EXPERT INSIGHT

Angular Projects

Build modern web apps in Angular 16 with 10 different projects and cutting-edge technologies

Third Edition

Foreword by:
Mark Thompson, Angular Team at Google

Aristeidis Bampakos

packt

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Foreword

Angular is a powerful web framework that helps teams build robust, scalable applications. Angular continues to evolve but the core values remain the same: build a platform developers love to use, enable developers to build applications that users love to use, and have a community where everyone feels welcomed.

Angular Projects is a book that embraces these values and takes a unique approach to empower new and experienced developers to build great applications using Angular. Aristeidis uses a project-driven approach to help learners understand modern Angular techniques in an intriguing and accessible way.

This guide will help learners to build their first application with the powerful Angular CLI, take advantage of Angular's strong PWA integration, build performant static applications with Scully, and more. This book will add significant value to developers looking to get the most out of their Angular experience.

As Angular continues to power incredible experiences inside Google and across the web, this book will serve as an excellent learning resource for developers looking to build great apps.

Mark Thompson

Angular Team at Google

Contributors

About the author

Aristeidis Bampakos has over 20 years of experience in the software development industry. He is a Greek national who currently works in Athens as a Web Development Team Leader at Plex-Earth, specializing in the development of web applications using Angular.

He studied Computer Technology at the University of Portsmouth and in 2002 he was awarded a Bachelor of Engineering degree with Second Class Honors (Upper Division). In 2004, he completed his MSc in Telecommunications Technology at Aston University. His career started as a C# .NET developer, but he saw the potential of web development and moved toward it in early 2011. He began working with AngularJS, and Angular later on, and in 2020 he was officially recognized as a **Google Developer Expert** (**GDE**) for Angular.

Aristeidis is passionate about helping the developer community learn and grow. His love for teaching has led him to become an award-winning author of 3 successful book titles about Angular (Learning Angular – 3rd/4th edition and Angular Projects – 2nd edition), as well as an Angular Senior Tech Instructor at Code.Hub, where he nurtures aspiring Angular developers and professionals. In his spare time, he enjoys being an occasional speaker in meetups, conferences, and podcasts where he talks about Angular. He is currently leading the effort of making Angular accessible to the Greek development community by maintaining the open source Greek translation of the official Angular documentation

To my amazing Expert Network Team at Packt for believing on my vision about the book and their great help and support.

About the reviewer

Chihab is an independent consultant and trainer, and a Google Developer Expert in Angular. With over a decade of experience, he has developed expertise in building web applications, component libraries, and tools for various companies. Chihab has coached numerous individuals, ranging from corporations to startups, on Angular and web technologies.

Passionate about knowledge-sharing, Chihab is the creator and organizer of various local meetups in Morocco, including Rabat.js, ngMorocco, and JS Morocco. Furthermore, Chihab serves as the host of AngularInDarija.dev, a captivating video streaming podcast that delivers comprehensive Angular tutorials in Darija, the Moroccan local dialect.

Chihab is the author of the @ngx-env/builder and @dotenv-run packages, both open source projects that help managing environment variables within Angular and Node.js projects.

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Preface

Angular is a popular JavaScript framework that can run on a broad range of platforms, including web, desktop, and mobile. It has an array of rich features right out of the box and a wide range of tools that makes it popular among developers. This updated third edition of Angular Projects will teach you how to build efficient and optimized web applications using Angular.

You will start by exploring the essential features of the framework by creating 10 different real-world web applications. Each application will demonstrate how to integrate Angular with a different library and tool. As you advance, you will learn how to implement popular technologies such as Angular Router, Scully, Electron, Angular's service worker, Nx's monorepo tools, NgRx, and more while building an issue tracking system, a PWA weather application, a mobile photo geotagging application, a component UI library, and many other exciting projects. In the concluding chapters, you'll get to grips with customizing Angular CLI commands using schematics.

By the end of this book, you will have the skills you need to build Angular apps using a variety of different technologies according to you or your client's needs.

Who this book is for

If you are a developer who has beginner-level experience with Angular and you're looking to become well versed in the essential tools for dealing with the various use cases you may encounter with Angular, then this Angular development book is for you. Beginner-level knowledge of web application development and basic experience of working with ES6 or TypeScript are assumed.

