();
    }
    private void ManageDataPaths()
    {
        CreateDirectoryIfNotExists(_settings.DataPath);
        CreateDirectoryIfNotExists($@"{_settings.DataPath}\{_
settings.BlogPostsFolder}");
        CreateDirectoryIfNotExists($@"{_settings.DataPath}\{_
settings.CategoriesFolder}");
        CreateDirectoryIfNotExists($@"{_settings.DataPath}\{_
settings.TagsFolder}");
        CreateDirectoryIfNotExists($@"{_settings.DataPath}\{_
settings.CommentsFolder}");
    }

    private static void CreateDirectoryIfNotExists(string path)
    {
        if (!Directory.Exists(path))
        {
            Directory.CreateDirectory(path);
        }
    }
```

   We get the injected setting and ensure we have the correct folder structure for our data.

8. Now, it's time to implement the API, but first, we need a couple of helper methods that can load the data from our file system. To do this, we add the following code to our class:

```
private async Task<List<T>> LoadAsync<T>(string folder)
{
    var list = new List<T>();
    foreach (var f in Directory.GetFiles($@"{_settings.DataPath}\
{folder}"))
    {
        var json = await File.ReadAllTextAsync(f);
        var blogPost = JsonSerializer.Deserialize<T>(json);
        if (blogPost is not null)
        {
            list.Add(blogPost);
        }
    }

    return list;
}
```

9. The `LoadAsync` method is a generic method that allows us to load blog posts, tags, comments, and categories using the same method. It will load data from the file system whenever we ask for it. This would be a great place to put in some cache logic, but this is closer to what the implementation would look like if we used a database (we would always ask the database).

10. Next, we will add a couple of methods to help manipulate the data, namely `SaveAsync` and `Delete`. Add the following methods:

```
private async Task SaveAsync<T>(string folder, string filename, T
item)
{
    var filepath = $@"{_settings.DataPath}\{folder}\{filename}.
json";
    await File.WriteAllTextAsync(filepath, JsonSerializer.
Serialize<T>(item));
}

private Task DeleteAsync(string folder, string filename)
```

```
 {
     var filepath = $@"{_settings.DataPath}\{folder}\{filename}.
json";
     if (File.Exists(filepath))
     {
         File.Delete(filepath);
     }
     return Task.CompletedTask;
 }
```

These methods are also generic to share as much code as possible and avoid repeating the code for every type of class (`BlogPost`, `Category`, `Comment`, and `Tag`).

11. Next, it's time to implement the API by adding the methods to get blog posts. Add the following code:

```
public async Task<int> GetBlogPostCountAsync()
 {
     var list = await LoadAsync<BlogPost>(_settings.
BlogPostsFolder);
     return list.Count;
 }

 public async Task<List<BlogPost>> GetBlogPostsAsync(int
numberofposts, int startindex)
 {
     var list = await LoadAsync<BlogPost>(_settings.
BlogPostsFolder);
     return list.Skip(startindex).Take(numberofposts).ToList();
 }
public async Task<BlogPost?> GetBlogPostAsync(string id)
    {
        var list = await LoadAsync<BlogPost>(_settings.
BlogPostsFolder);
        return list.FirstOrDefault(bp => bp.Id == id);
    }
```

The `GetBlogPostsAsync` method takes a couple of parameters we will use later for paging. It will get the blog posts from our JSON storage and return the posts we are asking for, skipping and taking the right amount for our paging.

We also have a method that returns the current blog post count, which we will use for paging. Last but not least, we have `GetBlogPostAsync` for getting a single blog post from our JSON storage.

12. Now, we need to add the same methods for categories. To do this, add the following code:

```
    public async Task<List<Category>> GetCategoriesAsync()
    {
        return await LoadAsync<Category>(_settings.
CategoriesFolder);
    }

    public async Task<Category?> GetCategoryAsync(string id)
    {
        var list = await LoadAsync<Category>(_settings.
CategoriesFolder);
        return list.FirstOrDefault(c => c.Id == id);
    }
```

13. The `Category` methods don't have any support for paging. Otherwise, they should look familiar as they do almost the same as the blog post methods.
14. Now, it's time to do the same thing for tags. Add the following code:

```
    public async Task<List<Tag>> GetTagsAsync()
    {
        return await LoadAsync<Tag>(_settings.TagsFolder);
    }

    public async Task<Tag?> GetTagAsync(string id)
    {
        var list = await LoadAsync<Tag>(_settings.TagsFolder);
        return list.FirstOrDefault(t => t.Id == id);
    }
```

As we can see, the tag code is basically a copy of the code for categories.

We also need a way to retrieve the comments for a blog post. We will not create a method to retrieve one comment; we always get all the comments for a specific post. Add the following method:

```
    public async Task<List<Comment>> GetCommentsAsync(string
blogPostId)
    {
        var list = await LoadAsync<Comment>(_settings.
CommentsFolder);
        return list.Where(t => t.BlogPostId == blogPostId).ToList();
    }
```

This method will get all the comments for a blog post.

15. We also need a couple of methods for saving the data, so next up, we'll add methods for saving blog posts, categories, comments, and tags.

    Add the following code:

```
public async Task<BlogPost?> SaveBlogPostAsync(BlogPost item)
{
    item.Id ??= Guid.NewGuid().ToString();
    await SaveAsync(_settings.BlogPostsFolder, item.Id, item);
    return item;
}

public async Task<Category?> SaveCategoryAsync(Category item)
{
    item.Id ??= Guid.NewGuid().ToString();
    await SaveAsync(_settings.CategoriesFolder, item.Id, item);
    return item;
}

public async Task<Tag?> SaveTagAsync(Tag item)
{
    item.Id ??= Guid.NewGuid().ToString();
    await SaveAsync(_settings.TagsFolder, item.Id, item);
    return item;
```

```
}
public async Task<Comment?> SaveCommentAsync(Comment item)
{
    item.Id ??= Guid.NewGuid().ToString();
    await SaveAsync(_settings.CommentsFolder, item.Id, item);
    return item;
}
```

The first thing we do is to check that the `id` of the item is not null. If it is, we create a new `Guid`. This is the `id` of the new item. And this is also going to be the name of the JSON files stored on the file system.

16. We now have a method for saving and getting items. But sometimes, things don't go as planned, and we need a way to delete the items that we have created. Next up, we will add some delete methods. Add the following code:

```
    public async Task DeleteBlogPostAsync(string id)
    {
        await DeleteAsync(_settings.BlogPostsFolder, id);

        var comments = await GetCommentsAsync(id);
        foreach (var comment in comments)
        {
            if (comment.Id != null)
            {
                await DeleteAsync(_settings.CommentsFolder, comment.
Id);
            }
        }
    }

    public async Task DeleteCategoryAsync(string id)
    {
        await DeleteAsync(_settings.CategoriesFolder, id);
    }

    public async Task DeleteTagAsync(string id)
    {
        await DeleteAsync(_settings.TagsFolder, id);
```

```
    }

    public async Task DeleteCommentAsync(string id)
    {
        await DeleteAsync(_settings.CommentsFolder, id);
    }
```

The code we just added calls the `DeleteAsync` method, which deletes the blog post, tag, category, etc.

Our JSON storage is done!

In the end, there will be four folders stored on the file system, one for blog posts, one for categories, one for comments, and one for tags.

The next step is to add and configure the Blazor project to use our new storage.

Adding the API to Blazor

We now have a way to access JSON files stored on our file system. In the repo on GitHub, you can find more ways of storing our data with RavenDB or SQL Server, but be mindful to keep the focus on what is important (Blazor).

Now it's time to add the API to our Blazor Server project:

1. In the `BlazorWebApp` project, **add a project reference** to the `Data` project. Open `Program.cs` and add the following namespaces:

```
using Data;
using Data.Models.Interfaces;
```

2. Add the following code after `.AddInteractiveWebAssemblyComponents();`:

```
builder.Services.AddOptions<BlogApiJsonDirectAccessSetting>().
Configure(options =>
{
    options.DataPath = @"..\..\..\Data\";
    options.BlogPostsFolder = "Blogposts";
    options.TagsFolder = "Tags";
    options.CategoriesFolder = "Categories";
    options.CommentsFolder = "Comments";
});
builder.Services.AddScoped<IBlogApi, BlogApiJsonDirectAccess>();
```

This snippet of code is the setting for where we want to store our files. You can change the data path property to where you want to store the files. Whenever we ask for `IOptions<BlogApiJsonDirectAccessSetting>`, the dependency injection will return an object populated with the information we have supplied above. This is an excellent place to load configuration from our .NET configuration, a key vault, or a database.

We are also saying that when we ask for an `IBlogAPI` we will get an instance of `BlogApiJsonDirectAccess` back from our dependency injection. We will return to dependency injection in *Chapter 4*, *Understanding Basic Blazor Components*.

Now, we can use our API to access the database in our Blazor project.

Summary

This chapter taught us how to create a simple JSON repository for our data. We also learned that other alternatives could be found in the GitHub repo if you want to look at other options.

We also created an interface to access the data, which we will use some more later in the book.

In the next chapter, we will learn about components, particularly the built-in components in Blazor templates. We will also create our first component using the API and repository we made in this chapter.

4

Understanding Basic Blazor Components

In this chapter, we will look at the components that come with the Blazor template and start to build our own components. Knowing the different techniques used for creating Blazor websites will help us when we start building our components.

Blazor uses components for most things, so we will use the knowledge from this chapter throughout the book.

We will start this chapter with theory and end by creating a component to show some blog posts using the API we created previously, in *Chapter 3*, *Managing State – Part 1*.

In this chapter, we will cover the following topics:

- Exploring components
- Learning Razor syntax
- Understanding dependency injection
- Changing the Render mode
- Figuring out where to put the code
- Lifecycle events
- Parameters
- Writing our first component

Technical requirements

Make sure you have followed the previous chapters or use the `Chapter03` folder as the starting point.

You can find the source code for this chapter's result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter04`.

Exploring components

In Blazor, a `component` is a `.razor` file containing a small, isolated functionality (code and markup), or it can be used as a page. A component can host other components as well. This chapter will show us how components work and how to use them.

There are three different ways we can create a component:

- Using Razor syntax, with the code and HTML sharing the same file
- Using a code-behind file together with a `.razor` file
- Using only a code-behind file

In this chapter, we will go through the different options. First, we'll go through the components in the template we used to create the project; these all use the first option, `.razor` files, where we have a mix of code and HTML in the same file.

The components in the template are as follows:

- **Counter**
- **Weather**

Counter

The `counter` page shows a button and a counter; if we click the button, the counter increases. We will now break the page apart, making it easier to understand. It is located in the `BlazorWebApp.Client` project, inside the `Pages` folder.

At the top of the page is the `@page` directive, which makes it possible to route to the component directly, as we can see in this code:

```
@page "/counter"
```

If we start the `BlazorWebApp` project and add `/counter` to the end of the URL, we see that we can directly access the component by using its route. We can also make the route take parameters, but we will return to that later.

Beneath that, we have the render mode:

```
@rendermode InteractiveAuto
```

This is the way we can set the render mode on a specific component. This means that when we use this component, it will first render the page using Blazor Server (with SignalR) and, in the background, download the WebAssembly version so that the next time we load the page, it will then run the WebAssembly version instead.

Next, let's explore the code. To add code to the page, we use the `@code` statement, and within that statement, we can add ordinary C# code, as shown:

```
@code {
    private int currentCount = 0;
    private void IncrementCount()
    {
        currentCount++;
    }
}
```

In the preceding code block, we have a private `currentCount` variable set to `0`. Then, we have a method called `IncrementCount()`, which increments the `currentCount` variable by `1`.

We show the current value by using the `@` sign. In Razor, the `@` sign indicates that it is time for some code:

```
<p role="status">Current count: @currentCount</p>
```

As we can see, Razor is very smart because it understands when the code stops and the markup continues, so there is no need to add something extra to transition from the code to the markup (more on that in the next section).

As we can see in the preceding example, we are mixing HTML tags with `@currentCount` and Razor understands the difference. Next, we have a button that is the trigger for changing the value:

```
<button class="btn btn-primary" @onclick="IncrementCount">Click me</
button>
```

This is an HTML button with a `Bootstrap` class (to make it look a bit nicer). `@onclick` binds the button's `onclick` event to the `IncrementCount()` method. If we were to use `onclick` without the `@`, it would refer to the JavaScript event and not work.

So, when we click the button, it will call the `IncrementCount()` method (depicted by 1 in *Figure 4.1*), the method increments the variable (depicted by 2), and due to changing the variable, the UI will automatically be updated (depicted by 3), as shown in *Figure 4.1*:

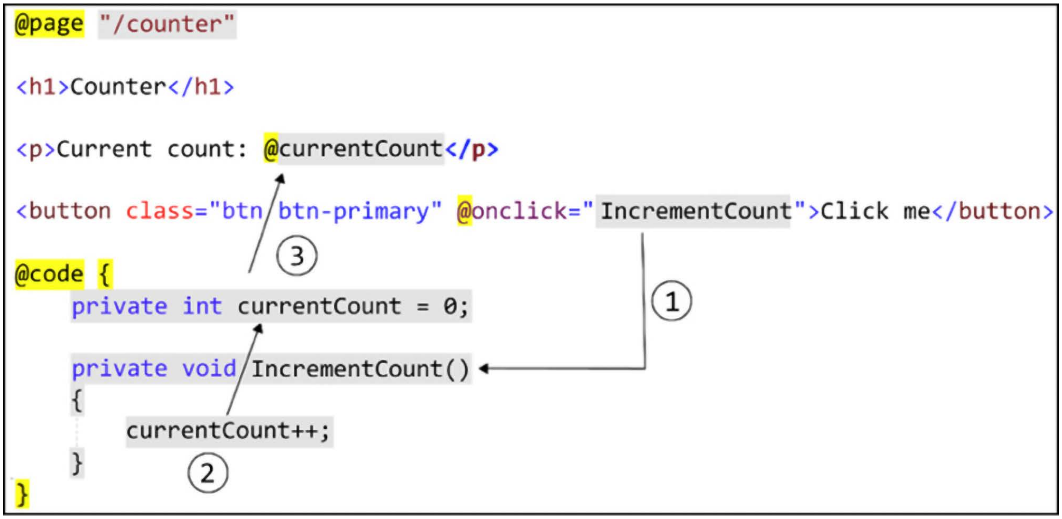


Figure 4.1: The flow of the counter component

The `counter` component is implemented inside the `BlazorWebApp.Client` project, which is the WebAssembly project. In that project, we should put all the components that we want to run as WebAssembly. The `BlazorWebApp` project is then referencing the `BlazorWebApp.Client` project, so that it finds all the components and can run them as Blazor Server components if we want to.

Weather

The next component we will take a look at is the `Weather` component. It's located in the `Components/Pages/Weather.razor` folder.

The `Weather` components introduces the new streaming rendering functionality. The file initially looks like this:

```
@page "/weather"
@attribute [StreamRendering(true)]
```

Just as with the `Counter` component, we first define a route. There is no render mode attribute on this page. The component will be rendered using **Server-Side Rendering** (**SSR**). This is the default behavior for all the components unless specified, like the Counter component.

When we started the project, we set **Interactivity location** to **Per Page/Component**. This means that when we want interactivity, we need to specify that. But with the `[StreamRendering(true)]` attribute, we will get a feeling of interactivity. The page will first load, showing loading text. Then, using the same request, we get the rest of the data, like a … well, stream. So, we will get fast loading without waiting for the data, with no need to add interactivity using WebAssembly or SignalR, but still get some loading progress happening. We will dive into this some more in a later section.

The HTML part of the `Weather` component looks like this:

```
<PageTitle>Weather</PageTitle>

<h1>Weather</h1>

<p>This component demonstrates showing data.</p>

@if (forecasts == null)
{
    <p><em>Loading...</em></p>
}
else
{
    <table class="table">
        <thead>
            <tr>
                <th>Date</th>
                <th>Temp. (C)</th>
                <th>Temp. (F)</th>
                <th>Summary</th>
            </tr>
        </thead>
        <tbody>
            @foreach (var forecast in forecasts)
            {
                <tr>
```

```
                    <td>@forecast.Date.ToShortDateString()</td>
                    <td>@forecast.TemperatureC</td>
                    <td>@forecast.TemperatureF</td>
                    <td>@forecast.Summary</td>
                </tr>
            }
        </tbody>
    </table>
}
```

If we don't have any forecasts, it will show "Loading..." and as soon as we have some data, it will render a table showing the data.

The code section that generates some mock data looks like this:

```
@code {
    private WeatherForecast[]? forecasts;

    protected override async Task OnInitializedAsync()
    {
        // Simulate asynchronous loading to demonstrate streaming
rendering
        await Task.Delay(500);

        var startDate = DateOnly.FromDateTime(DateTime.Now);
        var summaries = new[] { "Freezing", "Bracing", "Chilly", "Cool",
"Mild", "Warm", "Balmy", "Hot", "Sweltering", "Scorching" };
        forecasts = Enumerable.Range(1, 5).Select(index => new
WeatherForecast
        {
            Date = startDate.AddDays(index),
            TemperatureC = Random.Shared.Next(-20, 55),
            Summary = summaries[Random.Shared.Next(summaries.Length)]
        }).ToArray();
    }

    private class WeatherForecast
```

```
    {
        public DateOnly Date { get; set; }
        public int TemperatureC { get; set; }
        public string? Summary { get; set; }
        public int TemperatureF => 32 + (int)(TemperatureC / 0.5556);
    }
}
```

When the page is initialized, the `WeatherForecast` array is filled with random data.

This reminds me that someone (as a joke) added a bug report to one of Dan Roth's repos on GitHub, reporting "Weather forecast is unreliable."

The conversation continued, "The weather forecast feature was completely accurate during my trip to London but has proven to be misleading in California. Counter and overall purpleness are great." With Dan Roth replying: "Thanks for the feedback! I'll get in touch with the folks on the .NET core framework team to make sure that `System.Random` does a better job of taking California weather patterns into account."

This is one of many reasons why I love the .NET community.

As we can see, by using the Razor syntax, we are seamlessly mixing code with HTML. The code checks whether there is any data – if so, it will render the table; if not, it will show a loading message. The component will update automatically once we have data. We have full control over the HTML, and Blazor will not add anything to the generated HTML.

There are component libraries that can make this process a bit simpler, which we will look at in the next chapter, *Chapter 5*, *Creating Advanced Blazor Components*.

Now that we know how the sample template is implemented, it is time to dive deeper into the Razor syntax.

Learning Razor syntax

One of the things I like about the Razor syntax is that it is easy to mix code and HTML tags. By having the code close to the markup, it is, in my opinion, easier to follow and understand. The syntax is very fluid; the razor parser understands when the code stops and markup begins, which means we don't need to think about it that much. It is also not a new language; instead, we can leverage our existing C# and HTML knowledge to create our components. This section will contain a lot of theory to help us understand the Razor syntax.

To transition from HTML to code (C#), we use the @ symbol. There are a handful of ways we can add code to our file, which we'll explore in the following sections:

- Razor code blocks
- Implicit Razor expressions
- Explicit Razor expressions
- Expression encoding
- Directives

Razor code blocks

We have already seen some code blocks. A code block looks like this:

```
@code {
    //your code here
}
```

If we wish, we can skip the `code` keyword like so:

```
@{
    //your code here
}
```

Inside those curly braces, we can mix HTML and code like this:

```
@{
    void RenderName(string name)
    {
        <p>Name: <strong>@name</strong></p>
    }
    RenderName("Steve Sanderson");
    RenderName("Daniel Roth");
}
```

Notice how the `RenderName()` method transitions from code into the paragraph tags and back to code; this is an implicit transition.

If we want to output text without having an HTML tag, we can use the `text` tag instead of using the paragraph tags, as shown in the following example:

```
<text>Name: <strong>@name</strong></text>
```

This would render the same result as the previous code but without the paragraph tags, and the `text` tag wouldn't be rendered.

Implicit Razor expressions

Implicit Razor expressions are when we add code inside HTML tags.

We have already seen this in the `Weather` example:

```
<td>@forecast.Summary</td>
```

We start with a `<td>` tag, then use the `@` symbol to switch to C#, and switch back to HTML with the end tag. We can use the `await` keyword together with a method call, but other than that, implicit Razor expressions cannot contain any spaces.

We cannot call a generic method using implicit expressions since `<>` would be interpreted as HTML. Hence, to solve this issue, we can use explicit expressions.

Explicit Razor expressions

We can use explicit Razor expressions if we want to use spaces in the code. Write the code with the `@` symbol followed by parentheses `( )`. So, it would look like this: `@()`.

In this sample, we subtract `7` days from the current date:

```
<td>@(DateTime.Now - TimeSpan.FromDays(7))</td>
```

We can also use explicit Razor expressions to concatenate text; for example, we can concatenate text and code like this:

```
<td>Temp@(forecast.TemperatureC)</td>
```

The output would then be `<td>Temp42</td>`.

Using explicit expressions, we can easily call generic methods by using this syntax:

```
<td>@(MyGenericMethod<string>())</td>
```

The Razor engine knows whether we are using code or not. It also makes sure to encode strings to HTML when outputting it to the browser, called **expression encoding**.

Expression encoding

If we have HTML as a string, it will be escaped by default. Take this code, for example:

```
@("<span>Hello World</span>")
```

The rendered HTML would look like this:

```
&lt;span&gt;Hello World&lt;/span&gt;
```

To output the actual HTML from a string (something we will do later, in *Chapter 5*, *Creating Advanced Blazor Components*), you can use this syntax:

```
@((MarkupString)"<span>Hello World</span>")
```

Using `MarkupString`, the output will be HTML, showing the HTML tag span. In some cases, one line of code isn't enough; then, we can use code blocks.

Directives

There are a bunch of directives that change the way a component gets parsed or can enable functionality. These are reserved keywords that follow the `@` symbol. We will go through the most common and useful ones.

I find that it is pretty nice to have the layout and the code inside of the same `.razor` file.

Note that we can use code-behind to write our code to get a bit more separation between the code and layout. Later in this chapter, we will look at how to use code-behind instead of Razor syntax for everything. For now, the following examples will look at how we would do the same directives using both Razor syntax and code-behind.

Adding an attribute

To add an attribute to our page, we can use the `attribute` directive:

```
@attribute [Authorize]
```

If we were using a code-behind file, we would use the following syntax instead:

```
[Authorize] public partial class SomeClass {}
```

Adding an interface

To implement an interface (`IDisposable` in this case), we would use the following code:

```
@implements IDisposable
```

Then, we would implement the methods the interface needs in a `@code{}` section.

To do the same in a code-behind scenario, we would add the interface after the class name, as shown in the following example:

```
public partial class SomeClass : IDisposable {}
```

Inheriting

To inherit another class, we should use the following code:

```
@inherits TypeNameOfClassToInheritFrom
```

To do the same in a code-behind scenario, we would add the class we want to inherit from after the class name:

```
public class SomeClass : TypeNameOfClassToInheritFrom {}
```

Generics

We can define our component as a generic component.

Generics allow us to define the data type, so the component works with any data type.

To define a component as a generic component, we add the `@typeparam` directive; then, we can use the type in the code of the component like this:

```
@typeparam TItem
@code
{
      [Parameter]
      public List<TItem> Data { get; set; }
}
```

Generics are super-powerful when creating reusable components; this will make our components reusable for different data types. We will return to generics in *Chapter 6*, *Building Forms with Validation*.

Changing the layout

If we want to have a specific layout for a page (not the default one specified in the `Routes.razor` file), we can use the `@layout` directive:

```
@layout AnotherLayout
```

This way, our component will use the specified layout (this only works for components with the `@page` directive).

Setting a namespace

By default, the component's namespace will be the name of the default namespace of our project, plus the folder structure. If we want our component to be in a specific namespace, we can use the following:

```
@namespace Another.NameSpace
```

Setting a route

We have already touched on the `@page` directive. If we want our component to be directly accessed using a URL, we can use the `@page` directive:

```
@page "/theurl"
```

The URL can contain parameters, subfolders, and much more, which we will return to later in this chapter.

Adding a using statement

To add a namespace to our component, we can use the `@using` directive:

```
@using System.IO
```

If there are namespaces that we use in several of our components, then we can add them to the `_Imports.razor` file instead. This way, they will be available in all the components we create.

> If you want to dive further into directives, you can find more information here: `https://learn.microsoft.com/en-us/aspnet/core/mvc/views/razor?view=aspnetcore-8.0#directives`

Now we know more about how Razor syntax works. Don't worry; we will have plenty of time to practice it. There is one more directive that I haven't covered in this section, and that is `inject`. We first need to understand what **Dependency Injection** (**DI**) is and how it works, which we will see in the next section.

Understanding dependency injection

DI is a software pattern and a technique to implement **Inversion of Control** (**IoC**).

IoC is a generic term that means we can indicate that the class needs a class instance instead of letting our classes instantiate an object. We can say that our class wants either a specific class or a specific interface.

The creation of the class is somewhere else, and it is up to IoC what class it will create.

When it comes to DI, it is a form of IoC when an object (class instance) is passed through constructors, parameters, or service lookups.

Here is a great resource if you want to dive deeper into DI in .NET: `https://learn.microsoft.com/en-us/dotnet/core/extensions/dependency-injection`.

In Blazor, we can configure DI by providing a way to instantiate an object; this is a key architecture pattern that we should use. We have already seen a couple of references to it, for example, in `Program.cs`:

```
builder.Services.AddScoped<IBlogApi, BlogApiJsonDirectAccess>();
```

Here, we say that if any class wants `IBlogApi`, the application should instantiate an object of the `BlogApiJsonDirectAccess` type. In this case, we are using an interface; instead, we could just say:

```
builder.Services.AddScoped<BlogApiJsonDirectAccess>();
```

In this case, when we ask for a `BlogApiJsonDirectAccess` object, it will return an object of that type. If there only is one implementation of the thing we are building, there is no reason to create an interface for it. In the previous chapter, *Chapter 3*, *Managing State – Part 1*. We created an `IBlogApi` interface that returned an instance of `BlogApiJsonDirectAccess`. When we implement the WebAssembly version, DI will return another class instead.

There are many advantages to using DI. Our dependencies are loosely coupled, so we don't instantiate another class in our class. Instead, we ask for an instance, which makes it easier to write tests and change implementations depending on platforms.

Any external dependencies will be much more apparent since we must pass them into the class. We also can set the way we should instantiate the object in a central place. We configure the DI in `Program.cs`.

We can configure the creation of objects in different ways, such as the following:

- Singleton
- Scoped
- Transient

Singleton

When we use a singleton, the object will be the same for all site users. The object will only be created once.

To configure a singleton service, use the following:

```
services.AddSingleton<IWeatherForecastService, WeatherForecastService>();
```

We should use a singleton when we want to share our object with all the users of our site, but beware because since the state is shared, it can lead to issues if the object stores data specific to an individual user or a session because once this data is changed by one user, the change is reflected for all users who might be using the application simultaneously. It may also lead to data being shared unintentionally.

Scoped

When we use scoped, a new object will be created once for each connection, and since Blazor Server needs a connection to work, it will be the same object as long as the user has a connection. WebAssembly does not have the concept of scoped, since there is no connection, so all the code runs inside the user's web browser. If we use scoped, it will work the same way as a singleton for Blazor WebAssembly, since we only have one user and everything is running inside the browser. The recommendation is still to use scoped if the idea is to scope a service to the current user. This makes it easier to move code between Blazor Server and Blazor WebAssembly and gives a bit more context on how the service is supposed to be used.

To configure a scoped service, use the following:

```
services.AddScoped<IWeatherForecastService, WeatherForecastService>();
```

We should use scoped if we have data that belongs to the user. We can keep the user's state by using scoped objects. More on that in *Chapter 11*, *Managing State – Part 2*.

It's worth mentioning here that the new "per component" model will create a SignalR connection if there is any component currently running in InteractiveServer mode. If we navigate to a new page without any `InteractiveServer` components, the connection will eventually be disconnected. This means that the state will also be removed. So, when using the "per component" model, we need to make sure not to save any important information in a scoped variable unless we persist it in some other way as well.

Transient

When we use transient, a new object will be created every time we ask for it.

To configure a transient service, use the following:

```
services.AddTransient<IWeatherForecastService, WeatherForecastService>();
```

We can use transient if we don't need to keep any state, and we don't mind the object being created every time we ask for it.

Now that we know how to configure a service, we need to start using the service by injecting it.

Injecting the service

There are three ways to inject a service. We can use the `@inject` directive in the Razor file:

```
@inject WeatherForecastService ForecastService
```

This will make sure we have access to `WeatherForecastService` in our component.

The second way is to create a property by adding the `Inject` attribute if we are using code-behind:

```
[Inject]
public WeatherForecastService ForecastService { get; set; }
```

The third way is for when we want to inject a service into another service – then, we need to inject the services using the constructor:

```
public class MyService
{
    public MyService(WeatherForecastService
      weatherForecastService)
    {
    }
}
```

Now we know how DI works and why we should use it. In .NET 7, using a scoped service meant that the data was accessible as long as the connection (or circuit) was active. But with .NET 8, it changes just slightly depending on the render mode. Let's look at that next.

Changing the render mode

The biggest change when it comes to .NET 8 is the ability to change render mode in the same app. In .NET 7, we had to choose one or the other, but with .NET 8, we can change it as we see fit. Perhaps if a specific page is not interactive, we can use the new **Server-Side Rendering** (**SSR**). This is very similar to WebForms or MVC. The page gets rendered on the server. No additional interactivity will work. We can set the render mode on each component, or we can do it when we use the component. When we create the project, we select what interactive render mode we want.

Let's take a look at the different options:

- **None** – No interactivity, only static rendered files, no SignalR, and no WebAssembly. Using this option, we can use both static SSR and streaming server-side rendering.
- **Server** – This will give us access to interactivity using Blazor Server, not WebAssembly.
- **WebAssembly** – This will give us access to interactivity using Blazor WebAssembly, not Blazor Server.
- **Auto** (Server and WebAssembly) – Gives us the ability to use both Server and WebAssembly.

We also set **Interactivity location** to **Per page/component**, which means that the default behavior of the site is static, and we need to specify on each component if we want to use interactivity. We can also set it to **Global**, which will set the interactivity on the `Routes` component like this:

```
<Routes @rendermode="@InteractiveAuto" />
```

To change the render mode per component, we can use the syntax above or use the attribute we saw in the Counter component:

```
@rendermode InteractiveAuto
```

By default, all components are rendered using server pre-rendering. This means that the component is first rendered on the server and then pushed to the web browser. SignalR or WebAssembly starts up, and the component is rendered again, making additional calls to the database, for example. I personally rarely use server pre-rendering. I like that the pages load by first sending what the server has ready and then, when database calls are done, sends the rest. We can also disable pre-rendering by doing it like this:

```
<Routes @rendermode="new InteractiveServerRenderMode(prerender: false)" />
```

We will have plenty of time to learn more about render modes during the course of the book. In .NET 7, we had more templates, but by using combinations of these settings, we can create the same scenarios.

.NET 7 Template	.NET 8 Template	Interactive render mode	Interactivity location
Blazor Server App	Blazor Web App	Server	Global
Blazor WebAssembly App	Blazor WebAssembly Standalone App		
Blazor WebAssembly (ASP.NET Core Hosted)	Blazor Web App	WebAssembly	Global

If you are new to Blazor, this table has no significance, but if you have worked with Blazor in .NET 7 and want to use a project template that you have used in .NET 7, this is how to do it. In this chapter, we have mentioned code-behind a couple of times. In the next section, we will look at how we can use code-behind with Razor files and skip the Razor files altogether.

Figuring out where to put the code

We have seen examples of writing code directly in the Razor file. I prefer doing that unless the code gets too long or too complicated. I always lean in favor of readability.

There are four ways we can write our components:

- In the Razor file
- In a partial class
- Inheriting a class
- Only code

Let's go through each item on this list in more detail.

In the Razor file

If we are writing a file that is not that complex, it would be nice not to switch files when writing components. As we already covered in this chapter, we can use the `@code` directive to add code directly to our Razor file.

If we want to move the code to a code-behind file, then it is only the directives that we need to change. For the rest of the code, we can just move to the code-behind class. When I started with Blazor, writing code and markup in the same file felt strange, coming from an MVC world where the separation between code and markup is a big part of the way to use MVC. But I suggest you try it out when developing your web apps.

At work, we started using code-behind but switched to writing code in the `.razor` file instead, and we haven't looked back since.

However, many developers prefer code-behind, separating code from the layout. For that, we can use a partial class.

In a partial class

We can create a partial class with the same filename as the Razor file and add `.cs`.

If you have downloaded the source code (or you can check the code on GitHub), you can look at `WeatherCodeBehind.razor.cs` in the `Examples` folder. I have moved all the code to the code-behind file; the result when compiling this will be the same as if we kept the code in the Razor file. It is just a matter of preference.

The code-behind looks like this:

```
namespace BlazorWebApp.Components.Pages;
[StreamRendering(true)]
public partial class WeatherWithCodeBehind
{
    private WeatherForecast[]? forecasts;

    protected override async Task OnInitializedAsync()
    {
        // Simulate asynchronous loading to demonstrate streaming
rendering
        await Task.Delay(500);

        var startDate = DateOnly.FromDateTime(DateTime.Now);
        var summaries = new[] { "Freezing", "Bracing", "Chilly", "Cool",
"Mild", "Warm", "Balmy", "Hot", "Sweltering", "Scorching" };
        forecasts = Enumerable.Range(1, 5).Select(index => new
WeatherForecast
```

```
        {
            Date = startDate.AddDays(index),
            TemperatureC = Random.Shared.Next(-20, 55),
            Summary = summaries[Random.Shared.Next(summaries.Length)]
        }).ToArray();
    }

    private class WeatherForecast
    {
        public DateOnly Date { get; set; }
        public int TemperatureC { get; set; }
        public string? Summary { get; set; }
        public int TemperatureF => 32 + (int)(TemperatureC / 0.5556);
    }
}
```

Since we are using a partial class, there is no need to connect the razor with the code-behind. If it has the same name, it will just work. We can mix where we put the code; in this case, we have the `StreamingRendering` attribute in the code-behind, and we can keep it in the `.razor` file if we want to. If you prefer using code-behind, this is the way you want to do it.

This is not the only way to use a code-behind file; we can also inherit from a code-behind file.

Inheriting a class

We can also create a completely different class (the common pattern is to call it the same thing as the Razor file and add `Model` at the end) and inherit it in our Razor file. For that to work, we need to inherit from `ComponentBase`. In the case of a partial class, the class already inherits from `ComponentBase`, since the Razor file does that.

Fields must be protected or public (not private) for the page to access the fields. I recommend using the partial class if we don't need to inherit from our base class.

This is a snippet of the code-behind class declaration:

```
public class WeatherWithInheritsModel:ComponentBase
```

We'll need to inherit from `ComponentBase` or from a class that inherits from `ComponentBase`.

In the Razor file, we will use the `@inherits` directive:

```
@inherits WeatherWithInheritsModel
```

The Razor file will now inherit from our code-behind class (this was the first way available to create code-behind classes).

Both the partial and inherit options are simple ways of moving the code to a code-behind file. Inheriting a model was the first available way, but as I mentioned, use partial classes instead if you prefer code-behind. But another option is to skip the Razor file and use only code entirely.

Only code

Visual Studio will use source generators to convert the Razor code into C#. We will dig deeper into source generators in *Chapter 17, Examining Source Generators*. The Razor file will generate code at compile time. We can skip the Razor step if we want to and write our layout completely in code.

This file (`CounterWithoutRazor.cs`) is available on GitHub.

The counter example would look like this:

```
using Microsoft.AspNetCore.Components;
using Microsoft.AspNetCore.Components.Rendering;
using Microsoft.AspNetCore.Components.Web;
namespace BlazorWebApp.Component.Pages;

[Route("/CounterWithoutRazor")]
public class CounterWithoutRazor : ComponentBase
{
    protected override void BuildRenderTree
      (RenderTreeBuilder builder)
    {
        builder.AddMarkupContent(0, "<h1>Counter</h1>\r\n\r\n");
        builder.OpenElement(1, "p");
        builder.AddContent(2, "Current count: ");
        builder.AddContent(3, currentCount);
        builder.CloseElement();
        builder.AddMarkupContent(4, "\r\n\r\n");
        builder.OpenElement(5, "button");
        builder.AddAttribute(6, "class", "btn btn-primary");
        builder.AddAttribute(7, "onclick", EventCallback.Factory.
Create<MouseEventArgs>(this, IncrementCount));
```

```
            builder.AddContent(8, "Click me");
            builder.CloseElement();
        }
        private int currentCount = 0;
        private void IncrementCount()
        {
            currentCount++;
        }
    }
```

The Razor file will first be converted into something roughly the same as the previous code, and then the code is compiled. It adds the elements one by one, which, in the end, will render the HTML.

The numbers in the code are how Blazor keeps track of each element in the render tree. Some prefer to write the code as in the previous code block rather than using the Razor syntax; there are even efforts in the community to simplify the process of manually writing the `BuildRenderTree()` function.

Some of Microsoft's built-in components are built in this way.

I recommend never writing this manually, but I've kept it in the book because it shows how Razor files get compiled. Now that we know how to use code-behind, let's look at the lifecycle events of Blazor and when they get executed.

Lifecycle events

We can use a couple of lifecycle events to run our code. In this section, we will go through them and see when we should use them. Most lifecycle events have two versions – synchronous and asynchronous.

OnInitialized and OnInitializedAsync

The first time the component is loaded, `OnInitialized()` is called, then `OnInitializedAsync()`. This is a great method to load any data, as the UI has not yet been rendered. If we are doing long-running tasks (such as getting data from a database), we should put that code in the `OnInitializedAsync()` method.

These methods will only run once. If you want to update the UI when a parameter changes, see `OnParametersSet()` and `OnParametersSetAsync()`.

OnParametersSet and OnParametersSetAsync

`OnParametersSet()` and `OnParametersSetAsync()` are called when the component is initialized (after `OnInitialized()` and `OnInitializedAsync()`) and whenever we change the value of a parameter.

If we, for example, load data in the `OnInitialized()` method but it uses a parameter, the data won't be reloaded if the parameter is changed since `OnInitialized()` will only run once. We need to trigger a reload of the data in `OnParametersSet()` or `OnParametersSetAsync()` or move the loading to that method.

OnAfterRender and OnAfterRenderAsync

After the component renders, the `OnAfterRender()` and `OnAfterRenderAsync()` methods are called. When the methods are called, all the elements are rendered, so if we want/need to call any JavaScript code, we have to do that from these methods (we will get an error if we try to make a JavaScript interop from any of the other lifecycle event methods). This is a limitation of the prerendering. When the component prerenders, there is nothing connected to the web browser, and we will not be able to run any JavaScript. However, if we disable the prerendering, we can run JavaScript in the other lifecycle methods as well. We also have access to a `firstRender` parameter, so we can only run our code on the first render.

ShouldRender

`ShouldRender()` is called when our component is re-rendered; if it returns `false`, the component will not be rendered again. The component will always render once, even if this method returns `false`.

`ShouldRender()` does not have an asynchronous option.

Now we know when the different lifecycle events happen and in what order. A component can also have parameters, and that way, we can reuse them but with different data.

Parameters

A parameter makes it possible to send a value to a component. To add a parameter to a component, we use the `[Parameter]` attribute on the `public` property:

```
@code {
    [Parameter]
    public int MyParameter { get; set; }
}
```

The syntax for this is the same if we use a code-behind file. We can add a parameter to the route using the `@page` directive by specifying it in the route:

```
@page "/parameterdemo/{MyParameter}"
```

In this case, we have to have a parameter specified with the same name as the name inside the curly braces. To set the parameter in the `@page` directive, we go to `/parameterdemo/THEVALUE`.

There are cases where we want to specify another type instead of a string (string is the default). We can add the data type after the parameter name like this:

```
@page "/parameterdemo/{MyParameter:int}"
```

This will match the route only if the data type is an integer. We can also pass parameters using cascading parameters. We can also have more than one page directive per component if we want to handle more than one route.

Cascading parameters

If we want to pass a value to multiple components, we can use a cascading parameter.

Instead of using `[Parameter]`, we can use `[CascadingParameter]` like this:

```
[CascadingParameter]
public int MyParameter { get; set; }
```

To pass a value to the component, we surround it with a `CascadingValue` component like this:

```
<CascadingValue Value="MyProperty">
    <ComponentWithCascadingParameter/>
</CascadingValue>
@code {
    public string MyProperty { get; set; } = "Test Value";
}
```

`CascadingValue` is the value we pass to the component, and `CascadingParameter` is the property that receives the value.

As we can see, we don't pass any parameter values to the `ComponentWithCascadingParameter` component; the cascading value will match the parameter with the same data type. If we have multiple parameters of the same type, we can specify the name of the parameter in the component with the cascading parameter like this:

```
[CascadingParameter(Name = "MyCascadingParameter")]
```

We can also do so for the component that passes `CascadingValue`, like this:

```
<CascadingValue Value="MyProperty" Name="MyCascadingParameter">
    <ComponentWithCascadingParameter/>
</CascadingValue>
```

If we know that the value won't change, we can specify that by using the `IsFixed` property:

```
<CascadingValue Value="MyProperty" Name="MyCascadingParameter"
IsFixed="True">
    <ComponentWithCascadingParameter/>
</CascadingValue>
```

This way, Blazor won't look for changes, which is more efficient if we know the values won't change. The cascading values/parameters cannot be updated upward but are updated only downward. This means that to update a cascading value, we need to implement it in another way; updating it from inside the component won't change any components that are higher in the hierarchy.

In *Chapter 5*, *Creating Advanced Blazor Components*, we will look at events, which are one way to solve the problem of updating a cascading value.

Phew! This has been an information-heavy chapter, but now we know the basics of Blazor components. Now, it is time to build one!

Writing our first component

The first component we will build shows all the blog posts on a site. To be fair, we haven't written any blog posts yet, but we will temporarily solve that so we can start doing something fun.

In *Chapter 3*, *Managing State – Part 1*, we created a JSON repository and an API (or interface); now, it is time to use them.

We will share the code between the `BlazorWebApp` project and the `BlazorWebApp.Client` project. We will even change the implementation of how they run depending on whether they run as WebAssembly or not.

There is a whole chapter on sharing (*Chapter 9*, *Sharing Code and Resources*), but let's start now.

Creating a components library

The first thing we need to do is to create a new project and then add our components to that project. We could have added the components to the `BlazorWebApp` or the `BlazorWebApp.Client` project directly, but this demonstrates how we can build reusable components and distribute them as packages later on.

To create our first component, follow these instructions:

1. Right-click on the **MyBlog** solution and select **Add | New Project**.
2. Find the template **Razor Class Library** and click **Next**.
3. Name the project `SharedComponents` and click **Next**.
4. Select **.NET 8.0** and click **Create**.
5. We now have a project called `SharedComponents`, where we can add all the components we want to share. Remove `Component1.razor` and `ExampleJsInterop.cs` that are created by default.
6. In the `SharedComponents` project, add a project reference to `Data.Models` and add the `Nuget` package reference to `Microsoft.AspNetCore.Components.Web`.

We have a new project. This is where we can share components. Right now, we don't have any components to share, but that is what we will do next.

Using our components library

We have a nice library, but for our project to trigger when we navigate to a route, we need to add additional assemblies to the router.

To do that, we need to follow a couple of steps:

1. We already have a Home component in the `BlazorWebApp` project so let's delete that one. In the `Components/Pages` folder, delete the `Home.razor` file.
2. We need a component to navigate to. In the `SharedComponents` project, in the Pages folder, we need to create a new component. You can select the folder or project node in the solution explorer and press *Shift* + *F2*, type `Home.razor`, and press *Enter*. This is the fastest way to create new components.
3. In the `BlazorWebApp` project, add a project reference to the `SharedComponents` project.
4. Also in the `BlazorWebApp.Client` project, add a project reference to the `SharedComponents` project.
5. Now, we have access to the shared components in both the WebAssembly project (`BlazorWebApp.Client`) and the `BlazorWebProject`. This means that we can run any component we put into the shared project (`SharedComponents`) as `InteractiveWebAssembly` or `InteractiveServer`.
6. Open `Router.razor`. It looks like this:

```
<Router AppAssembly="@typeof(Program).Assembly"
AdditionalAssemblies="new[] { typeof(Client._Imports).Assembly }">
```

The router defines where to look for components. `AppAssembly` is where it will look first. We can also add additional assemblies, and as we can see, we already have an additional assembly. We are referencing the `BlazorWebbApp.Client` project so that we can pre - render and server render (SignalR) the Counter component. But now we want to add an additional assembly. Change the router to this:

```
<Router AppAssembly="@typeof(Program).Assembly"
AdditionalAssemblies="new[] { typeof(Client._Imports).
Assembly,typeof(SharedComponents.Pages.Home).Assembly }">
```

We add the new assembly to additional assemblies. The router will now look for components in the `SharedComponents` assembly as well.

7. We also have to add a row in `Program.cs`. In the `BlazorWebApp` project, open `Program.cs`. There, you will find these lines:

```
 app.MapRazorComponents<App>()
    .AddInteractiveServerRenderMode()
    .AddInteractiveWebAssemblyRenderMode()
    .AddAdditionalAssemblies(typeof(Counter).Assembly);
```

We need to add the new assembly there as well, like this:

```
app.MapRazorComponents<App>()
    .AddInteractiveServerRenderMode()
    .AddInteractiveWebAssemblyRenderMode()
    .AddAdditionalAssemblies(typeof(Counter).Assembly)
.AddAdditionalAssemblies(typeof(SharedComponents.Pages.Home).
Assembly);
```

We need to add additional assemblies in the `Program.cs` as well to get server-side rendering to work. Great! We have all components in a separate library and are sharing the components between the `BlazorWebApp` and the `BlazorWebApp.Client` projects.

Creating our own component

Now it's time to start adding our own component!

OK, this is not completely true because we will continue working on `Home.razor`. Let's start by creating a component that lists our blog posts:

1. In the `SharedComponents` project, open `Home.razor`.

2. Replace the contents of that file with the following code:

   ```
   @page "/"
   @using Data.Models.Interfaces
   @using Data.Models
   @inject IBlogApi _api
   @code{
   }
   ```

   If we start from the top, we can see a page directive. It will ensure that the component is shown when the route is “/". Then, we have three `@using` directives, bringing in the namespaces so we can use them in the Razor file.

   Then we inject our API (using DI) and name the instance `_api`.

3. Add a variable that holds all our posts. In the `code` section, add the following:

   ```
   protected List<BlogPost> posts = new();
   ```

4. Now, we need to load the data.

   To load posts, add the following in the `code` section:

   ```
   protected override async Task OnInitializedAsync()
   {
       posts = await _api.GetBlogPostsAsync(10, 0);
       await base.OnInitializedAsync();
   }
   ```

   Now, when the page loads, the posts will be loaded as well: `10` posts and page `0` (the first page).

5. Under the `@inject` row, add the following code:

   ```
   <ul>
       @foreach (var p in posts)
       {
           <li>@p.Title</li>
       }
   </ul>
   ```

We add an **Unordered List (UL)**; inside that, we loop over blog posts and show the title.

Now, we can run the application by pressing *Ctrl + F5* (**Debug | Start Without Debugging**). Make sure you have the `BlazorWebApp` selected as the startup project.

Since we don't have any blog posts, this would take us to an empty page. Luckily, there is a folder in the repo called `ExampleData`. If you download that, put those files in the `Data` folder that we created in *Chapter 3*, *Managing State – Part 1*, and reload the web, you should see a couple of posts.

Great job, we have created our first component!

There are a few noteworthy things. The `SharedComponents` project knows nothing about the JSON repository implementation and only knows about the `IBlogApi` interface.

The `Home` component asks for an instance of `IBlogApi`, and the `BlazorWebApp` project knows it should return an instance of `BlogApiJsonDirectAccess`. This is one of the things I love about Blazor; we can create components that only consume an interface and know nothing about the implementation.

We will return to this when we implement a web API for WebAssembly in *Chapter 7*, *Creating an API*.

Summary

In this chapter, we learned a lot about Razor syntax – something we will use throughout the book. We learned about DI, directives, and parameters and, of course, created our first component. This knowledge will help us understand how to create and reuse components.

In the next chapter, we will look at more advanced component scenarios.

5

Creating Advanced Blazor Components

In the last chapter, we learned all the basics of creating a component. This chapter will teach us how to take our components to the next level.

This chapter will focus on some of the features that will make our components reusable, which will enable us to save time and also give us an understanding of how to use reusable components made by others.

We will also look at some built-in components that will help you by adding additional functionality (compared to using HTML tags) when you build your Blazor app.

In this chapter, we will cover the following topics:

- Exploring binding
- Actions and EventCallback
- Using RenderFragment
- Exploring the new built-in components

Technical requirements

In this chapter, we will start building our components. For this, you'll need the code we developed in *Chapter 4*, *Understanding Basic Blazor Components*. You are good to go if you have followed the instructions in the previous chapters. If not, then make sure you clone/download the repository. The starting point for this chapter can be found in the `chapter04` folder, and the finished `chapter` is in `chapter05`.

You can find the source code for this chapter's result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter05`.

Exploring binding

When building applications, data is important, and we can use binding to show or change data. By using binding, you can connect variables within a component (so that it updates automatically) or by setting a component attribute. Perhaps the most fantastic thing is that by using binding, Blazor understands when it should update the UI and the variable (if the data changes in the UI).

In Blazor, there are two different ways that we can bind values to components, as follows:

- One-way binding
- Two-way binding

By using binding, we can send information between components and make sure we can update a value when we want to.

One-way binding

We have already discussed one-way binding in *Chapter 4*, *Creating Basic Blazor Components*. Let's look at the component again and continue building on it in this section.

In this section, we will combine parameters and binding.

The `Counter.razor` example looks like this:

```
@page "/counter" @rendermode InteractiveAuto

<PageTitle>Counter</PageTitle>
<h1>Counter</h1>
<p role="status">Current count: @currentCount</p>
<button class="btn btn-primary" @onclick="IncrementCount">Click me</
button>
@code {
    private int currentCount = 0;
    private void IncrementCount()
    {
        currentCount++;
    }
}
```

The component will show the current count and a button that will increment the current count. This is one-way binding. Even though the button can change the value of `currentCount`, it only flows in one direction to the screen.

Since this part is designed to demonstrate the functionality and theory and is not part of the finished project we are building, you don't have to write or run this code. The source code for these components is available on GitHub.

We can add a parameter to the `Counter` component. The code will then look like this:

```
@page "/counterwithparameter"
@rendermode InteractiveAuto

<h1>Counter</h1>
<p>Current count: @CurrentCount</p>
<button class="btn btn-primary" @onclick="IncrementCount">Click me</
button>
@code {
    [Parameter]
    public int IncrementAmount { get; set; } = 1;
    [Parameter]
    public int CurrentCount { get; set; } = 0;
    private void IncrementCount()
    {
        CurrentCount+=IncrementAmount;
    }
}
```

The code sample has two parameters, one for `CurrentCount` and one for `IncrementAmount`. By adding parameters to the components, we can change their behavior. This sample is, of course, a bit silly. The chances are that you won't have any use for a component like this that just counts up when pressing a button. But it illustrates the idea very well.

We can now take the component and add it to another component. This is how we can create a reusable component and change its behavior by changing the value of the parameters.

We change its behavior like this:

```
@page "/parentcounter"
@rendermode InteractiveAuto
<CounterWithParameter IncrementAmount="@incrementamount" CurrentCount="@
```

```
currentcount"/>
The current count is: @currentcount
@code {
    int incrementamount = 10;
    int currentcount = 0;
}
```

In this sample, we have two variables, `incrementamount` and `currentcount`, that we pass into our `CounterWithParameter` component.

If we were to run this, we would see a `Counter` component that counts in increments of `10`. However, the `currentcount` variable will not be updated since it is only a one-way binding (one direction).

To help us with that, we can implement two-way binding so that our parent component will be notified of any changes.

Two-way binding

Two-way binding binds values in both directions, and our `Counter` component will be able to notify our parent component of any changes. In the next chapter, *Chapter 6*, *Building Forms with Validation*, we will talk even more about two-way binding.

To make our `CounterWithParameter` component bind in two directions, we need to add an `EventCallback`. The name must consist of the parameter's name followed by `Changed`. This way, Blazor will update the value if it changes. In our case, we would need to name it `CurrentCountChanged`. The code would then look like this:

```
[Parameter]
public EventCallback<int> CurrentCountChanged { get; set; }
private async Task IncrementCount()
{
    CurrentCount += IncrementAmount;
    await CurrentCountChanged.InvokeAsync(CurrentCount);
}
```

By merely using that naming convention, Blazor knows that `CurrentCountChanged` is the event that will get triggered when a change to `CurrentCount` occurs.

`EventCallback` cannot be `null`, so there is no reason to do a null check (more on that in the next section).

We also need to change how we listen for changes:

```
<CounterWithParameterAndEvent IncrementAmount="@incrementamount" @bind-
CurrentCount="currentcount"/>
```

We need to add `@bind-` before the `CurrentCount` binding. You can also use the following syntax to set the name of the event:

```
<CounterWithParameterAndEvent IncrementAmount="@incrementamount" @bind-
CurrentCount="currentcount" @bind-CurrentCount:event="CurrentCountChang
ed"/>
```

By using `:event`, we can tell Blazor exactly what event we want to use; in this case, the `CurrentCountChanged` event.

In the next chapter, *Chapter 6*, *Building Forms with Validation*, we will continue to look at binding with input/form components.

We can, of course, also create events using **EventCallback**.

Actions and EventCallback

To communicate changes, we can use **EventCallback**, as shown in the *Two-way binding* section. `EventCallback<T>` differs a bit from what we might be used to in .NET. `EventCallback<T>` is a class that is specially made for Blazor to be able to have the event callback exposed as a parameter for the component.

In .NET, in general, you can add multiple listeners to an event (multi-cast), but with `EventCallback<T>`, you will only be able to add one listener (single-cast).

It is worth mentioning that you can use events the way you are used to from .NET in Blazor. However, you probably want to use `EventCallback<T>` because there are many upsides to using `EventCallback` over traditional .NET events, as follows:

- .NET events use classes, and `EventCallback` uses structs. This means that in Blazor, we don't have to perform a null check before calling `EventCallback` because a struct cannot be null.
- `EventCallback` is asynchronous and can be awaited. When `EventCallback` has been called, Blazor will automatically execute `StateHasChanged` on the consuming component to ensure the component updates (if it needs to be updated).

So, if you require multiple listeners, you can use `Action<T>`. Otherwise, it would be best if you used `EventCallback<T>`.

Some event types have event arguments that we can access. They are optional, so you don't need to add them in most cases.

You can add them by specifying them in a method, or you can use a lambda expression like this:

```
<button @onclick="@((e)=>message=$"x:{e.ClientX} y:{e.ClientY}")">Click
me</button>
```

When the `button` is clicked, it will set a variable called `message` to a string containing the mouse coordinates. The lambda has one parameter, `e`, of the `MouseArgs` type. However, you don't have to specify the type, and the compiler understands what type the parameter is.

Now that we have added actions and used **EventCallback** to communicate changes, we will see how we can execute **RenderFragment** in the next section.

Using RenderFragment

To make our components even more reusable, we can supply them with a piece of Razor syntax. In Blazor, you can specify **RenderFragment**, which is a fragment of Razor syntax that you can execute and show.

There are two types of render elements, `RenderFragment` and `RenderFragment<T>`. `RenderFragment` is simply a Razor fragment without any input parameters, and `RenderFragment<T>` has an input parameter that you can use inside the Razor fragment code by using the `context` keyword. We won't go into depth about how to use this now, but later in this chapter, we will talk about a component (**Virtualize**) that uses `RenderFragment<T>`, and in the next chapter, *Chapter 6*, *Building Forms with Validation*, we will implement a component using `RenderFragment<T>`.

We can make `RenderFragment` the default content inside of the component tags as well as giving it a default value. We will explore this next and build a component using these features.

When using components in a list, it can add some overhead. It needs to execute the whole lifetime cycle for each component. Here is where render fragments come to the rescue. We can create a method that returns a render fragment without the overhead of a component. Take this example:

```
@page "/RenderFragmentTest"

@for (int i = 0; i < 10; i++)
```

```
{
    @Render(i)
}

@code
{
    private RenderFragment Render(int number)
    {
        return @<p>This is a render fragment @number</p>;
    }
}
```

We have a component with a method that returns a render fragment.

The method could be static if we needed to use it in other components as well. When doing a loop like this, it will boost performance and will have a lower impact on memory consumption compared to having a component reference.

GRID COMPONENT

If you want to dig deeper into render fragments, please check out **Blazm.Components**, which have a grid component that heavily uses `RenderFragment<T>`.

You can find it on GitHub here: `https://github.com/EngstromJimmy/Blazm.Components`.

ChildContent

By naming the render fragment `ChildContent`, Blazor will automatically use whatever is between the component tags as content. This only works, however, if you are using a single render fragment; if you are using more than one, you will have to specify the `ChildComponent` tag as well. We will build a component using a `childcontent` render fragment in the next section.

Default value

We can supply `RenderFragment` with a default value or set it in code by using an `@` symbol:

```
@<b>This is a default value</b>;
```

Building an alert component

To better understand how to use render fragments, let's build an alert component that will use render fragments. The built-in templates use Bootstrap, so we will do the same for this component. Bootstrap has many components that are easy to import to Blazor. When working on big projects with multiple developers, building components is an easy way to ensure that everyone in a team is writing code the same way.

Let's build a simple alert component based on Bootstrap:

1. Create a folder by right-clicking on `SharedComponents project` | **Add** | **New folder** and name the folder `ReusableComponents`.
2. Create a new Razor component and name it `Alert.razor`.
3. Replace the content with the following code in the `Alert.razor` file:

```
<div class="alert alert-primary" role="alert">
    A simple primary alert—check it out!
</div>
```

   The code is taken from Bootstrap's web page, `http://getbootstrap.com`, and it shows an alert that looks like this:

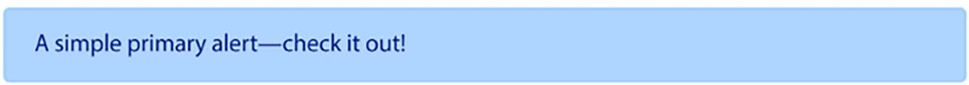


Figure 5.1: The default look of a Bootstrap alert component

   There are two ways in which we could customize this `alert` component. We could add a `string` parameter for the message.

   However, since this is a section on render fragments, we will explore the second option – yes, you guessed it, *render fragments*.

4. Add a code section with a `RenderFragment` property called `ChildContent` and replace the alert text with the new property:

```
<div class="alert alert-primary" role="alert">
    @ChildContent
</div>
@code{
    [Parameter]
```

```
    public RenderFragment ChildContent { get; set; } =@<b>This is a
default value</b>;
}
```

Now we have a `RenderFragment` and set a default value, displaying the fragment between the `div` tags. We also want to add an `enum` for the different ways you can style the alert box.

5. In the code section, add an `enum` containing the different styles available:

```
public enum AlertStyle
{
    Primary,
    Secondary,
    Success,
    Danger,
    Warning,
    Info,
    Light,
    Dark
}
```

6. Add a parameter/property for the `enum` style:

```
[Parameter]
public AlertStyle Style { get; set; }
```

7. The final step is to update the `class` attribute for `div`. Change the `class` attribute to look like this:

```
<div class="@($"alert alert-{Style.ToString().ToLower()}")"
role="alert">
```

8. In the `SharedComponents` project, in the `Pages` folder, create a new razor component and name it `AlertTest.razor`.

   Replace the code with the following snippet:

```
@page "/alerttest"
@using SharedComponents.ReusableComponents
<Alert Style="Alert.AlertStyle.Danger">
    This is a test
</Alert>
```

```
<Alert Style="Alert.AlertStyle.Success">
    <ChildContent>
        This is another test
    </ChildContent>
</Alert>
<Alert Style="Alert.AlertStyle.Success"/>
```

The page shows three alert components:

The first one has the `Danger` style, and we are not specifying what property to set for the `This is a test` text, but by convention, it will use the property called `ChildContent`.

In the second one, we have specified the `ChildContent` property. If you use more render fragments in your component, you must set them like this, with full names.

In the last one, we didn't specify anything that will give the property the default render fragment we specified in the component.

9. Run the `BlazorServer` project and navigate to `/AlertTest` to see the test page:

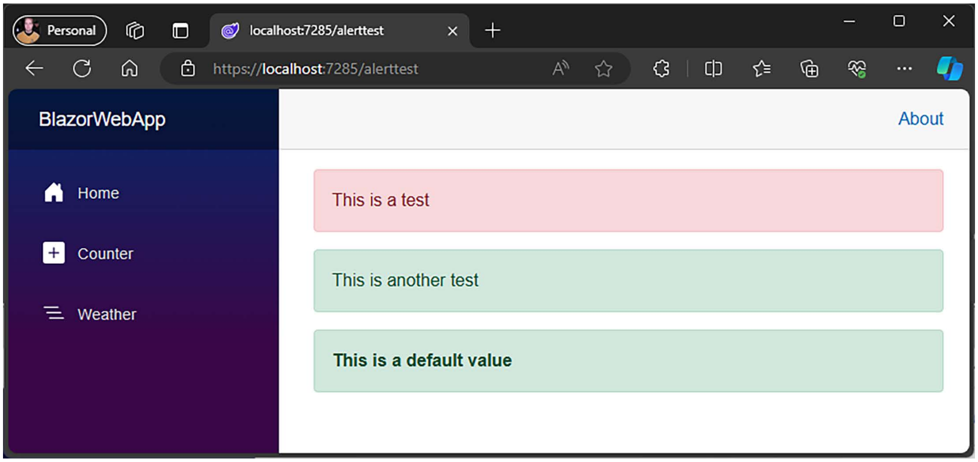


Figure 5.2: Screenshot of the test page

We have finished our first reusable component!

Creating reusable components is how I prefer to make my Blazor sites because I don't have to write the same code twice. This becomes even more apparent if you are working in a larger team. It makes it easier for all developers to produce the same code and end result, and with that, they can get a higher code quality and require fewer tests.

When we upgraded to the latest Bootstrap version, a few CSS classes were deprecated and replaced by others. Thankfully, we followed this approach by making reusable components, so we only had to change a handful of places. There were a couple of places where we still had some old code base (not using components), and it became very apparent that creating components was worth the effort.

Blazor has a bunch of built-in components. In the next section, we will dig deeper into what they are and how to use them.

When it comes to reusable components, we really invest some time in that. If you find yourself writing the same code twice, you might want to add that into a component. At my old job, we started using `Radzen`, an open-source component library (among other things). At my current job, we use `MudBlazor`. We use `Progress Telerik` on our stream. Using third-party components can speed up the development, but often, these components are built for many different users. They can do a lot of things. This means that every single developer on our team now has access to all that power. With great power comes great responsibility.

In one of my presentations, I had that quote with a picture of Batman and text saying "Superman." I didn't get a single reaction. I have never failed with a joke like that. But joking aside, this means that all developers need to keep in mind how to use the components. Otherwise, the UI might look different depending on which developer uses the components. I put a lot of time into designing reusable components that help the team to be productive. Hiding the parameters we don't use, giving the components reasonable default values. So, even if you use third-party components, try to figure out what you are using and perhaps create an abstraction on top of the third-party components. If you don't know, the quote is from Spiderman, or Uncle Ben, to be precise. But it did remind me of one of my favorite puns. Do you know why Spiderman always has such witty comebacks? Because with great power comes great response-ability. I will show myself out.

Exploring the new built-in components

When Blazor first came out, there were a couple of things that were hard to do, and, in some cases, we needed to involve JavaScript to solve the challenge. In this section, we will look at some of the new components we got in .NET 5, all the way to .NET 8.

We will take a look at the following new components or functions:

- Setting the focus of the UI
- Influencing the HTML head
- Component virtualization

- Error boundaries
- Sections

Setting the focus of the UI

One of my first Blazor blog posts was about how to set the focus on a UI element, but now this is built into the framework. The previous solution involved JavaScript calls to change the focus on a UI element.

By using `ElementReference`, you can now set the focus on the element.

Let's build a component to test the behavior of this new feature:

1. In the `SharedComponents` project, in the `Pages` folder, add a new Razor component, and name it `SetFocus.razor`.
2. Open `SetFocus.razor` and add a page directive:

   ```
   @page "/setfocus" @rendermode InteractiveAuto
   ```

3. Add an element reference:

   ```
   @code {
       ElementReference textInput;
   }
   ```

   `ElementReference` is precisely what it sounds like, a reference to an element. In this case, it is an input textbox.

   In the `_Imports` file, add the following line:

   ```
   @using static Microsoft.AspNetCore.Components.Web.RenderMode
   ```

4. Add the textbox and a button:

   ```
   <input @ref="textInput" />
   <button @onclick="() => textInput.FocusAsync()">Set focus</button>
   ```

   Using `@ref`, we specify a reference to any type of component or tag that we can use to access the input box. The `button onclick` method will execute the `FocusAsync()` method and set the focus on the textbox.

5. Press *F5* to run the project and then navigate to `/setfocus`.
6. Press the **Set focus** button and notice how the textbox gets its focus.

It could seem like a silly example since this only sets the focus, but it is a handy feature, and the `autofocus` HTML attribute won't work for Blazor. It would make more sense to call `FocusAsync` in the `OnAfterRender` method to get the focus change when we load the page, but that wouldn't make it as cool a demo.

In my blog post, I had another approach. My goal was to set the focus of an element without having to use code. In the upcoming chapter, *Chapter 6*, *Building Forms with Validation*, we will implement the `autofocus` feature from my blog post but use the new .NET features instead.

The release of .NET 5 solves many things we previously had to write with JavaScript; setting the focus is one example. In .NET 6, we have a way to influence the HTML head.

Influencing the HTML head

Sometimes, we want to set our page's title or change the social network meta tags. The `head` tag is located in the `App` component, and that part of the page isn't reloaded/rerendered (only the components within the routes component are rerendered). In previous versions of Blazor, you had to write code for that yourself using JavaScript.

But .NET has a new component called `HeadOutlet` that can solve that.

To use these components, we will create a page to view one of our blog posts. And we will use many of the techniques we have learned:

1. In the `SharedComponents` project, open `Home.razor`.
2. Change the `foreach` loop to look like this:

   ```
   <li><a href="/Post/@p.Id">@p.Title</a></li>
   ```

   We added a link to the title to look at one blog post. Notice how we can use the `@` symbol inside the `href` attribute to get the ID of the post.

3. In the Pages folder, add a Razor component, and name it `Post.razor`.
4. In the `code` section, add a parameter that will hold the ID of the post:

   ```
   [Parameter]
   public string BlogPostId { get; set; }
   ```

   This will hold the ID of the blog post that comes from the URL.

5. Add a `page` directive to get the set, the URL, and the ID:

   ```
   @page "/post/{BlogPostId}"
   ```

The page directive will set the URL for our blog post to `/post/`, followed by the ID of the post. We don't have to add a `using` statement to all our components. Instead, open `_Imports.razor` and add the following namespaces:

```
@using Data.Models.Interfaces
@using Data.Models
```

This will ensure that all our components will have these namespaces by default.

6. Open `Post.razor` again and, just beneath the page directive, inject the API (the namespace is now supplied from `_Imports.razor`):

```
@inject IBlogApi _api
@inject NavigationManager _navman
```

Our API will now be injected into the component, and we can retrieve our blog post. We also have access to a navigation manager.

7. In the `code` section, add a property for our blog post:

```
public BlogPost? BlogPost { get; set; }
```

This will contain the blog post we want to show on the page.

8. To load the blog post, add the following code:

```
protected async override Task OnParametersSetAsync()
{
    BlogPost=await _api.GetBlogPostAsync(BlogPostId);
    await base.OnParametersSetAsync();
}
```

In this case, we are using the `OnParametersSetAsync()` method. This is to make sure that the parameter is set when we get data from the database and that the content updates when the parameter changes.

9. We must also show the post and add the necessary `meta` tags. To do that, add the following code just above the `code` section:

```
@if (BlogPost != null)
```

```
{
    <PageTitle>@BlogPost.Title</PageTitle>
    <HeadContent>
    <meta property="og:title"
      content="@BlogPost.Title" />
    <meta property="og:description" content="@(new
      string(BlogPost.Text.Take(100).ToArray()))" />
    <meta property="og:image" content=
      "@($"{_navman.BaseUri}/pathtoanimage.png")" />
   <meta property="og:url" content="@_navman.Uri" />
   <meta name="twitter:card" content="@(new string(BlogPost.Text.
Take(100).ToArray()))" />
    </HeadContent>

    <h2>@BlogPost.Title</h2>
    @((MarkupString)BlogPost.Text)

}
```

When the page is first loaded, the `BlogPost` parameter can be null, so we first need to check whether we should show the content at all.

By adding the `Title` component, Blazor will set the title of our site to, in this instance, the title of our blog post.

According to the information I gathered on **Search Engine Optimization** (**SEO**), the meta tags we have added are the bare minimum to use with Facebook and X (formerly known as Twitter). We don't have an image for each blog post, but we can have one that is site-wide (for all blog posts) if we would like. Just change `Pathtoanimage.png` to the name of the image and put the image in the `wwwroot` folder.

If the blog post is loaded, then show an `H3` tag with the title and the text beneath that. You might remember `MarkupString` from *Chapter 4*, *Understanding Basic Blazor Components*. This will output the string from our blog post without changing the HTML (not escaping the HTML).

10. Run the project by pressing *F5* and navigate to a blog post to see the title change:

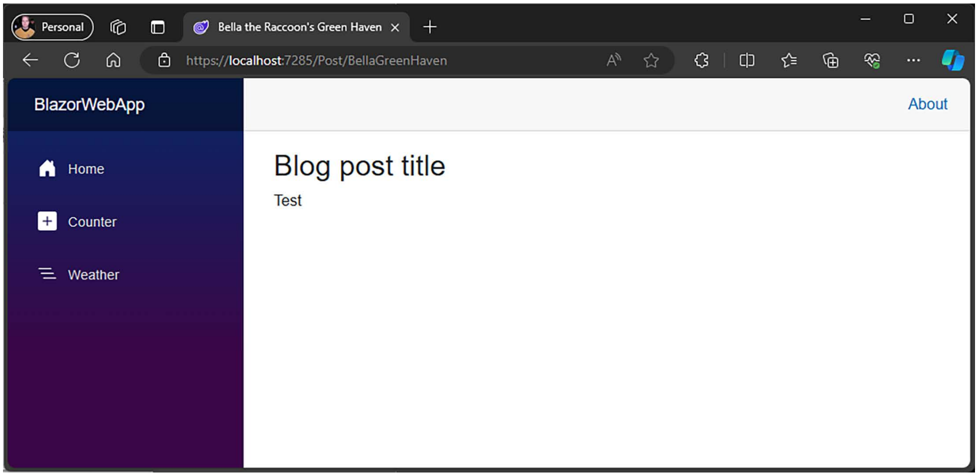


Figure 5.3: Blog post screenshot

Our blog is starting to take form. We have a list of blog posts, and can view a single post; we are far from done but we're well on our way.

Component virtualization

Virtualize is a component in Blazor that will make sure that it only renders the components or rows that can fit the screen. If you have a large list of items, rendering all of them will have a big impact on memory.

Many third-party component vendors offer grid components with the same virtualization function. The `Virtualize` component was, in my opinion, the most exciting thing in the .NET 5 release.

The `Virtualize` component will calculate how many items can fit on the screen (based on the size of the window and the height of an item). Blazor will add a `div` tag before and after the content list if you scroll the page, ensuring that the scrollbar is showing the correct position and scale (even though there are no items rendered).

The `Virtualize` component works just like a `foreach` loop.

The following is the code we currently have in our `Home.razor` file:

```
<ul>
    @foreach (var p in posts)
    {
        <li><a href="/Post/@p.Id">@p.Title</a></li>
```

```
    }
</ul>
```

Right now, it will show all our blog posts in our database in a long list. Granted, we only have a few right now, but we might have many posts one day.

We can change the code (don't change the code just yet) to use the new `Virtualize` component by changing it to the following:

```
<Virtualize Items="posts" Context="p">
        <li><a href="/Post/@p.Id">@p.Title</a></li>
</Virtualize>
```

Instead of the `foreach` loop, we use the `Virtualize` component and add a render fragment that shows how each item should be rendered. The `Virtualize` component uses `RenderFragment<T>`, which, by default, will send in an item of type `T` to the render fragment. In the case of the `Virtualize` component, the object will be one blog post (since items are `List<T>` of blog posts). We access each post with the variable named `context`. However, we can use the `Context` property on the `Virtualize` component to specify another name, so instead of `context`, we are now using `p`.

The `Virtualize` component is even more powerful than this, as we will see in the next feature that we implement:

1. In the `SharedComponents` project, open `Home.razor`.
2. Delete the `OnInitializedAsync` method and `protected List<BlogPost> posts = new List<BlogPost>();` we don't need them anymore.
3. Change the loading of the post to `Virtualize`:

   ```
   <ul>
       <Virtualize ItemsProvider="LoadPosts" Context="p">
           <li><a href="/Post/@p.Id">@p.Title</a></li>
       </Virtualize>
   </ul>
   ```

   In this case, we are using the `ItemsProvider` delegate, which will take care of getting posts from our API.

   We pass in a method called `LoadPosts`, which we also need to add to the file.

4. Now, let's add the `LoadPosts` method by adding the following code:

   ```
   public int totalBlogposts { get; set; }
   ```

```
private async ValueTask<ItemsProviderResult<BlogPost>>
LoadPosts(ItemsProviderRequest request)
{
    if (totalBlogposts == 0)
    {
        totalBlogposts = await _api.GetBlogPostCountAsync();
    }
    var numblogposts = Math.Min(request.Count, totalBlogposts -
request.StartIndex);
    var blogposts= await _api.
GetBlogPostsAsync(numblogposts,request.StartIndex);
    return new ItemsProviderResult<BlogPost>(blogposts,
totalBlogposts);
}
```

We will add a `totalBlogposts` property where we store how many posts we currently have in our database. The `LoadPost` method returns `ValueTask` with `ItemsProviderResult<Blogpost>`. The method has `ItemsProviderRequest` as a parameter, which contains the number of posts the `Virtualize` component wants and how many it wants to skip.

If we don't know how many total posts we have, we need to retrieve that information from our API by calling the `GetBlogPostCountAsync` method. Then, we need to figure out how many posts we should get; either we get as many posts as we need, or we get all the remaining posts (whatever value is the smallest).

Then, we call our API to get the actual posts by calling `GetBlogPostsAsync` and returning `ItemsProviderResult`.

We have implemented a `Virtualize` component that will load and render only the number of blog posts needed to fill the screen. But this is an interactive component that needs interactivity to work. If you try to run the project now, you will notice that the screen is blank. If we add `@rendermode InteractiveServer` to the `Home` component, it starts to work again. Right now, `InteractiveServer` is the only thing we can use. This is the only scenario we have everything set up for when it comes to DI.

Error boundaries

In .NET 6, we have a very handy component to handle errors called **ErrorBoundary**.

We can surround the component with an `ErrorBoundary` component; if an error occurs, it will show an error message instead of the whole page failing:

```
<ErrorBoundary>
   <ComponentWithError />
</ErrorBoundary>
```

This component takes two render fragments. By specifying it as in the previous example, we only set the `ChildContent` render fragment. This is the default.

We can also supply a custom error message like this:

```
<ErrorBoundary>
    <ChildContent>
        <ComponentWithError />
    </ChildContent>
    <ErrorContent>
        <h1 style="color: red;">Oops… something broke</h1>
    </ErrorContent>
</ErrorBoundary>
```

In this sample, we specify `ChildContent`, which makes it possible for us to specify more than one property, as is the case with `ErrorContent`. This is a great component to extend and create your own functionality. You can get access to the exception by using the `context` parameter (as we did with `virtualize`):

```
<ErrorBoundary Context="ex">
     <ChildContent>
        <p>@(1/zero)</p>
    </ChildContent>
    <ErrorContent>
       An error occurred
       @ex.Message
    </ErrorContent>
</ErrorBoundary>
@code {
    int zero = 0;
}
```

This is a great way to handle errors in the UI.

Sections

.NET 8 gives us the ability to add sections. You might remember a similar feature of `WebForms`.

We can use the `SectionOutlet` component to define an area in a layout component where we want to insert content. Then, inside our components, we can add a `SectionContent` where we add the content we want to appear in the outlet.

If we have more than one `SectionContent` referencing the `SectionOutlet`, it will render the latest `SectionContent`. We can refer to a `SectionOutlet` by using a section name or a section ID. A section name is simply a string that we can use. The ID is an object, so we can get a nicer syntax to keep track of our sections.

We can add a section to the layout file and add content to that section from our components. It's a layout thing. Let's say we want to add contextual menus. For example, that way, we could change a menu that is in a completely different component.

Let's look at some code.

First, we might need to add this namespace:

```
Microsoft.AspNetCore.Components.Sections;
```

Preferably in the _imports.razor file (since this is one of the build-in components.

In a layout component, we add an outlet like this:

```
<SectionOutlet SectionName="top-header"/>
```

Then, in our component, we can add a `SectionContent` like this:

```
<SectionContent SectionName="top-header">
    <b>Test</b>
</SectionContent>
```

If we instead want to use the section ID, we can do it like this: In the layout file, let's assume it is called `MainLayout`.

```
<SectionOutlet SectionId="MainLayout.TopHeader"/>
```

In the code section of `MainLayout`:

```
@code
{
```

```
    public static SectionOutlet TopHeader = new()
}
```

Then, inside the component, we change it to this:

```
<SectionContent SectionId="Layout.MainLayout.TopHeader">
    <b>Using SectionId</b>
</SectionContent>
```

This is a great way to change the layout files. By doing this, we can create more advanced layouts that work with every page/component. We can move more of the layout to the layout file instead of putting it in each component. I love this feature. This will clean up so much code.

Summary

In this chapter, we looked at more advanced scenarios for building components. Building components is what Blazor is all about. Components also make it easy to make changes along the way because there is only one point where you must implement the change. We also implemented our first reusable component, which will help maintain the same standard across the team and reduce duplicated code.

We also used some Blazor features to load and display data.

In the next chapter, we will look at forms and validation to start building the administration part of our blog.

Join our community on Discord

Join our community's Discord space for discussions with the author and other readers:

`https://packt.link/WebDevBlazor3e`

6

Building Forms with Validation

In this chapter, we will learn about creating forms and validating them, which is an excellent opportunity to build our admin interface, where we can manage our blog posts and also take a look at the new enhanced form navigation. We will also build multiple reusable components and learn about some of the new functionalities in Blazor.

This chapter will be super fun, and we will use a lot of the things we have learned up until now.

In this chapter, we will cover the following topics:

- Exploring form elements
- Adding validation
- Custom validation class attributes
- Looking at bindings
- Building an admin interface
- Adding an abstraction layer

Technical requirements

Make sure you have followed the previous chapters or use the `Chapter05` folder as a starting point.

You can find the source code for this chapter's result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter06`.

Exploring form elements

There are many form elements in HTML, and we can use them all in Blazor. In the end, what Blazor outputs is HTML.

Blazor does have components that will add to the functionality, so we can and should try to use those components instead of HTML elements. The built-in components give us great functionality for free.

Blazor offers the following components:

- `EditForm`
- `InputBase<>`
- `InputCheckbox`
- `InputDate<TValue>`
- `InputNumber<TValue>`
- `InputSelect<TValue>`
- `InputText`
- `InputTextArea`
- `InputRadio`
- `InputRadioGroup`
- `ValidationMessage`
- `ValidationSummary`

Let's go through them all in the next sections.

EditForm

`EditForm` renders as a `form` tag, but it has a lot more functionalities.

First, we will not create an action or method like traditional `form` tags; Blazor will handle all of that.

`EditForm` will create an `EditContext` instance as a cascading value so that all the components you put inside of `EditForm` will access the same `EditContext`. `EditContext` tracks the metadata regarding the editing process, such as what fields have been edited, and keeps track of any validation messages.

You need to assign either a model (a class you wish to edit) or an `EditContext` instance.

For most use cases, assigning a model is the way to go, but for more advanced scenarios, you might want to be able to trigger `EditContext.Validate()`, for example, to validate all the controls connected to `EditContext`. This is very rarely done, but it might be good to know it is possible.

`EditForm` has the following events that you can use to handle form submissions:

- `OnValidSubmit` gets triggered when the data in the form validates correctly (we will come back to validation in just a bit).
- `OnInvalidSubmit` gets triggered if the form does not validate correctly.
- `OnSubmit` gets triggered when the form is submitted, regardless of whether the form validates correctly or not. Use `OnSubmit` if you want to control the validation yourself.

Let's take a look at an example.

Consider a class that holds a person; the class has a name and an age for that person and looks like this:

```
public class Person
{
    public string Name { get; set; }
    public int Age { get; set; }
}
```

`EditForm` for this class would look like this (without any other elements for now):

```
<EditForm Model="personmodel" OnValidSubmit="@validSubmit">
    ...
    <button type="submit">Submit</button>
</EditForm>
@code {
    Person personmodel = new Person();
    private Task validSubmit()
    {
        //Do database stuff
        return Task.CompletedTask;
    }
}
```

`EditForm` specifies a model (in this case, `personmodel`), and we are listening to the `OnValidSubmit` event.

The `Submit` button is a regular HTML button that is not a specific Blazor component.

InputBase<>

All the Blazor input classes derive from the `InputBase` class. It has a bunch of things we can use for all of the `input` components; we will go through the most important ones.

`InputBase` handles `AdditionalAttributes`, which means that if we add any other attributes to the tag, they will automatically get transferred to the output. This means that the components derived from this class can leverage any HTML attributes since they will be part of the output.

`InputBase` has properties for `Value`, which we can bind to, and an event callback for when the value changes called `ValueChanged`.

We can also change `DisplayName` so that the automated validation messages will reflect the correct name and not the property's name, which is the default behavior.

Not all controls support the `DisplayName` property. Some properties are only used inside the component, and we will return to those in a bit.

InputCheckbox

The `InputCheckbox` component will render as `<input type="checkbox">`.

InputDate<TValue>

The `InputDate` component will render as `<input type="date">`. We can use `DateTime`, `DateOnly`, `TimeOnly`, and `DateTimeOffset` as values for the `InputDate` component.

There is no way to format the date; it will use the web browser's current setting. This behavior is by design and is part of the HTML5 spec.

InputNumber<TValue>

The `InputNumber` component will render as `<input type="number">`. We can use `Int32`, `Int64`, `Single`, `Double`, and `Decimal` as values for the `InputNumber` component.

InputSelect<TValue>

The `InputSelect` component will render as `<select>`. We will create `InputSelect` later in this chapter, so I won't go into further detail here.

InputText

The `InputText` component will render as `<input type="text">`.

InputTextArea

The `InputSelect` component will render as `<textarea>`. In this chapter, we will build our own version of this control.

InputRadio

The `InputRadio` component will render as `<input type="radio">`. Use this for individual options.

InputRadioGroup

The `InputRadioGroup` component is not an element itself but rather groups other `InputRadioInputs`. Use this to group options. We can add multiple `InputRadio` components inside of the `InputRadioGroup`.

InputFile

The `InputFile` component will render as `<Input type="file">`. This component will make it easier to get the file data. It will supply us with a stream for each file's content.

> We can dive into `InputFile` further by checking out the documentation here: `https://learn.microsoft.com/en-us/aspnet/core/blazor/file-uploads?view=aspnetcore-8.0`.

As we can see, there is a Blazor component for almost all the HTML form controls, with some added functionality such as validation, which we will see in the next section.

Adding validation

We have already touched on validation; there are some built-in functionalities in the `input` components and `EditForm` to handle validation.

One way to add validation to our form is to use `DataAnnotations`. Using DataAnnotations, we don't have to write any custom logic to ensure the data in the form is correct; instead, we can add attributes to the data model and let `DataAnnotationsValidator` take care of the rest.

There are a bunch of `DataAnnotations` instances in .NET already that we can use; we can also build our own annotations.

Some of the built-in data annotations are as follows:

- `Required`: This makes the field required.

- `Email`: This will check that the entered value is an email address.
- `MinLength`: This will check that the number of characters is not fewer than the value specified.
- `MaxLength`: This will check that the number of characters is not exceeded.
- `Range`: This will check that the value is within a specific range.

There are many more annotations that can help us validate our data. To test this out, let's add data annotations to our data classes:

1. In the `Data.Models` project, open `Models/BlogPost.cs`.
2. At the top of the file, add a `using` statement for `System.ComponentModel.DataAnnotations`:

   ```
   using System.ComponentModel.DataAnnotations;
   ```

3. Add the `Required` and `MinLength` attributes to the `Title` property:

   ```
   [Required]
   [MinLength(5)]
   public string Title { get; set; } = string.Empty;
   ```

   The `Required` attribute will ensure we can't leave the title empty, and `MinLength` will make sure it has at least 5 characters.

4. Add the `Required` attribute to the `Text` property:

   ```
   [Required]
   public string Text { get; set; } = string.Empty;
   ```

   The `Required` attribute will ensure the `Text` property cannot be empty, which makes sense – why would we create an empty blog post?

5. Open `Models/Category.cs`, and at the top of the file, add a `using` statement for `System.ComponentModel.DataAnnotations`.
6. Add the `Required` attribute to the `Name` property:

   ```
   [Required]
   public string Name { get; set; } = string.Empty;
   ```

   The `Required` attribute will make sure we can't leave the name empty.

7. Open `Models/Tag.cs`, and at the top of the file, add a `using` statement for `System.ComponentModel.DataAnnotations`.
8. Add the `Required` attribute to the `Name` property:

   ```
   [Required]
   public string Name { get; set; } = string.Empty;
   ```

   The `Required` attribute will make sure we can't leave the name empty.

9. Open `Models/Comment.cs`, and at the top of the file, add a `using` statement for `System.ComponentModel.DataAnnotations`.
10. Add the `Required` attribute to the `Name` and `Text` properties:

    ```
    [Required]
    public string Text { get; set; } = string.Empty;
    [Required]
    public string Name { get; set; } = string.Empty;
    ```

Great, now our data models have validation built into them. We need to give our users feedback on what went wrong with the validation.

We can do that by using the `ValidationMessage` or `ValidationSummary` components.

ValidationMessage

The `ValidationMessage` component can show us individual error messages for a specific property. We want to use this component to show validation errors under a form element.

To add a `ValidationMessage` component, we have to specify the `For` property with the name of the property we want to show the validation errors for:

```
<ValidationMessage For="@(() => personmodel.Name)"/>
```

ValidationSummary

The `ValidationSummary` component will show all the validation errors as a list for the entire `EditContext`:

```
<ValidationSummary/>
```

We don't need to supply any model or property to the `ValidationSummary` component since it gets access to the `EditContext` using the cascading value.

I prefer to show the error close to the problem so the user can see where the issue is. However, we also have the option to show the validation errors as a list using `ValidationSummary`.

To ensure our input controls match the Bootstrap theme (or whatever theme we might use), we can create our **custom validation class**.

Custom validation class attributes

By simply using the edit form, input components, and `DataAnnotationValidator`, the framework will automatically add classes to the components when it is and isn't valid.

By default, these classes are `.valid` and `.invalid`. In .NET 5, we were given a way to customize these class names ourselves.

When using Bootstrap, the default class names are `.is-valid` and `.is-invalid` , and the list of class names must also include `.form-control` to get the proper styles.

The next component we build will help us get the proper Bootstrap styling on all our form components.

We will create our own `FieldCssClassProvider` to customize what classes Blazor will use:

1. In the `SharedComponents` project, inside the `ResuableComponents` folder, add a new class called `BootstrapFieldCssClassProvider.cs`.
2. Open the new class and add the following code:

```
using Microsoft.AspNetCore.Components.Forms;
namespace SharedComponents.ResuableComponents ;
public class BootstrapFieldCssClassProvider : FieldCssClassProvider
{
    public override string GetFieldCssClass(EditContext editContext,
in FieldIdentifier fieldIdentifier)
   {
        var isValid = !editContext.
GetValidationMessages(fieldIdentifier).Any();
        var isModified = editContext.IsModified(fieldIdentifier);
        return (isModified, isValid) switch
        {
            (true, true) => "form-control modified is-valid",
            (true, false) => "form-control modified is-invalid",
            (false, true) => "form-control",
```

```
            (false, false) => "form-control"
        };
    }
}
```

`BootstrapFieldCssClassProvider` needs an `EditContext` instance to work.

The code will check whether the form (or `EditContext` to be specific) is valid and whether or not it has been modified. Based on that, it returns the correct CSS classes.

It returns the form control for all elements; that way, we don't have to add it to every element in the form. We could validate an untouched form as valid or invalid, but we don't want it to show that the form is OK just because it hasn't been changed yet.

Without the code we are about to build, we need to get the `EditContext` instance from our `EditForm` and then set `FieldCssClassProvider` on `EditContext` as follows:

```
CurrentEditContext.SetFieldCssClassProvider(provider);
```

Next, we will do that more elegantly (in my humble opinion) with the `CustomCssClassProvider` we will create next.

Earlier in this chapter, I mentioned that `EditForm` exposes its `EditContext` as `CascadingValue`.

That means we will build a component that we can just put inside of our `EditForm` and access `EditContext` that way.

3. In the `SharedComponents` project, in the root of the project, add a new class and name it `CustomCssClassProvider.cs`.
4. Open the new file and replace the content with the following code:

```
using Microsoft.AspNetCore.Components;
using Microsoft.AspNetCore.Components.Forms;
namespace SharedComponents;
public class CustomCssClassProvider<ProviderType> : ComponentBase
where ProviderType : FieldCssClassProvider, new()
{
    [CascadingParameter]
    EditContext? CurrentEditContext { get; set; }
    public ProviderType Provider { get; set; } = new();
    protected override void OnInitialized()
```

```
    {
        if (CurrentEditContext == null)
        {
            throw new
InvalidOperationException($"{nameof(CustomCssClassProvider
<ProviderType>)} requires a cascading parameter of
type {nameof(EditContext)}. For example, you can use
{nameof(CustomCssClassProvider<ProviderType>)} inside an
EditForm.");
        }
        CurrentEditContext.SetFieldCssClassProvider
         (Provider);
    }
}
```

This generic component takes a `type` value, in this case, the type of `Provider`.

We specified that `type` must inherit from `FieldCssClassProvider` and must have a constructor without parameters.

The component inherits from `ComponentBase`, which makes it possible to place the component inside a Blazor component.

In this case, we are writing our component with C# only, but it is not rendering anything.

We have a `Cascading` parameter that will be populated from `EditForm`. We throw an exception if `EditContext` is missing for some reason (for example, if we place the component outside of `EditForm`).

Finally, we set `FieldCssClassProvider` on `EditContext`.

To use the component, we have to add the following code inside of `EditForm` (don't worry, we will create an `EditForm` soon):

```
<CustomCssClassProvider ProviderType="BootstrapFieldCssClassProvider"/>
```

We provide our `CustomCssClassProvider` component with the right `ProviderType`: `BootstrapFieldCssClassProvider`.

This is one way of implementing components to help us encapsulate functionality. We could have written the code this way:

```
<EditForm Model="personmodel" @ref="CurrentEditForm">
```

```
…
</EditForm>
@code {
    public EditForm CurrentEditForm { get; set; }
    protected override Task OnInitializedAsync()
    {
        CurrentEditForm.EditContext.SetFieldCssClassProvider(new
BootstrapFieldCssClassProvider())
        return base.OnInitializedAsync();
    }
}
```

But with the new `CustomCssClassProvider` component, we can write the same thing like this:

```
<EditForm Model="personmodel">
<CustomCssClassProvider ProviderType="BootstrapFieldCssClassProvider" />
</EditForm>
```

If we are doing something with `EditContext`, we can always create a component like this since it is a `cascading` parameter.

Now, we have a component that will make our form controls look like Bootstrap controls and instead of adding specific code to every component, we can now add the `CustomCssClassProvider` component. Next, it's time to put that into practice and create a couple of forms by building our admin interface.

Looking at bindings

In this chapter, we are using bindings to bind data to our form controls. We briefly discussed bindings in *Chapter 5*, *Creating Advanced Blazor Components*, but it's time to dig deeper into bindings.

Binding to HTML elements

With HTML elements, we can use `@bind` to bind variables to the element.

So, if we are binding to a textbox, we would do it like this:

```
<input type="text" @bind="Variable"/>
```

`@bind` and `@bind-value` both work and do the same thing. Note the lower `v` in value. The input element is an HTML element that will render as a normal HTML element with no extra features (except binding). Compare this to `InputText`, which will work in a similar way but also give you additional features like validation and styles.

By default, the value in the variable will change when we leave the textbox. But we can change that behavior by adding a `@bind:event` attribute like this:

```
<input type="text" @bind="Variable" @bind:event="oninput"/>
```

We can even take full control over what is happening by using the `@bind:get` and `@bind:set` attributes like this:

```
<input type="text" @bind:get="SomeText" @bind:set="SetAsync" />
```

These are doing the same thing as `@bind`, so we can't use them together with `@bind`. The `@bind:set` attribute has another nice feature. We can run asynchronous methods when we set a value.

There is also a way for us to run a method after the value is set by using `@bind:after` like this:

```
<input type="text" @bind="SomeText" @bind:after="AfterAsync" />
```

This gives us great flexibility when it comes to binding to HTML elements.

On top of that, we can also set the culture using `@bind:culture`. Both date and number fields use invariant culture and will use the appropriate browser formatting, but if we use a text field, we can change the behavior like this:

```
<input type="text" @bind="SomeNumber" @bind:culture="GBCulture" />
```

Where `GBCulture`, in this case, is a `CultureInfo` object. Lastly, we can set the format using `@bind:format`. This is only implemented for `DateTime` at this point:

```
<input type="text" @bind="SomeDate" @bind:format="MM/dd/yyyy" />
<input type="text" @bind="SomeDate" @bind:format="yyyy-MM-dd" />
```

We now know how we can bind to HTML elements. Next, we will take a look at binding to components.

Binding to components

When binding to components, `Get`, `Set`, and `After` will also work. `Culture`, `Event`, and `Format` will work on some components.

When binding to a component, we use `@bind-{ParameterName}`, so for the parameter `Value`, it would look like this:

```
<InputText @bind-Value="text" />
```

In the background, `@bind-Value` will affect two other parameters, `ValueExpression` and `ValueChanged`. This means you will not be able to set them manually if you use `@bind-Value`. When we change the value, `ValueChanged` will get triggered, and we can listen to the event and make things happen when it changes.

We can also use `Get` and `Set` like this:

```
<InputText @bind-Value:get="text" @bind-Value:set="(value) => {text=value;
}" />
<InputText @bind-Value:get="text" @bind-Value:set="Set" />
<InputText @bind-Value:get="text" @bind-Value:set="SetAsync" />
```

We must always supply both `Get` and `Set` and they cannot be combined with `@bind-Value`. These samples use `InputText`, a built-in Blazor component, but this concept works with any parameter on any component. The same thing goes for `After`. It can be used with any component, like this:

```
<InputText @bind-Value="text" @bind-Value:after="() => { }" />
<InputText @bind-Value="text" @bind-Value:after="After" />
<InputText @bind-Value="text" @bind-Value:after="AfterAsync" />
```

We have access to some nice binding features, and they work when binding to components as well as HTML elements.

Next, we will build an admin interface using bindings.

Building an admin interface

Now, it's time to build a simple admin interface for our blog.

We need to be able to do the following:

- List categories
- Edit categories
- List tags
- Edit tags
- List blog posts
- Edit blog posts

If we look at the preceding list, we might notice that some of the things seem similar – perhaps we can build shared components for those. Categories and tags are very similar; they have names, and the name is the only thing we should be able to edit.

Let's make a component for that. The component is going to be responsible for listing, adding, deleting, and updating the object.

Since the object we are working with is either `Category` or `Tag`, we need to be able to call different APIs depending on the object, so our component needs to be generic:

1. In the `SharedComponents` project, in the root of the project, add a new Razor component and call it `ItemList.razor`.
2. Open the newly created file and at the top of the file, add:

   ```
   @typeparam ItemType
   ```

   `@typeparam` is to make the component generic, and the variable holding the generic type is called `ItemType`.

3. Add a `code` section (if you don't have one already), and add the following lines of code:

   ```
   @code{
   [Parameter]
   public List<ItemType> Items { get; set; } = new();
   [Parameter, EditorRequired]
       public required RenderFragment<ItemType> ItemTemplate { get;
   set; }
   }
   ```

4. We need two parameters: a list where we can add all the items and an `ItemTemplate` instance that we can use to change how we want the items to be shown. The `EditorRequired` attribute makes sure that we need to set this value when using the component. Otherwise, Visual Studio will show hostile error messages until we fix it.

   In this case, we are using `RenderFragment<T>`, which will give us access to the item inside the template (things will become clearer as soon as we implement it).

5. We also need a couple of events; add the following code to the `code` section:

   ```
   [Parameter]
   public EventCallback<ItemType> DeleteEvent { get; set; }
   [Parameter]
   public EventCallback<ItemType> SelectEvent { get; set; }
   ```

   We added two events; the first is when we delete a tag or a category. We will send an event to the parent component where we can add the code needed to delete the item.

The second one is when we select an item so that we can edit the item.

6. Now, it's time to add the UI; replace the top of the file below the `@typeparam` to the code tag with:

```
@using System.Collections.Generic
<h3>List</h3>
<table>
    <Virtualize Items="@Items" Context="item">
        <tr>
            <td>
                <button class="btn btn-primary" @onclick="@(()=>
{SelectEvent.InvokeAsync(item); })"> Select</button>
            </td>
            <td>@ItemTemplate(item)</td>
            <td>
                <button class="btn btn-danger" @onclick="@(()=>
{DeleteEvent.InvokeAsync(item);})"> Delete</button>
            </td>
        </tr>
    </Virtualize>
</table>
```

If we look back to *Step 3*, we'll notice that we used the variable for the lists and `RenderFragment`.

Then, we use the new `Virtualize` component to list our items; to be fair, we might not have that many categories or tags, but why not use it when we can? We set the `Items` property to `"Items"` (which is the name of our list) and the `Context` parameter to `"item"`.

We can give it whatever name we want; we're only going to use it inside of the `Virtualize` render template.

We added two buttons that simply invoke the `EventCallback` instance we added in *Step 4*. Between those buttons, we added `@ItemTemplate(item)`; we want Blazor to render the template, but we also send the current item in the loop.

That means we have access to the item's value inside our template.

Listing and editing categories

With our new component, it's now time to create a component for listing and editing our categories:

1. In the `SharedComponents` project, open `_Imports.razor`. Make sure the following namespaces are included: `@using SharedComponents` and `@using Microsoft.AspNetCore.Components.Forms`.
2. Right-click on the `Pages` folder, select **Add | New folder**, and name the folder `Admin`.
3. In the `Pages/Admin` folder, add a new Razor component and name it `CategoryList.razor`.
4. At the top of the component, replace `<h3>CategoryList</h3>` with the following code:

```
@page "/admin/categories"
@rendermode InteractiveServer @using SharedComponents.
ReusableComponents @inject IBlogApi _api <h3>Categories</h3>
```

   We started with the `@page` directive, telling Blazor that if we navigate to the `"admin/categories"` URL, we will get to the `CategoryList.Razor` component. This component has some interactivity, so we need to set what interactivity mode we wish to use. In this case, we are using `InteractiveServer`. If we want to use `InteractiveAuto` or `InteractiveWebAssembly`, we need to put the component in the `BlazorWebApp.Client` project. We will add a `using` statement and then inject our API.

5. The next step is to add a form to edit the categories. Add the following code under the code from the previous step:

```
<EditForm OnValidSubmit="Save" Model="Item">
    <DataAnnotationsValidator />
    <CustomCssClassProvider
ProviderType="BootstrapFieldCssClassProvider" />
    <InputText @bind-Value="@Item.Name" />
    <ValidationMessage For="@(()=>Item.Name)" />
    <button class="btn btn-success" type="submit">Save</button>
</EditForm>
```

   We added `EditForm`, which will execute the `Save` method if the form validates OK. For validation, we added `DataAnnotationsValidator`, which will validate the supplied data against the annotations we added to the `Tag` and `Category` classes.

Since we are using Bootstrap, we want our form controls to look the same, so we added `CustomCssClassProvider`, which we created earlier in this chapter.

We added `InputText` and connected it to a `Category` object called `Item` (which we will add in just a second).

Below that, we added `ValidationMessage`, which will show any errors for the `name` property, and then a **Submit** button.

6. Now, it's time to add our `ItemList` component; under the code we added in the previous step, add this code:

```
<ItemList Items="Items" DeleteEvent="@Delete" SelectEvent="@Select"
ItemType="Category">
    <ItemTemplate>
        @{
            var item = context as Category;
            if (item != null)
            {
                @item.Name
            }
        }
    </ItemTemplate>
</ItemList>
```

We add our component and we bind the `Items` property to a list of items (we will create that list in the next step).

We bind the `Select` and `Delete` events to methods and we specify the type of the list in the `ItemType` property. Then, we have `ItemTemplate`. Since we are using `RenderFragment<T>`, we now have access to a variable called `context`.

We convert that variable to a category and print out the name of the category. This is the template for each item that will be shown on the list.

7. Finally, we add the following code to replace the `code` section:

```
@code {
    private List<Category> Items { get; set; } = new();
    public Category Item { get; set; } = new();
    protected async override Task OnInitializedAsync()
```

```
    {
        Items = (await _api.GetCategoriesAsync()) ?? new();
        await base.OnInitializedAsync();
    }
    private async Task Delete(Category category)
    {
        try
        {
            await _api.DeleteCategoryAsync(category.Id!);
            Items.Remove(category);
        }
        catch { }
    }
    private async Task Save()
    {
        try
        {
            await _api.SaveCategoryAsync(Item);
            if (!Items.Contains(Item))
            {
                Items.Add(Item);
            }
            Item = new Category();
        }
        catch { }
    }
    private Task Select(Category category)
    {
        try
        {
            Item = category;
        }
        catch { }
        return Task.CompletedTask;
    }
}
```

We added a list to hold all our categories and a variable that holds one item (the item currently being edited). We use `OnInitializedAsync` to load all the categories from the API.

The `Delete` and `Save` methods call the API's corresponding method, and the `Select` method takes the provided item and puts it into the item variable (ready to be edited).

We check whether we already have the item in the list before we add it to the list. Run the project and navigate to `/admin/categories`.

8. Try to add, edit, or delete a category, as shown in *Figure 6.1*:

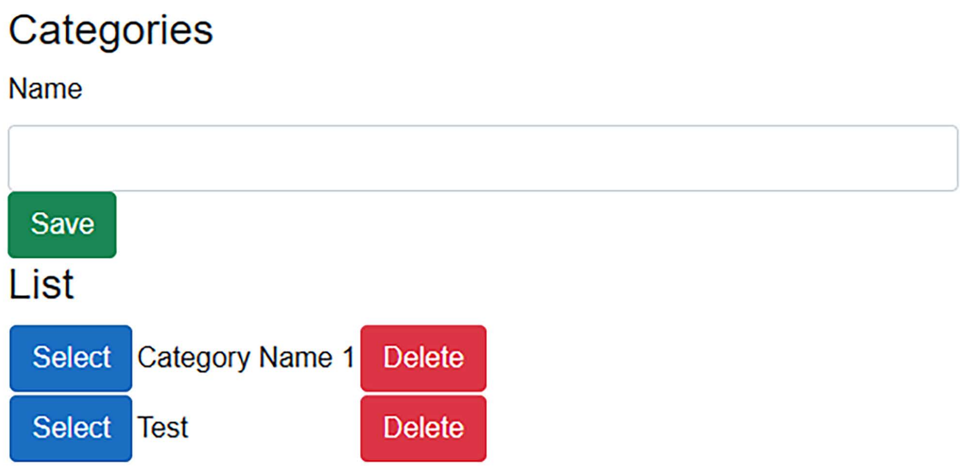


Figure 6.1: The Edit category view

Now, we need a component for listing and editing tags as well – it is pretty much the same thing, but we need to use `Tag` instead of `Category`.

Listing and editing tags

We just created a component for listing and editing categories; now, we need to create a component to list and edit tags:

1. In the `BlazorWebApp.Client` project, in the `Pages` folder, add a new folder called `Admin`.
2. Add a new Razor component called `TagList.razor`.
3. At the top of the component, replace `<h3>TagList</h3>` with the following code:

```
@page "/admin/tags"
@rendermode InteractiveServer
@using Data.Models
```

```
@using Data.Models.Interfaces
@using SharedComponents
@using SharedComponents.ReusableComponents
@inject IBlogApi _api <h3>Tags</h3>
```

We started with the @page directive telling Blazor that if we navigate to the `"admin/tags"` URL, we will get to the `TagList.Razor` component. We also specify the render mode as `InteractiveServer`. We add a `using` statement and then inject our API.

4. The next step is to add a form to edit the tags. Add the following code under the code from the previous step:

```
<EditForm OnValidSubmit="Save" Model="Item">
    <DataAnnotationsValidator />
    <CustomCssClassProvider
      ProviderType="BootstrapFieldCssClassProvider" />
    <InputText @bind-Value="@Item.Name" />
    <ValidationMessage For="@(()=>Item.Name)" />
    <button class="btn btn-success" type="submit">Save</button>
</EditForm>
```

We added `EditForm`, which will execute the `Save` method if the form validates without a problem. For validation, we added `DataAnnotationsValidator`, which will validate the supplied data against the annotations we added to the `Tag` and `Category` classes.

Since we are using Bootstrap, we want our form controls to look the same, so we added `CustomCssClassProvider`, which we created earlier in this chapter.

We added `InputText` and connected it to a `Tag` object called `Item` (which we will add in a moment).

Below it, we add a `ValidationMessage` instance that will show any errors for the `name` property and then a **Submit** button.

5. Now, it's time to add our `ItemList` component. Under the code we added in the previous step, add this code:

```
<ItemList Items="Items" DeleteEvent="@Delete" SelectEvent="@Select"
ItemType="Tag">
    <ItemTemplate>
        @{
            var item = context as Tag;
```

```
                if (item != null)
                {
                    @item.Name
                }
            }
        </ItemTemplate>
    </ItemList>
```

We added our component and bound the `Items` property to a list of items (we will create that list in the next step). We bind the `Select` and `Delete` events to methods and specify the `List` type in the `ItemType` property.

Then we have `ItemTemplate`; since we are using `RenderFragment<T>`, we now have access to a variable called `context`. We convert that variable to a tag and print out the tag's name.

This is the template for each item shown in the list.

6. Finally, we replace the code section with the following code:

```
@code {
    private List<Tag> Items { get; set; } = new List<Tag>();
    public Tag Item { get; set; } = new Tag();
    protected async override Task OnInitializedAsync()
    {
        Items = (await _api.GetTagsAsync())??new();
        await base.OnInitializedAsync();
    }
    private async Task Delete(Tag tag)
    {
        try
        {
            await _api.DeleteTagAsync(tag.Id!);
            Items.Remove(tag);
        }
        catch { }
    }
    private async Task Save()
    {
        try
```

```
            {
                await _api.SaveTagAsync(Item);
                if (!Items.Contains(Item))
                {
                    Items.Add(Item);
                }
                Item = new Tag();
            }
            catch { }
        }
        private Task Select(Tag tag)
        {
            try
            {
                Item = tag;
            }
            catch { }
            return Task.CompletedTask;
        }
    }
```

We added a list to hold all our tags and a variable that holds one item (the item currently being edited). We use `OnInitializedAsync` to load all the tags from the API.

The `Delete` and `Save` methods call the API's corresponding method and the `Select` method takes the provided item and puts it into the `Item` variable (ready to be edited).

We check whether we already have the item in the list before we add it to the list.

7. Run the project and navigate to `/admin/tags`.

8. Try to add, edit, and delete a tag, as shown in *Figure 6.2*:

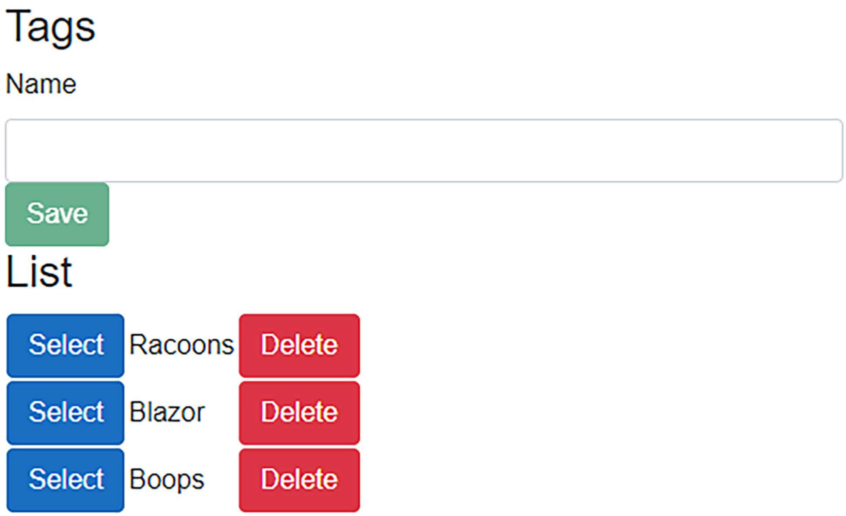


Figure 6.2: The Edit tag view

Now, we need ways to list and edit blog posts.

Listing and editing blog posts

Let's start with listing and editing blog posts:

1. In the `SharedComponents` project, in the `Pages/Admin` folder, add a new Razor component called `BlogPostList.razor`.
2. At the top of the `BlogPostList.razor` file, replace `<h3>BlogPostList</h3>` with the following code:

```
@page "/admin/blogposts"
@attribute [StreamRendering(true)]
@inject IBlogApi _api
<a href="/admin/blogposts/new">New blog post</a>
@if (posts?.Count == 0)
```

```
{
    <p>No blog posts found</p>
}
else if (posts == null)
{
    <p>Loading...</p>
}
else
{
    <ul>
        @foreach (var p in posts)
        {
            <li>
                @p.PublishDate
                <a href="/admin/blogposts/@p.Id">@p.Title</a>
            </li>
        }
    </ul>
}
```

We added a page directive, injected our API, and listed the blog posts using a `foreach` loop. We also enabled `StreamingRendering`, because this page doesn't have any interactivity, so there is no need to add that. This also means we can't use the `Virtualize` component since it is interactive.

We also linked the posts to a URL with the `Id` instance of the blog.

3. Add the following code in the code section:

```
private List<BlogPost>? posts = null;

protected override async Task OnInitializedAsync()
{
    await Task.Delay(1000);
    var numberofposts = await _api.GetBlogPostCountAsync();
    posts = await _api.GetBlogPostsAsync(numberofposts, 0);
    await base.OnInitializedAsync();
}
```

We added the functionality to load posts from the database and a small delay so that we can see **Loading...** for just a brief moment. Now, there is only one thing left in the section: adding a page where we can edit the blog post.

A very popular way of writing blog posts is using Markdown; our blog engine will support that. Since Blazor supports any .NET standard **dynamic link library** (**DLL**), we will add an existing library called `Markdig`.

This is the same engine that Microsoft uses for their `docs` site.

We can extend `Markdig` with different extensions (as Microsoft has done), but let's keep this simple and only add support for Markdown without all the fancy extensions.

4. Under the `SharedComponents` project, right-click on the **Dependencies** node in Solution Explorer and select **Manage NuGet Packages**.
5. Search for `Markdig` and click **Install**.
6. Add a new class in the root of the project called `InputTextAreaOnInput.cs`.
7. Open the new file and replace its contents with the following code:

```
using System.Diagnostics.CodeAnalysis;
using Microsoft.AspNetCore.Components.Rendering;
namespace Microsoft.AspNetCore.Components.Forms;
    public class InputTextAreaOnInput :
     InputBase<string?>
    {
        protected override void BuildRenderTree(RenderTreeBuilder
builder)
        {
            builder.OpenElement(0, "textarea");
            builder.AddMultipleAttributes(1, AdditionalAttributes);
            builder.AddAttribute(2, "class", CssClass);
            builder.AddAttribute(3, "value", BindConverter.
FormatValue(CurrentValue));
            builder.AddAttribute(4, "oninput", EventCallback.
Factory.CreateBinder <string?>(this, __value => CurrentValueAsString
= __value, CurrentValueAsString));
            builder.CloseElement();
        }
```

```
        protected override bool TryParseValueFromString(string?
value, out string? result, [NotNullWhen(false)] out string?
validationErrorMessage)
        {
            result = value;
            validationErrorMessage = null;
            return true;
        }
    }
```

The preceding code is taken from Microsoft's GitHub repository; it is how they implement the `InputTextArea` component.

In their build system, they can't handle `.razor` files, so that's why they implement the code this way. I made one change in Microsoft's code, and that is `oninput`, which used to say `OnChange`.

For most cases, `OnChange` will be just fine, which means when I leave the textbox, the value will be updated (and trigger validations). But in our case, we want the preview of the HTML to be updated in real time, which is why we had to implement our own.

One option could have been not to use the `InputTextArea` component and instead use the `TextArea` tag, but we would lose the validation highlighting. This is the way to go if we ever need to customize the behavior on an input control.

I recommend using `.razor` files over `.cs` files if you make many changes to the implementation.

8. In the `Pages/Admin` folder, add a new Razor component called `BlogPostEdit.razor`.
9. At the top of the `BlogPostEdit.razor` file, replace `<h3>BlogPostEdit</h3>` with the following code:

```
@page "/admin/blogposts/new"
@page "/admin/blogposts/{Id}"
@rendermode InteractiveServer
@inject IBlogApi _api
@inject NavigationManager _manager
@using Markdig; @using Microsoft.AspNetCore.Components.Forms
```

We add two different page directives because we want to be able to create a new blog post as well as supply an ID to edit an already existing one. If we do not supply an ID, the `Id` parameter will be null (or the default).

We inject our API and `NavigationManager` as well as adding `using` statements.

10. We also need some variables. Add the following code in the `code` section:

```
[Parameter]
public string? Id { get; set; }
BlogPost Post { get; set; } = new();
List<Category> Categories { get; set; }=new();
List<Tag> Tags { get; set; }= new();
string? selectedCategory = null;
string? markDownAsHTML { get; set; }
```

We added a parameter for the blog post ID (if we want to edit one), a variable to hold the post we are editing, one to hold all the categories, and one to hold all the tags. We also added a variable to hold the currently selected category and one to hold the Markdown converted to HTML.

Now, we need to add the form; add the following code:

```
<EditForm Model="Post" OnValidSubmit="SavePost">
    <DataAnnotationsValidator />
    <CustomCssClassProvider
ProviderType="BootstrapFieldCssClassProvider" />
    <InputText @bind-Value="Post.Title"/>
    <ValidationMessage For="()=>Post.Title"/>
    <InputDate @bind-Value="Post.PublishDate"/>
    <ValidationMessage For="()=>Post.PublishDate"/>
    <InputSelect @bind-Value="selectedCategory">
        <option value="0" disabled>None selected</option>
        @foreach (var category in Categories)
        {
            <option value="@category.Id">@category.Name </option>
        }
    </InputSelect>
    <ul>
        @foreach (var tag in Tags)
```

```
        {
        <li>
            @tag.Name
            @if (Post.Tags.Any(t => t.Id == tag.Id))
            {
                <button type="button" @onclick="@(() => {Post.Tags.
Remove(Post.Tags.Single(t=>t.Id==tag.Id)); })">Remove</button>
            }
            else
            {
                <button type="button" @onclick="@(()=> { Post.Tags.
Add(tag); })">Add</button>
            }
        </li>
        }
    </ul>
        <InputTextAreaOnInput @bind-Value="Post.Text" @
onkeyup="UpdateHTML"/>
        <ValidationMessage For="()=>Post.Text"/>
        <button type="submit" class="btn btn-success">Save</button>
    </EditForm>
```

We add an `EditForm`, and when we submit the form (if it is valid), we execute the `SavePost` method. We add `DataAnnotationValidator`, which will validate our model against the data annotations in the class.

We add `CustomCssClassProvider` so that we get the correct Bootstrap class names. Then, we add components for the title, publish date, category, tags, and, last but not least, the text (the blog post's content).

Finally, we add the text using the component we created in *Step 4* (the component that updates for each keystroke).

We also hook up the `@onkeyup` event to update the preview for each keystroke.

11. We also need to add our `SavePost` method. Add the following code in the `code` section:

```
public async Task SavePost()
{
    if (!string.IsNullOrEmpty(selectedCategory) && Categories !=
null)
```

```
    {
        var category = Categories.FirstOrDefault(c =>c.Id ==
selectedCategory);
        if (category != null)
        {
            Post.Category = category;
        }
    }
    await _api.SaveBlogPostAsync(Post);
    _manager.NavigateTo("/admin/blogposts");
}
```

12. Now, it's time to show the preview. Add the following code just below the `EditForm` close tag:

    ```
    @((MarkupString)markDownAsHTML)
    ```

    We use `MarkupString` to make sure Blazor outputs the HTML code without escaping the characters. You might remember that from *Chapter 4*, *Understanding Basic Blazor Components*.

13. Now, it is time to set up `Markdig`. Add the following code somewhere in the code section:

    ```
    MarkdownPipeline pipeline = default!;
    protected override Task OnInitializedAsync()
    {
        pipeline = new MarkdownPipelineBuilder()
                 .UseEmojiAndSmiley()
                 .Build();
        return base.OnInitializedAsync();
    }
    ```

    To configure `Markdig`, we need to create a pipeline. As I mentioned earlier in the chapter, this is the engine Microsoft uses for their documentation site. It has many extensions available, including source code highlighting and emoticons.

    We also added emoticons to the pipeline to make it a little more fun.

14. We must also add code to load the data (`blog posts`, `categories`, and `tags`). Add the following methods in the code section:

    ```
    protected void UpdateHTML()
    ```

```
{
    markDownAsHTML = Markdig.Markdown.ToHtml(Post.Text, pipeline);
}
 protected override async Task OnParametersSetAsync()
    {
        if (Id != null)
        {
            var p = await _api.GetBlogPostAsync(Id);
            if (p != null)
            {
                Post = p;
                if (Post.Category != null)
                {
                    selectedCategory = Post.Category.Id;
                }
                UpdateHTML();
            }
        }
        Categories = (await _api.GetCategoriesAsync());
        Tags = (await _api.GetTagsAsync());
        base.OnParametersSet();
    }
```

Now, run the site, navigate to `/admin/blogposts`, click on a blog post to edit it, and test the new Markdown support. *Figure 6.3* shows the **Edit** page with Markdown support:

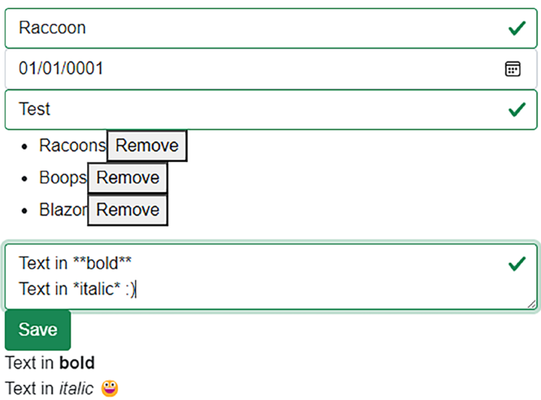


Figure 6.3: The Edit page with Markdown support

We still have one more thing to do: we need to ensure that the blog post page shows a converted HTML version of the Markdown.

15. Open `/Pages/Post.razor` and add the following `using` statement at the top of the file:

```
@using Markdig;
```

16. Add the following code to the `code` section:

```
MarkdownPipeline pipeline;
protected override Task OnInitializedAsync()
{
    pipeline = new MarkdownPipelineBuilder()
             .UseEmojiAndSmiley()
             .Build();
    return base.OnInitializedAsync();
}
```

17. Replace the following row:

```
@((MarkupString)BlogPost.Text)
```

Replace the preceding row with this:

```
@((MarkupString)Markdig.Markdown.ToHtml(BlogPost.Text, pipeline))
```

Great job! Now, we have an admin interface up and running so that we can start writing blog posts.

Looking at the code we wrote, no textbox has a label; what we can do is add a label in all the places we are using a textbox. Some component vendors have a label built into their components. I prefer doing that myself. Add an abstraction layer on top of any built-in components or third-party components.

Adding an abstraction layer

This has saved us more times than I can count. Adding an abstraction layer does take some time and effort, but I promise you, you will get that time back. So, why should we do this? Well, for several reasons: if we are using Bootstrap, for example, and we want to upgrade Bootstrap to the latest version, there might be classes that have changed. By using components, it's easy to only change those components. It also makes it easier to change component vendors in the future if you have your own components encapsulating the third-party components. But the real reason is that if we add a layer, we can set the team's programming style/language.

Everything we build will have the same default values, the same access to properties, and the same UX. We can add functionality, but in most cases, it is more important to limit the functionality.

A third-party component has a lot of functionality; it should cater to many different use cases. But they also mean that your team now has access to many different functionalities that can make the UX different for each developer that implements the functionality.

Let's add a couple of shared components to the project.

The first one is a textbox with a label and validation message built in.

If we take a look at our `CategoryList` component, the code looks like this:

```
    <InputText @bind-Value="@Item.Name" />
    <ValidationMessage For="@(()=>Item.Name)" />
```

A label using Bootstrap looks something like this:

```
<label for="validationCustomCategoryName" class="form-label">Category
name</label>
    <div class="input-group has-validation">
      <input type="text" class="form-control"
id="validationCustomCategoryName">
      <div class="invalid-feedback">
        Please choose a category name.
      </div>
    </div>
```

Let's see if we can combine these; some features are already built in. Since we only add a layer, we don't have to handle as much functionality. We rather need to send the parent component values to the encapsulated component. Let's look at some code to see what's going on:

1. In the `SharedComponent` project, in the `ResusableComponents` folder, add a new Razor component and call it `BlogInputText.razor`.
2. In the code section, add the following code:

```
    [Parameter]
    public string Id { get; set; } = Guid.NewGuid().ToString();
    [Parameter]
    public string? Label { get; set; }
    [CascadingParameter]
    public required EditContext CurrentEditContext { get; set; }
```

```
    [Parameter]
    public required string Value { get; set; }
    [Parameter]
    public EventCallback<string> ValueChanged { get; set; }
    [Parameter]
    public required Expression<Func<string>> ValueExpression { get;
set; }
```

3. Let's take a look at what is going on. First, we add a parameter so that we have an ID that we can use for the `label` tag in the next step. We add a string that can contain text for our label, id we do have some text, we render the label. If it is `null`, we don't render the label. I prefer not to have a "`ShowLabel`" property. If there is a text, it should show the label. We also have the current edit context, which we will use to send to the next level of components.
4. In our form we have an `EditForm`; the `EditForm` will send the `EditContext` to all the child components and will keep track of the state of the form. We want to grab that edit context and send that to all the components inside of this component as well.
5. Then, we have the trio of value parameters, `Value`, `ValueChanged`, and `ValueExpression`.
6. In the non-code part of the page, add the following (replacing the three tags):

```
@using System.Linq.Expressions
<CascadingValue Value="CurrentEditContext">
    @if(Label!=null)
    {
        <label for="@Id" class="form-label">@Label</label>
    }
    <InputText id="@Id" Value="@Value" ValueChanged="ValueChanged"
ValueExpression="ValueExpression" />
    <ValidationMessage For="@ValueExpression" />
</CascadingValue>
```

7. First, we grab the `CurrentEditContext` and send that to a child component; this way, all the children will have the same edit context as the parent `EditForm`. If we have any text in the `Label` parameter, we should show the label. Then we add the `InputText`, the built-in component. If we would like to do this with a third-party library, we would do it in a similar way. Next is where things get a bit more complicated; we could have simply said `@bind-Value`, which would notify Blazor that a change has happened, but it would notify the `EditContext` that the `Value` parameter of our component has been changed, not the model.

So, instead of doing that, we set the `Value` parameter and the `ValueChanged` parameter to the parameters that we send to the component. This way, the notification of the value changed will directly notify that the model has been changed. The `ValueExpression` will make sure that the `EditContext` gets notified of the change and will show the corresponding validation message. To be honest, in this example, it doesn't really matter, but if we were using a third-party component with validation built in, it might not work (depending on how they build the component). So, using this method should always work.

8. Then, we have the `ValidationMessage`, which shows any error in the model, and we are using the same `ValueExpression` here.
9. Now, we need to use this component. Let's change the `Taglist` first. In the `BlazorWebApp.Client` project, in the `Pages/Admin` folder, open `Taglist.razor`.
10. Right now, we have the following code:

```
<InputText @bind-Value="@Item.Name" />
<ValidationMessage For="@(()=>Item.Name)" />
```

Replace this code with the following:

```
<BlogInputText @bind-Value="@Item.Name" Label="Name" />
```

Now, isn't that kind of elegant?

11. Let's do the same with the `CategoryList`. In the `SharedComponent` project, in the `Pages/Admin` folder, open `CategoryList.razor`.
12. Replace the following code:

```
<InputText @bind-Value="@Item.Name" />
<ValidationMessage For="@(()=>Item.Name)" />
```

Replace the preceding code with the following code:

```
<BlogInputText @bind-Value="@Item.Name" Label="Name" />
```

This kind of change makes me genuinely happy – it simplifies usage, makes the UI easier to understand, and removes the need for duplicated code. Even though we know how to do this now, I want to add one more example that perhaps showcases the really nice benefits of working this way. Let's create a button component as well. This component will be a bit more to take in:

1. In the `SharedComponents` project, in the `ReusableComponents` folder, add a new component and name it `BlogButton.razor`.

2. Replace the content with this code:

```
@using Microsoft.AspNetCore.Components.Forms
<button type="@InternalButtonType" disabled="@Disabled" class="@
InternalCssClass" title="@Title" @onclick="OnButtonClick">@
ChildContent</button>
```

3. We are adding a normal HTML button, nothing fancy. We add functionality to change the type (`button` or `submit`), whether it is disabled or not, what CSS class it should have, a method to run, and the title.
4. Add the following code to the `code` section:

```
[CascadingParameter]
 public EditContext? EditContext { get; set; }

 [Parameter]
 public RenderFragment? ChildContent { get; set; }
```

5. Here, we are doing the same thing as with the `BlogTextbox`, and we bring in the `EditContext`, which we will use in just a bit.
6. We also have a `RenderFragment` for the content of the button.
7. Next, add the following code:

```
`private bool? _disabled = null;
 private string? _disabledHelpText = "";
 private string formerrors = "";

    [Parameter]
    public bool Disabled
    {
        get
        {
            if (_disabled != null && (_disabled == null || _
disabled.Value))
            {
                return _disabled!.Value;
            }

            if (EditContext == null)
            {
```

```
                return false;
            }

            formerrors = "";
            if (!TryGetValidationMessages(out var
validationmessages))
            {
                return true;
            }

            foreach (var m in validationmessages)
            {
                formerrors += m + (MarkupString)" \r\n";
            }
            return !EditContext.IsModified() || validationmessages.
Any();
        }

        set => _disabled = value;

    }
```

8. First, we add a couple of `private` fields that we will use in the component, then we add a property for whether the button is disabled or not. It will use `EditContext` to check whether there are any errors in the form, save those errors in a variable, and if the form is OK, enable the button, and if it is not, disable the button. There is a downside to this implementation; for the validation to trigger, we need to click somewhere else on the page to trigger the change in the field. So, now, the button will be disabled if the form is not OK.
9. Add the following code:

```
private string? Title => Disabled && !string.
IsNullOrWhiteSpace(DisabledHelpText) ? DisabledHelpText : HelpText;
[Parameter]
public string? DisabledHelpText { get { return _disabledHelpText
+ (MarkupString)"\r\n" + formerrors; } set { _disabledHelpText =
value; } }

[Parameter]
```

```
public string? HelpText { get; set; }
```

10. This code will get a `Title` for the button and it will be shown when hovering your mouse over the button. We can also set a `HelpText` or a disabled help text. If the function is disabled for any reason, it might not have anything to do with the for we will show a text that explains why the button is disabled. It will also add any form errors to the button so it is easy to understand what form element is the problem without having to scroll to the element.
11. Sometimes, we might want to use the button, but without a form, simply executing a method. Add the following code:

```
    [Parameter] public EventCallback OnClick { get; set; }

    private string InternalButtonType => OnClick.HasDelegate ?
"button" : "submit";

    private async Task OnButtonClick(EventArgs args)
    {
        if (OnClick.HasDelegate)
        {
            await OnClick.InvokeAsync(args);
        }
    }
```

12. If we have a delegate for `OnClick`, we want the button to simply be a button. If we don't have a delegate, we assume the button is used inside of an `EditForm`. When the button is clicked, the `OnButtonClick` method will run.
13. Now, we get to the really juicy part. Let's add an `enum`; we can add it in the `code` section:

```
public enum ButtonType
{
    Save,
    Cancel,
    Delete,
    Remove,
    Select
}
```

14. Notice that we are not using vocabulary like primary or danger – that's Bootstrap lingo. What we want to know is what the button is used for. When we add a button, what is the most likely scenario in which the button will be used?
15. Then, we add a parameter for `ButtonType` like this:

```
[Parameter] public ButtonType Type { get; set; }

private string InternalCssClass
{
    get
    {
        return Type switch
        {
            ButtonType.Save => "btn btn-success",
            ButtonType.Cancel => "btn btn-danger",
            ButtonType.Delete => "btn btn-danger",
            ButtonType.Remove => "btn btn-danger",
            ButtonType.Select => "btn btn-primary",
            _ => "btn btn-primary"
        };
    }
}
```

We add a parameter for `ButtonType` and an internal property that translates the "Save" use case, for example, to a Bootstrap CSS class.

16. Our team doesn't have to bother remembering which Bootstrap class they should use; they know it's a button, and they know what the button is used for. The component takes care of the rest.

Let's test it out!

17. In the `BlazorWebApp` project, in the `Pages/Admin` folder, open `TagList.razor`.
18. Replace the following line:

```
<button class="btn btn-success" type="submit">Save</button>
```

Replace the preceding line with the following line:

```
<BlogButton Type="BlogButton.ButtonType.Save">Save</BlogButton>
```

19. If you run the project now, you will see that the button is disabled if we haven't made any changes to the form, and will become enabled if we add something to the textbox.
20. Let's do the same for the `CategoryList`. In the `SharedComponents` project, in the folder `Pages/Admin`, open `CategoryList.razor`.
21. Replace the following line:

    ```
    <button class="btn btn-success" type="submit">Save</button>
    ```

    Replace the preceding line with the following line:

    ```
    <BlogButton Type="BlogButton.ButtonType.Save">Save</BlogButton>
    ```

    There are more places we can modify and add this button to, but let's not spend time on that for now. If you want, you can return to this and make sure we are using the new button and `InputText` everywhere.

We have one more component to build.

Locking the navigation

In .NET 7, we got a new component called `NavigationLock`. Right now, if we write a blog post and click somewhere in the menu, our changes will be lost. The same thing happens if we change the URL and press *Enter*. With `NavigationLock`, we can prevent that from happening.

`NavigationLock` can prevent us from leaving the page and navigating to another page in our site. In that case, we can show a custom message using JavaScript. If we navigate to another site, it can trigger a warning, but we don't have control over the message shown. This functionality is built into the browser.

We will implement this in the same way we did with `FieldCssClassProvider`, as a reusable component. We want to check whether our `EditContext` has any changes made so we can trigger the navigation lock:

1. In the `SharedComponents` project, in the `ReusableComponents` folder, add a new Razor component and name it `BlogNavigationLock.razor`.
2. At the top of the component, add the following code:

    ```
    @using Microsoft.AspNetCore.Components.Forms
    @using Microsoft.AspNetCore.Components.Routing
    @using Microsoft.JSInterop @inject IJSRuntime JSRuntime
    @implements IDisposable
    ```

We inject an `IJSRuntime` to make JavaScript calls. We will return to JavaScript interop in *Chapter 10, JavaScript Interop*.

We also implement the `IDisposable` interface.

3. In the code section, add the following code:

```
[CascadingParameter]
public required EditContext CurrentEditContext { get; set; }
public string InternalNavigationMessage { get; set; } = "You are
about to loose changes, are you sure you want to navigate away?";
public bool CheckNavigation { get; set; } = true;
```

We have a `CascadingParameter`, which gets the current `EditContext`, just as we did with `FieldCssClassProvider`.

We also added a string that is the message shown when we try to navigate from the page.

4. When a change happens in the `EditContext`, we need to update the component and make sure it locks the navigation. Add the following code:

```
protected override Task OnInitializedAsync()
{
    CurrentEditContext.OnFieldChanged += OnFieldChangedAsync;
    return base.OnInitializedAsync();
}
private async void OnFieldChangedAsync(object?
Sender,FieldChangedEventArgs args)
    {
        await InvokeAsync(StateHasChanged);
    }
void Idisposable.Dispose()
{
        CurrentEditContext.OnFieldChanged -= OnFieldChangedAsync;
    }
```

We start to listen for field changes, and if a field changes, we call the `StateHasChanged` method to update the component.

`InvokeAsync` is needed since the call comes from another thread.

We also override the `Dispose` method and remove the event listener.

5. In the code section, add the following code:

```
private async Task OnBeforeInternalNavigation
(LocationChangingContext context)
{
    if (CurrentEditContext.IsModified() && CheckNavigation)
    {
        var isConfirmed = await JSRuntime.
InvokeAsync<bool>("confirm",
            InternalNavigationMessage);
        if (!isConfirmed)
        {
            context.PreventNavigation();
        }
    }
}
```

   This method will make a JavaScript call if there are changes in the `EditContext` (or model), showing a confirm dialog and the message we added. If we do not confirm, the navigation will be prevented.

6. Now, we can add the `NavigationLock` component. Just under the directives, add the following code:

```
<NavigationLock ConfirmExternalNavigation="@
(CurrentEditContext.IsModified() && CheckNavigation)"
OnBeforeInternalNavigation="OnBeforeInternalNavigation" />
```

   This `NavigationLock` component will prevent external navigation (navigating to another site) and internal navigation (navigating to another page in our blog). It checks whether the `EditContext` (model) has any changes and prevents external navigation. On internal navigation, it will execute the `OnBeforeInternalNavigation` method, which checks whether the `EditContext` has been changed.

   Now, we only have one more thing to do.

7. In `Pages/Admin/BlogPostEdit.razor`, add the new Razor component we created just below the `CustomCssClassProvider`:

```
<BlogNavigationLock @ref="NavigationLock"/>
```

This will get the `EditContext` from the cascading value, and execute the code we just wrote.

Add the following:

```
@using SharedComponents.ReusableComponents
```

8. In the code section, add the following:

```
BlogNavigationLock? NavigationLock { get; set; }
```

9. In the `SavePostAsync` method, just before navigating to `admin/blogposts`, add the following:

```
NavigationLock?.CurrentEditContext.MarkAsUnmodified();
```

When saving the object, the `EditContext` doesn't know that, so we are telling the `EditContext` that the model is now unmodified, so the navigation should not be stopped.

10. Run the site, navigate to `Admin/BlogPosts`, and click a blog post.
11. Try to navigate to another site (it should work).
12. Try to navigate to another page (it should work).
13. Change the blog post.
14. Try navigating to another site (it should show a message box).
15. Try navigating to another page. You might notice that, in our case, it doesn't show a message box when we navigate to another page. What is up with that? It seems to be a limitation in how this component works. If we were running `InteractiveServer` or `InteractiveWebAssembly`, it would work. Navigation using static server rendering (which is what happens when we navigate) won't trigger the navigation change. If we want to test this, we can change our project to run as Blazor Server.
16. In the `BlazorWebApp` project, in the `Components` folder, open the `App.razor` file.

Replace the following line:

```
<Routes  />
```

Replace the preceding line with the following line:

```
<Routes @rendermode="RenderMode.InteractiveServer" />
```

17. Now we can try it again:

    a. Run the site, navigate to `Admin/BlogPosts`, and click a blog post.

b. Try to navigate to another site (it should work).
c. Try to navigate to another page (it should work).
d. Change the blog post.
e. Try navigating to another site (it should show a message box).
f. Try navigating to another page (it should show a message box).

   Now, change it back to `<Routes />`.

The point of this is to show that, in some cases, the built-in components will act differently depending on the render mode. I honestly think that this is a bug rather than a feature, but there are discussions about this.

Awesome! We have implemented another reusable component. Next, let's take a look at how we can use a form with a static server-side rendered component using enhanced form navigation.

Enhanced Form Navigation

In .NET 8, we got server-side rendering. Adding interactivity to a component is simple, as we have seen. But sometimes we just want a form and a submit button. Do we really have to enable WebAssembly or a SignalR connection for this? I'm glad you asked! The answer is, no, we don't.

Let's add a component to showcase that our blog posts need comments:

1. In the `SharedComponents` project, in the `Pages` folder, add a new Razor component called `Comments.razor`. This component should do two things: list comments and create a new comment.
2. In the `comments` file, replace the content with the following:

```
@using SharedComponents.ReusableComponents
@using Microsoft.AspNetCore.Components.Forms
@inject IBlogApi _api

<h3>Comments</h3>
@foreach (var c in comments)
{
    <div class="media mb-4">
        <div class="media-body">
            <h5 class="mt-0">@c.Name</h5>
            <p>@c.Text</p>
            <small class="text-muted">@c.Date</small>
```

```
        </div>
    </div>
}
```

This is a list of comments and some bootstrap classes to make it look better.

3. Continue by adding the form:

```
@if (Model != null)
{
    <EditForm method="post" Model="@Model" OnValidSubmit="@
ValidSubmitAsync" FormName="CommentForm">
        <DataAnnotationsValidator />
        <CustomCssClassProvider
ProviderType="BootstrapFieldCssClassProvider" />
        <BlogInputText @bind-Value="Model.Name" Label="Name" />
        <BlogInputText @bind-Value="Model.Text" Label="Comment" />
        <button type="submit">Add Comment</button>
    </EditForm>
}
```

4. We are still using an `EditForm` just as before and an `OnValidSubmit` property. There are some things that are new here, though. We are specifying the method we are using to post the form – in this case, a post method. We are also naming the form with the `FormName` parameter. These two properties must be there. We are using the `DataAnnotationValidator` and the `CustomCssClassProvider` we created earlier. We are even using the `BlogInputText`. But since this component isn't interactive, our button will not work as it is disabled by default, and if we remove the interactivity, it will stay disabled. So, in this case, we have to add a button the old-fashioned way. We can make sure that there is a non-interactive button for cases like this as well.

Now it is time for the code part of the form:

```

@code {
    [Parameter,EditorRequired]
    public required string BlogPostId { get; set; }
    [SupplyParameterFromForm]
    public Comment? Model { get; set; } = new();
    List<Comment> comments = new();
```

```
    protected override async Task OnInitializedAsync()
    {
        comments = await _api.GetCommentsAsync(BlogPostId);
    }

    public async Task ValidSubmitAsync()
    {
        Model.Id = Guid.NewGuid().ToString();
        Model.Date = DateTime.Now;
        Model.BlogPostId = BlogPostId;
        await _api.SaveCommentAsync(Model);
        comments = await _api.GetCommentsAsync(BlogPostId);
    }
}
```

5. Here, we are using a parameter so that our component knows what blog post to show comments for. It has `EditorRequired`, so Visual Studio will warn you if it is missing. The `Model` parameter has the `SupplyParameterFromForm` attribute, which is required. This is so Blazor knows what property to fill with data when the form is posted. The rest of the code is the same as the code we have used previously.
6. Open `Post.cs` and add the following code just beneath the line `@((MarkupString)Markdig.Markdown.ToHtml(BlogPost.Text, pipeline))`:

```
<Comments BlogPostId="@BlogPostId" />
```

So, what is happening?

When we submit our form, the component will be rerendered, creating a new instance of the component and filling the (in our case) `Model` parameter with the data from the post. With interactive components, `OnInitialized` and `OnInitializedAsync` will only run once (unless we are running prerendering). With these static components, it will reload the component. But we also get a "problem" because the scrolling positions get lost when the page reloads. We will now find ourselves at the top of the page, which is not a great user experience. Luckily, there is a solution; this is where the `Enhance` part comes in. By adding `Enhance` to our form, it will now keep its scroll position after posting the page. Pretty neat, right? We can also use a normal form instead of an `EditForm`.

It would then look something like this:

```
<form method="post" @onsubmit="…" @formname="name" data-enhance>
```

Instead of `Enhance`, we add `data-enhance`. Personally, I prefer to use an `EditForm` where I can, but it might be good to know that there are options.

We can also use `data-permanent` to keep the information in the form fields for a search parameter, for example. This way, the enhanced navigation will not update that data when the response is returned. How many times have we used a search field, misspelled something, and then the search field is empty and we need to retype everything? This is where `data-permanent` saves us.

Amazing!

This has been a heavy chapter, but wow, we have done so much – a whole bunch of new and reusable components and a complete admin interface.

Summary

This chapter taught us how to create forms and make API calls to get and save data.

We built custom input controls and got Bootstrap styling on our controls. Most business apps use forms; we can add logic close to the data by annotating data.

We also created multiple reusable components and used many of the things we discussed in previous chapters. We even touched on JavaScript interop, which we will go into more detail about in *Chapter 10*, *JavaScript Interop*.

The functionality that Blazor offers when it comes to validation and input controls will help us build amazing applications and give our users a great experience. You may notice that, right now, the admin pages are wide open. We need to secure our blog with a login, but we will come to that in *Chapter 8*, *Authentication and Authorization*.

In the next chapter, we will create a web API to get data when we are running components such as `InteractiveAuto` or `InteractiveWebAssembly`.

7

Creating an API

When running Blazor using WebAssembly (InteractiveWebAssembly or InteractiveAuto) we need to be able to retrieve data and also change our data. For that to work, we need an API to access the data. In this chapter, we will create a web API using **Minimal API**.

When using Blazor Server, the API will be secured by the page (if we add an **Authorize** attribute), so we get that for free. But with WebAssembly, everything will be executed in the browser, so we need something that WebAssembly can communicate with to update the data on the server.

To do this, we will need to cover the following topics:

- Creating the service
- Creating the client

Technical requirements

Make sure you have read the previous chapters or use the `Chapter06` folder as a starting point.

You can find the source code for this chapter's end result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter07`.

Creating the service

There are many ways to create a service, such as via REST.

For those who haven't worked with REST before, **REST** stands for **representational state transfer**. Simply put, it is a way for machines to talk to other devices using HTTP.

With REST, we use different HTTP verbs for different operations. They could look something like this:

URI	Verb	Action
`/BlogPosts`	Get	Gets a list of blog posts
`/BlogPosts`	Post	Creates a new blog post
`/BlogPosts/{id}`	Get	Gets a blog post with a specific ID
`/BlogPosts/{id}`	Put	Replaces a blog post
`/BlogPosts/{id}`	Patch	Updates a blog post
`/BlogPosts/{id}`	Delete	Deletes a blog post

Table 7.1: Rest calls

We will implement an API for **Tags**, **Categories**, and **blog posts**.

Since the API takes care of whether the `Post` should be created, we'll cheat and only implement `Put` (replace) because we don't know whether we are creating or updating the data.

We will implement the API in the **BlazorWebApp** project.

Learning about Minimal APIs

Before we jump into implementing the Minimal API, let's take a moment to learn about it. Back in November 2019, one of the members of the **Distributed Application Runtime** (**Dapr**) team wrote a couple of tutorials on how to build a distributed calculator using different languages.

They had examples using Go, Python, Node.js, and .NET Core. The code showed how much harder it was to write a distributed calculator in C# than in other languages.

Microsoft asked various non-.NET developers what their perception was of C#. Their response wasn't great. Then, Microsoft asked them to complete a tutorial using an early version of Minimal APIs.

After the tutorial, they were asked about their perception, and their response had shifted and was now more positive; it felt like home.

The goal of Minimal APIs was to reduce complexity and ceremony and embrace minimalism. I thought that "minimal" meant that I wouldn't be able to do everything, but digging deeper into the code, I soon realized that was not the case.

From my point of view, Minimal APIs are a much nicer way to code APIs. The idea is that if we need to, we can grow our API, and as soon as we feel like it, we can move our code into a controller to get more structure. At my workplace, we switched to Minimal APIs because we think the syntax is much nicer.

A very simple sample of adding a Minimal API would be just adding this line in `Program.cs`:

```
app.MapGet("/api/helloworld", () => "Hello world!");
```

We say that if we navigate to a URL without specifying any route, just `"/"`, we return a string with `"Hello World"`.

This is, of course, the simplest example possible, but it is possible to implement more complex things as well, as we will see in the next section.

Adding the API controllers

We have three data models: blog posts, Tags, and Categories.

Let's create three different files, one for each data model, to demonstrate that there are friendly ways to add more complex APIs using Minimal APIs. For a small project, it would probably make more sense to add everything in `Program.cs`.

Adding APIs for handling blog posts

Let's start by adding the API methods for handling blog posts.

Execute the following steps to create the API:

1. In the `BlazorWebApp` project, add a new folder called `Endpoints`.
2. In the `Endpoints` folder, create a class called `BlogPostEndpoints.cs`. The idea is to create an extension method we can use later in `Program.cs`.

   Add these `using` statements at the top of the file:

   ```
   using Data.Models;
   using Data.Models.Interfaces;
   using Microsoft.AspNetCore.Authorization;
   using Microsoft.AspNetCore.Mvc;
   ```

3. Replace the class with the following code:

   ```
   public static class BlogPostEndpoints
   {
   ```

```
    public static void MapBlogPostApi(this WebApplication app)
    {
        app.MapGet("/api/BlogPosts",
        async (IBlogApi api, [FromQuery] int numberofposts,
[FromQuery] int startindex) =>
        {
            return Results.Ok(await api.
GetBlogPostsAsync(numberofposts, startindex));
        });
       }
}
```

As we are creating an extension method, we must ensure the class is static. The `MapBlogPostApi` method uses the `this` keyword, which makes the method available on any `WebApplication` class.

We set up the Minimal API by using `MapGet` and a path, which means that the method will run if we access that path with the correct parameters using a `Get` verb.

The method takes a couple of parameters. The first is of the `IBlogApi` type, which will use dependency injection to get an instance of the class we need, in this case, `BlogApiJsonDirectAccess`, which will access the JSON files we have stored.

The other parameters will use the query string (since we are using the `query` attribute); in most cases, a Minimal API will figure these things out, but it's never wrong to nudge it in the right direction.

We have created a method that returns the data directly from the database (the same API the Blazor Server project is using).

We also need to make sure to call it from `Program.cs`.

4. In `Program.cs`, add the following namespace:

```
using BlazorWebApp.Endpoints;
```

5. Also, add the following code just above `app.Run();`:

```
app.MapBlogPostApi();
```

6. It's time to test the API; make sure to start the `BlazorWebApp` project. In .NET 6, the port numbers are random, so replace `{REPLACEWITHYOURPORTNUMBER}` with the port number for your project.

Go to the following URL: `https://localhost:{REPLACEWITHYOURPORTNUMBER}/Api/BlogPosts?numberofposts=10&startindex=0` (the port number might be something else). We will get some JSON back with a list of our blog posts.

We are off to a good start! Now, we need to implement the rest of the API as well.

7. In the `Endpoints/BlogPostEndpoint.cs` file, in the `MapBlogPostApi` method, let's add the code to get the blog post count:

```
app.MapGet("/api/BlogPostCount",
async (IBlogApi api) =>
{
    return Results.Ok(await api.GetBlogPostCountAsync());
});
```

   We use the `Get` verb but with another route.

8. We also need to be able to get one blog post. Add the following code:

```
app.MapGet("/api/BlogPosts/{*id}",
async (IBlogApi api, string id) =>
{
    return Results.Ok(await api.GetBlogPostAsync(id));
});
```

   In this case, we are using the *Get* verb but with another URL, containing the ID for `Post` that we want to get.

   We are using a string as an ID and some databases, like RavenDB, for example, use an ID that looks like this: `CollectionName/IdOfThePost`; we also make sure to add * to the parameter. This way, it will use anything that comes after as an ID, otherwise it would interpret the slash as part of the routing and not find the endpoint.

   Next, we need an API that is protected, typically the one that updates or deletes things.

9. Let's add an API that saves a blog post. Add the following code under the code we just added:

```
app.MapPut("/api/BlogPosts",
async (IBlogApi api, [FromBody] BlogPost item) =>
{
    return Results.Ok(await api.SaveBlogPostAsync(item));
}).RequireAuthorization();
```

As I mentioned earlier in this chapter, we will only add one API for creating and updating blog posts, and we will use the `Put` verb (replace) to do that. We have added the `RequireAuthorization` method at the end, which will ensure that the user needs to be authenticated to call the method.

10. Next up, we add a code for deleting blog posts. To do this, add the following code:

```
app.MapDelete("/api/BlogPosts/{*id}",
async (IBlogApi api, string id) =>
{
    await api.DeleteBlogPostAsync(id);
    return Results.Ok();
}).RequireAuthorization();
```

In this case, we use the `Delete` verb, and just as with saving, we add the `RequireAuthorization` method at the end.

Next, we need to do this for `Categories` and `Tags` as well.

Adding APIs for handling Categories

Let's start with `Categories`. Follow these steps:

1. In the `Endpoints` folder, add a new class called `CategoryEndpoints.cs`. Replace the code with the following:

```
using Data.Models;
using Data.Models.Interfaces;
using Microsoft.AspNetCore.Mvc;
namespace BlazorWebApp.Endpoints;
public static class CategoryEndpoints
{
    public static void MapCategoryApi(this WebApplication app)
    {
        app.MapGet("/api/Categories",
        async (IBlogApi api) =>
        {
            return Results.Ok(await api.GetCategoriesAsync());
        });
        app.MapGet("/api/Categories/{*id}",
        async (IBlogApi api, string id) =>
```

```
        {
            return Results.Ok(await api.GetCategoryAsync(id));
        });

        app.MapPut("/api/Categories",
        async (IBlogApi api, [FromBody] Category item) =>
        {
            return Results.Ok(await api.SaveCategoryAsync(item));
        }).RequireAuthorization();

        app.MapDelete("/api/Categories/{*id}",
        async (IBlogApi api, string id) =>
        {
            await api.DeleteCategoryAsync(id);
            return Results.Ok();
        }).RequireAuthorization();
    }
}
```

2. In `Program.cs`, add the following code just above `app.Run()`:

```
app.MapCategoryApi();
```

These are all the methods needed to handle `Categories`.

Next, let's do the same thing with `Tags`.

Adding APIs for handling Tags

Let's do the same things for Tags by following these steps:

1. In the `Endpoints` folder, add a new class called `TagEndpoints.cs`. Add the following code:

```
using Data.Models;
using Data.Models.Interfaces;
using Microsoft.AspNetCore.Mvc;
namespace BlazorWebApp.Endpoints;
public static class TagEndpoints
{
    public static void MapTagApi(this WebApplication app)
    {
```

```
        app.MapGet("/api/Tags",
        async (IBlogApi api) =>
        {
            return Results.Ok(await api.GetTagsAsync());
        });
        app.MapGet("/api/Tags/{*id}",
        async (IBlogApi api, string id) =>
        {
            return Results.Ok(await api.GetTagAsync(id));
        });
        app.MapPut("/api/Tags",
        async (IBlogApi api, [FromBody] Tag item) =>
        {
            return Results.Ok(await api.SaveTagAsync(item));
        }).RequireAuthorization();          app.MapDelete("/api/
Tags/{*id}",
        async (IBlogApi api, string id) =>
        {
            await api.DeleteTagAsync(id);
            return Results.Ok();
        }).RequireAuthorization();

    }
}
```

2. In `Program.cs`, add the following code just above `app.Run()`:

```
app.MapTagApi();
```

But wait! What about comments? The way we have implemented comments means that the component will never run as WebAssembly, so we don't really need to implement it in the API. But we are not going to leave the comments hanging – let's implement those as well!

Adding APIs for handling comments

Let's do the same things for comments by following these steps:

1. In the `Endpoints` folder, add a new class called `CommentEndpoints.cs`. Add the following code:

```
using Data.Models;
```

```
using Data.Models.Interfaces;
using Microsoft.AspNetCore.Mvc;
namespace BlazorWebApp.Endpoints;
public static class CommentEndpoints
{
    public static void MapCommentApi(this WebApplication app)
    {
        app.MapGet("/api/Comments/{*blogPostid}",
        async (IBlogApi api, string blogPostid) =>
        {
            return Results.Ok(await api.
GetCommentsAsync(blogPostid));
        });
        }).RequireAuthorization();

        app.MapPut("/api/Comments",
        async (IBlogApi api, [FromBody] Comment item) =>
        {
            return Results.Ok(await api.SaveCommentAsync(item));
        }).RequireAuthorization();

        app.MapDelete("/api/Comments/{*id}",
        async (IBlogApi api, string id) =>
        {
            await api.DeleteCommentAsync(id);
            return Results.Ok();
    }
}
```

2. In `Program.cs`, add the following code just above `app.Run()`:

```
app.MapCommentApi();
```

Great! We have an API! Now, it's time to create the client that will access that API.

Creating the client

To access the API, we need to create a client. There are many ways of doing this, but we will do it in the simplest way possible by writing the code ourselves.

The client will implement the same `IBlogApi` interface. This way, we have the same code regardless of which implementation we are using, and direct JSON access with `BlogApiJsonDirectAccess` or `BlogApiWebClient`, which we are going to create next:

1. Right-click on the **Dependencies** node under `BlazorWebApp.Client` and select **Manage NuGet Packages**.
2. Search for `Microsoft.AspNetCore.Components.WebAssembly.Authentication` and click **Install**.
3. Also, search for `Microsoft.Extensions.Http` and click **Install**.
4. In the `BlazorWebApp.Client` project, in the root of the project, add a new class and name it `BlogApiWebClient.cs`.
5. Open the newly created file and add the following namespaces:

```
using Data.Models;
using Data.Models.Interfaces;
using Microsoft.AspNetCore.Components.WebAssembly.Authentication;
using System.Net.Http.Json;
using System.Text.Json;
```

6. Add `IBlogApi` to the class and make it public like this:

```
namespace BlazorWebApp.Client;
public class BlogApiWebClient : IBlogApi
{
}
```

7. Some API calls will be public (do not require authentication), but `HttpClient` will be configured to require a token.

   The handling of tokens is handled automatically by Blazor, so we only need one client, and, in this case, we call it `Api`.

   To be able to call the API, we need to inject `HttpClient`. Add the following code to the class:

```
    private readonly IHttpClientFactory _factory;
    public BlogApiWebClient(IHttpClientFactory factory)
    {
        _factory = factory;
    }
```

8. Now, it's time to implement calls to the API. Let's begin with the *Get* calls for blog posts. Add the following code:

```
public async Task<BlogPost?> GetBlogPostAsync(string id)
    {
        var httpclient = _factory.CreateClient("Api");
        return await httpclient.GetFromJsonAsync<BlogPost>($"api/
BlogPosts/{id}");
    }
    public async Task<int> GetBlogPostCountAsync()
    {
        var httpclient = _factory.CreateClient("Api");
        return await httpclient.GetFromJsonAsync<int>("/api/
BlogPostCount");
    }
    public async Task<List<BlogPost>?> GetBlogPostsAsync(int
numberofposts, int startindex)
    {
        var httpclient = _factory.CreateClient("Api");
        return await httpclient.
GetFromJsonAsync<List<BlogPost>>($"/api/
BlogPosts?numberofposts={numberofposts}&startindex={startindex}");
    }
```

We use the `HttpClient` we injected and then call `GetFromJsonAsync`, which will automatically download the JSON and convert it into the class we supply to the generic method.

Now, it gets a little trickier: we need to handle authentication. Luckily, this is built into `HttpClient` so we only need to handle `AccessTokenNotAvailableException`. If a token is missing, it will automatically try and renew it, but if there is a problem (for example, the user is not logged in), we can redirect to the login page.

We will come back to tokens and how authentication works in *Chapter 8*, *Authentication and Authorization*.

9. Next, we add the API calls that need authentication, such as saving or deleting a blog post.

   Add the following code under the code we just added:

```
public async Task<BlogPost?> SaveBlogPostAsync(BlogPost item)
{
    try
```

```
    {
        var httpclient = _factory.CreateClient("Api");
        var response = await httpclient.PutAsJsonAsync<BlogPost>
           ("api/BlogPosts", item);
        var json = await response.Content.ReadAsStringAsync();
        return JsonSerializer.Deserialize<BlogPost>(json);
    }
    catch (AccessTokenNotAvailableException exception)
    {
        exception.Redirect();
    }
    return null;
}
public async Task DeleteBlogPostAsync(string id)
{
    try
    {
        var httpclient = _factory.CreateClient("Api");
        await httpclient.DeleteAsync($"api/BlogPosts/{id}");
    }
    catch (AccessTokenNotAvailableException exception)
    {
        exception.Redirect();
    }
}
```

If the call throws `AccessTokenNotAvailableException`, that means `HttpClient` couldn't get or renew a token automatically, and the user needs to log in.

This state should probably never happen because we will ensure that when the user navigates to that page, they will need to be logged in, but it's better to be safe than sorry.

10. Now, we need to do the same for `Categories`. Add the following code to the `BlogApiWebClient` class:

```
public async Task<List<Category>?> GetCategoriesAsync()
{
    var httpclient = _factory.CreateClient("Api");
```

```
    return await httpclient.GetFromJsonAsync<List<Category>>($"api/
Categories");
}
public async Task<Category?> GetCategoryAsync(string id)
{
    var httpclient = _factory.CreateClient("Api");
    return await httpclient.GetFromJsonAsync<Category>($"api/
Categories/{id}");
}
public async Task DeleteCategoryAsync(string id)
{
    try
    {
        var httpclient = _factory.CreateClient("Api");
        await httpclient.DeleteAsync($"api/Categories/{id}");
    }
    catch (AccessTokenNotAvailableException exception)
    {
        exception.Redirect();
    }
}
public async Task<Category?> SaveCategoryAsync(Category item)
{
    try
    {
        var httpclient = _factory.CreateClient("Api");
        var response = await httpclient.
PutAsJsonAsync<Category>("api/Categories", item);
        var json = await response.Content.ReadAsStringAsync();
        return JsonSerializer.Deserialize<Category>(json);
    }
    catch (AccessTokenNotAvailableException exception)
    {
        exception.Redirect();
    }
    return null;
}
```

11. Next up, we will do the same for Tags. Add the following code just under the code we just added:

```
public async Task<Tag?> GetTagAsync(string id)
{
    var httpclient = _factory.CreateClient("Api");
    return await httpclient.GetFromJsonAsync<Tag>($"api/Tags/{id}");
}
public async Task<List<Tag>?> GetTagsAsync()
{
    var httpclient = _factory.CreateClient("Api");
    return await httpclient.GetFromJsonAsync<List<Tag>>($"api/
Tags");
}
public async Task DeleteTagAsync(string id)
{
    try
    {
        var httpclient = _factory.CreateClient("Api");
        await httpclient.DeleteAsync($"api/Tags/{id}");
    }
    catch (AccessTokenNotAvailableException exception)
    {
        exception.Redirect();
    }
}
public async Task<Tag?> SaveTagAsync(Tag item)
{
    try
    {
        var httpclient = _factory.CreateClient("Api");
        var response = await httpclient.PutAsJsonAsync<Tag>("api/
Tags", item);
        var json = await response.Content.ReadAsStringAsync();
        return JsonSerializer.Deserialize<Tag>(json);
    }
    catch (AccessTokenNotAvailableException exception)
```

```
    {
        exception.Redirect();
    }
    return null;
}
```

12. Let's not forget about our comments! Add the following code just under the code we just added:

```
public async Task<List<Comment>> GetCommentsAsync(string blogpostid)
    {
        var httpclient = _factory.CreateClient("Api");
        return await httpclient.
GetFromJsonAsync<List<Comment>>($"api/Comments/{blogpostid}");
    }

    public async Task DeleteCommentAsync(string id)
    {
        try
        {
            var httpclient = _factory.CreateClient("Api");
            await httpclient.DeleteAsync($"api/Comments/{id}");
        }
        catch (AccessTokenNotAvailableException exception)
        {
            exception.Redirect();
        }
    }
    public async Task<Comment?> SaveCommentAsync(Comment item)
    {
        try
        {
            var httpclient = _factory.CreateClient("Api");
            var response = await httpclient.
PutAsJsonAsync<Comment>("api/Comments", item);
            var json = await response.Content.ReadAsStringAsync();
            return JsonSerializer.Deserialize<Comment>(json);
        }
```

```
        catch (AccessTokenNotAvailableException exception)
        {
            exception.Redirect();
        }
        return null;
    }
```

Great job! Our API client is now done!

Summary

In this chapter, we learned how to create an API using Minimal APIs and an API client, which is an important part of most applications. This way, we can get blog posts from our database and show them when we are running on WebAssembly. It is worth mentioning that we can always run our applications using a web API; this is just to show that we can use different ways to access our data depending on what hosting model we are currently using.

In the next chapter, we will add the login functionality to our sites and call our API for the first time.

8

Authentication and Authorization

In this chapter, we will learn how to add **authentication** and **authorization** to our blog because we don't want just anyone to be able to create or edit blog posts.

Covering authentication and authorization could take a whole book, so we will keep things simple here. This chapter aims to get the built-in authentication and authorization functionalities working, building on the already existing functionality that's built into ASP.NET. That means that there is not a lot of Blazor magic involved here; many resources already exist that we can take advantage of.

Almost every system today has some way to log in, whether it is an admin interface (like ours) or a member login portal. There are many different login providers, such as Google, Twitter, and Microsoft. We can use all of these providers since we will just be building on existing architecture.

Some sites might already have a database for storing login credentials, but for our blog, we will use a service called Auth0 to manage our users. It is a very powerful way to add many different social providers (if we want to), and we don't have to manage the users ourselves.

We can check the option to add authentication when creating our project. The authentication works differently when it comes to Blazor Server, Blazor WebAssembly, and the API, which we will look at in more detail in this chapter.

We will cover the following topics in this chapter:

- Setting up authentication

- Securing Blazor Server
- Securing Blazor WebAssembly
- Securing the API
- Adding authorization

Technical requirements

Make sure you have followed the previous chapters or use the `Chapter07` folder as a starting point.

You can find the source code for this chapter's end result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter08`.

Setting up authentication

There are a lot of built-in functionalities when it comes to authentication. The easiest way to add authentication is to select an authentication option when creating a project.

We need to implement authentication separately for the Blazor Server project and the Blazor WebAssembly project because they work differently.

But there are still things we can share between these two projects. First, we need to set up Auth0.

Auth0 is a service that can help us with handling our users. There are many different services like this, but Auth0 is a good fit for us. We can connect one or more social connectors, which will allow our users to log in with Facebook, Twitter, Twitch, or whatever we add to our site.

Even though all of this can be achieved by writing code ourselves, integration like this is a great way to add authentication quickly and also get a very powerful solution. Also, authentication is complex, so don't write this unless you are sure of what you are doing. Auth0 is free for up to 7,000 users (which our blog probably won't reach, especially not the admin interface).

It also has great functionality to add data to our users that we have access to. We will do that later in the chapter when we add roles to our users. You'll need to take the following steps:

1. Head over to `https://auth0.com` and create an account.
2. Click the **Create Application** button.
3. Now, it's time to name our application. Use `MyBlog`, for example. Then, it's time to select what kind of application type we are using. Is it a native app? Is it a **single-page web application**, **regular web application**, or **machine-to-machine application**?

This depends on what hosting model we are going to run.

The beautiful thing with how we have the project set up right now is that the server is going to handle all the authentication and hand that over to WebAssembly (if we have a component that is running in InteractiveAuto or InteractiveWebAssembly). But it won't limit the functionality, only what we need to configure when setting up our application.

If we intend to only run as Blazor Server (InteractiveServer), we should use a regular web application. But we might want to change to running everything in InteractiveWebAssembly, so let's not limit ourselves here.

Select **Single Page Application**, that way we get the option to use our authentication in any hosting model.

Next, we will choose what technology we are using for our project. We have Apache, .NET, Django, Go, and many other choices, but we don't have a choice for Blazor specifically, at least not at the time of writing.

Just skip this and click the **Setting** tab.

Now, we will set up our application. There are a couple of values we need to save and use later. You need to make sure that you write down the `Domain`, `Client ID`, and `Client Secret`, as we will use those in a bit.

If we scroll down, we can change the logo, but we will skip that.

4. Leave `Application Login URI` empty. Starting with .NET 6, the port numbers are random, so make sure you add your application's port number:

   a. `Allowed callback URLs`: `https://localhost:PORTNUMBER/callback`

   b. `Allowed logout URLs`: `https://localhost:PORTNUMBER/`

   Allowed callback URLs are the URLs `Auth0` will make a call to after the user authentication and allowed logout URLs are where the user should be redirected after logging out.

Now, press **Save Changes** at the bottom of the page.

Configuring our Blazor app

We are done with configuring Auth0. Next, we will configure our Blazor application.

There are many ways to store secrets in .NET (a file that is not checked in, Azure Key Vault, etc.). You can use the one that you are most familiar with.

We will keep it very simple and store secrets in our `appsettings.json`. Make sure to remember to exclude the file when you check in. You don't check the secrets in source control. You can right-click on the file and select **Git**, **Ignore and Untrack Item**.

To configure our Blazor project, follow these steps:

1. In the `BlazorWebApp.Client` project, in the root, add a new class called `UserInfo.cs`, and add the following content:

```
namespace BlazorWebApp.Client;
public class UserInfo
{
    public required string UserId { get; set; }
    public required string Email { get; set; }
    public required string[] Roles { get; set; }
}
```

   This is taken from the Blazor template.

2. In the `BlazorWebApp` project, open `appsettings.json` and add the following code to the root of the existing app settings object:

```
  "Auth0": {
    "Authority": "Get this from the domain for your application at
Auth0",
    "ClientId": "Get this from Auth0 setting"
  }
```

   These are the values we made a note of in the previous section. Replace the values with our own values from `Auth0`.

   Since our site is an ASP.NET site with some added Blazor functionality, this means we can use a NuGet package to get some of the functionality out of the box.

3. In the `BlazorWebApp` project, add a reference to the `Auth0.AspNetCore.Authentication` `NuGet` package.

4. In the root of the project, create a new class named `PersistingServerAuthenticationStateProvider.cs`, and add the following code:

```
using BlazorWebApp.Client;
using Microsoft.AspNetCore.Components;
```

```
using Microsoft.AspNetCore.Components.Authorization;
using Microsoft.AspNetCore.Components.Server;
using Microsoft.AspNetCore.Components.Web;
using Microsoft.AspNetCore.Identity;
using Microsoft.Extensions.Options;
using System.Diagnostics;

namespace BlazorWebApp;

internal sealed class PersistingServerAuthenticationStateProvider :
ServerAuthenticationStateProvider, IDisposable
{
    private readonly PersistentComponentState state;
    private readonly IdentityOptions options;

    private readonly PersistingComponentStateSubscription
subscription;

    private Task<AuthenticationState>? authenticationStateTask;

    public PersistingServerAuthenticationStateProvider(
        PersistentComponentState persistentComponentState,
        IOptions<IdentityOptions> optionsAccessor)
    {
        state = persistentComponentState;
        options = optionsAccessor.Value;

        AuthenticationStateChanged += OnAuthenticationStateChanged;
        subscription = state.RegisterOnPersisting(OnPersistingAsync,
RenderMode.InteractiveWebAssembly);
    }

    private void
OnAuthenticationStateChanged(Task<AuthenticationState> task)
    {
        authenticationStateTask = task;
    }
```

```
    private async Task OnPersistingAsync()
    {
        if (authenticationStateTask is null)
        {
            throw new UnreachableException($"Authentication state
not set in {nameof(OnPersistingAsync)}().");
        }

        var authenticationState = await authenticationStateTask;
        var principal = authenticationState.User;

        if (principal.Identity?.IsAuthenticated == true)
        {
            var userId = principal.FindFirst(options.ClaimsIdentity.
UserIdClaimType)?.Value;
            var email = principal.FindFirst(options.ClaimsIdentity.
EmailClaimType)?.Value;
            var roles = principal.FindAll(options.ClaimsIdentity.
RoleClaimType);

            if (userId != null)
            {
                state.PersistAsJson(nameof(UserInfo), new UserInfo
                {
                    UserId = userId,
                    Email = email,
                    Roles=roles.Select(r=>r.Value).ToArray()
                });
            }
        }
    }

    public void Dispose()
    {
        subscription.Dispose();
        AuthenticationStateChanged -= OnAuthenticationStateChanged;
    }
}
```

5. I have taken this file from the Blazor template (when we choose to add authentication right away). I added roles to it so if `Auth0` delivers any roles, they will be stored in the state as well. Right now, `Auth0` won't give us any roles, so we will get back to roles in a bit. What is happening is when we log in, it will save the logged-in user in the `PersistentComponentState` so that we can easily transfer the user over to WebAssembly. The server will render the data on the DOM, and WebAssembly will then pick that up.
6. Open `Program.cs` and add the following at the top of the file:

```
using BlazorWebApp;
using Auth0.AspNetCore.Authentication;
using Microsoft.AspNetCore.Authentication;
using Microsoft.AspNetCore.Authentication.Cookies;
```

7. Add the following code just before `WebApplication app = builder.Build();`:

```
builder.Services.AddScoped<AuthenticationStateProvider,
PersistingServerAuthenticationStateProvider>();
builder.Services.AddCascadingAuthenticationState();
builder.Services
    .AddAuth0WebAppAuthentication(options =>
    {
        options.Domain = builder.
Configuration["Auth0:Authority"]??"";;
        options.ClientId = builder.
Configuration["Auth0:ClientId"]??"";;
    });
```

8. In previous versions of Blazor, we had to first make sure that when our components asked for `AuthenticationStateProvider`, we sent back an instance of our `PersistingServerAuthenticationStateProvider`. We also add a call to `AddCascadingAuthenticationState`, which will make sure to always send an `AuthenticationState` to all our components regardless of hosting method.
9. Also, add the following code just after `app.UseAntiforgery();`. This code will allow us to secure our site:

```
app.UseAuthentication();
app.UseAuthorization();
```

10. In `Program.cs`, add the following code just before `app.Run()`:

```
app.MapGet("account/login", async (string redirectUri, HttpContext
```

```
 context) =>
{
    var authenticationProperties = new
LoginAuthenticationPropertiesBuilder()
         .WithRedirectUri(redirectUri)
         .Build();
    await context.ChallengeAsync(Auth0Constants.
AuthenticationScheme, authenticationProperties);
});
```

When our site redirects to `authentication/login`, the Minimal API endpoint will kick off the login functionality.

11. We need to add a similar functionality for logging out. Add the following code below the previous endpoint from *Step 7*:

```
app.MapGet("authentication/logout", async (HttpContext context) =>
{
    var authenticationProperties = new
LogoutAuthenticationPropertiesBuilder()
         .WithRedirectUri("/")
         .Build();
    await context.SignOutAsync(Auth0Constants.AuthenticationScheme,
authenticationProperties);
    await context.SignOutAsync(CookieAuthenticationDefaults.
AuthenticationScheme);
});
```

It needs to sign out twice, once for the `Auth0` authentication scheme and once for the cookie authentication scheme. The configuration is all set. Now, we need something to secure.

Securing our Blazor app

Blazor uses `App.razor` for routing. To enable securing Blazor, we need to add a couple of components in the app component.

We need to add `CascadingAuthenticationState`, which will send the authentication state to all the components that are listening for it. We also need to change the route view to `AuthorizeRouteView`, which can have different views depending on whether or not you are authenticated:

1. In the `BlazorWebApp` project, open `Components/_Imports.razor` and add the namespaces:

```
@using Microsoft.AspNetCore.Components.Authorization
@using BlazorWebApp.Components.Layout
@using BlazorWebApp.Components
```

2. Open the `Components/Routes.razor` component and replace everything inside the `Router` component with the following:

```
<Found Context="routeData">
     <AuthorizeRouteView RouteData="@routeData" DefaultLayout="@
typeof(MainLayout)">
         <Authorizing>
             <p>Determining session state, please wait...</p>
         </Authorizing>
         <NotAuthorized>
             <h1>Sorry</h1>
             <p>You're not authorized to reach this page. You need
to log in.</p>
         </NotAuthorized>
     </AuthorizeRouteView>
     <FocusOnNavigate RouteData="@routeData" Selector="h1" />
 </Found>
 <NotFound>
     <PageTitle>Not found</PageTitle>
     <LayoutView Layout="@typeof(MainLayout)">
         <p role="alert">Sorry, there's nothing at this address.</p>
     </LayoutView>
 </NotFound>
```

   In previous versions of Blazor, we had to surround the code with `<CascadingAuthenticationState>`, but with .NET 8, that is handled automatically by adding the call to `AddCascadingAuthenticationState`.

   Now, only two things remain: a page that we can secure and a login link display.

3. In the `Components` folder, add a new Razor component called `LoginStatus.razor`.

   Replace the content with the following:

```
<AuthorizeView>
    <Authorized>
```

```
            <a href="authentication/logout">Log out</a>
        </Authorized>
        <NotAuthorized>
            <a href="account/login?returnUrl=/">Log in</a>
        </NotAuthorized>
    </AuthorizeView>
```

`LoginStatus` is a component that will show a login link if we are not authenticated and a logout link if we are authenticated.

4. Open `Components/Layout/MainLayout.razor`:

```
<AuthorizeView Roles="Administrator">
        <div class="sidebar">
            <NavMenu />
        </div>
</AuthorizeView>
```

Replace the about link with the following:

```
<LoginStatus />
```

Now, our layout page will show us whether or not we're logged in and give us the opportunity to log in or log out.

5. In `SharedComponents` and the `BlazorWebApp.Client` project, in the `_Imports` file of each project, add the following:

```
@using Microsoft.AspNetCore.Authorization
```

6. Add the `authorize` attribute to the component we wish to secure.
7. We have the following components in the `SharedComponents` project:

`Pages/Admin/BlogPostEdit.razor`

`Pages/Admin/BlogPostList.razor`

`Pages/Admin/CategoryList.razor`

`Pages/Admin/TagList.razor (in the BlazorWebApp.Client project)`

In each of the preceding components, add the following attribute:

```
@attribute [Authorize]
```

This is all it takes, some configuration, and then we are all set.

Now, start our `BlazorWebApp` and see if you can access the `/admin/blogposts` page (spoiler: you shouldn't be able to); log in (create a user) and see if you can access the page now.

Our admin interface is secured.

In the next section, we will secure the Blazor WebAssembly version of our blog and the API.

Securing Blazor WebAssembly

In the previous editions of this book, we built two versions of the blog, one for Blazor Server and one for Blazor WebAssembly. In this edition, the whole point is that we don't have to choose one over the other. As previously mentioned, there are two projects, `BlazorWebApp` and `BlazorWebApp.Client`. In the client project, we add all the components we want to be able to run as WebAssembly. Here is the really cool part. We have our `TagList` component in the client project. If we are running it as InteractiveAuto, it will first render on the server using SignalR using the configuration found in the `BlazorWebApp` project. But the next time the site runs, it will load the WebAssembly version and use the configuration in the `BlazorWebApp.Client` project. So, the same component can use a different dependency injection. In one case, it will use direct data access, and in the other, it will use the API client we created in the previous chapter.

For us to be able to access our API, we need to set up `HttpClient`:

But first, we need to get authentication information from the server. WebAssembly doesn't really log in; it gets the information from the server and uses the authentication cookie for additional calls to the server.

In the server project, we added a `PersistingServerAuthenticationStateProvider` to store information about the logged-in user. On the client, we need to get that information.

1. In the `BlazorWebApp.Client` project, add a new class in the root called `PersistentAuthenticationStateProvider.cs`.
2. Replace the code with the following:

```
using BlazorWebApp.Client;
using Microsoft.AspNetCore.Components;
using Microsoft.AspNetCore.Components.Authorization;
using System.Security.Claims;

namespace BlazorApp1.Client;
```

```
internal class PersistentAuthenticationStateProvider :
AuthenticationStateProvider
{
    private static readonly Task<AuthenticationState>
defaultUnauthenticatedTask =
        Task.FromResult(new AuthenticationState(new
ClaimsPrincipal(new ClaimsIdentity())));

    private readonly Task<AuthenticationState>
authenticationStateTask = defaultUnauthenticatedTask;

    public
PersistentAuthenticationStateProvider(PersistentComponentState
state)
    {
        if (!state.TryTakeFromJson<UserInfo>(nameof(UserInfo), out
var userInfo) || userInfo is null)
        {
            return;
        }

        List<Claim> claims = new();

        claims.Add(new Claim(ClaimTypes.NameIdentifier, userInfo.
UserId));
        claims.Add(new Claim(ClaimTypes.Name, userInfo.Email??""));
        claims.Add(new Claim(ClaimTypes.Email, userInfo.Email??""));
        foreach (var role in userInfo.Roles)
        {
            claims.Add(new Claim(ClaimTypes.Role, role));
        }

        authenticationStateTask = Task.FromResult(
            new AuthenticationState(new ClaimsPrincipal(new
ClaimsIdentity(claims,
                authenticationType:
nameof(PersistentAuthenticationStateProvider)))));
```

```
    }

    public override Task<AuthenticationState>
GetAuthenticationStateAsync() => authenticationStateTask;
}
```

3. This is also taken from the Blazor template (with authentication). Only minor modifications appear here, like adding roles.
4. In the `BlazorWebApp.Client` project, in `Program.cs`, add the following lines just above `builder.Build().RunAsync();`:

```
builder.Services.AddAuthorizationCore();
builder.Services.AddCascadingAuthenticationState();
builder.Services.AddSingleton<AuthenticationStateProvider,
PersistentAuthenticationStateProvider>();


builder.Services.AddHttpClient("Api",client => client.BaseAddress =
new Uri(builder.HostEnvironment.BaseAddress));
```

This will enable authentication, add cascading `authentication state` to our components, and get the logged-in user from the `Persistent Component State`. The name of the `HttpClient` is "`Api`"; this is the name we used in *Chapter 7*, *Creating an API*.

We also need to set up dependency injection so that when we ask for an `IBlogAPI`, we will get the `BlogApiWebClient` that we created in *Chapter 7*, *Creating an API*.

5. In `Program.cs`, add the following code below the `builder.Services.AddSingleton<AuthenticationStateProvider, PersistentAuthenticationStateProvider>();` line:

```
builder.Services.AddTransient<IBlogApi, BlogApiWebClient>();
```

Now, when we ask for an `IBlogApi`, we will get the API web client that accesses the data through an API. The really cool thing here is that, depending on whether the component is rendered on the server (Static, InteractiveServer), the client (InteractiveWebAssembly), or a combination (InteractiveAuto), it will choose the right client for that scenario. We have the ability to choose the one that is best suited.

6. Make sure to add the required namespaces as well.

Now, everything is prepared for us to secure when running in WebAssembly mode.

This sample is about securing WebAssembly when running with an ASP.NET backend. In *Chapter 16*, *Going Deeper into WebAssembly*, we will take a look at how to secure a Blazor WebAssembly app.

Let's give it a try:

1. In the `BlazorWebApp.Client` project, open the `Pages/Admin/TagList.razor`. We have been running our component with the InteractiveServer render mode up to this point. Now, let's change that and run it as InteractiveWebAssembly instead.

Change `@rendermode InteractiveServer` to `@rendermode InteractiveWebAssembly`. That's it! Now, our component will first render on the server (since we are running server pre-rendering), and then WebAssembly will take over and render the component again. It will pick up the authentication information stored in the component state and use our web API to retrieve the data from our API. This is because the WebAssembly application is configured to use `BlogApiWebClient` when we ask for an instance of `IBlogApi`. So, the same component is first prerendered on the server using direct data access, then again using the web API. Pretty cool!

Now, run the project, navigate to `/Admin/Tags`, and try to edit some tags. This component is now running on WebAssembly. You can try to change it to `@rendermode InteractiveAuto`. To see the behavior, this will first hook up SignalR and then, on the next load, switch to WebAssembly.

But what if different users have different permissions?

That is where roles come in.

Adding roles

Blazor Server and Blazor WebAssembly handle roles a bit differently; it's nothing major, but we need to do different implementations. In this chapter, we will take a look at implementing it for our current project (per component) and return to roles in *Chapter 16*, *Going Deeper into WebAssembly*.

Configuring Auth0 by adding roles

Let's start by adding roles in Auth0:

1. Log in to `Auth0`, navigate to **User Management** | **Roles**, and click **Create Role**.
2. Enter the name `Administrator` and the description `Can do anything` and press **Create**.
3. Go to the **Users** tab, click **Add Users**, search for your user, and then click **Assign**. You can also manage roles from the **Users** menu on the left.
4. By default, roles won't be sent to the client, so we need to enrich the data to include roles.

   We do that by adding an action.

5. Go to **Actions**, and then **Flows**.

   Flows are a way to execute code in a particular flow.

   We want `Auth0` to add our roles when we log in.

6. Select **Login**, and there we will see the flow; in our case, we don't have anything yet.
7. On the right-hand side, click **Custom** and the plus sign. As a small pop-up menu appears, select **Build from scratch**.
8. Name the action `Add Roles`, leave **Trigger** and **Runtime** as is, and press **Create**.

   We will see a window where we can write our action.

9. Replace all the code with the following:

```
/**
 * @param {Event} event - Details about the user and the context in
which they are logging in.
 * @param {PostLoginAPI} api - Interface whose methods can be used
to change the behavior of the login.
 */
exports.onExecutePostLogin = async (event, api) => {
  const claimName  = 'http://schemas.microsoft.com/ws/2008/06/
identity/claims/role'
  if (event.authorization) {
    api.idToken.setCustomClaim(claimName, event.authorization.
roles);
    api.accessToken.setCustomClaim(claimName, event.authorization.
roles);
  }
}
```

10. Click **Deploy** and then **Back to flow**.
11. Click **Custom** again, and we will see our newly created action.
12. Drag the **Add Roles** action to the arrow between **Start** and **Complete**.
13. Click **Apply**.

Now, we have an action that will add the roles to our login token.

Our user is now an administrator. It's worth noting that roles are a paid feature in Auth0 and will only be free during the trial.

Now, let's set up Blazor to use this new role.

Adding roles to Blazor

Since we are using the Auth0 library, the setup is almost done for Blazor.

Let's modify a component to show whether the user is an administrator:

1. In the `Components` project, open `Shared/NavMenu.razor`.
2. At the top of the component, add the following:

```
<AuthorizeView Roles="Administrator">
    <Authorized>
        Hi admin!
    </Authorized>
    <NotAuthorized>
        You are not an admin =(
    </NotAuthorized>
</AuthorizeView>
```

3. Now, run our BlazorWebApp project.

If we log in, we should be able to see text to the left saying **Hi Admin!** in black text on top of dark blue, so it might not be very visible. We will take care of this in *Chapter 9*, *Sharing Code and Resources*.

Summary

In this chapter, we learned how to add authentication to our existing site. It is easier to add authentication when creating a project. Still, now we have a better understanding of what is going on under the hood and how to handle adding an external source for authentication.

Throughout the book, we have shared components between the different hosting models.

In the next chapter, we will look at sharing even more things, like static files and CSS, and try to make everything look nice.

9

Sharing Code and Resources

Throughout the book, we have been building a project that can run in many different hosting models. This is a great way to build our projects if we want to switch technologies further down the road or, as we do at work, share components between the customer portal and our internal **customer relationship management** (**CRM**) system.

Always think about if there might be a sharable part of the component we are building; that way, we can reuse it, and if we add something to the component, we get that benefit for all our components.

But it's not only about sharing components inside our own projects. What if we want to create a library that can be shared with other departments, or even an open-source project sharing components with the world?

In this chapter, we will look at some of the things we already use when sharing components, and also at sharing CSS and other static files.

In this chapter, we will cover the following topics:

- Adding static files
- CSS isolation

Technical requirements

Make sure you have followed the previous chapters or use the `Chapter08` folder as a starting point.

You can find the source code for this chapter's result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter09`.

If you are jumping into this chapter using the code from GitHub, make sure you have added `Auth0` account information in the settings files. You can find the instructions in *Chapter 8*, *Authentication and Authorization*.

Adding static files

Blazor can use static files, such as images, CSS, and JavaScript. If we put our files in the `wwwroot` folder, they will automatically be exposed to the internet and be accessible from the root of our site. The nice thing about Blazor is that we can do the same with a library; it is super easy to distribute static files within a library.

At work, we share components between all of our Blazor projects, and the shared library can also depend on other libraries. By sharing components and building our own components (sometimes on top of other libraries), we ensure we have the same look and feel throughout a site. We also share static content like images and CSS, and this makes it simple and fast if we need to change something and we want all of our sites to be affected.

To link to a resource in another library/assembly, we can use the `_content` folder.

Take a look at this example:

```
<link rel="stylesheet" href="_content/SharedComponents/MyBlogStyle.min.
css" />
```

The HTML `link` tag, `rel`, and `href` are ordinary HTML tags and attributes, but adding the URL that starts with `_content` tells us that the content we want to access is in another library. The name of the library (assembly name), in our case, `SharedComponents`, is followed by the file we want to access, which is stored in the `wwwroot` folder in our library.

Blazor is, in the end, just HTML, and HTML can be styled using CSS. As mentioned, the Blazor templates are using Bootstrap by default, and we will continue to use that as well.

There is an excellent site with easy-to-use Bootstrap themes ready to be downloaded, which can be found at `https://bootswatch.com/`.

I like the Darkly theme, so that's the one we'll use, but feel free to experiment with this later on.

Choosing between frameworks

I often get asked about how to style Blazor apps, and the truth is you can use all the things you are used to. In the end, Blazor will output HTML. There are many languages and frameworks we can use to write our CSS.

We can use CSS, **Syntactically Awesome Stylesheets** (**SASS**), and **Leaner CSS** (**LESS**). As long as the output is CSS, we can use it.

In this chapter, we will stick with Bootstrap and continue using CSS. SASS and LESS are beyond the scope of this book.

Tailwind is a popular framework for Blazor, and it is absolutely possible to use it together with Blazor. Tailwind is very component focused and needs a bit of configuration to start, but if it is something you have worked with and like, you can use it together with Blazor.

Adding a new style

Many templates use Bootstrap as a base, so if you are looking for a design for your website, using a Bootstrap-based template will be an easy implementation.

The problem with Bootstrap (and why some people don't like it) is that many sites use Bootstrap and "all sites look the same." This can be good if we are building a **line of business** (**LOB**), but it can be bad if we are trying to be innovative. Bootstrap is also quite large when it comes to downloading, so that is also an argument against it.

This chapter is about making our blog look a bit nicer, so we will stick with Bootstrap, but we should know that if we use something else to handle our CSS, it will work with Blazor.

One of these template sites is `Bootswatch`, which gives us some nice variations from the traditional Bootstrap themes:

1. Navigate to `https://bootswatch.com/darkly/`.
2. In the top menu called `Darkly`, there are some links. Download `bootstrap.min.css`.
3. In the `SharedComponents` project, in the `wwwroot` folder, add the `bootstrap.min.css` file.

We have all the prerequisites and CSS that we can add to our site.

Adding CSS

Now, it's time to add a new style to our site:

1. In the `BlazorWebApp` project, open `Components/App.razor`.
2. Locate this row:

   ```
   <link rel="stylesheet" href="bootstrap/bootstrap.min.css" />
   ```

Replace the preceding row with the following:

```
<link rel="stylesheet" href="_content/SharedComponents/bootstrap.
min.css" />
```

3. Run the project by pressing *Ctrl* + *F5*.

Great! Our Blazor project is now updated to use the new style. The main color should now be dark, but there is still some work to do.

Making the admin interface more usable

Let's now clean it up some more. We have only started with the admin functionality, so let's make it more accessible. The menu on the left is no longer required, so let's change it so that it is only visible if you are an administrator:

1. Open `Components/Layout/MainLayout.razor` and put `AuthorizeView` around the `sidebar` `div` like this:

```
<AuthorizeView Roles="Administrator">
    <div class="sidebar">
        <NavMenu />
    </div>
</AuthorizeView>
```

In this case, we are not specifying `Authorized` or `NotAuthorized`. The default behavior is `Authorized`, so if we are only looking for an authorized state, we don't need to specify it by name.

Start the project to see it in action. The menu should not be shown if we are not logged in.

Now, we need to make the menu look better. Even though the counter is really fun to click on, it doesn't make much sense regarding our blog.

Making the menu more useful

We should replace the links with links to our admin pages instead:

1. In the `BlazorWebApp` project, open the `Components/Layout/Navmenu.razor` file.

Edit the code so that it looks like this:

```
<div class="top-row ps-3 navbar navbar-dark">
    <div class="container-fluid">
```

```
        <a class="navbar-brand" href="">MyBlog Admin</a>
    </div>
</div>

<input type="checkbox" title="Navigation menu" class="navbar-
toggler" />

<div class="nav-scrollable" onclick="document.querySelector('.
navbar-toggler').click()">
    <nav class="flex-column">
        <div class="nav-item px-3">
            <NavLink class="nav-link" href="" Match="NavLinkMatch.
All">
                <span class="bi bi-house-door-fill-nav-menu" aria-
hidden="true"></span> Home
            </NavLink>
        </div>

        <div class="nav-item px-3">
            <NavLink class="nav-link" href="Admin/Blogposts">
                <span class="bi bi-plus-square-fill-nav-menu" aria-
hidden="true"></span> Blog posts
            </NavLink>
        </div>

        <div class="nav-item px-3">
            <NavLink class="nav-link" href="Admin/Tags">
                <span class="bi bi-plus-square-fill-nav-menu" aria-
hidden="true"></span> Tags
            </NavLink>
        </div>

        <div class="nav-item px-3">
            <NavLink class="nav-link" href="Admin/Categories">
                <span class="bi bi-plus-square-fill-nav-menu" aria-
hidden="true"></span> Categories
            </NavLink>
        </div>
```

```
    </nav>
</div>
```

2. If we start the project and resize the screen, we will notice that the menu shows up on large screens but is hidden on smaller ones. One thing worth noticing is that `NavMenu` doesn't contain code, so the menu hiding and showing up depending on screen size is all done using CSS.

Great! Our blog is looking more like a blog, but we can do more!

Making the blog look like a blog

The admin interface is done (at least, for now), and we should focus on the front page of our blog. The front page should have the title of the blog post and some descriptions:

1. In the `SharedComponents` project, open the `Pages/Home.razor` file.
2. Add a `using` statement for `Markdig` at the top of the file:

```
@using Markdig;
```

3. Add an `OnInitializedAsync` method to handle the instantiation of the `Markdig` pipeline (this is the same code we have in the `Post.razor` file):

```
MarkdownPipeline pipeline;
protected override Task OnInitializedAsync()
{
    pipeline = new MarkdownPipelineBuilder()
                .UseEmojiAndSmiley()
                .Build();
    return base.OnInitializedAsync();
}
```

4. Inside the `Virtualize` component, change the content (`RenderFragment`) to the following:

```
    <article>
        <h2>@p.Title</h2>
        @((MarkupString)Markdig.Markdown.ToHtml(new string(p.Text.
Take(100).ToArray()), pipeline))
        <a href="/Post/@p.Id">Read more</a>
    </article>
```

5. Also, remove the `<ul>` tags.

Now, run the project using *Ctrl* + *F5* and look at our new front page. Our blog is starting to take form, but we still have work to do.

CSS isolation

In .NET 5, Microsoft added something called isolated CSS. This is something that many other frameworks have as well. The idea is to write CSS specifically for one component. The upside, of course, is that the CSS that we create won't impact any of the other components.

The template for Blazor uses isolated CSS for `Components/Layout/MainLayout.razor` and `NavMenu.Razor`. If we expand `MainLayout.razor`, we'll see a file called `MainLayout.razor.css`. The tree is made possible thanks to using the same naming.

We can also use SASS here by adding a file called `MainLayout.razor.scss`. The important thing is that the file we add should generate a file called `MainLayout.razor.css` for the compiler to pick up.

This naming convention will make sure to rewrite CSS and the HTML output.

CSS has the following naming convention:

```
main {
    flex: 1;
}
```

It will be rewritten as follows:

```
main[b-bfl5h5967n] {
    flex: 1;
}
```

This means the elements need to have an attribute called `b-bfl5h5967n` (in this case) for the style to be applied. This is a randomly generated string for this component.

The `div` tag that has the `CSS` tag within the `MainLayout` component will be outputted like this:

```
<main b-bfl5h5967n>
```

For all of this to happen, we also need to have a link to the CSS (which is provided by the template), and it looks like this:

```
<link href="{Assemblyname}.styles.css" rel="stylesheet">
```

This becomes useful for component libraries. We have components that have isolated CSS in our shared library (`NavMenu` and `MainLayout`), and the CSS for the `NavMenu` component is included in the `{Assemblyname}.styles.css` file.

We don't have to do anything extra to include our shared CSS. If we are creating a library for anyone, we should consider using the isolated CSS approach if our components need some CSS to work correctly.

If we are starting our Blazor project from an empty template, we need to add a link to the isolated CSS.

This way, our users won't have to add a reference to our CSS, and there is no risk of our CSS breaking something in the user's app (since it's isolated). The important thing is that we use the right approach when it makes sense.

Suppose we are creating a component that has very specific styles, which only that component will use. In that case, isolated CSS is a great way to go, it is easier to find (right by the component), and we can use CSS variables for colors and such.

We should be careful when styling similar things inside of the isolated CSS, so we don't end up having a bunch of different CSS files styling a button, for example.

As mentioned, the isolated CSS only affects the HTML tags inside the component, but what if we have a component inside our component?

If we open `Component/Layout/NavMenu.razor.css`, we can see that for the `.nav-item` styles, some of them are using the `::deep` keyword; this is to say that even child components should also be affected by this style.

Take a look at this code:

```
.nav-item ::deep a {…}
```

It is targeting the `<a>` tag, but the Razor code looks like this:

```
<li class="nav-item px-3">
     <NavLink class="nav-link" href="Admin/Blogposts">
         <span class="oi oi-signpost" aria-hidden="true"></span> Blog
posts
     </NavLink>
</li>
```

It is the `NavLink` component that renders the `<a>` tag; by adding `::deep`, we are saying we want to apply this style to all elements with the `.nav-item` class and all the `<a>` tags inside that element.

There is one more thing we need to know about – `::deep`; it makes sure to share the ID of the attribute (`b-bf15h5967n`, for example), and it needs an HTML tag to do so. So, if we have a component that consists of other components (not adding any HTML tags at all), we need to add an HTML tag around the content to make `::deep` work.

Before we summarize this chapter, let us do one more thing.

Let's fix the background color of the menu:

1. Open `Components/Layout/MainLayout.razor.css`.
2. Look for the `.sidebar` style and replace it with the following code:

```
.sidebar {
    background-image: linear-gradient(180deg, var(--bs-body-bg)
0%,var(--bs-gray-800) 70%);
}
```

3. Replace the `.top-row` style with the following code:

```
.top-row {
    background-color: var(--bs-primary);
    justify-content: flex-end;
    height: 3.5rem;
    display: flex;
    align-items: center;
}
```

   We replaced the background color and removed a border.

4. In the `.top-row ::deep a, .top-row ::deep .btn-link` style, add the following:

```
color:white;
```

Now, we are able to see the login/logout link a bit better.

We now have a working admin interface and a good-looking site.

Summary

In this chapter, we have added shared CSS.

We saw how to create shared libraries (for others to use). This is also a great way to structure our in-house projects (so that it is easy to change from Blazor Server to Blazor WebAssembly, or the other way around).

If you have a site already, you can build your Blazor components in a shared library, which we have done throughout the book.

Using components as part of your site (using Blazor Server), you can get started with Blazor bit by bit until you have converted the whole thing. When that is done, you can decide whether or not to keep using Blazor Server (as I mentioned, we use Blazor Server at my workplace) or move to Blazor WebAssembly, or use both as our project does.

We talked about how we can use SASS and CSS in our site, both *regular* CSS and *isolated* CSS.

In the next chapter, we will learn about the one thing we are trying to avoid (at least, I am) as Blazor developers – JavaScript.

10

JavaScript Interop

In this chapter, we will take a look at JavaScript. In specific scenarios, we still need to use JavaScript, or we will want to use an existing library that relies on JavaScript. Blazor uses JavaScript to update the **Document Object Model** (**DOM**), download files, and access local storage on the client.

So, there are, and always will be, cases when we need to communicate with JavaScript or have JavaScript communicate with us. Don't worry, the Blazor community is an amazing one, so chances are someone has already built the interop we need.

In this chapter, we will cover the following topics:

- Why do we need JavaScript?
- .NET to JavaScript
- JavaScript to .NET
- Implementing an existing JavaScript library
- JavaScript interop in WebAssembly

Technical requirements

Ensure you have followed the previous chapters or use the `Chapter09` folder as a starting point.

You can find the source code for this chapter's result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter10`.

If you are jumping into this chapter using the code from GitHub, make sure you have added the `Auth0` account information in the settings files. You can find the instructions in *Chapter 8, Authentication and Authorization*.

Why do we need JavaScript?

Many say Blazor is the JavaScript killer, but the truth is that Blazor needs JavaScript to work. Some events only get triggered in JavaScript, and if we want to use those events, we need to make an interop.

I jokingly say that I have never written so much JavaScript as when I started developing with Blazor. it's not that bad.

I have written a couple of libraries that require JavaScript to work. They are called `Blazm.Components` and `Blazm.Bluetooth`.

The first one is a grid component that uses JavaScript interop to trigger C# code (JavaScript to .NET) when the window is resized, to remove columns if they can't fit inside the window.

When that is triggered, the C# code calls JavaScript to get the size of the columns based on the client width, which only the web browser knows, and based on that answer, it removes columns if needed.

The second one, `Blazm.Bluetooth`, makes it possible to interact with Bluetooth devices using Web Bluetooth, which is a web standard accessible through JavaScript.

It uses two-way communication; Bluetooth events can trigger C# code, and C# code can iterate over devices and send data to them. They are both open source, so if you are interested in looking at a real-world project, you can check them out on my GitHub: `https://github.com/EngstromJimmy`.

As mentioned earlier, in most cases, I would argue that we won't need to write JavaScript ourselves. The Blazor community is very big, so chances are that someone has already written what we need. But we don't need to be afraid of using JavaScript either. Next, we will look at different ways to add JavaScript calls to our Blazor project.

.NET to JavaScript

Calling JavaScript from .NET is pretty simple. There are two ways of doing this:

- Global JavaScript
- JavaScript isolation

We will go through both ways to see what the difference is.

Global JavaScript (the old way)

To access the JavaScript method, we need to make it accessible. One way is to define it globally through the JavaScript window object. This is a bad practice since it is accessible by all scripts and could replace the functionality in other scripts (if we accidentally use the same names).

What we can do, for example, is use scopes, create an object in global space, and put our variables and methods on that object so that we lower the risk a bit, at least.

Using a scope could look something like this:

```
<script>
window.myscope = {};
window.myscope.methodName = () => { alert("this has been called"); }
</script>
```

We create an object with the name `myscope`. Then, we declare a method on that object called `methodName`. In this example, there is no code in the method; this only demonstrates how it could be done.

Then, to call the method from C#, we would call it using `JSRuntime` like this:

```
@using Microsoft.JSInterop
@inject IJSRuntime jsRuntime
await jsRuntime.InvokeVoidAsync("myscope.methodName");
```

There are two different methods we can use to call JavaScript:

- `InvokeVoidAsync`, which calls JavaScript but doesn't expect a return value
- `InvokeAsync<T>`, which calls JavaScript and expects a return value of type `T`

We can also send in parameters to our JavaScript method if we want. We also need to refer to JavaScript, and JavaScript must be stored in the `wwwroot` folder.

The other way is JavaScript isolation, which uses the methods described here, but with modules.

JavaScript Isolation

In .NET 5, we got a new way to add JavaScript using JavaScript Isolation, which is a much nicer way to call JavaScript. It doesn't use global methods, and it doesn't require us to refer to the JavaScript file.

This is awesome for component vendors and end users because JavaScript will be loaded when needed. It will only be loaded once (Blazor handles that for us), and we don't need to add a reference to the JavaScript file, which makes it easier to start and use a library.

So, let's implement that instead.

Isolated JavaScript can be stored in the `wwwroot` folder, but since an update in .NET 6, we can add them in the same way we add isolated CSS. Add them to your component's folder and name it, adding `.js` to the end (`mycomponent.razor.js`).

Let's do just that!

In our project, we can delete categories and components. Let's implement a simple JavaScript call to reveal a prompt to make sure that the user wants to delete the category or tag. But we have talked about doing things in a reusable way, so let's do that:

1. In the `SharedComponents` project, select the `ReusableComponents/BlogButton.razor` file, create a new JavaScript file, and name the file `BlogButton.razor.js`.
2. Open the new file (it is located under `BlogButton.razor` in the solution explorer) and add the following code:

   ```
   export function showConfirm(message) {
       return confirm(message);
   }
   ```

   JavaScript Isolation uses the standard **EcmaScript** (**ES**) modules and can be loaded on demand. The methods it exposes are only accessible through that object and not globally, as with the *old* way.

3. Open `BlogButton.razor` and inject `IJSRuntime` at the top of the file:

   ```
   @using Microsoft.JSInterop
   @inject IJSRuntime jsRuntime
   ```

4. In the code section, let's add a method that will call JavaScript:

   ```
       IJSObjectReference jsmodule;
       [Parameter]
       public string? ConfirmMessage { get; set; } = null;
       private async Task<bool> ShouldExecute()
       {
           if (ConfirmMessage != null)
   ```

```
        {
            jsmodule = await jsRuntime.
InvokeAsync<IJSObjectReference>("import", "/_content/
SharedComponents/ReusableComponents/BlogButton.razor.js");
            return await jsmodule.InvokeAsync<bool>("showConfirm",
ConfirmMessage);
        }
        else
        {
            return true;
        }
    }
```

`IJSObjectReference` is a reference to the specific script that we will import further down. It has access to the exported methods in our JavaScript, and nothing else.

We run the `Import` command and send the filename as a parameter. This will run the `let mymodule = import("/_content/SharedComponents/ReusableComponents/BlogButton.razor.js")` JavaScript command and return the module. We also add a `ConfirmMessage` parameter so we know that if we have a `ConfirmMessage` we should show a confirm message.

Then, in our `OnButtonClick` method, we first check whether we `shoudExecute` the method or not. Change it to the following:

```
if (OnClick.HasDelegate && await ShouldExecute())
 {
     await OnClick.InvokeAsync(args);
 }
```

Now, we can use our button to confirm whether we want to delete the `Category` or `Tag`.

5. Open `ItemList.razor`, and let's add our `BlogButton` to the component. Inside the `Virtualize` component, change the content to the following:

```
    <tr>
        <td>
            <BlogButton OnClick="@(()=> {SelectEvent.InvokeAsync(item); })">
Select</BlogButton>
        </td>
        <td>@ItemTemplate(item)</td>
```

```
        <td>
            <BlogButton ConfirmMessage="Are you sure you want to delete this
item?" Type="BlogButton.ButtonType.Delete" OnClick="@(()=> {DeleteEvent.
InvokeAsync(item);})"> Delete</BlogButton>
        </td>
    </tr>
```

Instead of just calling our `Delete` event callback, we first call our new method. Let JavaScript confirm that you really want to delete it, and if so, then run the `Delete` event callback.

This is a simple implementation of JavaScript.

JavaScript to .NET

What about the other way around? I would argue that calling .NET code from JavaScript isn't a very common scenario, and if we find ourselves in that scenario, we might want to think about what we are doing.

As Blazor developers, we should avoid using JavaScript as much as possible.

I am not bashing JavaScript in any way, but I see this often happen where developers kind of shoehorn what they've used before into their Blazor projects.

They are solving things with JavaScript that are easy to do with an `if` statement in Blazor. So, that's why I think it's essential to think about when to use JavaScript and when not to use JavaScript.

There are, of course, times when JavaScript is the only option, and as I mentioned earlier, `Blazm` uses communication both ways.

There are three ways of doing a callback from JavaScript to .NET code:

- A static .NET method call
- An instance method call
- A component instance method call

Let's take a closer look at them.

Static .NET method call

To call a .NET function from JavaScript, we can make the function static, and we also need to add the `JSInvokable` attribute to the method.

We can add a function such as this in the code section of a Razor component, or inside a class:

```
[JSInvokable]
public static Task<int[]> ReturnArrayAsync()
{
   return Task.FromResult(new int[] { 1, 2, 3 });
}
```

In the JavaScript file, we can call that function using the following code:

```
DotNet.invokeMethodAsync('BlazorWebAssemblySample', 'ReturnArrayAsync')
      .then(data => {
        data.push(4);
          console.log(data);
      });
```

The `DotNet` object comes from the `Blazor.js` or `blazor.server.js` file.

`BlazorWebAssemblySample` is the name of the assembly, and `ReturnArrayAsync` is the name of the static .NET function.

It is also possible to specify the name of the function in the `JSInvokeable` attribute if we don't want it to be the same as the method name like this:

```
[JSInvokable("DifferentMethodName")]
```

In this sample, JavaScript calls back to .NET code, which returns an `int` array.

It is returned as a promise in the JavaScript file that we are waiting for, and then (using the `then` operator) we continue with the execution, adding a 4 to the array and then outputting the values in the console.

Instance method call

This method is a bit tricky; we need to pass an instance of the .NET object to call it (this is the method that `Blazm.Bluetooth` is using).

First, we need a class that will handle the method call:

```
using Microsoft.JSInterop;
public class HelloHelper
{
    public HelloHelper(string name)
```

```
    {
        Name = name;
    }
    public string Name { get; set; }
    [JSInvokable]
    public string SayHello() => $"Hello, {Name}!";
}
```

This class takes a string (a name) in the constructor and a method called `SayHello` that returns a string containing `"Hello,"` and the name we supplied when we created the instance.

So, we need to create an instance of that class, supply a name, and create `DotNetObjectReference<T>`, which will give JavaScript access to the instance.

But first, we need JavaScript that can call the .NET function:

```
export function sayHello (dotnetHelper) {
    return dotnetHelper.invokeMethodAsync('SayHello').then(r => alert(r));
}
```

In this case, we are using the export syntax, and we export a function called `sayHello`, which takes an instance of `DotNetObjectReference` called `dotnetHelper`.

In that instance, we invoke the `SayHello` method, which is the `SayHello` method on the .NET object. In this case, it will reference an instance of the `HelloHelper` class.

We also need to call the JavaScript method, and we can do that from a class or, in this case, from a component:

```
@page "/interop" @using Microsoft.JSInterop
@inject IJSRuntime jsRuntime
@implements IDisposable
<button type="button" class="btn btn-primary" @onclick="async ()=> {
await TriggerNetInstanceMethod(); }">    Trigger .NET instance method
HelloHelper.SayHello </button>
@code {
    private DotNetObjectReference<HelloHelper> objRef;

    IJSObjectReference jsmodule;
    public async ValueTask<string>
      TriggerNetInstanceMethod()
```

```
    {
        objRef = DotNetObjectReference.Create(new HelloHelper("Bruce
Wayne"));
        jsmodule = await jsRuntime.
InvokeAsync<IJSObjectReference>("import", "/_content/MyBlog.Shared/
Interop.razor.js");
        return await jsmodule.InvokeAsync<string>("sayHello", objRef);
    }
    public void Dispose()
    {
        objRef?.Dispose();
    }
}
```

Let's go through the class. We inject `IJSRuntime` because we need one to call the JavaScript function. To avoid any memory leaks, we also have to make sure to implement `IDisposable` interface, and toward the bottom of the file, we make sure to dispose of the `DotNetObjectReference` instance.

We create a private variable of the `DotNetObjectReference<HelloHelper>` type, which is going to contain our reference to our `HelloHelper` instance. We create `IJSObjectReference` so that we can load our JavaScript function.

Then, we create an instance of `DotNetObjectReference.Create(new HelloHelper("Bruce Wayne"))` of our reference to a new instance of the `HelloHelper` class, which we supply with the name `"Bruce Wayne"`.

Now, we have `objRef`, which we will send to the JavaScript method, but first, we load the JavaScript module, and then we call `JavaScriptMethod` and pass in the reference to our `HelloHelper` instance. Now, the JavaScript `sayHello` method will run `hellohelperref.invokeMethodAsync('SayHello')`, which will make a call to `SayHelloHelper` and get back a string with `"Hello, Bruce Wayne"`.

There are two more ways that we can use to call .NET functions from JavaScript. We can call a method on a component instance where we can trigger an action, but it is not a recommended approach for Blazor Server. We can also call a method on a component instance by using a `helper` class.

Since calling .NET from JavaScript is rare, we won't go into the two examples. Instead, we'll dive into things to think about when implementing an existing JavaScript library.

Implementing an existing JavaScript library

The best approach, in my opinion, is to avoid porting JavaScript libraries. Blazor needs to keep the DOM and the render tree in sync, and having JavaScript manipulate the DOM can jeopardize that.

Most component vendors, such as Telerik, Synfusion, Radzen, and, of course, `Blazm`, have native components. They don't just wrap JavaScript but are explicitly written for Blazor in C#. Even though the components use JavaScript in some capacity, the goal is to keep that to a minimum.

So, if you are a library maintainer, my recommendation would be to write a native Blazor version of the library, keep JavaScript to a minimum, and, most importantly, not force Blazor developers to write JavaScript to use your components.

Some components will be unable to use JavaScript implementations since they need to manipulate the DOM.

Blazor is pretty smart when syncing the DOM and render tree, but try to avoid manipulating the DOM. If you need to use JavaScript for something, make sure to put an HTML tag outside the manipulation area, and Blazor will then keep track of that tag and not think about what is inside the tag.

Since we started using Blazor at my workplace very early, many vendors had not yet come out with Blazor components. We needed a graph component fast. On our previous website (before Blazor), we used a component called **Highcharts**.

`Highcharts` is free to use for non-commercial projects. When building our wrapper, we had a couple of things we wanted to ensure. We wanted the component to work in a similar way to the existing one, and we wanted it to be as simple to use as possible.

Let's walk through what we did.

First, we added a reference to the `Highcharts` JavaScript:

```
<script src="https://code.highcharts.com/highcharts.js"></script>
```

Then, we added a JavaScript file as follows:

```
export function loadHighchart(id, json) {
var obj = looseJsonParse(json);
    Highcharts.chart(id, obj);
};
export function looseJsonParse(obj) {
    return Function('"use strict";return (' + obj + ')')();
}
```

The `loadHighchart` method takes `id` of the `div` tag, which should be converted into a chart, and the JSON for configuration.

There is also a method that converts the JSON into a JSON object so that it can be passed into the `chart` method.

The `Highchart` Razor component looks like this:

```
@using Microsoft.JSInterop
@inject Microsoft.JSInterop.IJSRuntime jsruntime
<div>
    <div id="@id"></div>
</div>
@code
{
    [Parameter] public string Json { get; set; }
    private string id { get; set; } = "Highchart" + Guid.NewGuid().
ToString();
    protected override void OnParametersSet()
    {
        StateHasChanged();
        base.OnParametersSet();
    }
    IJSObjectReference jsmodule;
    protected async override Task OnAfterRenderAsync(bool firstRender)
    {
        if (!string.IsNullOrEmpty(Json))
        {
            jsmodule = await jsruntime.
InvokeAsync<IJSObjectReference>("import", "/_content/Components/
SharedComponents/HighChart.razor.js");
            await jsmodule.InvokeAsync<string>("loadHighchart", new
object[] { id, Json });
        }
        await base.OnAfterRenderAsync(firstRender);
    }
}
```

The important thing to notice here is that we have two nested `div` tags: one on the outside that we want Blazor to track and one on the inside that Highcharts will add things to.

We pass a JSON parameter in the JSON for the configuration and then call our JavaScript function. We run our JavaScript interop in the `OnAfterRenderAsync` method because, otherwise, it would throw an exception, as you may recall from *Chapter 4*, *Understanding Basic Blazor Components*.

Now, the only thing left to do is to use the component, and that looks like this:

```
@rendermode InteractiveServer @page "/HighChartTest"
<HighChart Json="@chartjson">
</HighChart>
@code {
    string chartjson = @" {
    chart: { type: 'pie'},
    series: [{
        data: [{
            name: 'Does not look like Pacman',
            color:'black',
            y: 20,
        }, {
            name: 'Looks like Pacman',
            color:'yellow',
            y: 80
        }]
    }]
}";
}
```

This test code will show a pie chart that looks like *Figure 10.1*:

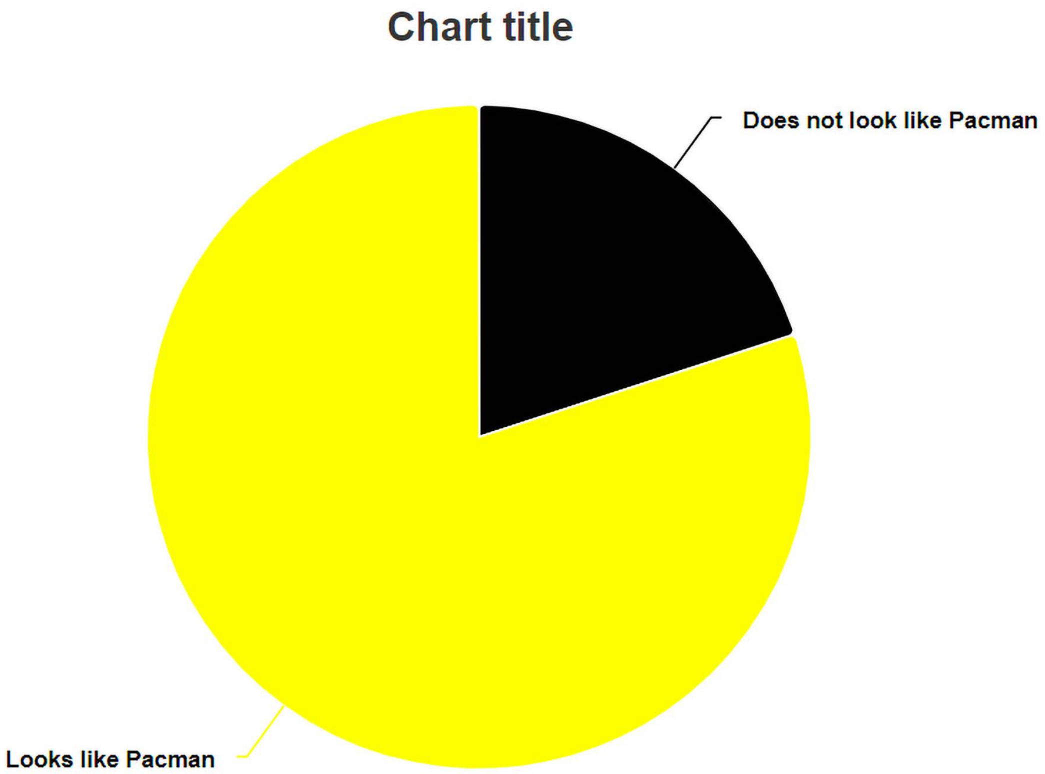


Figure 10.1: Chart example

We have now gone through how we got a JavaScript library to work with Blazor, so this is an option if there is something we need.

As mentioned, component vendors are investing in Blazor, so chances are that they have what we need, so we might not need to invest time in creating our own component library.

JavaScript interop in WebAssembly

All the things mentioned so far in this chapter will work great for Blazor Server and Blazor WebAssembly.

But with Blazor WebAssembly, we have direct access to the `JSRuntime` (since all the code is running inside the browser). Direct access will give us a really big performance boost. For most applications, we are doing one or two JavaScript calls. Performance is not really going to be a problem. Some applications are more JavaScript-heavy though and would benefit from using the `JSRuntime` directly.

We have had direct access to the `JSRuntime` using the `IJSInProcessRuntime` and `IJSUnmarshalledRuntime`. But with .NET 7, both are now obsolete, and we have gotten a nicer syntax.

In the GitHub repository, I have added a couple of files to the `SharedComponents` project if you want to try the code.

We will start by looking at calling JavaScript from .NET. Please note that since our project is prerendering on the server, these code samples will not work (since they don't work when running on the server). These samples must run in a WebAssembly-only project or disable the prerendering. They are included in the source code on GitHub for reference.

To be able to use these features, we need to enable them in the project file by enabling `AllowUnsafeBlocks`:

```
<PropertyGroup>
  <AllowUnsafeBlocks>true</AllowUnsafeBlocks>
</PropertyGroup>
```

.NET to JavaScript

To show the difference, the following sample is the same `ShowAlert` function as earlier in the chapter.

The Razor file looks like this:

```
@page "/nettojswasm"
@using System.Runtime.InteropServices.JavaScript
<h3>This is a demo how to call JavaScript from .NET</h3>
<button @onclick="ShowAlert">Show Alert</button>
@code {
```

```
    protected async void ShowAlert()
    {
        ShowAlert("Hello from .NET");
    }
    protected override async Task OnInitializedAsync()
    {
        await JSHost.ImportAsync("nettojs", "../JSInteropSamples/NetToJS.
razor.js");
    }
}
```

We are using `JSHost` to import the JavaScript and give it the name `"nettojs"`. A source generator generates the implementation for calling the JavaScript, and to be sure that it can pick up what it should do, we need to add some code in a code-behind. We will go into more depth on source generators in *Chapter 17, Examining Source Generators*. The code-behind looks like this:

```
using System.Runtime.InteropServices.JavaScript;
namespace BlazorWebAssembly.Client.JSInteropSamples;
public partial class NetToJS
{
    [JSImport("showAlert", "nettojs")]
    internal static partial string ShowAlert(string message);
}
```

The JavaScript file looks like this:

```
export function showAlert(message) {
    return alert(message);
}
```

We add a `JSImport` attribute to a method, which will automatically be mapped to the JavaScript call.

This is a much nicer implementation, I think, and a lot faster.

Next, we will look at calling .NET from JavaScript.

JavaScript to .NET

When calling a .NET method from JavaScript, a new attribute makes that possible called `JSExport`.

The Razor file implementation looks like this:

```
@page "/jstostaticnetwasm"
@using System.Runtime.InteropServices.JavaScript
<h3>This is a demo how to call .NET from JavaScript</h3>
<button @onclick="ShowMessage">Show alert with message</button>
@code {
    protected override async Task OnInitializedAsync()
    {
        await JSHost.ImportAsync("jstonet", "../JSInteropSamples/
JSToStaticNET.razor.js");
    }
}
```

Calling `JSHost.ImportAsync` is not necessary for the `JSExport` part of the demo, but we need it to call JavaScript so that we can make the .NET call from JavaScript.

Similarly, here we need to have the methods in a code-behind class that looks like this:

```
using System.Runtime.InteropServices.JavaScript;
using System.Runtime.Versioning;
namespace BlazorWebAssembly.Client.JSInteropSamples;
[SupportedOSPlatform("browser")]
public partial class JSToStaticNET
{
    [JSExport]
    internal static string GetAMessageFromNET()
    {
        return "This is a message from .NET";
    }
    [JSImport("showMessage", "jstonet")]
    internal static partial void ShowMessage();
}
```

Here, we are using the `SupportedOSPlatform` attribute to ensure that this code can only run on a browser.

The JavaScript portion of this demo looks like this:

```
export async function setMessage() {
    const { getAssemblyExports } = await globalThis.getDotnetRuntime(0);
```

```
    var exports = await getAssemblyExports("BlazorWebAssembly.Client.
dll");
    alert(exports.BlazorWebAssembly.Client.JSInteropSamples.JSToStaticNET.
GetAMessageFromNET());
}
export async function showMessage() {
    await setMessage();
}
```

We call the `showMessage` JavaScript function from .NET, and it will then call the `setMessage` function.

The `setMessage` function uses the `globalThis` object to access the .NET runtime and get access to the `getAssemblyExports` method.

It will retrieve all the exports for our assembly and then run the method. The .NET method will return the `"This is a message from .NET"` string and show the string in an alert box.

Even though I prefer not to make any JavaScript calls in my Blazor applications, I love having the power to bridge between .NET code and JavaScript code with ease.

Summary

This chapter taught us about calling JavaScript from .NET and calling .NET from JavaScript. In most cases, we won't need to do JavaScript calls, and chances are that the Blazor community or component vendors have solved the problem for us.

We also looked at how we can port an existing library if needed.

In the next chapter, we will continue to look at state management.

Join our community on Discord

Join our community's Discord space for discussions with the author and other readers:

`https://packt.link/WebDevBlazor3e`

11

Managing State – Part 2

In this chapter, we continue to look at managing state. Most applications manage state in some form.

A state is simply information that is persisted in some way. It can be data stored in a database, session states, or even something stored in a URL.

The user state is stored in memory either in the web browser or on the server. It contains the component hierarchy and the most recently rendered UI (render tree). It also contains the values or fields and properties in the component instances as well as the data stored in service instances in dependency injection.

If we make JavaScript calls, the values we set are also stored in memory. Blazor Server relies on the circuit (SignalR connection) to hold the user state, and Blazor WebAssembly relies on the browser's memory. But when we have a mix of both states, state management becomes a bit trickier. If we reload the page, the circuit and the memory will be lost. The same goes for switching pages; if there are no more `InteractiveServer` components on the page, the SignalR connection will be terminated and the state lost. Managing state is not about handling connections or connection issues but rather how we can keep the data even if we reload the web browser.

Saving state between page navigations or sessions improves the user experience and could be the difference between a sale and no sale. Imagine reloading the page and all your items in the shopping cart are gone; the chances are you won't shop there again.

Now imagine returning to a page a week or month later and all those things are still there.

In this chapter, we will cover the following topics:

- Storing data on the server side
- Storing data in the URL
- Implementing browser storage
- Using an in-memory state container service
- State management frameworks
- Root-level cascading values

We have already talked about and even implemented some of these things. Let's take this opportunity to recap the things we have already talked about, as well as introduce some new techniques.

Technical requirements

Make sure you have followed the previous chapters or use the `Chapter10` folder as a starting point.

You can find the source code for this chapter's end result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter11`.

If you are jumping into this chapter using the code from GitHub, make sure you have added `Auth0` account information in the `Settings` files. You can find the instructions in *Chapter 8*, *Authentication and Authorization*.

Storing data on the server side

There are many different ways in which to store data on the server side. The only thing to remember is that Blazor WebAssembly (or `InteractiveWebAssembly`) will always need an API. Blazor Server (or `InteractiveServer`) doesn't need an API since we can access the server-side resources directly.

I have had discussions with many developers regarding APIs or direct access, which all boils down to what you intend to do with the application. If you are building a Blazor Server application and have no interest in moving to Blazor WebAssembly, I would probably go for direct access, as we have done in the `MyBlog` project.

I would not do direct database queries in the components, though. I would keep them in an API, just not a Web API. As we have seen, exposing those API functions in an API, as we did in *Chapter 7*, *Creating an API*, does not require a lot of steps. We can always start with direct server access and move to an API if we want to.

When it comes to storing data, we can save it in Blob storage, key-value storage, a relational database, a document database, table storage, and so on.

There is no end to the possibilities. If .NET can communicate with the technology, we will be able to use it.

Storing data in the URL

At first glance, this option might sound horrific but it's not. Data, in this case, can be the blog post ID or the page number if we use paging. Typically, the things you want to save in the URL are things you want to be able to link to later on, such as blog posts in our case.

To read a parameter from the URL, we use the following syntax:

```
@page "/posts/{PageNumber:int}"
```

The URL is `posts` followed by the page number (for paging through blog posts) of the post.

To find that particular route, `PageNumber` must be an integer; otherwise, the route won't be found.

We also need a `public` parameter with the same name:

```
[Parameter]
public int PageNumber{ get; set; }
```

If we store data in the URL, we need to make sure to use the `OnParametersSet` or `OnParametersSetAsync` method; otherwise, the data won't get reloaded if we change the parameter. If the parameter changes, Blazor won't run `OnInitializedAsync` again.

This is why our `post.razor` component loads the things that change based on the parameter in the URL in `OnParametersSet`, and loads the things that are not affected by the parameter in `OnInitializedAsync`.

We can use optional parameters by specifying them as nullable, like this:

```
@page "/post/{PageNumber:int?}"
```

So this route would match "`/post/`" and "`/post/42`", for example.

Route constraints

When we specify what type the parameter should be, this is called a **route constraint**. We add a constraint so the match will only happen if the parameter value can be converted into the type we specified.

The following constraints are available:

- `bool`
- `datetime`
- `decimal`
- `float`
- `guid`
- `int`
- `long`

The URL elements will be converted in to a **C#** object. Therefore, it's important to use an invariant culture when adding them to a URL. string is not part of the list because that is the default behavior.

Using a query string

So far, we have only talked about routes that are specified in the page directive, but we can also read data from the query string.

`NavigationManager` gives us access to the URI, so by using this code, we can access the query string parameters:

```
@inject NavigationManager Navigation
@code{
var query = new Uri(Navigation.Uri).Query;
}
```

We won't dig deeper into this, but now we know that it is possible to access query string parameters if we need to.

We can also access the query parameter using an attribute like this:

```
[Parameter, SupplyParameterFromQuery(Name = "parameterName")]
public string ParameterFromQuery { get; set; }
```

This syntax is a bit nicer to work with.

Having data in the URL does not really mean storing the data. If we navigate to another page, we need to make sure to include the new URL; otherwise, it would be lost. We can use the browser storage instead if we want to store data that we don't need to include every time in the URL.

Implementing browser storage

The browser has a bunch of different ways of storing data in the web browser. They are handled differently depending on what type we use. **Local storage** is scoped to the user's browser window. The data will still be saved if the user reloads the page or even closes the web browser.

The data is also shared across tabs. **Session storage** is scoped to the **Browser** tab; if you reload the tab, the data will be saved, but if you close the tab, the data will be lost. `SessionsStorage` is, in a way, safer to use because we avoid risks with bugs that may occur due to multiple tabs manipulating the same values in storage.

To be able to access the browser storage, we need to use JavaScript. Luckily, we won't need to write the code ourselves.

In .NET 5, Microsoft introduced **Protected Browser Storage**, which uses data protection in ASP.NET Core and is not available in WebAssembly. We can, however, use an open-source library called `Blazored.LocalStorage`, which can be used by both Blazor Server and Blazor WebAssembly.

But we are here to learn new things, right?

So, let's implement an interface so that we can use both versions in our app, depending on which hosting model we are using. There is a problem with this implementation. If we are running in `AutoMode`, the state will not be shared between the different hosting models. The solution is to stick to `Blazored.LocalStorage` in both implementations. But to show the difference between the implementations, we will do both in this case. Please note that this is stored in clear text on the user's computer, so be careful with what you store.

Creating an interface

First, we need an interface that can read and write to storage:

1. In the `SharedComponents` project, create a new folder called `Interfaces`.
2. In the new folder, create a new class called `IBrowserStorage.cs`.
3. Replace the content in the file with the following code:

```
namespace SharedComponents.Interfaces;
public interface IBrowserStorage
{
    Task<T?> GetAsync<T>(string key);
    Task SetAsync(string key, object value);
```

```
    Task DeleteAsync(string key);
}
```

Now we have an interface containing `get`, `set`, and `delete` methods.

Implementing Blazor Server (InteractiveServer)

For Blazor Server, we will use protected browser storage:

1. In the `BlazorWebApp` project, add a new folder called `Services`.
2. In the new folder, create a new class called `BlogProtectedBrowserStorage.cs`.

   (I realize the naming is overkill, but it will be easier to tell the Blazor Server and the Blazor WebAssembly implementation apart because we will soon create another one.)

3. Open the new file and add the following `using` statements:

```
using Microsoft.AspNetCore.Components.Server.ProtectedBrowserStorage;
using SharedComponents.Interfaces;
```

4. Replace the class with this one:

```
public class BlogProtectedBrowserStorage : IBrowserStorage
{
    ProtectedSessionStorage Storage { get; set; }
    public BlogProtectedBrowserStorage(ProtectedSessionStorage
storage)
    {
        Storage = storage;
    }
    public async Task DeleteAsync(string key)
    {
        await Storage.DeleteAsync(key);
    }
    public async Task<T?> GetAsync<T>(string key)
    {
        var value = await Storage.GetAsync<T>(key);
        return value.Success ? value.Value : default(T);
    }
    public async Task SetAsync(string key, object value)
```

```
    {
        await Storage.SetAsync(key, value);
    }
}
```

The `BlogProtectedBrowserStorage` class implements the `IBrowserStorage` interface for protected browser storage. We inject a `ProtectedSessionStorage` instance and implement the `set`, `get`, and `delete` methods.

5. In `Program.cs`, add the following namespaces:

```
using SharedComponents.Interfaces;
using BlazorWebApp.Services;
```

6. Add the following just beneath the line ending with `.AddInteractiveWebAssemblyComponents();`:

```
builder.Services.
AddScoped<IBrowserStorage,BlogProtectedBrowserStorage>();
```

We are configuring Blazor to return an instance of `BlogProtectedBrowserStorage` when we inject `IBrowserStorage`.

This is the same as we did with the API. We inject different implementations depending on the platform.

Implementing WebAssembly (InteractiveWebAssembly)

For Blazor WebAssembly, we will use `Blazored.SessionStorage`:

1. In the `BlazorWebApp.Client` project, add a `NuGet` reference to `Blazored.SessionStorage`.
2. Add a new folder called `Services`.
3. In the new folder, create a new class called `BlogBrowserStorage.cs`.
4. Open the new file and replace the content with the following code:

```
using Blazored.SessionStorage;
using SharedComponents.Interfaces;
namespace BlazorWebApp.Client.Services;
public class BlogBrowserStorage : IBrowserStorage
{
    ISessionStorageService Storage { get; set; }
    public BlogBrowserStorage(ISessionStorageService storage)
```

```
    {
        Storage = storage;
    }
    public async Task DeleteAsync(string key)
    {
        await Storage.RemoveItemAsync(key);
    }
    public async Task<T?> GetAsync<T>(string key)
    {
        return await Storage.GetItemAsync<T>(key);
    }
    public async Task SetAsync(string key, object value)
    {
        await Storage.SetItemAsync(key, value);
    }
}
```

The implementations of `ProtectedBrowserStorage` and `Blazored.SessionStorage` are pretty similar to one another. The names of the methods are different but the parameters are the same.

5. In the `Program.cs` file, add the following namespaces:

```
using Blazored.SessionStorage;
using SharedComponents.Interfaces;
using BlazorWebApp.Client.Services;
```

6. Just above `await builder.Build().RunAsync();` add the following:

```
builder.Services.AddBlazoredSessionStorage();
builder.Services.AddScoped<IBrowserStorage, BlogBrowserStorage>();
```

The `AddBlazoredSessionStorage` extension method hooks up everything so that we can start using the browser session storage.

Then we add our configuration for `IBrowserStorage`, just as we did with the server, but in this case, we return `BlogBrowserStorage` when we ask the dependency injection for `IBrowserStorage`.

Implementing the shared code

We also need to implement some code that calls the services we just created:

1. In the SharedComponents project, open Pages/Admin/BlogPostEdit.razor. We are going to make a couple of changes to the file.
2. Inject IBrowserStorage:

```
@inject SharedComponents.Interfaces.IBrowserStorage _storage
```

3. Since we can only run JavaScript calls when doing an action (like a click) or in the OnAfterRender method, let's create an OnAfterRenderMethod:

```
protected override async Task OnAfterRenderAsync(bool firstRender)
{
    if (firstRender && string.IsNullOrEmpty(Id))
    {
        var saved = await _storage.
GetAsync<BlogPost>("EditCurrentPost");
        if (saved != null)
        {
           Post = saved;
   StateHasChanged();
        }
    }
    await base.OnAfterRenderAsync(firstRender);
}
```

When we load the component and the Id is null, this means we are editing a new file, and then we can check whether we have a file saved in browser storage.

This implementation can only have one file in the drafts and only saves new posts. If we were to edit an existing post, it would not save those changes.

4. We need our UpdateHTML method to become async. Change the method to look like this:

```
protected async Task UpdateHTMLAsync()
{
    if (!string.IsNullOrEmpty(Post.Text))
```

```
    {
        markDownAsHTML = Markdig.Markdown.ToHtml(Post.Text,
pipeline);
        if (string.IsNullOrEmpty(Post.Id))
        {
            await _storage.SetAsync("EditCurrentPost", Post);
        }
    }
}
```

5. If `Id` on the blog post is `null`, we will store the post in the browser storage. Make sure to change all the references from `UpdateHTML` to `UpdateHTMLAsync`.

   Make sure to await the call as well in the `OnParametersSetAsync` method like this:

   ```
   await UpdateHTMLAsync();
   ```

6. There is one problem with this implementation: we are currently prerendering our components. When we are prerendering, no connection is made to the web browser. There is no state to retrieve. Simply put, we need to disable the prerendering on this component to make it work. So, let's do that!
7. Change `@rendermode InteractiveServer` to:

   ```
   @rendermode @(new InteractiveServerRenderMode(prerender: false))
   ```

We are done. Now it's time to test the implementation:

1. Run the project by pressing *Ctrl* + *F5*.
2. Log in to the site (so we can access the admin tools).
3. Click **Blog posts** followed by **New blog post**.
4. Type anything in the boxes, and as soon as we type something in the text area, it will save the post to storage.
5. Click **Blog posts** (so we navigate away from our blog post).
6. Click **New blog post** and all the information will still be there.

7. Press *F12* to see the browser developer tools. Click **Application** | **Session storage** | **https://localhost:portnumber**.

   You should see one post with the key `EditCurrentPost`, and the value of that post should be an encrypted string, as seen in *Figure 11.1*:

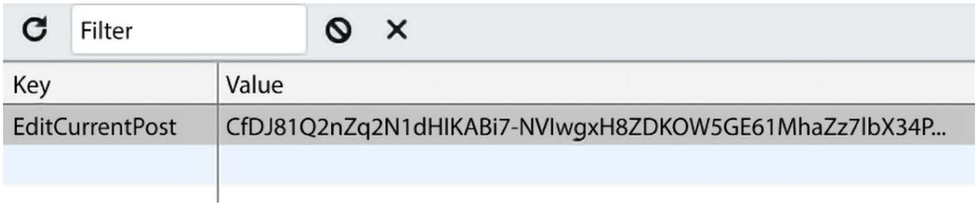


Figure 11.1: The encrypted protected browser storage

   Let's test Blazor WebAssembly (InteractiveWebAssembly) next.

8. Open the `EditPost.razor` file again and change `@rendermode @(new InteractiveServerRenderMode(prerender: false))` to:

```
@rendermode @(new InteractiveWebAssemblyRenderMode(prerender:
false))
```

9. You might need to clean and rebuild your project to make this work.
10. Log in to the site (so we can access the admin tools).
11. Click **Blog posts** and then **New blog post**. You may notice that there is a delay between loading the page and the components showing up. This is the initial WebAssembly load time to get everything started.
12. Type anything in the boxes, and as soon as we type something in the text area, it will save the post to storage.
13. Click **Blog posts** (so we navigate away from our blog post).
14. Click **New blog post** and all the information should still be there.
15. Press *F12* to see the browser developer tools. Click **Application** | **Session storage** | **https://localhost:portnumber**.

You should see one post with the key `EditCurrentPost`, and the value of that post should be a JSON string, as seen in *Figure 11.2*.

If we were to change the data in the storage, it would also change in the application, so keep in mind that this is plain text, and the end user can manipulate the data:

Figure 11.2: Browser storage that is unprotected

Now, we have implemented protected browser storage for Blazor Server and session storage for Blazor WebAssembly. The way we can mix and match the hosting model where we need it is a really amazing power of .NET 8.

We only have one way left to go through, so let's make it the most fun.

Using an in-memory state container service

When it comes to in-memory state containers, we simply use dependency injection to keep the instance of the service in memory for the predetermined time (scoped, singleton, or transient).

In *Chapter 4*, *Understanding Basic Blazor Components*, we discussed how the scope of dependency injections differs from Blazor Server and Blazor WebAssembly. The big difference for us in this section is the fact that Blazor WebAssembly runs inside the web browser and doesn't have a connection to the server or other users.

To show how the in-memory state works, we will do something that might seem a bit overkill for a blog but it will be cool to see. When we edit our blog post, we will update all the web browsers connected to our blog in real time (I did say overkill).

We will have to implement that a bit differently, depending on the host. Let's start with Blazor Server.

Implementing real-time updates on Blazor Server

The implementation for Blazor Server can also be used for Blazor WebAssembly. Since WebAssembly is running in our browser, it would only notify the users connected to the site, which would be just you. But it might be good to know that the same thing works in Blazor Server as well as Blazor WebAssembly:

1. In the `SharedComponents` project, in the `Interfaces` folder, create an interface called `IBlogNotificationService.cs`.
2. Add the following code:

   ```
   using Data.Models;
   namespace SharedComponents.Interfaces;
   public interface IBlogNotificationService
   {
       event Action<BlogPost>? BlogPostChanged;
       Task SendNotification(BlogPost post);
   }
   ```

   We have an action that we can subscribe to when the blog post is updated and a method we can call when we update a post.

3. In the `Services` folder in the `BlazorWebServer` project, add a new class called `BlazorServerBlogNotificationService.cs`.

   It might seem unnecessary to give the class a name that includes `BlazorServer`, but it makes sure we can easily tell the classes apart.

   Replace the content with the following code:

   ```
   using SharedComponents.Interfaces;
   using Data.Models;
   namespace BlazorServer.Services;
   public class BlazorServerBlogNotificationService :
   IBlogNotificationService
   {
       public event Action<BlogPost>? BlogPostChanged;
       public Task SendNotification(BlogPost post)
       {
           BlogPostChanged?.Invoke(post);
   ```

```
            return Task.CompletedTask;
        }
    }
```

The code is pretty straightforward here. If we call `SendNotification`, it will check whether anyone is listening for the `BlogPostChanged` action and whether to trigger the action.

4. In `Program.cs`, add the dependency injection:

```
builder.Services.AddSingleton<IBlogNotificationService,
BlazorServerBlogNotificationService>();
```

Whenever we ask for an instance of the `IBlogNotificationService` type, we will get back an instance of `BlazorServerBlogNotificationService`.

We add this dependency injection as a singleton. I can't stress this enough. When using Blazor Server, this will be the same instance for *ALL* users, so we must be careful when we use `Singleton`.

In this case, we want the service to notify all the visitors of our blog that the blog post has changed.

5. In the `SharedComponents` project, open `Post.razor`.
6. Add the following code at the top (or close to the top) of the page:

```
@using SharedComponents.Interfaces
@inject IBlogNotificationService _notificationService
@implements IDisposable
```

We add dependency injection for `IBlogNotificationService` and we also need to implement `IDisposable` to prevent any memory leaks.

At the top of the `OnInitializedAsync` method, add the following:

```
_notificationService.BlogPostChanged += PostChanged;
```

We added a listener to the event so we know when we should update the information.

7. We also need the `PostChanged` method, so add this code:

```
private async void PostChanged(BlogPost post)
{
    if (BlogPost?.Id == post.Id)
    {
```

```
        BlogPost = post;
        await InvokeAsync(()=>this.StateHasChanged());
    }
}
```

If the parameter has the same ID as the post we are currently viewing, then replace the content with the post in the event and call `StateHasChanged`.

Since this is happening on another thread, we need to call `StateHasChanged` using `InvokeAsync` so that it runs on the UI thread.

We also need to stop listening to the updates by implementing the `Dispose` method. Add the following:

```
void IDisposable.Dispose()
{
    _notificationService.BlogPostChanged -= PostChanged;
}
```

We remove the event listener to prevent any memory leaks.

The `Post` component is currently a static rendered component. We don't have any interactivity, so let's enable that.

Add this to the component:

```
@rendermode InteractiveServer
```

8. In the `SharedComponents` project, open the `Pages/Admin/BlogPostEdit.Razor` file.
9. When we make changes to our blog post, we need to send a notification as well. At the top of the file, add the following:

```
@using SharedComponents.Interfaces
@inject IBlogNotificationService _notificationService
```

We add a namespace and inject our notification service.

10. In the `UpdateHTMLAsync` method, add the following just under the `!string.IsNullOrEmpty(Post.Text)` `if` statement:

```
await _notificationService.SendNotification(Post);
```

Every time we change something, it will now send a notification that the blog post has changed. I do realize that it would make more sense to do this when we save a post, but it makes for a much cooler demo.

Let's start with testing `InteractiveServer`. In `BlogPortEditPage.razor`, change `@rendermode @(new InteractiveWebAssemblyRenderMode(prerender: false))` to:

```
@rendermode @(new InteractiveServerRenderMode(prerender: false))
```

11. Run the project by pressing *Ctrl* + *F5*.
12. Copy the URL and open another web browser. We should now have two web browser windows open showing us the blog.
13. In the first window, open a blog post (doesn't matter which one), and in the second window, log in and edit the same blog post.

When we change the text of the blog post in the second window, the change should be reflected in real time in the first window.

I am constantly amazed how a feature that would be a bit tricky to implement without using Blazor only requires 10 steps (not counting the test), and if we didn't prepare for the next step, it would take even fewer steps.

Next, we will implement the same feature for Blazor WebAssembly, but Blazor WebAssembly runs inside the user's web browser. There is no real-time communication built in, as with Blazor Server.

Implementing real-time updates on Blazor WebAssembly

We already have a lot of things in place. We only need to add a real-time messaging system. Since SignalR is both easy to implement and awesome, let's use that.

The first time I used SignalR, my first thought was, "Wait, it can't be that easy. I must have forgotten something, or something must be missing". Hopefully, we will have the same experience now.

Let's see whether that still holds true today:

1. In the `BlazorWebApp` project, add a new folder called `Hubs`.
2. In the new folder, create a class called `BlogNotificationHub.cs`.
3. Replace the code with the following:

```
using Data.Models;
using Microsoft.AspNetCore.SignalR;
namespace BlazorWebApp.Hubs;
public class BlogNotificationHub : Hub
{
    public async Task SendNotification(BlogPost post)
```

```
        {
            await Clients.All.SendAsync("BlogPostChanged", post);
        }
    }
```

The class inherits from the `Hub` class. There is a method called `SendNotification`. Keep that name in mind; we will come back to that.

We call `Clients.All.SendAsync`, which means we will send a message called `BlogPostChanged` with the content of a blog post.

The name `BlogPostChanged` is also important, so keep that in mind as well.

4. In the `Program.cs` file, add the following:

```
builder.Services.AddSignalR();
```

This adds SignalR. We already have access to SignalR since this project is a mix of hosting models.

5. Add the following namespace:

```
using BlazorWebApp.Hubs;
```

6. Just above `app.MapRazorComponents<App>()`, add:

```
app.MapHub<BlogNotificationHub>("/BlogNotificationHub");
```

Here, we configure what URL `BlogNotificationHub` should use. In this case, we are using the same URL as the name of the hub.

The URL here is also important. We will use that in just a bit.

7. In the `BlazorWebApp.Client`, add a reference to the `Microsoft.AspNetCore.SignalR.Client NuGet` package.
8. In the `Services` folder, create a class called `BlazorWebAssemblyBlogNotificationService.cs`.

In this file, we will implement the SignalR communication.

9. Add the following namespaces:

```
using Microsoft.AspNetCore.Components;
using Microsoft.AspNetCore.SignalR.Client;
using Data.Models;
using SharedComponents.Interfaces;
```

10. Add this class:

```
public class BlazorWebAssemblyBlogNotificationService :
IBlogNotificationService, IAsyncDisposable
{
    public
BlazorWebAssemblyBlogNotificationService(NavigationManager
navigationManager)
    {
        _hubConnection = new HubConnectionBuilder()
        .WithUrl(navigationManager.ToAbsoluteUri("/
BlogNotificationHub"))
        .Build();
        _hubConnection.On<BlogPost>("BlogPostChanged", (post) =>
        {
            BlogPostChanged?.Invoke(post);
        });
        _hubConnection.StartAsync();
    }
    private readonly HubConnection _hubConnection;
    public event Action<BlogPost>? BlogPostChanged;

    public async Task SendNotification(BlogPost post)
    {
        await _hubConnection.SendAsync("SendNotification", post);
    }
    public async ValueTask DisposeAsync()
    {
        await _hubConnection.DisposeAsync();
    }
}
```

A lot is happening here. The class is implementing `IBlogNotificationService` and `IAsyncDisposable`.

In the constructor, we use dependency injection to get `NavigationManager` so we can figure out the URL to the server.

Then, we configure the connection to the hub. Then, we specify the URL to the hub; this should be the same as we specified in *step 7*.

Now, we can configure the hub connection to listen for events. In this case, we listen for the `BlogPostChanged` event, the same name we specified in *step 3*. When someone sends the event, the method we specify will run.

The method, in this case, triggers the event we have in `IBlogNotificationService`. Then, we start the connection. Since the constructor can't be async, we won't await the `StartAsync` method.

`IBlogNotificationService` also implements the `SendNotification` method, and we trigger the event with the same name on the hub, which will result in the hub sending the `BlogPostChanged` event to all connected clients.

The last thing we do is make sure that we dispose of the hub connection.

11. In the `Program.cs` file, we need to configure dependency injection. Just above `await builder.Build().RunAsync();`, add the following:

```
builder.Services.AddSingleton<IBlogNotificationService,
BlazorWebAssemblyBlogNotificationService>();
```

12. This is where things get a bit tricky, since we have different implementations depending on whether we're using InteractiveServer or InteractiveWebAssembly. We need to make sure to run it in the same way both for `EditPost` and the `Post` component. In a mixed scenario like this, it is a better option to always implement it with a SignalR connection because then we can use the same implementation regardless of the hosting model. In the `SharedComponents` project, open `Pages/Admin/BlogPostEdit.razor` and change `@rendermode @(new InteractiveServerRenderMode(prerender: false))` to:

```
@rendermode @(new InteractiveWebAssemblyRenderMode(prerender:
false)).
```

You might need to clean and rebuild the solution to make it work.

13. Open `Post.razor` and do the same thing; change `@rendermode InteractiveServer` to:

```
@rendermode InteractiveWebAssembly.
```

Now, it's time to carry out testing, run the project by pressing *Ctrl* + *F5*.

14. Copy the URL and open another web browser. We should now have two web browser windows open showing us the blog.

15. In the first window, open a blog post (it doesn't matter which one), and in the second window, log in and edit the same blog post.

When we change the text of the blog post in the second window, the change should be reflected in real time in the first window.

In *13* steps (not counting testing), we have implemented real-time communication between the server and client, a Blazor WebAssembly client with .NET code running inside the web browser.

And no JavaScript!

State management frameworks

Speaking of JavaScript, in the JavaScript framework world of Angular, React, and so on, there are frameworks we can use to manage state (**Redux** and **ngRX**, to name a couple). This is the case for Blazor as well. Very simply, we have a state that we can change using methods; if the state changes, the components that are listening to that change will be notified.

There are a bunch of frameworks like that for Blazor. I have personally never used a framework but instead built a `Singleton` service and connected my components to that (basically what these frameworks do).

Check out Fluxor or Blazor-State if you want to dive deeper into that. There is another way to share state between components, which is called root-level cascading values.

Root-level cascading values

Root-level cascading values are a new feature in .NET 8. This is a great way to share state not only between components but also between different render modes. It will automatically add a cascading value; we have already used this feature, and then we added `AddCascadingAuthenticationState()`, which uses the root-level cascading value in the background.

This does not share the value between InteractiveServer and InteractiveWebAssembly, though, but gives us a way to share the state between components without using dependency injection.

The really nice thing is that if the value changes, it will automatically change the parameter and trigger a rerender of the component. No special code is needed inside the component. But subscribing to value changes does have a cost, so be careful with how many things you use with root-level cascading values.

Usage could look something like this:

```
@(Preferences?.DarkTheme)

@code {

    [CascadingParameter(Name = "Preferences")]
    public Preferences Preferences { get; set; }
}
```

And in `Program.cs`:

```
builder.Services.AddCascadingValue<Preferences>(sp =>
{
    var preferences = new Preferences { DarkTheme = true };
    var source = new CascadingValueSource<Preferences>("Preferences",
preferences, isFixed: false);
    return source;
});
```

It is possible to update the values by calling the `NotifyChangedAsync` method on `CascadingValueSource`. An implementation could look something like this:

```
builder.Services.AddCascadingValue<Preferences>(sp =>
{
    var preferences = new Preferences { DarkTheme = true };
    var source = new CascadingValueSource<Preferences>("Preferences",
preferences, isFixed: false);

    if (preferences is INotifyPropertyChanged changed)
        changed.PropertyChanged += (sender, args) => source.
NotifyChangedAsync();

    return source;
});
```

Here, we are using the `INotifyPropertyChanged` interface to call `NotifyChangedAsync` when we change the property. On GitHub, you can find a full example of this if you want to play further with it.

Summary

In this chapter, we learned how we can handle state in our application and how we can use local storage to store data, both encrypted and not. We looked at different ways of doing that, and we also made sure to include SignalR to be able to use real-time communication with the server.

Almost all applications need to save data in some form. Perhaps it can be settings or preferences. The things we covered in the chapter are the most common ones, but we should also know that there are many open-source projects we can use to persist state. I personally prefer the components to load state from a database when needed be self-contained, and not have to rely on state coming or being somewhere else. This approach has served me well in the past.

In the next chapter, we will take a look at debugging. Hopefully, you haven't needed to know how to debug yet!

12

Debugging the Code

In this chapter, we will take a look at debugging. The debugging experience of Blazor is a good one; hopefully, you haven't gotten stuck earlier on in the book and had to jump to this chapter.

Debugging code is an excellent way to solve bugs, understand the workflow, or look at specific values. Blazor has three different ways to debug code, and we will look at each one.

In this chapter, we will cover the following:

- Making things break
- Debugging Blazor Server
- Debugging Blazor WebAssembly
- Debugging Blazor WebAssembly in the browser
- Hot Reload

Technical requirements

Make sure you have followed the previous chapters or use the `Chapter11` folder as a starting point.

You can find the source code for this chapter's end result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter12`.

If you are jumping into this chapter using the code from GitHub, make sure you have added `Auth0` account information in the settings files. You can find the instructions in *Chapter 8*, *Authentication and Authorization*.

To debug something, we should first make something break!

Making things break

Edsger W. Dijkstra once said,

"If debugging is the process of removing software bugs, then programming must be the process of putting them in."

This is definitely true in this section because we will add a page that will throw an exception:

1. In the `SharedComponents` project, in the `Pages` folder, create a new Razor component called `ThrowException.razor`.
2. Replace the contents of the file with the following code block:

```
@page "/ThrowException"
@rendermode @(new InteractiveServerRenderMode(prerender: false))
<button @onclick="@(()=> {throw new Exception("Something is
broken"); })">Throw an exception</button>
```

This page shows a button, and when you press it, it throws an exception.

Great! We have our application's Ivan Drago (he wants to break us, but we might just beat him with some fancy debugging).

The next step is to take a look at Blazor Server debugging.

Debugging Blazor Server

If you have debugged any .NET application in the past, you will feel right at home. Don't worry; we will go through it if you haven't. Debugging Blazor Server is just as we might expect and is the best debugging experience of the three different types we will cover.

I usually keep my Razor pages in a shared library, and while building my project, I use Blazor Server for two reasons. First, running the project is a bit faster, and second, the debugging experience is better.

Let's give it a try!

1. Press *F5* to start the project (this time with debugging).
2. Using the web browser, navigate to `https://localhost:portnumber/throwexception` (the port number may vary).
3. Press *F12* to show the web browser developer tools.
4. In the developer tools, click **Console**.

5. Click the **Throw exception** button on our page.

   At this point, Visual Studio should request focus, and it should show the exception as shown in *Figure 12.1*:

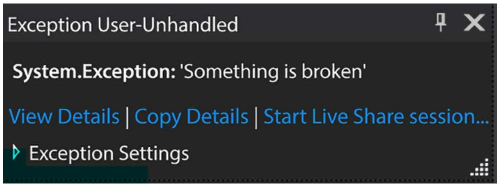
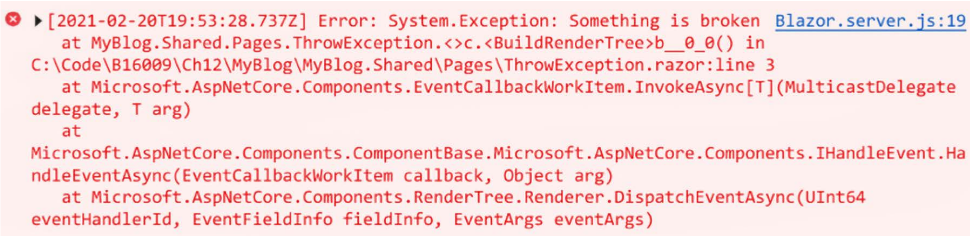


Figure 12.1: Exception in Visual Studio

6. Press *F5* to continue and switch back to the web browser. We should now be able to see the exception message in the developer tools, as shown in *Figure 12.2*:



```
[2021-02-20T19:53:28.737Z] Error: System.Exception: Something is broken Blazor.server.js:19
   at MyBlog.Shared.Pages.ThrowException.<>c.<BuildRenderTree>b__0_0() in
C:\Code\B16009\Ch12\MyBlog\MyBlog.Shared\Pages\ThrowException.razor:line 3
   at Microsoft.AspNetCore.Components.EventCallbackWorkItem.InvokeAsync[T](MulticastDelegate
delegate, T arg)
   at
Microsoft.AspNetCore.Components.ComponentBase.Microsoft.AspNetCore.Components.IHandleEvent.Ha
ndleEventAsync(EventCallbackWorkItem callback, Object arg)
   at Microsoft.AspNetCore.Components.RenderTree.Renderer.DispatchEventAsync(UInt64
eventHandlerId, EventFieldInfo fieldInfo, EventArgs eventArgs)
```

Figure 12.2: Exception in the web browser

   As we can see in *Figure 12.1* and *Figure 12.2*, we get the exception both in Visual Studio while debugging and also in the developer tools.

   This makes it quite easy to find the problem if there is an exception in an app in production (perish the thought) – that feature has saved us many times.

   Now let's try a breakpoint:

7. In Visual Studio, open `Pages/Home.razor`.
8. Anywhere in the `LoadPosts` method, set a breakpoint by clicking the leftmost border (making a red dot appear). We can also add a breakpoint by pressing *F9*.
9. Go back to the web browser and navigate to `https://localhost:portnumber/` (the port number may vary).

Visual Studio should now hit the breakpoint, and by hovering over variables, we should be able to see the current values.

Both breakpoints and exception debugging work as we might expect. Next, we will take a look at debugging Blazor WebAssembly.

Debugging Blazor WebAssembly

Blazor WebAssembly can, of course, be debugged as well. There are a couple of things to keep in mind. Debugging `InteractiveWebAssembly`, like we are using in our blog, is going to work just the same as with Blazor Server. Breakpoints and exceptions will work just the same. However, there is an option to run Blazor WebAssembly as a standalone app. And that works a bit differently.

To be able to play around with that, we need to add another project.

1. Right-click on the **MyBlog solution**, select **Add**, **New Project…**, and select **Blazor WebAssembly Standalone App**.
2. Change the project name to `BlazorWebAssemblyApp`.
3. Leave the default values as is and click **Create**.
4. Right-click on our **BlazorWebAssemblyApp** project and select **Set as Startup Project**.
5. In the **Pages** folder, open `Counter.razor` and add a breakpoint on the `currentCount++` row.
6. Run the project by pressing *F5*, and lo and behold, the breakpoint is hit.

This has not always been the case, and I was actually pleasantly surprised it worked that well. In previous versions of .NET, you had to click on another page and then back to have breakpoints hit.

Debugging Blazor WebAssembly is made possible by the following line of code in the `launchSettings.json` file:

```
"inspectUri": "{wsProtocol}://{url.hostname}:{url.port}/_framework/debug/
ws-proxy?browser={browserInspectUri}"
```

But it is supplied for us when we create the project, so we don't need to add that manually.

Now let's see what happens with our exception:

1. Copy our `ThrowException.razor` file and put it in the `BlazorWebAssemblyApp/Pages` folder.
2. In the copied file, remove the `@rendermode` line. Since the WebAssembly project is all WebAssembly, we don't need to specify render mode.
3. In the web browser, navigate to `https://localhost:portnumber/throwexception`.
4. Click the **Throw exception** button.

5. The unhandled exception won't get hit in Visual Studio. We get the exception in the developer tools in the web browser, as shown in *Figure 12.3*:

```
crit:                                            blazor.webassembly.js:1
Microsoft.AspNetCore.Components.WebAssembly.Rendering.WebAssemblyRende
rer[100]
      Unhandled exception rendering component: Something is broken
System.Exception: Something is broken
   at MyBlog.Shared.Pages.ThrowException.<>c.<BuildRenderTree>b__0_0()
in
C:\Code\B16009\Ch12\MyBlog\MyBlog.Shared\Pages\ThrowException.razor:li
ne 3
   at
Microsoft.AspNetCore.Components.EventCallbackWorkItem.InvokeAsync[Obje
ct](MulticastDelegate delegate, Object arg)
   at
Microsoft.AspNetCore.Components.EventCallbackWorkItem.InvokeAsync[Obje
ct arg)
   at
Microsoft.AspNetCore.Components.ComponentBase.Microsoft.AspNetCore.Com
ponents.IHandleEvent.HandleEventAsync(EventCallbackWorkItem callback,
Object arg)
   at Microsoft.AspNetCore.Components.EventCallback.InvokeAsync(Object
arg)
   at
Microsoft.AspNetCore.Components.RenderTree.Renderer.DispatchEventAsync
(UInt64 eventHandlerId, EventFieldInfo fieldInfo, EventArgs eventArgs)
```

Figure 12.3: WebAssembly error

The debugging experience in Blazor WebAssembly is not as polished as with Blazor Server, but it is polished enough to get the job done.

We have one method left to explore – debugging in the web browser.

Debugging Blazor WebAssembly in the web browser

The first debugging experience for Blazor WebAssembly was the ability to debug right in the web browser:

1. In Visual Studio, start the project by pressing *Ctrl* + *F5* (run without debugging).
2. In the web browser, press *Shift* + *Alt* + *D*.

   We will get an error message with instructions on how to start the web browser in debug mode.

I am running Edge, so the way to start Edge would be something like this:

```
msedge --remote-debugging-port=9222 --user-data-dir="C:\Users\
Jimmy\AppData\Local\Temp\blazor-edge-debug" --no-first-run https://
localhost:5001/
```

The `port` and `user-data-dir` values will differ from the example above. Copy the command from your web browser.

3. Press *Win* + *R* and paste the command.
4. A new instance of Chrome or Edge will open. In this new instance, press *Shift* + *Alt* + *D*.
5. We should now see a **Sources** tab containing C# code from our project. From here, we can put breakpoints that will be hit and hover over variables. Make sure to have only this tab open in the web browser (not multiple tabs open).

The debug UI can be seen in *Figure 12.4*:

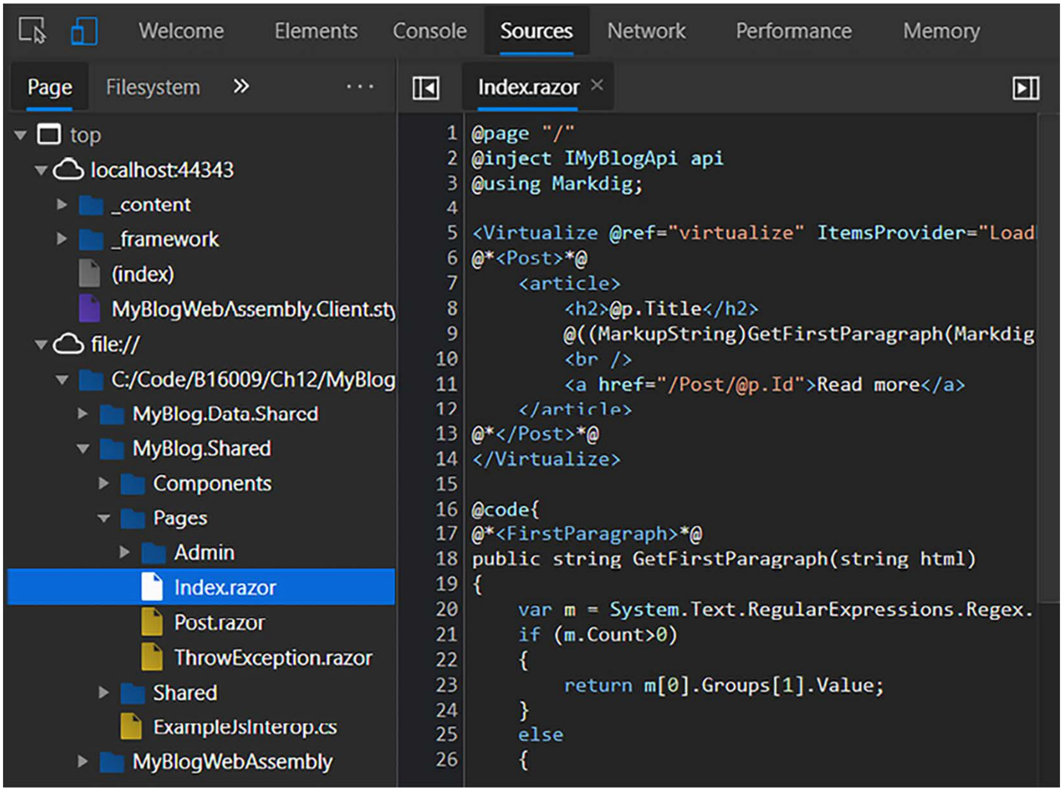


Figure 12.4: Screenshot of the in-browser debug UI

Debugging C# code in the browser is pretty amazing, but since we have been directly debugging in Visual Studio, I don't see much use for this kind of debugging.

Next, we will look at something that might not fall under debugging but is useful while developing Blazor apps.

Hot Reload

In Visual Studio and the **dotnet CLI**, we can enable **Hot Reload**. This means that as soon as we make changes in our application, our Blazor app will automatically get reloaded, and we will (in most cases) not lose the state.

To set this up, do the following:

1. In Visual Studio, there is a small fire icon. We can use this button to trigger **Hot Reload** manually.

   It is only clickable when the application is running (with or without debugging).

2. Select the **Hot Reload on File Save** option.
3. Start the project by pressing *Ctrl* + *F5*.
4. In the web browser, bring up the counter page by adding `/counter` to the URL.
5. Make a change to the `/Pages/Counter.razor` file and click **Save**.

Our web browser should now reload, and the change will be shown. At the time of writing, my Hot Reload did not find any changes when running in Visual Studio, but it did work with `dotnet watch`.

Hot Reload does save time and is pretty amazing. Not having to recompile the project and start up a web browser and seeing the changes in the browser just seconds after you save the file is simply amazing. However, there are some cases where our site behaves oddly, and then we need to rebuild. Therefore, you need to remember that if there is an unexplainable issue, you might need to build the project again.

This also works from the command line by running the following command:

```
dotnet watch
```

Hot reload gets better and better with each release. I usually run preview versions of Visual Studio to get the best experience, but that can also sometimes have its drawbacks.

Summary

This chapter looked at different ways to debug our Blazor application. There will always be moments when we need to step through the code to find a bug or see what is happening. When these moments are upon us, Visual Studio delivers world-class functionality to help us achieve our goals.

The nice thing is that debugging Blazor applications, whether it's Blazor Server or Blazor WebAssembly, will work as expected from a Microsoft product. We get C# errors that are (in most cases) easy to understand and solve.

In the next chapter, we will look at testing our Blazor components.

13

Testing

In this chapter, we will take a look at testing. Writing tests for our projects will help us develop things rapidly.

We can run tests to ensure we haven't broken anything with the latest change. Also, we don't have to invest our time in testing components manually since it is all done by the tests. Testing will improve the quality of the product since we'll know that things that worked earlier still function as they should.

But writing tests for UI elements isn't always easy; the most common way is to spin up the site, use tools that click on buttons, and then read the output to determine whether things work. The upside of this method is that we can test our site on different browsers and devices. The downside is that it usually takes a lot of time to do these tests. We need to spin up the website, start a web browser, verify the test, close the web browser, and repeat for the next test.

We can use this method in Blazor as well (as with any ASP.NET site), but with Blazor, we have other opportunities when it comes to testing.

Steve Sanderson created an embryo of a test framework for Blazor that Microsoft MVP Egil Hansen picked up and continued the development of.

Egil's framework is called **bUnit** and has become an industry standard in the Blazor community for testing Blazor components.

This chapter covers the following topics:

- What is bUnit?
- Setting up a test project

- Mocking the API
- Writing tests
- `Blazm` extension

Technical requirements

Make sure you have read the previous chapters or use the `Chapter12` folder as a starting point.

You can find the source code for this chapter's result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter13`.

If you are jumping into this chapter using the code from GitHub, make sure you have added the `Auth0` account information in the settings files. You can find the instructions in *Chapter 8*, *Authentication and Authorization*.

What is bUnit?

As mentioned in the introduction, some tests spin up web browsers to test pages/components, but bUnit takes another approach.

bUnit is made specifically for Blazor. It can define and set up tests using C# or Razor syntax. It can mock JavaScript interop as well as Blazor's authentication and authorization. To make our components more testable, sometimes we need to think about these things from the beginning or make minor changes to our code.

bUnit doesn't rely on a web browser but renders the output internally and exposes it to us so that we can test against predefined outputs. This is also a limitation – we are not testing the real site; we are testing the component, so think of this as unit tests, not integration tests.

It's time for us to get our hands dirty, so let's create a test project.

Setting up a test project

To be able to run tests, we need a test project:

1. To install the **bUnit** templates, open PowerShell and run the following command:

   ```
   dotnet new install bunit.template
   ```

2. Check which is the latest version of the templates on the bUnit web page: `https://bunit.dev/`.

3. In Visual Studio, right-click the **MyBlog** solution and choose **Add** | **New Project**.
4. Search for **bUnit**, select **bUnit Test Project** in the results, and then click **Next**. Sometimes, it takes time to find a template, and we can also change the **Project Type** dropdown to **bUnit** to find the template. We might need to reboot Visual Studio to find it.
5. Name the project `MyBlog.Tests`, leave the location as is, and click **Next**.
6. Select **xUnit** as the unit test framework and target framework: **.NET 8.0**, and click **Create**.

Great! We now have a test project. Before we mock the API, let's look at the different methods available to us so we can get a feel for how bUnit works.

In `MyBlog.Tests`, we should have the following four files:

- `_Imports.razor` contains the namespaces that we want all of our Razor files to have access to.
- `Counter.razor` is a copy of the same `Counter` components we get by default in the Blazor template.
- `CounterCSharpTest.cs` contains tests written in C#.
- `CounterRazorTest.razor` contains tests written in Razor.

Let's start with the `CounterCSharpTest.cs` file, which contains two tests: one that checks that the counter starts at `0` and one that clicks the button and verifies the counter is now `1`. These two simple tests make sense for testing the `Counter` component.

The `CounterStartsAtZero` test looks like this:

```
[Fact]
public void CounterStartsAtZero()
{
    // Arrange
    var cut = RenderComponent<Counter>();
    // Assert that content of the paragraph shows counter
    // at zero
    cut.Find("p").MarkupMatches("<p>Current count: 0</p>");
}
```

Let's break this down. The `Fact` attribute tells the test runner that this is a *normal* test with no parameters. We can also use the `Theory` attribute to tell the test runner that the `test` method needs parameter values, but we don't need parameters for this use case.

First, we arrange the test. Simply put, we set up everything we need to do the test. Egil uses cut as the component's name, which stands for **component under testing**.

In this case, we run the `RenderComponent` method and pass in the component type, which is the `Counter` component. Next, we assert whether the component outputs the correct thing or not. We use the `Find` method to find the first paragraph tag and then verify that the HTML looks like `<p>Current count: 0</p>`.

The second test is a bit more advanced, and it looks like this:

```
[Fact]
public void ClickingButtonIncrementsCounter()
{
    // Arrange
    var cut = RenderComponent<Counter>();
    // Act - click button to increment counter
    cut.Find("button").Click();
    // Assert that the counter was incremented
    cut.Find("p").MarkupMatches("<p>Current count: 1</p>");
}
```

As with the previous test, we start arranging by rendering our `Counter` component. The next step is acting, where we click the button. We look for the button and then click the button in our `Counter` component. There is only one button, so in this case, it's safe to look for the button this way.

Then it's time to assert again, and we check the markup in the same way as the previous test, but we look for `1` instead of `0`.

There is also another alternative where we can write out tests with Razor syntax. If we look at the `CounterRazorTests.razor` files, we can see the exact same tests but with different syntax:

```
    [Fact]
    public void CounterStartsAtZero()
    {
        // Arrange
        var cut = Render(@<Counter />);
        // Assert that content of the paragraph shows counter at zero
        cut.Find("p").MarkupMatches(@<p>Current count: 0</p>);
    }
```

It is really only the way we render the component that differs. This does the same thing and is only a matter of preference. I prefer using the Razor version; it is easier to read, and it's also easier to add parameters to our component while testing.

Now, let's run the tests and see whether they pass:

1. In Visual Studio, bring up **Test Explorer** by searching for it using *Ctrl* + *Q*. We can also find it in **View** | **Test Explorer**.
2. Click **Run All Test** in the view. Test Explorer should look like *Figure 13.1*:

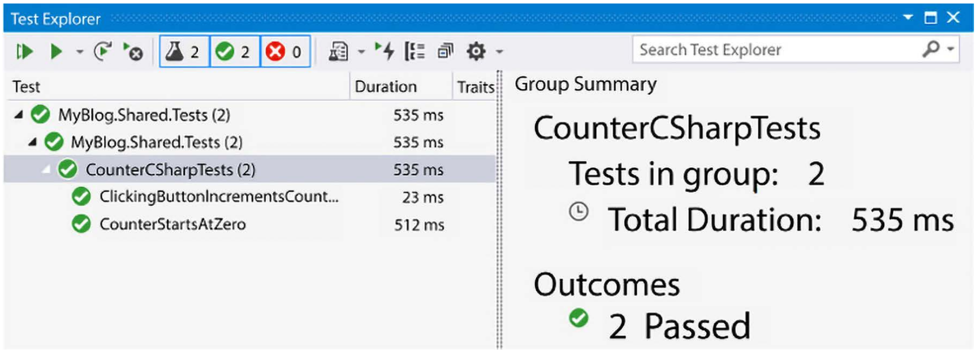


Figure 13.1: Visual Studio Test Explorer

Wonderful! Now, our first test is running and hopefully passing.

Next, we will take a look at mocking the API.

Mocking the API

There are different ways to test our application. Testing the API is beyond the scope of this book, but we still need to test the components, which are dependent on the API. We could spin up the API and test against the API, but in this case, we are only interested in testing the Blazor component.

We can then mock the API or create a fake copy of the API that doesn't read from the database but reads from a predefined dataset. This way, we always know what the output should be.

Luckily, the interface we created for our API is just what we need to create a mock API.

We won't implement 100% of the tests for the project, so we don't have to mock all the methods. Please feel free to implement tests for all methods as an exercise at the end of the chapter.

There are two ways we can implement the mock API. We could spin up an in-memory database, but to keep things simple, we will choose the other option and generate posts when we ask for them:

1. In the `MyBlog.Tests` project, add a project reference to the `SharedComponents` and `BlazorWebApp` project.
2. Create a new class called `BlogApiMock.cs`.
3. Add the following namespaces:

```
using Data.Models;
using Data.Models.Interfaces;
using System.Collections.Generic;
using System.Threading.Tasks;
```

4. Implement the `IBlogApi` interface; the class should look like this:

```
internal class BlogApiMock :IBlogApi
{
}
```

   Now, we will implement each of the methods so we can get data.

5. For `BlogPost`, add the following code in the class:

```
public async Task<BlogPost?> GetBlogPostAsync(string id)
{
    BlogPost post = new()
    {
        Id = id,
        Text = $"This is a blog post no {id}",
        Title = $"Blogpost {id}",
        PublishDate = DateTime.Now,
        Category = await GetCategoryAsync("1"),
    };
    post.Tags.Add(await GetTagAsync("1"));
    post.Tags.Add(await GetTagAsync("2"));
    return post;
}
public Task<int> GetBlogPostCountAsync()
{
    return Task.FromResult(10);
```

```
}
public async Task<List<BlogPost>?> GetBlogPostsAsync(int
numberofposts, int startindex)
    {
        List<BlogPost> list = new();
        for (int a = 0; a < numberofposts; a++)
        {
            list.Add(await GetBlogPostAsync($"{startindex + a}"));
        }
        return list;
    }
```

When we run the GetBlogPostAsync method, we create a blog post and fill it with pre-defined information we can use later in our tests. The same thing goes for getting a list of blog posts.

We also say that we have a total of `10` blog posts in the database.

For categories, add the following code:

```
    public async Task<List<Category>?> GetCategoriesAsync()
    {
        List<Category> list = new();
        for (int a = 0; a < 10; a++)
        {
            list.Add(await GetCategoryAsync($"{a}"));
        }
        return list;
    }
    public Task<Category?> GetCategoryAsync(string id)
    {
        return Task.FromResult(new Category() { Id = id, Name =
$"Category {id}" });
    }
```

Here, we do the same thing: we create categories named `Category` followed by a number.

6. For comments, add the following:

```
    public Task<List<Comment>> GetCommentsAsync(string blogPostId)
    {
        var comments= new List<Comment>
```

```
        {
            new Comment { BlogPostId = blogPostId, Date = DateTime.
Now, Id = "Comment1", Name = "Rocket Raccoon", Text = "I really want
that arm!" }
        };
        return Task.FromResult(comments);
    }
```

Here, we create a comment.

The same thing goes for tags; add the following code:

```
    public Task<Tag?> GetTagAsync(string id)
    {
        return Task.FromResult(new Tag() { Id = id, Name = $"Tag
{id}" });
    }
    public async Task<List<Tag>?> GetTagsAsync()
    {
        List<Tag> list = new();
        for (int a = 0; a < 10; a++)
        {
            list.Add(await GetTagAsync($"{a}"));
        }
        return list;
    }
```

We will not add tests for other methods in the API. We do need to add them to the mock class to fulfill the interface:

```
    public Task<BlogPost?> SaveBlogPostAsync(BlogPost item)
    {
        return Task.FromResult(item);
    }
    public Task<Category?> SaveCategoryAsync(Category item)
    {
        return Task.FromResult(item);
    }
    public Task<Tag?> SaveTagAsync(Tag item)
    {
```

```
        return Task.FromResult(item);
    }     public Task<Comment?> SaveCommentAsync(Comment item)
    {
        return Task.FromResult(item);
    }
    public Task DeleteBlogPostAsync(string id)
    {
        return Task.CompletedTask;
    }
    public Task DeleteCategoryAsync(string id)
    {
        return Task.CompletedTask;
    }
    public Task DeleteTagAsync(string id)
    {
        return Task.CompletedTask;
    }
  public Task DeleteCommentAsync(string id)
  {
        return Task.CompletedTask;
  }
```

We now have a mock API that does the same thing repeatedly so we can make reliable tests.

Writing tests

It's time to write some tests. As I mentioned earlier in the chapter, we won't create tests for the entire site; we will leave that to you to finish later if you want to. This is just to get a feel for how to write tests:

1. In the `MyBlog.Tests` project, create a new folder called `Pages`. This is just so we can keep a bit of a structure (the same folder structure as the project we are testing).
2. Select the `Pages` folder and create a new Razor component called `HomeTest.razor`.
3. In the `_Imports` file, add the following namespaces:

```
@using SharedComponents.Pages
@using Data.Models.Interfaces
@using SharedComponents.ReusableComponents
```

4. In the `HomeTest.razor` file, inherit from `TestContext` by adding the following code:

```
@inherits TestContext
```

5. Now, we will add the test. Add the following code:

```
@code{
[Fact(DisplayName ="Checks that the Home component shows 10 posts")]
    public void Shows10Blogposts()
    {
        // Act
        var cut = Render(@<Home />);
        // Assert that the content has 10 article tags (each
representing a blogpost)
        Assert.Equal(10,cut.FindAll("article").Count());
    }
}
```

We give our test a display name so we understand what it does. The test is pretty simplistic; we know we have `10` blog posts from the mock API. We also know that each blog post is rendered within an `article` tag. We find all `article` tags and make sure we have `10` in total.

Since we are using injection, we need to configure dependency injection, which we can do in the constructor.

6. We need to add the `HomeTest` method:

```
public HomeTest()
{
      Services.AddScoped<IBlogApi, BlogApiMock>();
}
```

This method will run when the class is created, and here, we declare that if the components ask for an instance of `BlogApi`, it will return an instance of our mock API.

This works the same way as with Blazor Server, where we return an API that talks directly to the database, and with Blazor WebAssembly, where we return an instance of the API that talks to a web API.

In this case, it will return our mock API, which returns data that is easy to test. Now, we need to run the actual test.

7. Delete the default tests:

```
Counter.razor
CounterCSharpTests.cs
CounterRazorTests.cs
```

8. In Visual Studio, bring up Test Explorer by searching for it using *Ctrl* + *Q*. We can also find it in **View** | **Test Explorer**.

   Run our tests to see whether we get a green light, as shown in *Figure 13.2*:

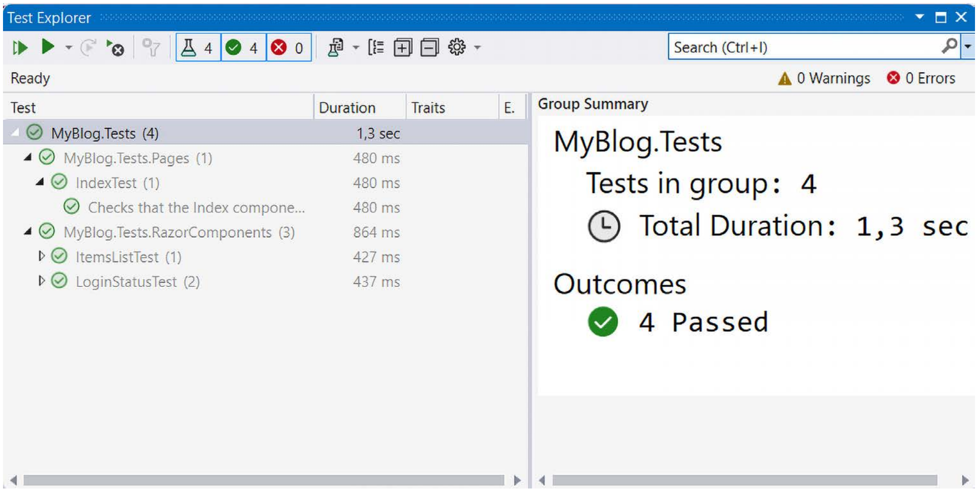


Figure 13.2: Test Explorer with IndexTest

Now, we have a test that checks that 10 posts are rendered.

bUnit is an excellent framework for testing, and the fact that it is explicitly written for Blazor so that it takes advantage of Blazor's power makes it amazing to work with.

Now, we have a simplistic test for our blog, but bUnit has support for more advanced features, such as authentication.

Authentication

Using bUnit, we can test authentication and authorization.

It is, however, not the components themselves that are doing the authentication. We added `AuthorizeRouteView` to `App.razor` in *Chapter 8*, *Authentication and Authorization*, so testing that in individual components won't make a difference.

But we can use `AuthorizeView`, for example, and we have it in our blog in the `LoginStatus` component, which displays a login link when we are not authorized and a logout link when we are authorized. Please feel free to add these tests as we did in the previous section, or use them as a reference.

We can use the `AddTestAuthorization` method to authorize our tests like this:

```
    [Fact(DisplayName ="Checks if log in is showed")]
    public void ShouldShowLogin()
    {
        // Arrange
        this.AddTestAuthorization();
        // Act
        var cut = Render(@<LoginStatus />);

        // Assert that there is a link with the text Log in
        Assert.Equal("Log in",cut.Find("a").InnerHtml);
    }
```

This method adds `TestAuthorization` but is not authorized. The page will then display a link with the text `Log in`. To test when the user is authorized, we just set the user as authorized:

```
    [Fact(DisplayName ="Checks if logout is showed")]
    public void ShouldShowLogout()
    {
        // Arrange
        var authContext = this.AddTestAuthorization();
        authContext.SetAuthorized("Testuser", AuthorizationState.
Authorized);
        // Act
        var cut = Render(@<LoginStatus />);

        // Assert that there is a link with the text Log out
        Assert.Equal("Log out",cut.Find("a").InnerHtml);
    }
```

We can add claims, roles, and much more. The user we utilize for testing does not correlate with the users or roles in the database; the authorization is mocked by bUnit.

Authentication and authorization could be tricky to test, but using bUnit is really simple. Testing JavaScript is a bit harder, but bUnit has a solution for that as well.

Testing JavaScript

Testing JavaScript is not supported by bUnit, which is understandable. We can, however, test the interop ourselves.

In this book, we have used the .NET 5 syntax for our JavaScript. In our `SharedComponents\ReusableComponents\BlogButton.razor` component, we make a JavaScript interop to confirm the deletion of an item.

The JavaScript call looks like this:

```
jsmodule = await jsRuntime.InvokeAsync<IJSObjectReference>("import", "/_content/SharedComponents/ReusableComponents/BlogButton.razor.js");
return await jsmodule.InvokeAsync<bool>("showConfirm", ConfirmMessage);
```

We make sure that we load the JavaScript module and then execute the `showConfirm` method.

JavaScript testing in bUnit can be done in two modes – `strict` and `loose`. The default value is `strict`, so we need to specify every module and every method.

If we choose `loose`, all methods will just return the default value. For a Boolean, it would return `false`, for example.

To test the preceding JavaScript call, we can do that by adding something like this:

```
var moduleInterop = this.JSInterop.SetupModule("/_content/SharedComponents/ReusableComponents/BlogButton.razor.js");
    var showconfirm = moduleInterop.Setup<bool>("showConfirm", "Are you sure?").SetResult(true);
```

We set up a module with the same path to JavaScript as before. Then, we specify the method and any parameters.

Lastly, we specify what the result should be. In this case, we return `true`, which would return from JavaScript if we want to delete the item. We could also verify whether the JavaScript method is being called. A complete example for testing this in the `ItemList` component would look like this:

```
@using Data.Models; @using SharedComponents.ReusableComponents;
@inherits TestContext
@code {
```

```
    [Fact(DisplayName = "Test if js method 'showConfirm' is called upon
using JS interop")]
    public void ShouldShowConfirm()
    {
        // Arrange
        var moduleInterop = this.JSInterop.SetupModule("/_content/
SharedComponents/ReusableComponents/BlogButton.razor.js");
        moduleInterop.Setup<bool>("showConfirm", "Are you sure?").
SetResult(true);
        var cut = Render(@<BlogButton OnClick="()=>{}" ConfirmMessage="Are
you sure?"/>);
        // Act
        var buttons = cut.FindAll("button");
        buttons.First().Click();
        // Assert
        JSInterop.VerifyInvoke("showConfirm");
}
}
```

Great job! We now have tests in our project. Even though we aren't covering all the components, we should have all the building blocks to complete the tests.

If you want to learn more about bUnit, check out the following link: `https://bunit.dev/docs/getting-started/index.html`.

Their documentation is fantastic.

It is good to know that it is also possible to use other testing frameworks. We use a combination of Playwright tests and bUnit but we test completely different things. You can find Playwright here: `https://playwright.dev/dotnet/docs/intro`.

Before we summarize this chapter, we have one more thing to talk about.

Blazm extension

There are things that are a bit tedious when developing Blazor applications. We have done many of those things throughout the book. I tend to spell things wrong when I code, and when creating an isolated CSS or JavaScript file, I tend to get the name wrong from time to time and even get the file extension wrong. So, I thought, is there a better way to do this?

Yes, there is!

I built a Visual Studio extension that will add some very nice features to Visual Studio.

But why in the world have I waited so long to talk about this!? Well, it's important to learn the "real" way first, then take the shortcuts.

You can check out the extension here: `https://marketplace.visualstudio.com/items?itemName=EngstromJimmy.BlazmExtension`

It can help us add a code-behind file and isolated CSS and JavaScript files. It can also help us move namespaces into the `_imports` file and much more. But it can also help us generate tests, not the whole way, but it will help us on the way. Do you remember the `Alerts` component we used in *Chapter 4*? We can right-click that component and choose `Generate` **bUnit test**, and then as **Razor syntax**. It will generate the code to the clipboard so we can paste it where we want it. It will automatically give us this code:

```
@inherits TestContext
@using Bunit
@using SharedComponents.ReusableComponents;
@code
    {
        [Fact]
        public void AlertTest()
        {
            //Arrange

            SharedComponents.ReusableComponents.Alert/AlertStyle style =
default!;

            var cut = Render(@<Alert
                  Style="@style"
                  >
                  <ChildContent>
<b>ChildContent fragment</b></ChildContent>
                  </Alert>
);
            //Act
```

```
            //Assert
        }
    }
```

The result is not perfect as we can see, but it gives us something to stand on. If we were to write a test for the `Alert` component, it would look something like this:

```
[Fact]
 public void AlertStyleTest()
 {
     //Arrange
     Alert.AlertStyle style = Alert.AlertStyle.Primary;
     var cut = Render(@<Alert Style="@style">
     <ChildContent>
         <b>ChildContent fragment</b>
     </ChildContent>
 </Alert>
 );
     //Act