What this book covers

Chapter 1, Creating Your First Web Application in Angular, explores the main features of the Angular framework and teaches you about the basic building blocks that comprise a typical Angular application. You will investigate the different tools and IDE extensions that are available in the Angular ecosystem to enhance the developer's workflow and experience.

Chapter 2, Building an SPA Application with Scully and Angular Router, looks at how an Angular application is based on the **Single-Page Application** (**SPA**) architecture, where typically we have multiple pages that are served by different URLs or routes. On the other hand, Jamstack is a hot technology that is emerging and allows you to build fast, static websites and serve them directly from a CDN. In this chapter, we will use the Angular Router to implement routing functionality in an Angular application. We will also use Scully, the best static site generator for Angular, to create a personal blog that embraces the Jamstack architecture.

Chapter 3, Building an Issue Tracking System Using Reactive Forms, is where we build an issue tracking management system and use Angular reactive forms to add new issues to the system. We will design our forms using Clarity Components from VMware, and we will incorporate built-in and custom validations. We will also react to value changes in the forms and take actions accordingly.

Chapter 4, Building a PWA Weather Application Using Angular Service Worker, covers how the user experience of a web application is not the same for all users, especially in places with poor network coverage and connectivity. When we build a web application, we should take into account all sorts of network types. In this chapter, we will create an application that uses the OpenWeather API to display the weather of a specified region. We will learn how to deploy the application to Firebase Hosting. We will also explore PWA techniques using the Angular service worker to provide a seamless user experience when offline.

Chapter 5, Building a WYSIWYG Editor for the Desktop Using Electron, a cross-platform JavaScript framework for building desktop applications using web technologies. When combined with Angular, it can yield really performant apps. In this chapter, we will create a WYSIWYG editor that can run on the desktop. We will build an Angular application and integrate it with ngx-wig, a popular WYSIWYG Angular library, and we will use Electron to package it as a desktop application. Data is persisted locally in the filesystem using a Node.js API.

Chapter 6, Building a Mobile Photo Geotagging Application Using Capacitor and 3D Maps, covers Capacitor, a service provided by the Ionic framework that turns any web application, such as one created with Angular, into a native one. Its main advantage is that we can build a native mobile application and a web app using the same code base. Cesium is a popular JavaScript framework for building 3D maps. In this chapter, we will use Capacitor to build a geotagging mobile application for our photos. We will use various Ionic plugins to take a photo in a specified location and persist it to Cloud Firestore. We will then display a list of all photos taken inside the Cesium 3D viewer.

Chapter 7, *Building an SSR Application for a GitHub Portfolio Using Angular*, dives into **Search Engine Optimization** (**SEO**), a critical aspect for any website nowadays. Who doesn't want their website to look good when sharing it via social media? The real challenge for client web applications is to optimize it, which can be accomplished by rendering content on the server. In this chapter, we will learn how to create a GitHub portfolio application using the GitHub API. We will then render it on the server and learn how to transfer the state to the browser. We will also see how to set the page title and additional metadata dynamically.

Chapter 8, *Building an Enterprise Portal Using Nx Monorepo Tools and NgRx*, covers monorepo architecture, which is a popular technique for when working with multiple applications under a single repository, giving speed and flexibility to the development process. In this chapter, we will use Nx monorepo development tools to create two portals: one for the end user, in which they will be able to select a **Point of Interest** (**POI**) and visit it on a map, and another for admins to check on visit statistics for a given POI. Application state is managed using NgRx.

Chapter 9, *Building a Component UI Library Using Angular CLI and Angular CDK*, addresses how enterprise organizations usually need custom UI libraries that can be used across different web applications. The Angular CDK provides a broad range of functionalities for creating accessible and high-performing UI components. In this chapter, we will create two different components using the Angular CDK and the Bulma CSS framework. We will also package them as a single Angular library and learn how to publish them on npm, so that they can be re-used in different apps. We will also investigate how we can use each component as an Angular element.

Chapter 10, *Customizing Angular CLI Commands Using Schematics*, covers how organizations usually follow different guidelines when it comes to creating Angular entities such as components or services. Angular schematics can assist them by extending Angular CLI commands and providing custom automation. In this chapter, we will learn how to use the Angular schematics API to build our own set of commands for generating components and services. We will build a schematic for creating an Angular component that contains the Tailwind CSS framework. We will also build an Angular service that uses the built-in HTTP client by default.

To get the most out of this book

You will need a version of Angular 16 installed on your computer, preferably the latest one. All code examples have been tested using the Angular 16.0.0 on Windows OS but they should work with any future release of Angular 16 as well.

Download the example code files

The code bundle for the book is hosted on GitHub at `https://github.com/PacktPublishing/Angular-Projects-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/UbmtQ`.

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: "Mount the downloaded `WebStorm-10*.dmg` disk image file as another disk in your system."

A block of code is set as follows:

```
getWeather(city: string): Observable<Weather> {
  const options = new HttpParams()
    .set('units', 'metric')
    .set('q', city)
    .set('appId', this.apiKey);
  return this.http.get<Weather>(this.apiUrl + 'weather', { params: options
});
}
```

When we wish to draw your attention to a particular part of a code block, the relevant lines or items are set in bold:

```
import { HttpClientModule } from '@angular/common/http';
import { NgModule } from '@angular/core';
import { BrowserModule } from '@angular/platform-browser';
```

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

```
ng generate service weather
```

Bold: Indicates a new term, an important word, or words that you see on the screen. For instance, words in menus or dialog boxes appear in the text like this. For example: "Select **System info** from the **Administration** panel."

Warnings or important notes appear like this.

Tips and tricks appear like this.

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1

Creating Your First Web Application in Angular

Angular is a popular and modern **JavaScript** framework that can run on different platforms, including the web, desktop, and mobile. Angular applications are written in **TypeScript**, a superset of JavaScript that provides syntactic sugar, such as strong typing and object-oriented techniques.

Angular applications are created and developed using a command-line tool made by the Angular team called the **Angular CLI**. It automates many development tasks, such as scaffolding, testing, and deploying Angular applications, which would take much time to configure manually.

The popularity of the Angular framework is considerably reflected in its broad tooling support. The **Visual Studio Code (VS Code)** editor contains various extensions that enhance the development experience when working with Angular.

In this chapter, we will cover the following topics:

- An introduction to the Angular CLI
- Exploring the rich ecosystem of Angular tooling in VS Code
- Creating our first Angular application
- Interacting with the Angular framework
- Using **Nx Console** to automate Angular CLI commands

Essential background theory and context

The Angular framework is a cross-platform JavaScript framework that can run on various environments, including the web, server, mobile, and desktop. It consists of a collection of JavaScript libraries that we can use to build highly performant and scalable web applications. The architecture of an Angular application is based on a hierarchical representation of components. Components are the fundamental building blocks of an Angular application. They represent and control a particular portion of a web page called the **view**. Some examples of components are as follows:

- A list of blog posts
- An issue reporting form
- A weather display widget

Components of an Angular application can be logically organized as a tree:

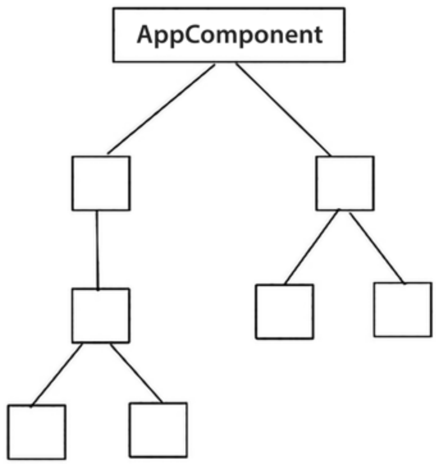


Figure 1.1 – Component tree

An Angular application typically has one main component by convention, called `AppComponent`. Each component in the tree can communicate and interact with its siblings using an application programming interface, defined by each component.

An Angular application can have many features that are called **modules**. Each module serves a block of single functionality corresponding to a particular application domain or workflow. Angular modules are used to group Angular components that share similar functionality:

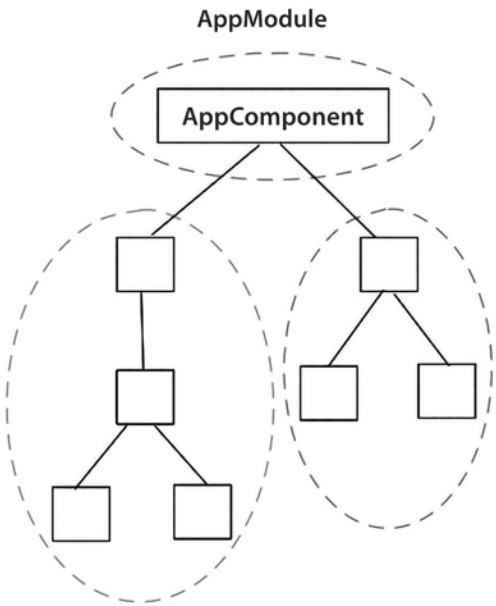


Figure 1.2 – Module hierarchy

In the previous diagram, the dashed line circles represent Angular modules. An Angular application typically has one main module by convention, called `AppModule`. Each module can import other modules in an Angular application if they wish to use part of their functionality.

The functionality of a module can be further analyzed in the presentational and business logic of a feature. Angular components should only handle the presentational logic and delegate business logic tasks to services. The Angular framework provides Angular services to components using a built-in **dependency injection (DI)** mechanism.

The Angular DI framework uses special-purpose objects, called **injectors**, to hide much of the complexity of providing dependencies to an Angular application. Components are not required to know the actual implementation of an Angular service. They only need to ask for it from an injector.

An Angular service should follow the **single responsibility principle** and not cross boundaries between different modules. Some examples of services are as follows:

- Accessing data from a backend API using the HTTP protocol
- Interacting with the local storage of the browser
- Error logging
- Data transformations

An Angular developer does not need to remember how to create components, modules, and services by heart while building an Angular application. Luckily, the Angular CLI can assist us by providing a command-line interface to accomplish these tasks.

Introduction to the Angular CLI

The Angular CLI is a tool created by the Angular team that improves the developer experience while building Angular applications. It hides the complexity of scaffolding and configuring an Angular application while allowing developers to concentrate on what they do best – coding! Before we can start using the Angular CLI, we need to set up the following prerequisites in our system:

- **Node.js**: A JavaScript runtime that is built on the v8 engine of Chrome. You can download any **Long-Term Support (LTS)** version from `https://nodejs.org`.
- **npm**: A package manager for the Node.js runtime.

We can then install the Angular CLI using `npm` from the command line:

```
npm install -g @angular/cli
```

We use the `-g` option to install the Angular CLI globally, since we want to create Angular applications from any operating system path.

> Installing the Angular CLI may require administrative privileges in some operating systems.

To verify that the Angular CLI has been installed correctly, we can run the following from the command line:

```
ng version
```

The previous command will report the version of the Angular CLI installed in our system. The Angular CLI provides a command-line interface through the `ng` command, which is the binary executable of the Angular CLI. It can accept various options, including the following:

- `serve`: Build and serve an Angular application.
- `build`: Build an Angular application.
- `test`: Run the unit tests of an Angular application.

- `generate`: Generate a new Angular artifact, such as a component or module.
- `add`: Install a third-party library compatible with the Angular framework.
- `new`: Create a new Angular application.

The previous options are the most common ones. If you want to view all the available commands, execute the following in the command line:

```
ng help
```

The previous command will display a list of all the supported commands from the Angular CLI.

The Angular tooling ecosystem is full of extensions and utilities that can help us when developing Angular applications. In the next section, we will learn some of those that work with VS Code.

Exploring the rich ecosystem of Angular tooling in VS Code

There are many extensions available in the **VS Code Marketplace** that enhance the Angular tooling ecosystem. In this section, we will learn about the most popular ones that can significantly help us in Angular development:

- Nx Console
- Angular Language Service
- Angular Snippets
- Angular Evergreen
- Material Icon Theme

The preceding list is not exhaustive; some extensions are already included in the **Angular Essentials** extension pack. However, you can browse more Angular extensions for VS Code at `https://marketplace.visualstudio.com/search?term=angular&target=VSCode`.

Nx Console

Nx Console is a VS Code extension developed by the Nrwl team that provides a graphical user interface over the Angular CLI. It contains most of the Angular CLI commands and uses the Angular CLI internally to execute each one. We will learn more about this extension in the *Building our application with Nx Console* section.

Angular Language Service

The **Angular Language Service** extension provides various enhancements while editing HTML templates in an Angular application, including the following:

- Code autocompletion
- Compile error messages
- Go-to definition techniques

Code autocompletion is a feature that helps us find the right property or method to use while typing. It works by displaying a list of suggestions while we start typing in HTML content:

Figure 1.3 – Code completion

In the previous screenshot, the Angular Language Service suggests the **description** component property when we start typing the word `descr`. Notice that code completion only works for the public properties and methods in a component.