     //Assert
     cut.MarkupMatches("""<div class="alert alert-primary"
role="alert"><b>ChildContent fragment</b></div>""");
 }
```

We had to clean up some namespaces and add an assertion. It's pretty neat if you ask me, but then again, I am pretty biased on this topic. I really hope this extension will help you, and I would love for you to give it a five-star review if you enjoy it.

Summary

In this chapter, we looked at testing our application. We looked at how we can mock an API to make reliable tests. We also covered how to test JavaScript interop as well as authentication.

Tests can speed up our development and, most importantly, build quality. With bUnit combined with dependency injection, it is easy to build tests that can help us test our components.

Since we can test every component by itself, we don't have to log in, navigate to a specific place on our site, and then test the entire page, as many other testing frameworks would have us do.

Now, our site contains reusable components, authentication, APIs, Blazor Server, Blazor WebAssembly, authentication, shared code, JavaScript interop, state management, and tests. We only have one more thing to do: ship it!

In the next chapter, *Chapter 14*, *Deploying to Production*, it's time to ship.

14

Deploying to Production

In this chapter, we will take a look at the different options we have when deploying our Blazor application to production. Since there are many different options, going through them all would be a book all by itself.

We won't go into detail but rather cover the different things we need to think about so that we can deploy to any provider.

In the end, deploying is what we need to do to make use of what we build.

In this chapter, we will cover the following:

- Continuous delivery options
- Hosting options

Technical requirements

This chapter is about general deployment, so we won't need any code.

Continuous delivery options

When deploying anything to production, we should think about making sure to remove uncertain factors. For example, if we are deploying from our own machine, how do we know it's the latest version? How do we know that our teammates didn't recently solve a problem and we don't have the fix in our branch? To be honest, how do we even know that the version in source control is the same in production, or if the version in production even exists in source control? You know the old saying: "Friends don't let friends right-click and publish" (to production, that is)?

This is where **Continuous Integration** and **Continuous Delivery/Deployment** (**CI/CD**) come into the picture. We make sure that something else makes the deployment to production. Entire books could be written on deployment, so we won't go that deep into the subject.

GitHub Actions and Azure DevOps (or Azure Pipelines) are two products from Microsoft for CI/CD. There are many more, such as Jenkins, TeamCity, and GitLab – the list is long. If the CI/CD system we are currently using supports deploying ASP.NET, it will be able to handle Blazor because, in the end, Blazor is just an ASP.NET site.

If we have tests (which we should have), we should also make sure to set up tests as part of our CI/CD pipeline. The nice thing is that we don't need to add any specific hardware to test our components; it will work if our CI/CD pipeline can run unit tests.

Since Blazor is ASP.NET, nothing is stopping us from going even further with the automated testing of our site.

There is also something called **wasm-tools**, which we will take a look at in *Chapter 16*, *Going Deeper into WebAssembly*.

Hosting options

When it comes to hosting Blazor, there are many options. Any cloud service that can host ASP.NET Core sites should be able to run Blazor without any problems.

We need to think about some things, so let's go through the options one by one.

Hosting Blazor Server/InteractiveServer

If the cloud provider can enable/disable WebSockets, we want to enable them since that's the protocol used by SignalR.

Sometimes, the cloud provider may support .NET Core 3.x but not .NET 8 out of the box. But don't worry; by making sure to publish our application with the deployment mode as self-contained, we make sure the deployment also adds any files necessary to run the project (this might not be true for all hosting providers).

This is also a good thing to do to make sure that we are running on the exact framework version we expect.

Hosting InteractiveWebAssembly

InteractiveWebAssembly is using a .NET Core backend (like we do for the blog), we are hosting a .NET Core website, so the same rules apply as with hosting Blazor Server. For our blog, we also added SignalR, so we need WebSockets enabled as well.

Hosting Blazor WebAssembly Standalone

If we are using the Blazor WebAssembly Standalone template, we don't need to think about .NET Core hosting. We can host our application in Azure Static Web Apps or even GitHub Pages. This is one of the upsides of doing a Blazor WebAssembly Standalone site.

Hosting on IIS

We can also host our application on **Internet Information Server** (**IIS**). Install the hosting bundle, and it will also make sure to include the ASP.NET Core IIS module if installed on a machine with IIS.

You need to make sure to enable the WebSocket protocol on the server.

We currently run our sites on IIS and use Azure DevOps to deploy our sites. Since we are using Blazor Server, the downtime is very evident. As soon as the web loses the SignalR connection, the site will display a reconnect message.

For the sites we are using, there are about 8 to 10 seconds of downtime when deploying a new version, which is pretty quick.

Summary

In this chapter, we talked about why we should use CI/CD since it makes a huge difference in ensuring the quality of the application. We looked at some of the things we need to do to run our Blazor app on any cloud provider supporting .NET 8.

Deploying is perhaps the most important step when it comes to an application. Without deploying our application, it's just code. With the things we mentioned in this chapter, such as CI/CD, hosting, and deployment, we are now ready to deploy the code.

In the next chapter, we will dig deeper into how we can port a current site, use Blazor with other technologies, or use other technologies with Blazor.

15

Moving from, or Combining with, an Existing Site

In this chapter, we will take a look at how we can combine different technologies and frameworks with Blazor.

What if we already have a site?

There are different options when it comes to moving from an existing site; the first question is, do we want to move from it, or do we want to combine it with the new technology?

Microsoft has a history of making it possible for technologies to co-exist, and this is what this chapter is all about.

How can we use Angular and React in our Blazor site, or how can we introduce Blazor into an existing Angular and React site?

In this chapter, we will cover the following:

- Introducing web components
- Exploring custom elements
- Exploring the Blazor component
- Adding Blazor to an Angular site
- Adding Blazor to a React site
- Adding Blazor to MVC/Razor Pages
- Adding web components to a Blazor site
- Migrating from web forms

Combining technologies can be very useful, either because we can't convert a whole site in one go or because other technologies are a better fit for what we are trying to accomplish.

Having said that, I prefer using one technology on my site, not mixing Blazor with Angular or React. But during a migration period or if our team is mixed, there are benefits to mixing.

There is a cost to mixing technologies, which we will look at throughout the chapter.

While writing this chapter, revisiting Angular and React, I must take the opportunity to say how much I love the Razor syntax. React is JavaScript with HTML tags inside, and Angular has templates, which I find pretty nice and remind me of what the Razor syntax looks like.

However, there are a lot of things involved: almost 300 MB of Node.js modules, npm, TypeScript, and webpack. Well, the list is long.

I love working with Blazor because I don't need to work with everything I just mentioned. In my opinion, Blazor has the best syntax out of the three options.

Technical requirements

This chapter is a reference chapter and is not connected in any way with the other chapters of the book.

You can find the source code for this chapter's examples at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter15`.

Introducing web components

To work with JavaScript, whether it's bringing JavaScript to Blazor or bringing Blazor into JavaScript, we can use a technology called web components.

Web components are a set of web platform APIs that allow us to create new, custom, reusable HTML tags. They are packaged in an encapsulated way, and we can use them very similarly to how we use components in Blazor.

The really nice thing is that we can use them in any JavaScript library or framework that supports HTML.

Web components are built on top of existing web standards like shadow DOM, ES modules, HTML templates, and custom elements.

We will also recognize some of these technologies or variations of them in Blazor. Shadow DOM is the same as Blazor's render tree, and ES modules are the type of JavaScript modules we looked at in *Chapter 10*, *JavaScript Interop*.

The technology we are going to take a look at in this chapter is **custom elements**.

Exploring custom elements

To bring Blazor into an existing Angular or React site, we use a feature called `CustomElements`. It was introduced as an experimental feature in .NET 6 and has been a part of the framework since .NET 7.

The idea is to create parts of your site in Blazor without having to migrate fully over to Blazor.

For this feature to work, we need to have an ASP.NET backend or manually make sure the `_framework` files are available. This is so that we can serve the Blazor framework files.

There are two ways of running `CustomElements`; we can run it as Blazor WebAssembly or as the Blazor Server. Since we are adding Blazor to a client framework like React or Angular, the most relevant method is to run it as Blazor WebAssembly. Therefore, the examples in these first sections will be for Blazor WebAssembly.

In the GitHub repo, there is a folder called `CustomElements` in which you will find the code for the projects, from which we will see sample code in this chapter.

It is worth mentioning that since the components are being served and used on the client, there is nothing that hinders us (or people who mean us harm) from decompiling the code (if we are using WebAssembly). This is something client-side developers of all frameworks deal with all the time, but it is worth mentioning again.

Exploring the Blazor component

The first thing we need to try out is a Blazor component. I have created a `counter` component inside a Blazor WebAssembly project named `BlazorCustomElements`.

The default template comes with a lot of things, and the repo project is stripped to the bare minimum, so it is easy to understand.

The component is nothing different from what we have seen in the book previously; it's a `counter` component with a parameter that sets how much the counter should count up. It looks like this:

```
<h1>Blazor counter</h1>
<p role="status">Current count: @currentCount</p>
<p>Increment amount: @IncrementAmount</p>
<button class="btn btn-primary" @onclick="IncrementCount">Click me</
button>
```

```
@code {
    private int currentCount = 0;
    [Parameter] public int IncrementAmount { get; set; } = 1;
    private void IncrementCount()
    {
        currentCount += IncrementAmount;
    }
}
```

The project also needs a reference to the NuGet package:

```
Microsoft.AspNetCore.Components.CustomElements
```

In the `Program.cs`, we need to register the component/custom element like this:

```
builder.RootComponents.RegisterCustomElement<Counter>("my-blazor-
counter");
```

That's it for the Blazor project.

Now it's time to use our custom element.

Adding Blazor to an Angular site

Let's look at how we can add Blazor to an existing Angular site. This demo is based on the Angular and ASP.NET Core template in Visual Studio.

The folder is called `Angular`.

First, we need a reference to our Blazor library. I added the `BlazorCustomElement` project as a reference to the server project.

We need a reference to the `Microsoft.AspNetCore.Components.WebAssembly.Server` NuGet package; this is so we can serve the framework files.

To make our site serve the framework files, we need to add the following to `Program.cs`:

```
app.UseBlazorFrameworkFiles();
```

By default, Angular will be upset when we add our custom element because it does not recognize the tag. To fix this, we need to tell Angular that we are using custom elements. In the `angularproject.client/src/app/app.module.ts`, add the following things:

```
import { CUSTOM_ELEMENTS_SCHEMA, NgModule } from '@angular/core';
```

Make sure to replace the row that already has an import for `NgModule`.

A bit further down in the same file, add:

```
    schemas: [
      CUSTOM_ELEMENTS_SCHEMA // Tells Angular we will have custom tags in
  our templates
    ]
```

Now Angular is okay with having custom elements.

Next, it's time to add our component. In `angularproject.client /src/app/app.component.html`, we add our custom tag:

```
<my-blazor-counter increment-amount="10"></my-blazor-counter>
```

In this case, we set the `increment-amount` parameter to `10`, which will increase the counter by `10` every time we click it.

To make this all work, we need to load a couple of JavaScript scripts. In `angularproject.client/src/index.html`, we need to add:

```
<script src="_content/Microsoft.AspNetCore.Components.CustomElements/
Microsoft.AspNetCore.Components.CustomElements.lib.module.js"></script>
<script src="_framework/blazor.webassembly.js"></script>
```

We have one last thing we need to fix. When running the Angular project, it spins up a developer server. Actually, it spins up two: one for the ASP.NET backend and one for the Angular frontend. We need to make the Angular server send all the framework requests to the ASP.NET backend.

In the default project template, this is already done for the `/weatherforecast` path. Add the following code to the `angularproject.client/proxy.conf.js` file:

```
    context: [
    "/weatherforecast",
    "/_framework",
    "/_content",
  ],
```

We tell the developer server that if there is a request going to `weatherforecast`, `_framework`, or `_content`, we want to redirect that request to the ASP.NET backend.

We now have a working Angular/Blazor WebAssembly hybrid. I was honestly amazed at how easy and straightforward this was the first time I tried it. It makes it so easy to include some Blazor components on your Angular site, so you can convert it into Blazor step by step, and component by component.

Next, we will do the same using a React site.

Adding Blazor to a React site

Adding Blazor to a React site is very similar to Angular. This demo is based on the React and ASP.NET Core template in Visual Studio. The project is called `ReactProject`.

First, we need a reference to our Blazor library, and I added the `BlazorCustomElement` project as a reference.

We need a reference to the `Microsoft.AspNetCore.Components.WebAssembly.Server NuGet` package; this is so we can serve the framework files.

To make our site serve the framework files, we need to add the following to `Program.cs`:

```
app.UseBlazorFrameworkFiles();
```

Next, it's time to add our component. In `reactproject.client/src/ /App.tsx`, we add our custom tag:

```
<my-blazor-counter increment-amount="10"></my-blazor-counter>
```

In this case, we set the `increment-amount` parameter to `10`, which will increase the counter by `10` every time we click it.

To make this all work, we need to load a couple of JavaScript. In `reactproject.client/index.html`, we need to add:

```
    <script src="_content/Microsoft.AspNetCore.Components.CustomElements/
Microsoft.AspNetCore.Components.CustomElements.lib.module.js"></script>
<script src="_framework/blazor.webassembly.js"></script>
```

These scripts will make sure our components load.

We have one last thing we need to fix. When running the React project, it spins up a developer server. Actually, it spins up two: one for the ASP.NET backend and one for the React frontend.

We need to make the React server send all the framework requests to the ASP.NET backend. In the default project template, this is already done for the `/weatherforecast` path.

Add the following code to the `reactproject.client/vite.config.ts` file:

```
'^/_framework': {
    target,
    secure: false
},
'^/_content': {
    target,
    secure: false
},
```

We tell the developer server that if a request goes to `weatherforecast`, `_framework`, or `_content`, we want to redirect that request to the ASP.NET backend.

We now have a working React/Blazor WebAssembly hybrid. This is very similar to Angular, and I was amazed at how easy and straightforward this was as well. It makes it so easy to include some Blazor components on your React site, so you can convert it to Blazor step by step, component by component.

Next, we will do the same using a Razor Pages site.

Adding Blazor to MVC/Razor Pages

When I started with Blazor, this was exactly the scenario we wanted to address. We had an MVC/Razor Pages mix, and it was time for an upgrade.

We solved it by implementing Razor Pages that referred to Razor components. Looking back at it now, it was not a pretty solution, at least not for a while, until we got to the point where most of the code was rewritten in Blazor.

The challenge is that if we navigate to a page that has a Blazor component (a Razor component), that page is connected to the server and establishes a WebSocket. If we navigate away from a Blazor page to an MVC page, for example, we reload the entire page, and the script gets reloaded as well. A new connection was established, leaving the old one on the server for 3 minutes.

We don't have many users, and for us, that technique works long enough for us to finish the migration and launch a new Blazor version of the site.

But I have some good news!

We can also use the same custom elements to run on a Razor Pages site.

Let's take a look!

The project is called `RazorPagesProject`.

In the previous examples with Angular and React, those technologies are client side; therefore, we used WebAssembly. Razor Pages is server side, and even though we could use WebAssembly here as well, this is an excellent opportunity to take a look at making the **custom component** use Blazor Server.

First, we need a reference to our Blazor library. I added the `BlazorCustomElement` project as a reference.

Then we need to enable Blazor Server in our Razor Pages by adding the following code to `Program.cs`:

```
builder.Services.AddRazorComponents()
    .AddInteractiveServerComponents(options =>
    {
        options.RootComponents.RegisterCustomElement<Counter>("my-
counter");
    });
```

And:

```
app.MapBlazorHub();
```

In `Pages/Shared/_Layout.cshtml`, we need to add the JavaScript:

```
    <script src="_content/Microsoft.AspNetCore.Components.CustomElements/
Microsoft.AspNetCore.Components.CustomElements.lib.module.js"></script>
<script src="_framework/blazor.server.js"></script>
```

In this case, we add the script for Blazor Server.

Last but not least, we need to add our component. In `Pages/Index.cshtml`, we add:

```
<my-counter increment-amount="10"></my-counter>
```

And we are done; the custom component is now running inside our Razor Pages site (which, of course, is an ASP.NET site with Razor Pages turned on).

The cool part is that with only a few changes, we can switch this implementation to run WebAssembly instead of Blazor Server for the Blazor components.

Again, I am super impressed by this; it makes it so simple to migrate existing sites to Blazor.

Next, we will look at how we can use Angular or React controls on our Blazor website.

Adding web components to a Blazor site

We have looked at adding Blazor to an existing Angular, React, and even MVC/Razor Pages site.

But sometimes, that perfect library you love to use might not have a Blazor counterpart. We know that we can make a JavaScript interop and build it ourselves, but can we also use Angular and React libraries from Blazor?

We have two options here; either we can convert our site into an Angular/React site and use those examples, or we can convert the JavaScript library into a web component and use it from Blazor.

Until now, we haven't used npm or anything like that because, in most cases, we don't need it. But now we are mixing technologies, and for that, npm is the easiest way. `npm` is outside the scope of this book, so I will not go into any details about it.

How to convert Angular/React or anything else into a web component is also outside the scope of this book.

The project is called `BlazorProject`.

We can browse some of the web components on this site: `https://www.webcomponents.org/`.

I found a Markdown editor from GitHub. Even though we are not implementing it on our blog, feel free to go back and do so if you want to.

We can read about the editor here:

`https://www.webcomponents.org/element/@github/markdown-toolbar-element`

To get the required JavaScript files, we need to set up `npm`. In the project folder (`BlazorProject.Client`), run the following commands:

```
npm init
npm install -save @github/markdown-toolbar-element
```

This will bring down the JavaScript we need.

Next, copy the `BlazorProject\node_modules\@github\markdown-toolbar-element\` folder to the `wwwroot` folder (in the server project) and include it in the project.

Now, the JavaScript will be accessible from our project.

In `app.razor`, we need to add a reference to the JavaScript, and we put it below the Blazor JavaScript:

```
<script type="module" src="markdown-toolbar-element/dist/index.js"></
script>
```

This component is an ES6 module, so we set the type to `"module"`.

Now, all that is remaining is to add our component. In the demo project, I added it to the `MarkdownDemo` component.

First, the component:

```
<markdown-toolbar for="textarea" role="toolbar">
    <md-bold class="btn btn-sm" tabindex="0">bold</md-bold>
    <md-header class="btn btn-sm" tabindex="-1">header</md-header>
    <md-italic class="btn btn-sm" tabindex="-1">italic</md-italic>
    <md-quote class="btn btn-sm" tabindex="-1">quote</md-quote>
    <md-code class="btn btn-sm" tabindex="-1">code</md-code>
    <md-link class="btn btn-sm" tabindex="-1">link</md-link>
    <md-image class="btn btn-sm" tabindex="-1">image</md-image>
    <md-unordered-list class="btn btn-sm" tabindex="-1">unordered-list</
md-unordered-list>
    <md-ordered-list class="btn btn-sm" tabindex="-1">ordered-list</md-
ordered-list>
    <md-task-list class="btn btn-sm" tabindex="-1">task-list</md-task-
list>
    <md-mention class="btn btn-sm" tabindex="-1">mention</md-mention>
    <md-ref class="btn btn-sm" tabindex="-1">ref</md-ref>
    <md-strikethrough class="btn btn-sm" tabindex="-1">strikethrough</md-
strikethrough>
</markdown-toolbar>
```

Then the text area with binding to a C# variable, `markdown`:

```
<textarea @bind="markdown" @bind:event="oninput" rows="6" class="mt-3
d-block width-full" id="textarea" contenteditable="false"
spellcheck="false"></textarea>
@markdown
@code
{
```

```
    private string markdown = "Hello, **world**!";
}
```

The C# variable changes as soon as we edit the textbox, either by using the toolbar or typing some text.

We have integrated a web component into our Blazor project, which binds to a C# variable.

This is super powerful and gives us new possibilities to add existing functionality to our Blazor site.

Now we know how to handle SPA frameworks like React and Angular. But what about server frameworks like Web Forms? This is what we will look at next.

Migrating from Web Forms

Last but not least, we have **web forms**.

There is honestly not any good upgrade path for web forms; there was a project that aimed for code reuse when migrating to Blazor, but it is not being actively worked on.

The first thing we should know is that Blazor is in many ways very similar to web forms, so the learning curve to get to Blazor is almost nonexistent since we have state management in web forms as well as Blazor.

There are some migration strategies where you would use **Yet Another Reverse Proxy** (**YARP**). Still, my recommendation would be to migrate a part of the website to Blazor and have two sites running, until we reach the point where it is feature-complete. Moving to Blazor is fairly quick to do, and in the end, I believe it will save you time.

When we moved our site from MVC to Blazor, we realized that, in some cases, it was faster to rewrite the component to Blazor than trying to solve it in MVC.

Web forms should be even faster to convert since the backend code is more similar to Blazor than MVC.

So, what should we do? Should we upgrade or keep using web forms? Upgrade – you will not be disappointed!

Summary

We discussed adding Blazor to other technologies, like Angular, React, and Razor Pages, using web components in this chapter. We looked at how to add web components to a Blazor project and leverage JavaScript libraries in our Blazor app.

Upgrading a current site to Blazor can be a lot of work. At my former employer, we made this journey 4 years ago. In our case, we wanted to update our MVC site to be more interactive. We went for Blazor, and I would argue it saved our project and made us more productive, resulting in a more interactive user experience.

In the next chapter, we will delve deeper into Blazor WebAssembly.

Join our community on Discord

Join our community's Discord space for discussions with the author and other readers:

`https://packt.link/WebDevBlazor3e`

16

Going Deeper into WebAssembly

In this chapter, we will go deeper into technologies that are only relevant for Blazor **WebAssembly**.

Most things in Blazor can be applied to Blazor Server and Blazor WebAssembly. Still, since Blazor WebAssembly runs inside the web browser, we can do some things to optimize the code and use other libraries that we can't use server-side.

We will also look at some common problems and how to solve them.

In this chapter, we will cover the following:

- Exploring the WebAssembly template
- .NET WebAssembly build tools
- AOT compilation
- WebAssembly **Single Instruction, Multiple Data** (**SIMD**)
- Trimming
- Lazy loading
- Progressive web apps
- Native dependencies
- Common problems

Some parts of this chapter are a great opportunity to follow along, while other parts are for reference so that you can find the right information when you need it.

Technical requirements

This chapter is a reference chapter and is not connected with the book's other chapters. You can find the source code for this chapter's result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter16`.

Exploring the WebAssembly template

The WebAssembly template looks slightly different from the templates we looked at in *Chapter 2*, Creating Your First Blazor App. In the Blazor Web App template, our entry point is the `app.razor` file. It contains the HTML tags we need to get started. The WebAssembly template had an `Index.html` file. Let's create a project so we can take a look:

1. Create a new project and use the `Blazor WebAssembly Standalone App` template.
2. Name the project `BlazorWebAssembly`.
3. Leave the defaults as is and press **Create**.

First, in the `wwwroot` folder, we have a `Index.html` that has all the CSS, JavaScript, and so on. This is the same content as the `App.razor` file in the Blazor Web App template. We have an `app.razor` file in the WebAssembly project as well, but that contains the same things as the `Routes.razor` file. So it is a bit confusing if we work with both templates.

Let's take a look at each file but only focus on the things that are specific to WebAssembly. In `Index.html`, we have some interesting code:

```
<div id="app">
    <svg class="loading-progress">
        <circle r="40%" cx="50%" cy="50%" />
        <circle r="40%" cx="50%" cy="50%" />
    </svg>
    <div class="loading-progress-text"></div>
</div>
```

This is a `div`, and the content is a progress bar showing the WebAssembly loading progress. In the `css/app.css` file, we have this:

```
.loading-progress circle:last-child {
    stroke: #1b6ec2;
    stroke-dasharray: calc(3.141 * var(--blazor-load-percentage, 0%) *
0.8), 500%;
    transition: stroke-dasharray 0.05s ease-in-out;
```

```
}

.loading-progress-text:after {
    content: var(--blazor-load-percentage-text, "Loading");
}
```

These are just some of the CSS classes for the loading progress, but what is interesting is that Blazor will give us two CSS values, `--blazor-load-percentage-text` and `--blazor-load-percentage`. This gives us some indication of how much time is left when loading our WebAssembly app. This is a great way to customize our progress indicator. The content of the `div` will be replaced by the WebAssembly app once it has loaded.

If we take a look at `Program.cs`, it contains a bit more now when we are running WebAssembly standalone:

```
var builder = WebAssemblyHostBuilder.CreateDefault(args);
builder.RootComponents.Add<App>("#app");
builder.RootComponents.Add<HeadOutlet>("head::after");

builder.Services.AddScoped(sp => new HttpClient { BaseAddress = new
Uri(builder.HostEnvironment.BaseAddress) });

await builder.Build().RunAsync();
```

Here, we set up our WebAssembly project and tell .NET that we want to render the `app.razor` component in the `HTML` tag with the `id` app. We also tell .NET to render the `HeadOutlet` as the last child of the `head` tag.

Run the project and explore it for a bit. The components inside of the project are the same as the ones we have already looked at in *Chapter 4*, *Understanding Basic Blazor Components*, so there is nothing new going on there.

When we start the project the first time, it takes a couple of seconds to load our app. This is when everything is downloaded and started. The next time our users visit our site, much of the files will be cached and we won't need to download them again.

.NET WebAssembly build tools

When it comes to the more "advanced" scenarios, we need additional tooling installed. There are two ways of installing the tools.

We can select the **.NET WebAssembly Build Tools** option when installing Visual Studio (or add them using the Visual Studio installer) or run the following command in a command prompt (as administrator):

```
dotnet workload install wasm-tools
```

The .NET WebAssembly build tools are based on **Emscripten**, a compiler toolchain for the web platform.

AOT compilation

By default, the only thing that is running as WebAssembly in a Blazor WebAssembly app is the runtime. Everything else is ordinary .NET assemblies running on the browser using a .NET **Intermediate Language** (**IL**) interpreter implemented in WebAssembly.

I was not too fond of that when I started playing around with Blazor; it felt wasteful to run everything using IL instead of something the browser would understand natively. Then, I thought the browser was running the same code as I would on the server. The same code in the browser! That is pretty amazing!

However, we have the option to compile directly to WebAssembly; this is called **ahead-of-time** (**AOT**) compilation. It has a downside: the app download size will increase, but it will run and load faster.

An AOT-compiled app is generally twice the size of an IL-compiled app. AOT will take the .NET code and compile that directly into WebAssembly.

AOT does not trim managed assemblies, and more code is needed to represent high-level .NET IL instructions when using native WebAssembly. That is why the size is much larger, and it is also less compressible over HTTP.

AOT is not for everyone; most apps running without AOT will work fine. However, for CPU-intensive apps, there is a lot to gain by using AOT.

My ZX Spectrum emulator is one of those apps; it runs many iterations per second, and the performance gain by running AOT for these apps is remarkable.

To compile our Blazor WebAssembly project using AOT, we add the following property in the `csproj` file:

```
<PropertyGroup>
  <RunAOTCompilation>true</RunAOTCompilation>
</PropertyGroup>
```

AOT compilation is only performed when the app is published. It can take a long time to compile (seven minutes for the ZX Spectrum emulator), so it is pretty nice that we don't have to wait for that every time we compile our application.

However, running in release mode may be a problem, so if you want to do a quick test in release mode, temporarily disable the preceding setting.

Don't forget to enable it again; I have some experience in that area.

WebAssembly Single Instruction, Multiple Data (SIMD)

One of the new features in .NET7 is SIMD, a type of parallel processing recently added to WebAssembly.

SIMD is a type of computer architecture that allows a CPU to perform the same operation on multiple data points simultaneously, improving the performance of certain kinds of tasks. SIMD instructions are often used to perform vector arithmetic, in which a single instruction is applied to multiple elements of a vector simultaneously. SIMD can be beneficial for tasks such as image and video processing, where large amounts of data need to be processed quickly.

SIMD is enabled by default. To disable SIMD, we need to disable it in the project file like this:

```
<PropertyGroup>
  <WasmEnableSIMD>false</WasmEnableSIMD>
</PropertyGroup>
```

We need to use AOT compilation for SIMD to work.

This is beyond the scope of this book, but I wanted to mention it in case this is what you need for your project.

Trimming

By default, when publishing a Blazor WebAssembly app, trimming will be performed. It will remove unnecessary things and, by doing so, reduce the size of the app.

If our application uses reflection, the trimmer may have problems identifying what can and cannot be removed.

For most applications, the trimming is automatic and will work. To read more about trimming options, you can look here: `https://learn.microsoft.com/en-us/dotnet/core/deploying/trimming/trimming-options?pivots=dotnet-8-0`.

Lazy loading

When working with Blazor WebAssembly, one of the challenges is download size. Even though it's not a big problem, in my opinion, we can do some things to handle the download and loading time. We will get back to this in the *Common problems* section later in this chapter.

When navigating to a Blazor WebAssembly application, all the DLLs for our application and the DLLs from .NET Framework are downloaded. It takes a bit of time to get everything started up. We can load some DLLs when needed by using **lazy loading** to solve this.

Let's say that our application is massive where it has a reporting part. Reporting is perhaps not used every day and not used by everyone, and it would make sense to remove that part from the initial download and only load it when we need to.

To make that happen, the part we want to lazy load must be in a separate project/DLL. In the `csproj` file of the Blazor WebAssembly client project, add a reference to the DLL by adding the following code:

```
<ItemGroup>
  <BlazorWebAssemblyLazyLoad Include="{ASSEMBLY NAME}.dll" />
</ItemGroup>
```

The snippet will make sure the file is not downloaded from the start. To load the DLL when we need it, we will use a built-in service called `LazyAssemblyLoader`.

The `LazyAssemblyLoader` service will make a JS interop call to download the assembly and load it into the runtime.

We make sure to download the necessary assemblies/DLLs in the router (`App.razor`) so we make sure they are downloaded before we navigate to the component that is using them:

```
@using Microsoft.AspNetCore.Components.Routing
@using Microsoft.AspNetCore.Components.WebAssembly.Services
@using Microsoft.Extensions.Logging
@inject LazyAssemblyLoader AssemblyLoader
@inject ILogger<App> Logger
<Router AppAssembly="@typeof(App).Assembly"
    OnNavigateAsync="@OnNavigateAsync">
    ...
</Router>
@code {
```

```
    private async Task OnNavigateAsync(NavigationContext args)
    {
        try
           {
               if (args.Path == "{PATH}")
               {
                   var assemblies = await AssemblyLoader.
LoadAssembliesAsync(
                       new[] { {LIST OF ASSEMBLIES} });
               }
           }
           catch (Exception ex)
           {
               Logger.LogError("Error: {Message}", ex.Message);
           }
    }
}
```

We need to inject `LazyAssemblyLoader`; it is registered as a singleton by default in a Blazor WebAssembly project.

You need to set up an `OnNavigateAsync` event, and in that method, check the path and make sure to load the assemblies we need.

This event can also be used for routable components by doing something similar to this:

```
@using System.Reflection
@using Microsoft.AspNetCore.Components.Routing
@using Microsoft.AspNetCore.Components.WebAssembly.Services
@using Microsoft.Extensions.Logging
@inject LazyAssemblyLoader AssemblyLoader
@inject ILogger<App> Logger
<Router AppAssembly="@typeof(App).Assembly"
    AdditionalAssemblies="@lazyLoadedAssemblies"
    OnNavigateAsync="@OnNavigateAsync">
    ...
</Router>
@code {
    private List<Assembly> lazyLoadedAssemblies = new();
```

```
    private async Task OnNavigateAsync(NavigationContext args)
    {
        try
        {
            if (args.Path == "{PATH}")
            {
                var assemblies = await AssemblyLoader.
LoadAssembliesAsync(
                    new[] { {LIST OF ASSEMBLIES} });
                lazyLoadedAssemblies.AddRange(assemblies);
            }
        }
        catch (Exception ex)
        {
            Logger.LogError("Error: {Message}", ex.Message);
        }
    }
}
```

We need to replace the `{PATH}` in the preceding snippet with the path where we want to load the assemblies, something like this: `"/fetchdata"`. The `{LIST OF ASSEMBLIES}`, which contains a list of assemblies we wish to load, can be `"sample.dll"`.

This makes it possible not to load the admin interface for the users who don't have access to it, for example. We can of course trigger the downloading of additional assemblies when it makes sense to do so (and not wait for a user to hit a specific part of the application and then download the assemblies).

Progressive web apps

Both Blazor Server and Blazor WebAssembly can create **Progressive Web Apps** (**PWAs**), but it is much more common for Blazor WebAssembly. PWAs make it possible to download our web app and run it as an app on our phone or computer. They will make it possible to add nice-looking icons and launch our website in a web browser without a URL input field, so it will feel more like an app.

When creating our project, we select **Progressive Web App**. By doing that, we will get some configuration and JavaScript to set everything up.

PWAs are beyond the scope of this book, but there are great resources to get us started. You can find more information here: `https://learn.microsoft.com/en-us/aspnet/core/blazor/progressive-web-app?view=aspnetcore-8.0&tabs=visual-studio`.

Native dependencies

Since we are running WebAssembly, we can use WebAssembly assemblies written in other languages in our project. This means that we can use any native dependencies right inside our project.

One way is to add C files right into our project. In the `Chapter16` folder in the repository, you will find an example.

I have added a file called `Test.c` with the following content:

```
int fact(int n)
{
    if (n == 0) return 1;
    return n * fact(n - 1);
}
```

In the project file, I have added a reference to that file:

```
<ItemGroup>
    <NativeFileReference Include="Test.c" />
</ItemGroup>
```

In `Home.razor`, I have added the following code:

```
@page "/"
@using System.Runtime.InteropServices
<PageTitle>Native C</PageTitle>
<h1>Native C Test</h1>
<p>
    @@fact(3) result: @fact(3)
</p>
@code {
    [DllImport("Test")]
    static extern int fact(int n);
}
```

In our C# project, we now have a C file that we can call from our Blazor project. It is compiled into WebAssembly, and then we can reference that WebAssembly file (which happens automatically). We can take this even further by using a library that is using a C++ library. Skia is an open-source graphics engine written in C++.

Read more here: `https://github.com/mono/SkiaSharp`. We can add that library to a Blazor WebAssembly app by adding the NuGet package `SkiaSharp.Views.Blazor`.

In the `Chapter16` folder in the repository, you can explore a project called `SkiaSharpDemo`.

In the `Home.razor` file, I have added the following code:

```
<SKCanvasView OnPaintSurface="@OnPaintSurface" />
@code {
    private void OnPaintSurface(SKPaintSurfaceEventArgs e)
    {
        var canvas = e.Surface.Canvas;
        canvas.Clear(SKColors.White);
        using var paint = new SKPaint
        {
            Color = SKColors.Black,
            IsAntialias = true,
            TextSize = 24
        };
        canvas.DrawText("Raccoons are awesome!", 0, 24, paint);
    }
}
```

The page will draw `"Raccoons are awesome"` on the canvas.

In this case, we are using a C# library that is using a C++ library.

We can even refer to libraries that have already been built with Emscripten directly by adding **object files** (`.o`), **archive files** (`.a`), **bitcode** (`.bc`), and **standalone WebAssembly modules** (`.wasm`). If we find a library written in another language, we could compile that to WebAssembly and then use it from our Blazor application. This opens up so many doors!

Next, we will look at some common problems I have encountered.

Common problems

Let's dive into this one right from the start.

The most common comments regarding Blazor WebAssembly are download size and load time. A small project is around 1 MB in size, but I believe the problem is the loading time and not the download size/time since everything is cached and, in most parts of the world, we have access to high-speed internet.

There are a couple of solutions to this problem.

Progress indicators

When it comes to **User Experience** (**UX**), we can give the users a perceived sense of speed.

The default Blazor WebAssembly template has a loading progress indicator, which gives the users something to look at instead of a blank page. It is built so that it is easy to customize using CSS variables. We can use the `--blazor-load-percentage` and `--blazor-load-percentage-text` variables to customize and create our progress bar.

It doesn't even have to indicate what is happening; Dragons Mania Legends has comments like "Sewing mini Vikings," which is obviously not what is going on. So depending on the application we are building, showing something is more important than showing nothing.

Prerendering on the server

In previous versions of Blazor, we had to do some magic ourselves to make prerendering work. But with the new Blazor Web App template, we get this out of the box. Up until now, we have talked about features in Blazor WebAssembly using the Blazor WebAssembly Standalone template; in this section, we are using the Blazor Web App template. The better solution is to run it as `InteractiveAuto`; that way, we get the power of fast loading on the server, and then get WebAssembly without the wait.

This is a great and simple way to add SEO to our site.

There is one problem: it will load data when rendering on the server, and then again when the WebAssembly loads.

There is a way to work around that, which we will take a look at next.

Preloading and persisting the state

We don't want our component to call the database twice if we can avoid it.

If you run the `BlazorPrerender` example and go to the **Weather** page, you should be able to see it load twice since the data is random and generated every time we request it.

This is the same behavior you see when using `InteractiveServer, InteractiveWebAssembly, and InteractiveAuto`. The page first gets rendered on the server. Then, SignalR or WebAssembly gets hooked up and loads the page again.

The source for this example is the `BlazorPrerender` project.

We used this technique when we passed information about the logged-in user to WebAssembly.

In previous versions of Blazor, we had to add a component called `persist-component-state`, but this component is added by default in .NET 8. This component will render the saved state of the component when it renders on the server, and, when SignalR or WebAssembly takes over, the state is already there.

In the Client project and in the component where we want to have the persistence (`Weather.razor` in the sample), we inject a `PersistanceComponentState` and also make the component implement `Idisposable`:

```
@inject PersistentComponentState ApplicationState
@implements IDisposable
```

We add a `PersistingComponentStateSubscription` component, which saves the data to the application state:

```
private PersistingComponentStateSubscription _subscription;
```

In `OnInitializedAsync`, we register to listen to run code when the component wants to persist the data:

```
_subscription = ApplicationState.RegisterOnPersisting(PersistState);
```

When we load the data, we make sure first to check the application state. If the data is not available, we can continue and make an `HTTP` request:

```
if (ApplicationState.TryTakeFromJson<WeatherForecast[]>("weatherdata", out
var stored))
{
    forecasts = stored;
```

```
}
else
{
    await Task.Delay(500);
    var startDate = DateOnly.FromDateTime(DateTime.Now);
    var summaries = new[] { "Freezing", "Bracing", "Chilly", "Cool",
"Mild", "Warm", "Balmy", "Hot", "Sweltering", "Scorching" };
    forecasts = Enumerable.Range(1, 5).Select(index => new WeatherForecast
        {
            Date = startDate.AddDays(index),
            TemperatureC = Random.Shared.Next(-20, 55),
            Summary = summaries[Random.Shared.Next(summaries.Length)]
        }).ToArray();
}
```

It refers to a method that will persist the data in the application state:

```
private Task PersistState()
{
    ApplicationState.PersistAsJson("weatherdata", forecasts);
    return Task.CompletedTask;
}
public void Dispose()
{
    _subscription.Dispose();
}
```

The server will first render the content, and when the server is done, it will respond with the whole page, including a `Base64`-encoded JSON string with data that looks something like this:


```
<!--Blazor:{"type":"server","prerenderId":"d0b382c5fa7d4b65a8002157a8b6a1
a2","key":{"locationHash":"F2AAEE86A5A9C5406A2EF4551C02A263059448AC:0"
,"formattedComponentKey":""},"sequence":0,"descriptor":"CfDJ8EzYgDK6\
u002BdZLqM2gwGUPDtNbwNLH7VoJxc6/
d6CZ4gHE0LtdIMqSoBfSh8OHGynUVW5DKNVBSG4cZBgETzOixExgSkzmqvPY7I58TMjl4XliAJ
ae5d2fmVTS7\u002ByDOooQOqVN41jgj\
u002BthTcmHEkBng1MukO5/28AsARyCKVXGxlw3cu9ohFo6b38BprF63EPjo7zQqNYRQT2k
xkxn9TiFzTga//RyoyQKIwvEkb044SW\
u002Bj9tHP1bBt3B8rpE5EATAvbtKEu7yjwUFGb3xsDHvJ6jGAtQOKOXQhKoWM5pp8
z0RMKkxMfeyuQUubu7i48qPSPvvWCnoym79o64FsTlataWG9JeO8V1X9ihTQppyw/
```

```
jkc0RHp9Si49UgCVlEuPWMXTjVSVj7gBizQRc7eT0t2v30NwpBrYHvQS0t\u002BgssPyT\
u002BTQWCfEcEc7iMboA/oCSqcAJRTWCcGbWroCIKchU1mdTJj48vAuMKKu5tw6Yqo61V\
u002BM4wTR7XJ1ffk0KCQ7lKCqNr2ffNRz1RxjbQX8oVU4s="}-->
```

Since everything we put into the application state is stored as JSON, it is important not to include any sensitive data that we were not thinking of displaying. This is, of course, true for all calls since we are sending data with JSON.

We can also use `PersistentComponentState` on `InteractiveServer, InteractiveWebAssembly, and InteractiveAuto`. I usually turn off prerendering on my websites, but this is great to use if your site needs SEO, for example.

Now, we know a couple of common problems and how to solve them.

Summary

In this chapter, we looked at some of the Blazor WebAssembly-specific things in Blazor. For the most part, we can reuse components in both Blazor Server and Blazor WebAssembly, and we can speed up WebAssembly by using what we learned in this chapter.

We also looked at native dependencies, opening up the possibilities to reuse other libraries and mixing languages. If our application doesn't need to support both scenarios, we can use WebAssembly to the fullest.

In the next chapter, we will examine *source generators*.

17

Examining Source Generators

In this chapter, we will look at writing code that generates code. Even though this chapter isn't directly related to Blazor development, it still has a connection to Blazor, as we'll discover.

The subject of source generators is a book on its own, but I wanted to introduce it since they are used by Blazor and, honestly, it is one of my favorite features.

I am the kind of person that spends a day writing source code that saves me 10 minutes if I know I will need to repeat those 10 minutes over and over again. Repetitive tasks have never been a favorite of mine.

In this chapter, we will cover the following:

- What a source generator is
- How to get started with source generators
- Community projects

The idea for this chapter is for you to use it as a reference so that you can implement a new project on your own.

Technical requirements

This chapter is a reference chapter and is not connected in any way with the book's other chapters.

You can find the source code for this chapter's result at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter17`.

What a source generator is

In many cases, we find ourselves writing the same kind of code repeatedly. In the past, I have used T4 templates to generate code and even written **stored procedures** and applications that can help me generate code. **Source generators** are part of the .NET compiler platform (Roslyn) SDK.

A generator gives us access to a compilation object representing all the user code currently being compiled. From there, the object can be inspected, and we can, based on that, write additional code.

Okay, this sounds complicated, and I would be lying if I said it was easy to write a source generator, but it instantly saves us a lot of time. So, let's break it down a bit.

When we compile our code, the compiler does the following steps:

1. The compilation runs.
2. Source generators analyze code.
3. The source generators generate new code.
4. The compilation continues.

Steps 2 and *3* are what source generators do.

In Blazor, source generators are used all the time; it is a source generator that takes the `.razor` files and converts them to C# code.

We can look at what Blazor generates by adding the following to our `.csproj` file:

```
<EmitCompilerGeneratedFiles>true</EmitCompilerGeneratedFiles>
```

Adding this code will emit generated files into the `obj` folder for the `razor` component.

We can find them here: `\obj\Debug\net8.0\generated\Microsoft.NET.Sdk.Razor.SourceGenerators\Microsoft.NET.Sdk.Razor.SourceGenerators.RazorSourceGenerator`.

We can choose where to emit the files by using:

```
<CompilerGeneratedFilesOutputPath>THEPATH</
CompilerGeneratedFilesOutputPath>
```

You can replace `THEPATH` with a path you would like to have the files emitted to.

In that folder, we can find a file called `Pages_Counter_razor.g.cs`, which is the C# representation of the counter component.

The `Microsoft.NET.Sdk.Razor.SourceGenerators-generator` is, of course, a very advanced source generator.

Let's think of a scenario: at work, we create services and interfaces for those services. The only use of these interfaces is for testing purposes, the same way we have built our repositories throughout the book.

In this case, adding a method to a service means we need to add the method to the class and the interface. We tried simplifying the process by putting the interface and the class in the same file. However, we still forgot about the interface, pushed the code, and didn't notice the mistake until everything was built and a NuGet package was generated.

We found a source generator called `InterfaceGenerator`; adding an attribute to our class will generate the interface for us.

Let's take a look at this example:

```
public class SampleService
{
    public double Multiply(double x, double y)
    {
        return x * y;
    }
    public int NiceNumber => 42;
}
```

This is a simple service class (taken from the `InterfaceGenerator` GitHub page). Adding an attribute to the code will automatically generate an interface, and we can add a reference to that interface:

```
[GenerateAutoInterface]
public class SampleService: ISampleService
…
```

The generated interface will always be up to date. This sample is an excellent example of when source code generators will save time and remove pain points.

Source generators are powerful; we get access to a syntax tree that we can query. We can iterate over all classes and find the ones with a specific attribute or that implement an interface, for example, and based on that, generate code.

There are some limitations. There is no way to know in what order the source generators will run, so we can't generate code based on generated code. We can only add code, not modify code.

The following section will look at how we can build our source generators.

How to get started with source generators

It's time to look at how we can build our source code generators. The `Chapter17` folder is a finished example of what we discuss here. The instructions will not be a step-by-step guide.

To create a source code generator, we need a class library targeting *.NET Standard 2.0*. We also need to add a reference to the NuGet packages `Microsoft.CodeAnalysis.CSharp` and `Microsoft.CodeAnalysis.Analyzers` in that library. We also need to make sure that our `.csproj` file has `<LangVersion>latest</LangVersion>`.

To create a source generator, we need to create a class that has two things:

- It needs to have the `[Generator]` attribute.
- It needs to implement `ISourceGenerator`.

The template code should look something like this:

```
using Microsoft.CodeAnalysis;
namespace SourceGenerator;
[Generator]
public class HelloSourceGenerator : ISourceGenerator
{
    public void Execute(GeneratorExecutionContext context)
    {
        // Code generation goes here
    }
    public void Initialize(GeneratorInitializationContext context)
    {
        // No initialization required for this one
    }
}
```

In the `Initialize` method, we add any initialization that may be needed; and in the `Execute` method, we write the generated code.

The generator we are building now is, of course, a silly example, but it also shows some of the power of source generators.

In the Execute method, we add the following code:

```
        // Build up the source code
        string source = """
namespace BlazorWebAssemblyApp;
public class GeneratedService
    {
        public string GetHello()
        {
            return "Hello from generated code";
        }
    }
""";
        // Add the source code to the compilation
        context.AddSource($"GeneratedService.g.cs", source);
```

It will take the code in the source variable and save it as `GeneratedService.g.cs`. We also use raw string literals in this file – the feature in .NET7 I have been the most excited about. By adding three double quotes, we don't need to escape the string; we are free to add more double quotes inside of the string. If you want to escape more than three double quotes, you can add more at the start and end.

To add a source generator to our project, we can add the project like this:

```
  <ItemGroup>
    <ProjectReference
        Include="..\SourceGenerator\SourceGenerator.csproj"
        OutputItemType="Analyzer"
        ReferenceOutputAssembly="false"/>
  </ItemGroup>
```

When we compile our project, the `GeneratedService` will be generated, and we can use the code.

Now we can inject the service and use it inside of our components:

```
@page "/"
@inject GeneratedService service
<h1>@service.GetHello()</h1>
```

Don't forget to add it to `Program.cs` as well:

```
builder.Services.AddScoped<GeneratedService>();
```

The example above isn't really how you would use it in a real-world scenario, but I wanted to show that it is not that tricky to get started.

Sometimes the Visual Studio editor won't pick up these generated files, and we will see some red squiggles in the code editor. This is because the order of the source generators (there is no guaranteed order) will result in these problems, especially when combining source generators with other classes that are also generated, like `.razor` files.

In the next section, we will look at some of the source generators we can use in our projects.

Community projects

Source generators have been around since .NET5/6, and there are a lot of community/open-source projects we can use in our projects. Let's explore them in the following sections.

InterfaceGenerator

We have already talked about `InterfaceGenerator`. Generating interfaces without having to write the same thing twice will save time and help you avoid problems, especially if you use interfaces only for testing.

We can find it here:

`https://github.com/daver32/InterfaceGenerator`

Blazorators

David Pine, with many contributors, has built Blazorators, which can take a TypeScript definition file and generate JavaScript interop ready to be used in any Blazor project. Blazorators take away a lot of the pain points when writing JavaScript interop.

Check out his project here:

`https://github.com/IEvangelist/blazorators`

C# source generators

Amadeusz Sadowski, with many contributors, has made an impressive list of where to find more information on source generators and some outstanding ones. You can find this fantastic resource here:

`https://github.com/amis92/csharp-source-generators`

Roslyn SDK samples

Microsoft has added some samples to their Roslyn SDK repository. It's a great start to dig a bit deeper into source generators. You can find the samples here:

`https://github.com/dotnet/roslyn-sdk/tree/main/samples/CSharp/SourceGenerators`

Microsoft Learn

Microsoft Learn is an excellent source for learning anything C# related, and source generators are no exception.

If you think, just like me, that source generators sound like the best thing since sliced bread, I recommend that you dive into the documentation found at Microsoft Learn:

`https://learn.microsoft.com/en-us/dotnet/csharp/roslyn-sdk/source-generators-overview`

Summary

In this chapter, we looked at code that writes code to save time and reduce repetitive tasks.

Blazor uses source generators to convert razor code into C# code, so, indirectly, we are using them all the time.

In the next chapter, we will look at Blazor Hybrid by visiting .NET MAUI.

18

Visiting .NET MAUI

So far, we have talked about Blazor WebAssembly and Blazor Server, but what about the third option?

In this chapter, we will visit **.NET MAUI**, Microsoft's new cross-platform development platform.

This chapter will not be a deep dive into .NET MAUI, since that can be a book all in itself.

In this chapter, we will cover the following:

- What is .NET MAUI?
- Creating a new project
- Looking at the template
- Developing for Android
- Developing for iOS
- Developing for macOS
- Developing for Windows
- Developing for Tizen

The idea for this chapter is for you to use it as a reference so that you will be able to implement a new project on your own.

Technical requirements

This chapter is a reference chapter and is not connected in any way with the book's other chapters.

You can find the source code for this chapter at `https://github.com/PacktPublishing/Web-Development-with-Blazor-Third-Edition/tree/main/Chapter18`.

What is .NET MAUI?

We'll start with a bit of history.

Xamarin is a software company founded in May 2011 by the engineers who created Mono, a free and open-source version of .NET Framework. Microsoft acquired the company in 2016, and it is now a vital part of the .NET development platform, providing tools and services for building native cross-platform mobile apps using C# and .NET. Xamarin's technology allows developers to write native iOS, Android, and Windows apps using a single shared code base, making it easier to develop and maintain apps for multiple platforms.

.NET Multi-Platform App UI (**MAUI**) is the new framework from Microsoft, and is an evolution of Xamarin.Forms.

This is a way to create one UI, deploy it to many different platforms, and get native controls on each platform. .NET MAUI can also host Blazor, which is called Blazor Hybrid. This way, we can render Blazor content inside of a .NET MAUI app, using the same controls and code that we build for the web. The controls that are rendered using Blazor Hybrid are web controls, so we will not get the native controls. We can, however, mix native and Blazor Hybrid content.

Many years ago, I sat in a meeting with a bunch of consultants. The company I was working for wanted to invest in an app, and we turned to one of the big consultancy firms in Sweden to get some help on how we should proceed.

After a week, we had another meeting, during which they presented their findings. Their recommendation was to build natively and not use any of the cross-platform frameworks.

They had a bunch of arguments, but two that really stuck with me are as follows:

- Native apps look better and give the user a "real" device experience.
- Shared code (between platforms) means that if one platform has a bug, the same bug is now in all platforms.

Since .NET MAUI (formerly Xamarin.Forms) uses native controls, there is no way for the users to know the difference between developing a native app and developing using .NET MAUI. In the end, it will look and feel like a native app. This is not true for Blazor Hybrid, which uses web controls. So, there are some valid arguments for the first point. Now, we must ask ourselves, how important is that native look and feel? Looking at the apps on my iPhone, not many apps look the same, so I would argue it is not that important as long as you uphold a good UX. The second argument made me so angry. Were they trying to convince us that sharing code was terrible? Yes, they were. Sharing code between platforms is fantastic; you only need to write the code once, fix a bug once, and fix it on all platforms.

.NET MAUI gives us both options. We can use native UI with C# code or use Blazor Hybrid to get web controls.

Creating a new project

To develop cross-platform applications, we must install cross-platform tools in Visual Studio.

If you haven't done that, please open the Visual Studio installer and select the **.NET Multi-Platform App UI** development workflow.

.NET MAUI has a couple of templates: **.NET MAUI App**, **.NET MAUI Blazor Hybrid App**, and **.NET MAUI class library**.

.NET MAUI App

The .NET MAUI App template uses XAML to create applications.

XAML is also used for **Windows Presentation Foundation** (**WPF**) and **Universal Windows Platform** (**UWP**). Every XAML version differs just a bit but if you have worked with WPF or UWP before, they should feel familiar.

The XAML is converted into native elements. This way, if our app runs on Windows, it will have the look and feel of a Windows application. If we run it on an iOS device, it will look and feel like a native iOS app.

This is probably our best option if we want to use our C# skills to create a cross-platform application. Using this approach, we will get the native feel without the need to write native code in Kotlin or Swift.

.NET MAUI Class Library

.NET MAUI Class Library is used to share content, classes, and functionality between applications.

.NET MAUI Blazor Hybrid App

Since this is a book about Blazor, we will focus on the .NET MAUI Blazor Hybrid `App` template. This is a template that embeds a Blazor application inside of a native shell.

For the .NET MAUI Blazor App project, we need at least:

- Android 7.0 (API 24) or higher
- iOS 14 or higher
- macOS 11 or higher, using Mac Catalyst

The .NET MAUI Blazor Hybrid App project uses BlazorWebView to render the Blazor content. It is not the same as Blazor Server and does not run WebAssembly; it is simply the third option we have for hosting Blazor applications.

Let's start a new project and dig a bit deeper:

1. In Visual Studio, create a new `.NET MAUI Blazor Hybrid App` project.
2. Name the project `BlazorHybridApp` and make sure you select **.NET 8**.
3. At the top of Visual Studio, select **Windows Machine** and run the project.

That's it. We now have our first cross-platform Blazor Hybrid app!

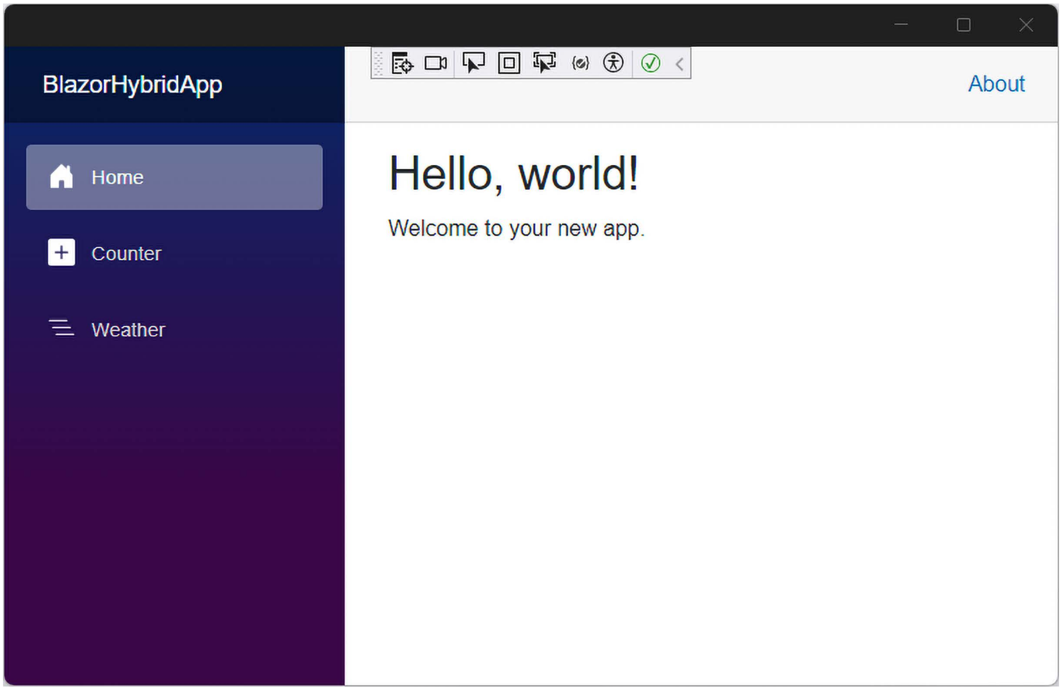


Figure 18.1: .NET MAUI app running on Windows

We might need to enable developer mode on our machine. If there is a message asking us to, just follow the instructions and run the app again. Great! We now have a project. In the next section, we will take a look at what the template looks like.

Looking at the template

When running the project, we should recognize the UI. It is the same *Hello, world!* page, the same counter, and the same weather forecast.

If we take a look in the `Components/Pages` folder, we'll find the Razor components, and if we open the `Counter.razor` file, we will find a familiar component that looks like this:

```
@page "/counter"
<h1>Counter</h1>
<p role="status">Current count: @currentCount</p>
<button class="btn btn-primary" @onclick="IncrementCount">Click me</
button>
@code {
    private int currentCount = 0;
    private void IncrementCount()
    {
        currentCount++;
    }
}
```

To create a Blazor Hybrid app, adding components like this is all that you need to know to get started, but let's dig a bit deeper. The template is .NET MAUI App with some added Blazor startup code.

To understand what is happening, we will start in the `Platforms` folder. In the `Platforms` folder, we will find different a folder for each platform we can develop for Android, iOS, Mac Catalyst, Tizen, and Windows.

This is the starting point for each platform, and they have a bit of a different implementation, but in the end, they all point to the `MauiProgram` file located at the project's root.

The `MauiProgram` class sets everything up, like fonts and dependency injection:

```
namespace BlazorHybridApp;
public static class MauiProgram
{
    public static MauiApp CreateMauiApp()
    {
        var builder = MauiApp.CreateBuilder();
        builder
            .UseMauiApp<App>()
```

```
                .ConfigureFonts(fonts =>
                {
                    fonts.AddFont("OpenSans-Regular.ttf", "OpenSansRegular");
                });
            builder.Services.AddMauiBlazorWebView();
#if DEBUG
            builder.Services.AddBlazorWebViewDeveloperTools();
            builder.Logging.AddDebug();
#endif
            builder.Services.AddSingleton<WeatherForecastService>();
            return builder.Build();
        }
}
```

The essential thing in the file is `UseMauiApp<App>`, which gives us a clue about what is happening next. The next step is to load the `App.xaml`.

The `App.xaml` file has a bunch of resources for styling. The Blazor magic starts to happen in `App.xaml.cs`:

```
namespace BlazorHybridApp;
public partial class App : Application
{
    public App()
    {
        InitializeComponent();
        MainPage = new MainPage();
    }
}
```

It sets the application `MainPage` to an instance of the class `MainPage`. In `MainPage.xaml`, we have reached the first Blazor reference in the app, the `BlazorWebView`:

```
<BlazorWebView x:Name="blazorWebView" HostPage="wwwroot/index.html">
    <BlazorWebView.RootComponents>
        <RootComponent Selector="#app" ComponentType="{x:Type
local:Components.Routes}" />
    </BlazorWebView.RootComponents>
</BlazorWebView>
```

In this case, we are referring to `index.html`, located in the `wwwroot` folder, and also set up the root component (similar to what we do in `Program.cs` in Blazor Server and Blazor WebAssembly).

Here, we can also add XAML components, which makes it possible to mix XAML and Blazor components. Even though the implementation looks different, we should be familiar with the concepts.

The `index.html` is almost the same as in Blazor WebAssembly:

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="utf-8" />
    <meta name="viewport" content="width=device-width, initial-scale=1.0,
maximum-scale=1.0, user-scalable=no, viewport-fit=cover" />
    <title>BlazorHybridApp</title>
    <base href="/" />
    <link rel="stylesheet" href="css/bootstrap/bootstrap.min.css" />
    <link href="css/app.css" rel="stylesheet" />
    <link href="BlazorHybridApp.styles.css" rel="stylesheet" />
</head>
<body>
    <div class="status-bar-safe-area"></div>
    <div id="app">Loading...</div>
    <div id="blazor-error-ui">
        An unhandled error has occurred.
        <a href="" class="reload">Reload</a>
        <a class="dismiss">/</a>
    </div>
    <script src="_framework/blazor.webview.js" autostart="false"></script>
</body>
</html>
```

The only difference worth mentioning is the JavaScript that differs from the others (Blazor Server and Blazor WebAssembly implementations). From this point, the application is now running pure Blazor.

As we can see in the `MainPage.xaml`, we are loading a Razor file called `Routes`. This is a familiar name from the Blazor Web App template. It looks like this:

```
<Router AppAssembly="@typeof(MauiProgram).Assembly">
```

```
    <Found Context="routeData">
        <RouteView RouteData="@routeData" DefaultLayout="@typeof(Layout.
MainLayout)" />
        <FocusOnNavigate RouteData="@routeData" Selector="h1" />
    </Found>
</Router>
```

This is where we find the router, where we configure where to find the Razor components, and handle the requests that are not found.

We will not go deeper into the Blazor parts because everything past our router is the same as any other Blazor hosting model (Blazor Server and Blazor WebAssembly). There is a `MainLayout`, `NavMenu`, and component for each function (`Hello, world!`, `Counter`, and `Weather`).

With Blazor Server and Blazor WebAssembly, we need to make JavaScript calls to access local resources like Bluetooth, a battery, and a flashlight, to name a few. Blazor Hybrid adds the ability to write code that directly accesses local resources. We can access the flashlight (because we all love things that light up) by using code similar to this:

```
try
{
    if (FlashlightSwitch.IsToggled)
        await Flashlight.Default.TurnOnAsync();
    else
        await Flashlight.Default.TurnOffAsync();
}
catch (FeatureNotSupportedException ex)
{
    // Handle not supported on device exception
}
catch (PermissionException ex)
{
    // Handle permission exception
}
catch (Exception ex)
{
    // Unable to turn on/off flashlight
}
```

This code will not work if we run a Blazor Server or Blazor WebAssembly app. If we still want to share components between .NET MAUI and Blazor web apps, we can do that using dependency injection just like we have done a couple of times in the book already, one implementation for the web and one for mobile.

Next, we will get our amazing app to run on Android.

Developing for Android

There are two options when it comes to developing for Android. We can run our application in an *emulator* or on a *physical device*.

To publish our application, we need to have a Google Developer license, but we don't need one for development and testing.

Running in an emulator

We first need to install an emulator to run our app on an Android emulator:

1. In Visual Studio, open **Tools** | **Android** | **Android Device Manager**.
2. Click the **New** button and configure a new device (the default settings should be OK):

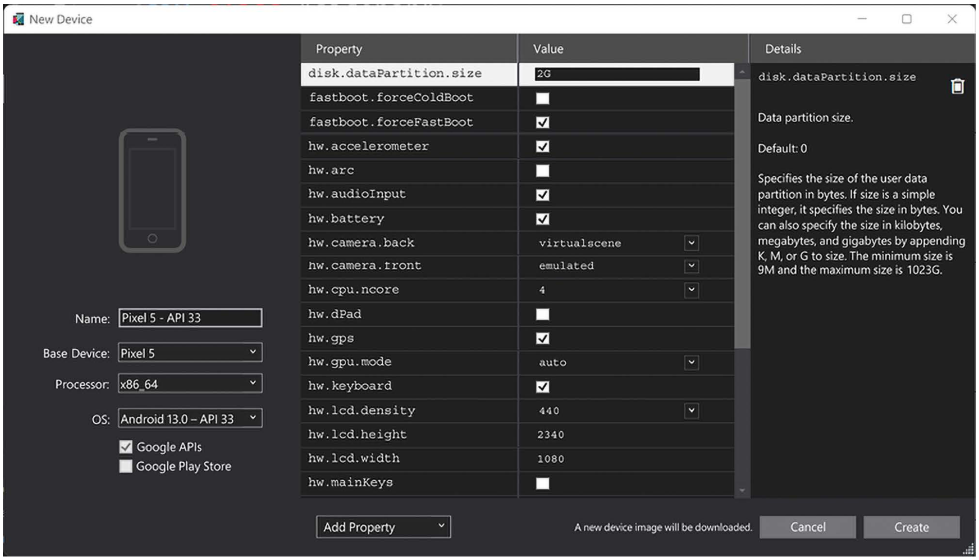


Figure 18.2: Android device configuration

3. Click **Create** to download a device image and configure it.

4. Select the newly created emulator at the top of Visual Studio and run the project. Starting the emulator will take a couple of minutes. When developing, make sure not to close the emulator for a faster deployment time.

To get the emulator to run fast, we can enable hardware acceleration, depending on the processor we use.

To enable hardware acceleration, please refer to the official documentation: `https://learn.microsoft.com/en-us/xamarin/android/get-started/installation/android-emulator/hardware-acceleration?pivots=windows`.

Great! We now have our app running inside an Android emulator:

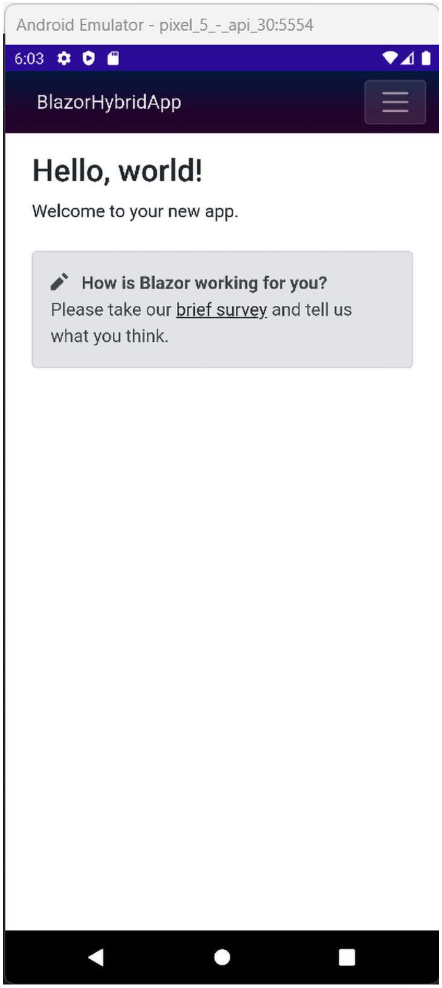


Figure 18.3: App running inside an Android emulator

Next, we will run the application on a physical device.

Running on a physical device

If we want to try our application on a physical device, we need to do a few things on our Android device. This may differ from device to device.

First, we need to make sure the phone is developer-unlocked:

1. Go to the **Settings** screen.
2. Select **About phone**.
3. Tap **Build Number** seven times until **You are now a developer!** is visible.

Second, we need to enable USB debugging:

1. Go to the **Settings** screen.
2. Select **Developer options**.
3. Turn on the **USB debugging** option.
4. Some devices also need to enable **Install via USB**.

We are now all set to try our app on a physical device.

1. Connect your device to the computer using a USB cable.
2. In the menu at the top of Visual Studio, click the arrow under **Android local devices** and select your device.
3. Press **Run**, and Visual Studio will deploy the application to the device.

We should now have our application running on our device.

It is an extraordinary feeling to run code on another device. Over the years, I have developed over 100 applications for Windows 8 and Windows Phone. However, to this day, it still gives me the same feeling to see my application deploy to another physical device.

Next, we will look at what options we have for developing for iOS.

Developing for iOS

Apple does not allow iOS code to be compiled on something that is not an Apple computer. There are also cloud options like MacinCloud and MacStadium, but we won't go into those options in this book.

This means we must own a Mac (to use the simulator) or have an Apple Developer license (to use hot restart).

To enable our iOS device to work, we need to set it in Developer Mode:

1. Open up your iPhone's **Settings** app.
2. Scroll down a bit and find **Privacy & Security**, then tap on it.
3. Look for something called **Developer Mode**. If you can't find it, you might need to connect your phone to Xcode. It differs between versions of the operating system, but ask Google or Bing for help. There are many resources to be found on how to solve it with your versions.
4. There should be a toggle switch; flip it to enable Developer Mode.
5. Your iOS device might give you a heads-up about this potentially making your device a bit less secure. No worries, just tap **Restart** to move forward.
6. Once your device reboots, unlock it. You'll see another alert asking if you're sure about enabling Developer Mode. Go ahead and tap **Turn On**, and if it asks for your passcode, enter it.

Hot restart

To test our application on a physical device, we can use hot restart. The hot restart feature is only designed for us to test our application while we are developing it, and we will not be able to publish the application.

First, we need to have iTunes installed. If you don't have iTunes, you can install that from the Windows store.

In the top menu in Visual Studio, if we select **iOS Local Device**, we will get a nice wizard telling us precisely what we need to do. The first steps are informative and let us install iTunes.

Next, it's time to enter our App Store Connect API key information. To be able to supply that information, we need to have an Apple Developer account. At the time of writing, it costs $99.

There are excellent instructions on where to find that information.

You will be prompted with this screen:

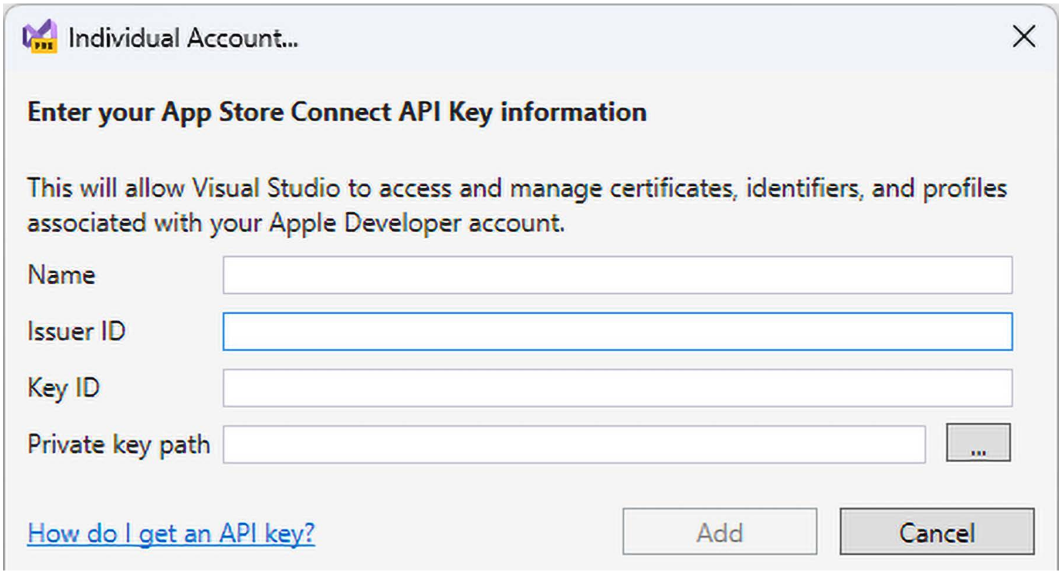


Figure 18.4: Apple Connect API Key information screen

Then, you will need to take the following steps:

1. You can create a new key by going to `https://appstoreconnect.apple.com/access/api`.
2. Click **Request API key** and then **Generate API Key**.
3. Enter the name `Visual Studio` and select **Access Developer**.
4. Copy the different values to Visual Studio, download the API key, and select the file as the **Private key path**.
5. Next, select a team, and we are all set.

6. Run the application and see it run on your iPhone:

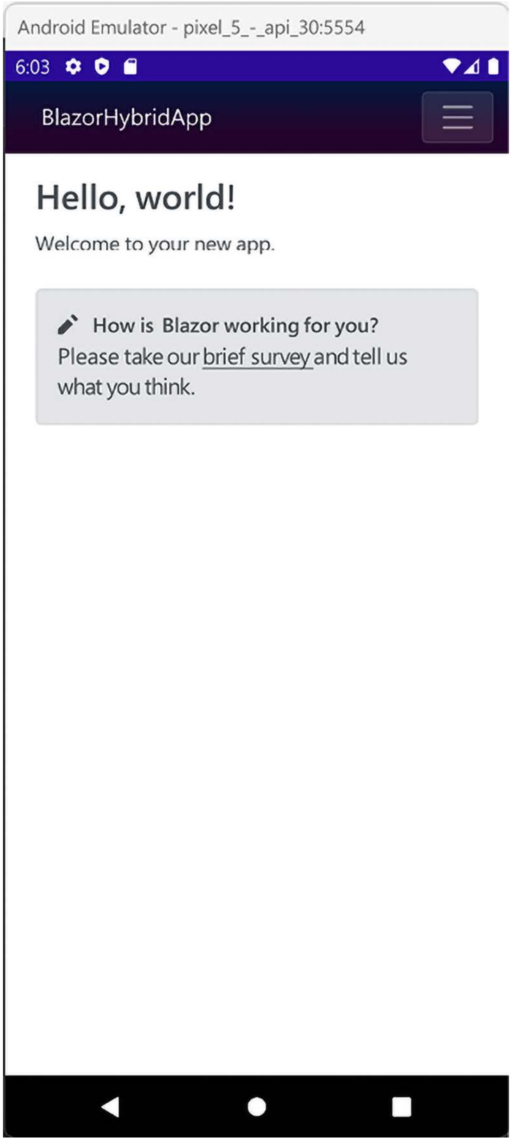


Figure 18.5: Application running on an iPhone

Next, we will look at how to set up a simulator.

Simulator

A simulator runs the app on a Mac but shows the result on a PC. A simulator differs from an emulator. An emulator runs the code on the machine (in our case, a PC). A simulator runs on top of the native OS (macOS), mimicking an iPad or an iPhone.

To get simulators to work, we need to have an Apple computer on the same network. Visual Studio will help us along the way to set everything up. We must install Xcode. On your Mac, install Xcode from the App Store, and start it to agree to the license agreement and select what devices you want to develop for.

We also need to open remote access to the Mac. We can do that by doing the following:

1. On the Mac, invoke Spotlight by pressing *cmd* + *space*, searching for **remote login**, and then opening **Sharing System Preferences**.
2. Enable the **Remote Login** option to allow Visual Studio to connect to the Mac.
3. Set access for **Only these users** and ensure your user is included in the list or group.

We now have everything prepared on the Mac. In Visual Studio on the PC, we can now pair our Mac:

1. Select **Tools | iOS | Pair to Mac**.
2. Follow the instructions in the wizard (same as above).
3. Select the Mac from the list and click **Connect**. Visual Studio can now help you install the things you need to get started. It might take a while for the Mac to install all the things, so if it doesn't work, the simulators are probably not installed yet.

4. In the dropdown at the top of Visual Studio, we can select **iOS Simulators**, and then choose a device to run our app.

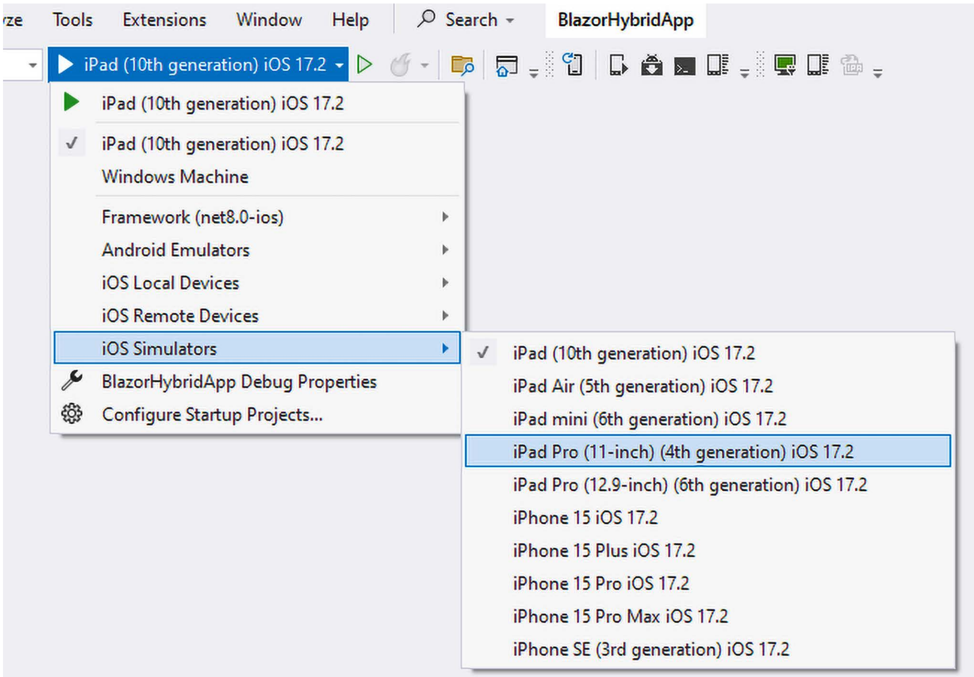


Figure 18.6: Device selection in Visual Studio

5. Run the app and the simulator will start. This is what the app would look like if we ran it on an iPad Mini:

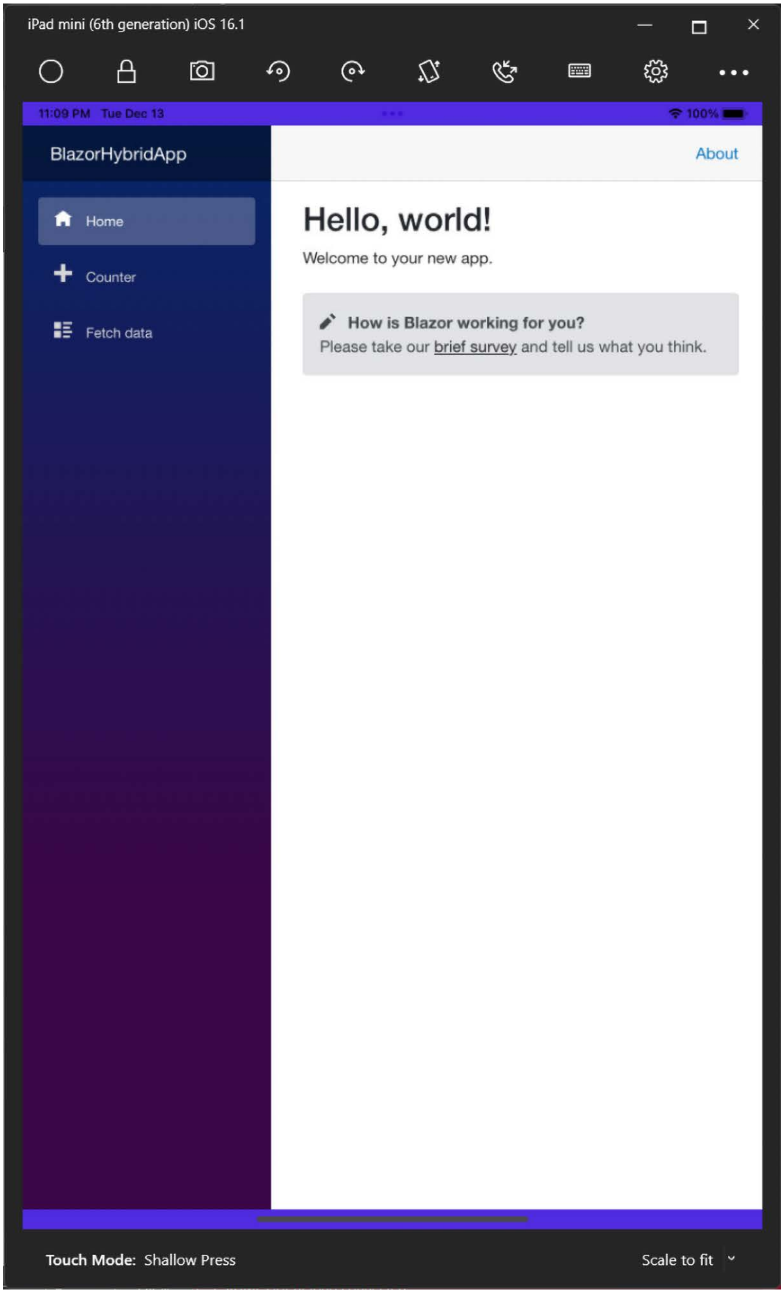


Figure 18.7: App running in an iPad simulator

We now have two ways of running and testing on iOS devices. We can also connect an iPhone directly to the Mac and run the application over Wi-Fi. There is more information on debugging over Wi-Fi in the official docs: `https://learn.microsoft.com/en-us/xamarin/ios/deploy-test/wireless-deployment`.

Next, we will build an app for macOS.

Developing for macOS

We don't have an option for macOS to run or deploy from a Windows machine. To run our application on the Mac, follow these steps:

1. On the Mac, open our project in VS Code.
2. At the time of writing, installing the .NET MAUI tooling in VS Code is still a bit of a preview, and Microsoft announced that VS for Mac is discontinued. This is the best source to keep up to date with installing the tools on a Mac: `https://learn.microsoft.com/en-us/dotnet/maui/get-started/installation?view=net-maui-8.0&tabs=visual-studio-code`. Follow the instructions in the link.
3. Run the project, and our app will show up:

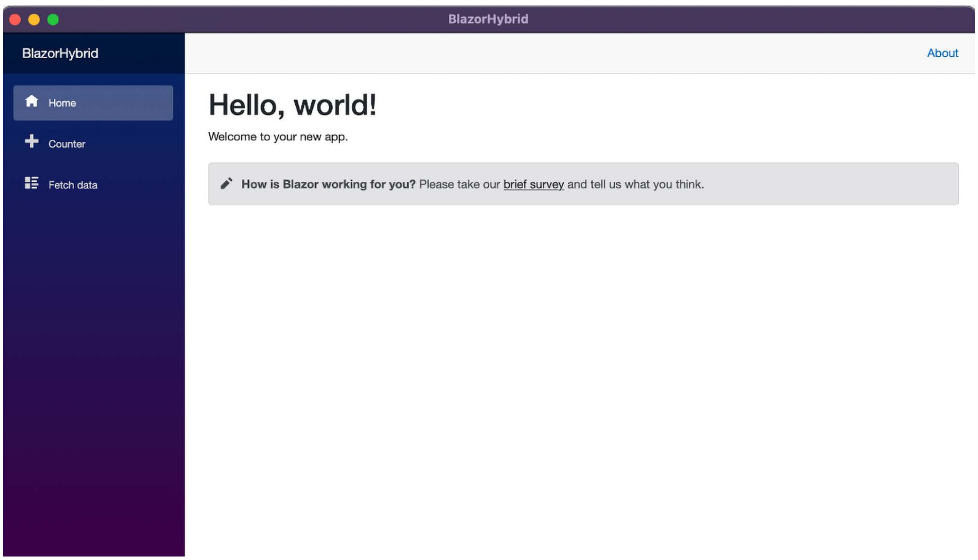


Figure 18.8: App running on macOS

In this case, we are running the application on the same platform, with no emulators or simulators, which is much less complicated than running it on a separate device.

Next, we will run our application on Windows.

Developing for Windows

Running the application on Windows is what we did in *step 3* of the *.NET MAUI Blazor Hybrid App* section. To reiterate, perform the following step:

1. Change the dropdown to **Windows Machine** and run the project. We can see the result in *Figure 18.1* at the beginning of the chapter.

As with macOS, we run the application on the same platform, with no emulators or simulators, which is much less complicated than running it on a separate device.

Next, we will take a look at Tizen.

Developing for Tizen

Tizen is an operating system mainly for TVs and watches. My Samsung Gear S3 runs Tizen. Samsung manages Tizen and not Microsoft. This ability for other manufacturers to hook into the platform just shows how great the .NET MAUI platform is.

At the time of writing, the Tizen experience lags a bit. Since this is not an official platform and because of the state of the tooling, I have decided not to include a guide.

But Tizen is working on the tooling, so if you want to transfer your app to TVs running Tizen, you should look into it.

Summary

In this chapter, we looked at cross-platform development with Blazor Hybrid. I mentioned this before in this chapter, but it is worth mentioning again that running code on a phone or a device that is not a computer is such a fun thing to do. You can't beat that feeling. Even if you don't intend to develop for mobile devices, give it a try.

With .NET MAUI, we can leverage our existing C# knowledge and, perhaps more importantly, our Blazor knowledge to create mobile applications.

19

Where to Go from Here

The book is coming to an end, and I want to leave you with some of the things we have encountered while running Blazor in production ever since it was in preview. We will also talk about where to go from here.

In this chapter, we will cover the following topics:

- Take-aways from running Blazor in production
- The next steps

Take-aways from running Blazor in production

Since Blazor was in preview, we have been running Blazor Server in production. In most cases, everything has run without issues. Occasionally, we have encountered a few problems, and I will share our take-aways from this with you in this section.

We will look at the following:

- Solving memory problems
- Solving concurrency problems
- Solving errors
- Old browsers

These are some of the things we ran into, and we have solved them all in a way that works for us.

Solving memory problems

Our latest upgrade added many users and, with that, a bigger load on the server. The server manages memory quite well, but with this release, the backend system was a bit slow, so users would press *F5* to reload a page. Then, the circuit would disconnect and a new circuit would be created. The old circuit would wait for the user to connect to the server again for 3 minutes (by default).

The user would then have a new circuit and would never connect to the old circuit again, but for three minutes, the user's state would still take up memory. This is probably not a problem for most applications, but we are loading a lot of data into memory—the data, the render tree, and everything surrounding that will be kept in memory.

So, what can we learn from that? Blazor is a single-page application. Reloading the page is like restarting an app, which means we should always make sure to add the ability to update the data from within the page (if that makes sense for the application). We could also update the data as it changes, as we did in *Chapter 11, Managing State – Part 2*.

In our case, we added more memory to the server and then made sure there were reload buttons in the UI that refresh the data without reloading the whole page. The ultimate goal is to add real-time updates that continuously update the UI when the data changes.

If adding more memory to the server isn't an option, we can try to change the garbage collection from the server to the desktop. The .NET garbage collection has two modes:

- **Workstation** mode is optimized for running on a workstation that typically doesn't have a lot of memory. It runs the garbage collection multiple times per second.
- **Server** mode is optimized for servers where there is usually lots of memory and prioritizes speed, meaning it will only run the garbage collector every 2 seconds.

The mode of the garbage collector can be set in the project file or the `runtimeconfig.json` file by changing the `ServerGarbageCollection` node:

```
<PropertyGroup>
    <ServerGarbageCollection>true</ServerGarbageCollection>
</PropertyGroup>
```

Adding more memory is probably a better idea, though.

We have also noticed the importance of disposing of our database contexts. Make sure to use `IDbContextFactory` to create an instance of the data context and, when we are done, dispose of it by using the `Using` keyword.

Then the data context will only be available for a short time and then disposed of, freeing up memory fast.

Solving concurrency problems

We have often run into problems where the data context was already in use and couldn't access the database from two different threads.

This is solved by using `IDbContextFactory` and disposing of the data context when we are finished using it.

In a non-Blazor site, having multiple components to load at the same time is never a problem (because the web does one thing at a time), so the fact that Blazor can do multiple things at the same time is something we need to think about when we design our architecture.

Solving errors

Blazor usually gives us an error that is easy to understand, but in some rare cases, we do run into problems that are hard to figure out. We can add detailed errors to our circuit (for Blazor Server) by adding the following option in `Startup.cs`:

```
services.AddServerSideBlazor().AddCircuitOptions(options => { options.
DetailedErrors = true; });
```

By doing so, we will get more detailed errors. I don't recommend using detailed errors in a production scenario, however. With that said, we have the setting turned on for an internal app in production because the internal users are briefed on it and understand how to handle it. It makes it easier for us to help our users, and the error message is only visible in the developer tools of the web browser and not in the interface of the user.

Old browsers

Some of our customers were running old browsers on old systems, and even though Blazor supports all major browsers, that support doesn't include really old browsers. We ended up helping those customers upgrade to Edge or Chrome simply because we didn't think they should be browsing the web using browsers that no longer receive security patches.

Even our TV at home can run Blazor WebAssembly, so old browsers are probably not a big problem, but it can be worth thinking about when it comes to browser support. What browsers do we need/want to support?

The next steps

At this point, we know the difference between Blazor Server and Blazor WebAssembly, and we know when to choose what, and picking one of them is not really that important. We know how to create reusable components, make APIs, manage state, and much more. But where do we go from here? What are the next steps?

The community

The Blazor community is not as big as other frameworks but is growing fast. Many people share content with the community through blogs or videos. YouTube and PluralSight have a lot of tutorials and courses. Twitch has a growing amount of Blazor content, but it is not always easy to find in the vast content catalog.

There are a number of resources worth mentioning:

- **Jimmy Engström** – I wouldn't be much of a Blazor enthusiast if I didn't make it into my own list. I talk about Blazor and throw in a pun here and there. When we stream, we do that using CodingAfterWork (see below). My blog has a lot of Blazor content and more to come: `https://engstromjimmy.com/`. X: `@EngstromJimmy`.
- The **Blazm** component library that we have written can be found here: `http://blazm.net/`. There are many better grid components out there, but this shows how easy and yet complex a grid component can be.
- **Coding after Work** has many episodes of our podcast and our stream covering Blazor; please follow us on social media: `http://codingafterwork.com/FindUs`.
- **Daniel Roth** is the PM for Blazor. Amazing to listen to, he has been a guest on our podcast. Search for him on YouTube. X: `@danroth27`.
- **Steve Sanderson** is the guy who invented Blazor; he is definitely worth a follow. He continues to do groundbreaking things in his talks; search for him on YouTube. Make sure to see his NDC Oslo talk where he shows Blazor for the first time. X: `@stevensanderson`.
- **Awesome-Blazor** has a huge list of Blazor-related links and resources that can be found here: `https://github.com/AdrienTorris/awesome-blazor`.
- **Jeff Fritz** shares Blazor knowledge (among other things) on Twitch: `https://www.twitch.tv/csharpfritz`. X: `@csharpfritz`.
- **Chris Sainty** is a fellow author and has made many really amazing packages for Blazor. He has lots of content on his blog: `https://chrissainty.com/`. X: `@chris_sainty`.

- **Carl Franklin** has done a lot of Blazor videos on `https://BlazorTrain.com/`. X: `@carlfranklin`.
- **John Hilton** has a lot of Blazor content. You can find him here: `https://jonhilton.net/`. X: `@jonhilt`.
- **Patrick God** has a lot of great content on his YouTube channel: `https://www.youtube.com/@PatrickGod`. X: `@_PatrickGod`.
- **David Pine** is a fellow author and the creator of Blazorators and can be found here: `https://github.com/IEvangelist/blazorators`. X: `@davidpine7`.
- **Peter Morris** is the creator of Fluxor and is a great person to follow. X: `@MrPeterLMorris`
- **Michael Washington** is a fellow author, and we can find him here: `https://adefwebserver.com/`. X: `@ADefWebserver`.
- **Ed Charbeneau** always has great content. Make sure to follow him. `https://edcharbeneau.com/` `https://www.twitch.tv/edcharbeneau`, `https://www.youtube.com/edwardcharbeneau`, `https://www.twitch.tv/codeitlive`, `https://www.youtube.com/@telerik`. X: `@EdCharbeneau`.
- **Eric Johansson** is a regular on Twitch, showing his projects and modernizing his .NET Framework apps to a more modern platform `https://www.twitch.tv/thindal` X: `@EricJohansson`.
- **Egil Hansen** is the creator of bUnit. We can find him here: `https://egilhansen.com/about/`. X: `@egilhansen`.
- **Sam Basu** is a great person to follow when it comes to .NET MAUI content. `https://www.twitch.tv/codeitlive` and `https://www.youtube.com/@telerik`. X: `@samidip`.
- **Junichi Sakamoto** has made loads of fantastic Blazor libraries, everything from connecting to gamepads to translation and pre-rendering. You can find his projects here: `https://github.com/jsakamoto`. X: `@jsakamoto`.
- **Blazor University** has a lot of training material and is a great resource to learn more: `https://blazor-university.com/`.
- **Gerald Versluis** has plenty of content on his YouTube channel related to all kinds of .NET things: `https://youtube.com/GeraldVersluis`. X: `@jfversluis`.
- **Maddy Montaquilla** is amazing to watch; search for her on YouTube to watch her videos. X: `@maddymontaquila`.
- **James Montemagno** has a great YouTube channel with loads of .NET MAUI content: `https://www.youtube.com/JamesMontemagno`. X: `@JamesMontemagno`.

- **Daniel Hindrikes** has some great .NET MAUI content on this YouTube channel: `https://www.youtube.com/@DanielHindrikes`. X: `@hindrikes`.

The components

Most third-party component vendors, such as Progress Telerik, DevExpress, Syncfusion, Radzen, ComponentOne, and many more, have invested in Blazor. Some cost money and some are free. There are also a lot of open-source component libraries that we can use.

This question comes up a lot: *I am new to Blazor. What third-party vendor should I use?* My recommendation is to try to figure out what you need before investing in a library (either in terms of money or time).

Many vendors can do all the things we need, but in some cases, it will take a bit more effort to make an app work. We started to work on a grid component ourselves, and after a while, we decided to make it open-source.

This is how Blazm was born. We had a few special requirements (nothing fancy), but they required us to write a lot of code over and over again to make it work in a third-party vendor component.

We learned so much from writing our component, which is really easy to do. My recommendation is not always to write your own components. It is much better to focus on the actual business problem you are trying to solve.

For us, building a pretty advanced grid component taught us so much about the inner workings of Blazor.

Think about what you need and try out the different vendors to see what works best for you. Perhaps it would be better to build the component yourself, at least in the beginning, to learn more about Blazor.

But always look at your code. If you repeat the same code, wrap it in a component. Always think: *Could this be a reusable component?*

We currently use a component vendor, but we wrap all the components in one of our components. This way, it is easy to set defaults and add logic that is right for us, just as we have learned throughout the book.

Summary

In this chapter, we examined some of the challenges we have encountered while running Blazor in production and discussed where to go from here.

Throughout the book, we have learned how Blazor works and how to create basic and advanced components. We implemented security with both authentication and authorization. We created and consumed an API connected to a "database."

We made JavaScript calls and real-time updates. We debugged our application and tested our code, and last but not least, we looked at deploying to production.

We are now ready to apply all this knowledge to the next adventure, another app. I hope you have had as much fun reading this book as I have had writing it. Being part of the Blazor community is so much fun, and we learn new things every day.

Thank you for reading this book. Please stay in touch. I would love to learn about the things you build!

Welcome to the Blazor community!

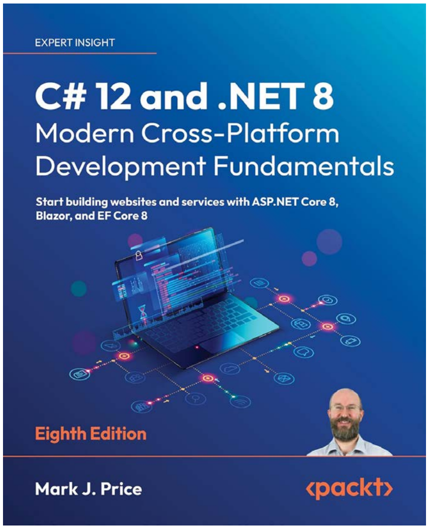
Join our community on Discord

Join our community's Discord space for discussions with the author and other readers:

`https://packt.link/WebDevBlazor3e`

Other Books You May Enjoy

If you enjoyed this book, you may be interested in these other books by Packt:



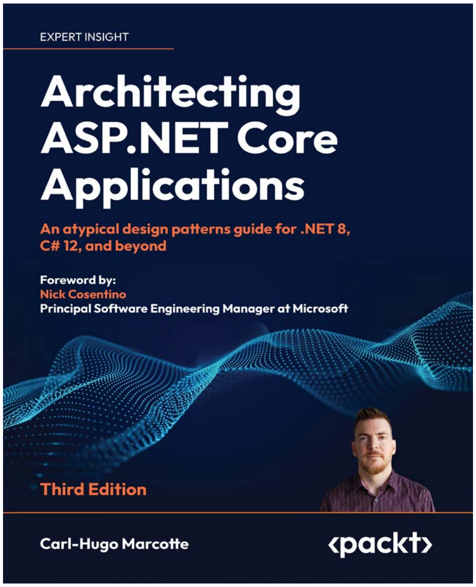
C# 12 and .NET 8 - Modern Cross-Platform Development Fundamentals - Eighth Edition

Mark J Price

ISBN: 9781837635870

- Discover C# 12's new features, including aliasing any type and primary constructors
- Try out the native AOT publish capability for ASP.NET Core 8 Minimal APIs web services
- Build rich web experiences using Blazor Full Stack, Razor Pages, and other ASP.NET Core features

- Integrate and update databases in your apps using Entity Framework Core models
- Query and manipulate data using LINQ
- Build and consume powerful services using Web API and Minimal API



Architecting ASP.NET Core Applications - Third Edition

Carl-Hugo Marcotte

ISBN: 9781805123385

- Apply the SOLID principles for building flexible and maintainable software
- Test your apps effectively with automated tests, including black-box testing
- Embark on mastering ASP.NET Core dependency injection
- Work with GoF design patterns including strategy, decorator, facade, and composite
- Design REST APIs using Minimal APIs and ASP.NET Core MVC
- Discover layering and the tenets of clean architecture
- Use feature-oriented techniques as an alternative to layering
- Explore microservices, CQS, REPR, vertical slice architecture, and many more patterns

Packt is searching for authors like you

If you're interested in becoming an author for Packt, please visit `authors.packtpub.com` and apply today. We have worked with thousands of developers and tech professionals, just like you, to help them share their insight with the global tech community. You can make a general application, apply for a specific hot topic that we are recruiting an author for, or submit your own idea.

Share your thoughts

Now you've finished *Web Development with Blazor*, we'd love to hear your thoughts! If you purchased the book from Amazon, please `click here to go straight to the Amazon review` page for this book and share your feedback or leave a review on the site that you purchased it from.

Your review is important to us and the tech community and will help us make sure we're delivering excellent quality content.

Index

A

B

C

D

Download a free PDF copy of this book

Thanks for purchasing this book!

Do you like to read on the go but are unable to carry your print books everywhere?

Is your eBook purchase not compatible with the device of your choice?

Don't worry, now with every Packt book you get a DRM-free PDF version of that book at no cost.

Read anywhere, any place, on any device. Search, copy, and paste code from your favorite technical books directly into your application.

The perks don't stop there, you can get exclusive access to discounts, newsletters, and great free content in your inbox daily.

Follow these simple steps to get the benefits:

1. Scan the QR code or visit the link below:

   `https://packt.link/free-ebook/9781835465912`

2. Submit your proof of purchase.
3. That's it! We'll send your free PDF and other benefits to your email directly.