One of the most common issues when developing web applications is detecting errors before the application reaches production. This problem can be solved partially by the Angular compiler, which is bootstrapped upon building an Angular application for production. Moreover, the Angular Language Service can take this further by displaying compilation error messages long before our application reaches the compilation process:

Figure 1.4 – Compile error message

For example, if we accidentally misspell the name of a property or method of the component, the Angular Language Service will display an appropriate error message.

Angular Snippets

The **Angular Snippets** extension contains a collection of Angular code snippets for TypeScript and HTML. In TypeScript, we can use it to create components, modules, or services in a blank TypeScript file:

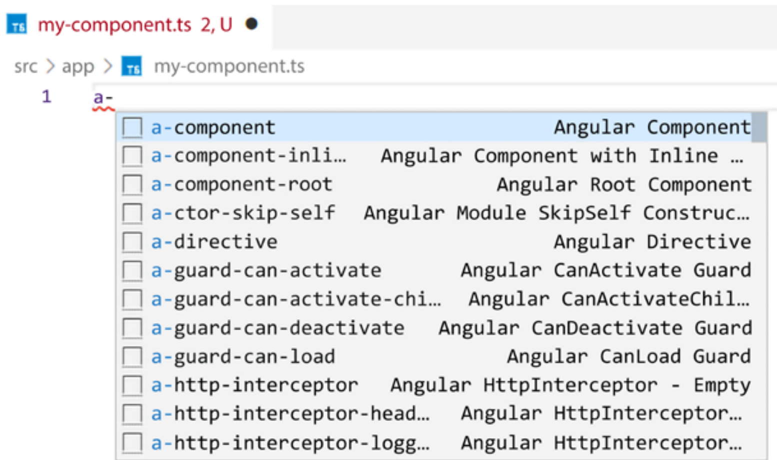


Figure 1.5 – New Angular component snippet

In an HTML template, we can use the extension to create useful Angular artifacts, such as the ***ngFor** directive, to loop through a list in HTML:

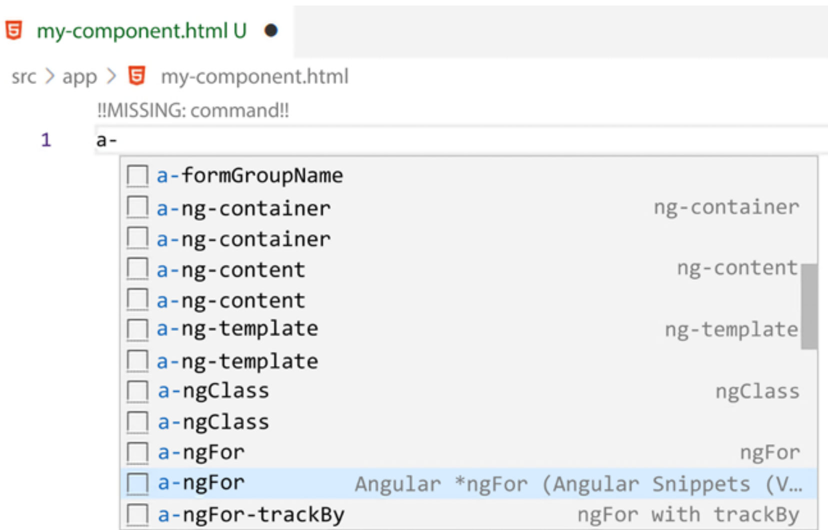


*Figure 1.6 – *ngFor snippet*

Due to the widespread popularity and capabilities of the Angular CLI, it looks more convenient to use it to generate Angular artifacts in TypeScript. However, Angular Snippets does a great job with the HTML part, where there are more things to remember by heart.

Angular Evergreen

A primary factor that makes the Angular framework so stable is that it follows a regular release cycle based on semantic versioning. If we want our Angular applications to be packed with the latest features and fixes, we must update them regularly. But how can we stay up to date most efficiently? We can use the **Angular Evergreen** extension!

It compares the Angular and Angular CLI versions of an Angular CLI project with the latest ones and alerts you about whether you need to update it:

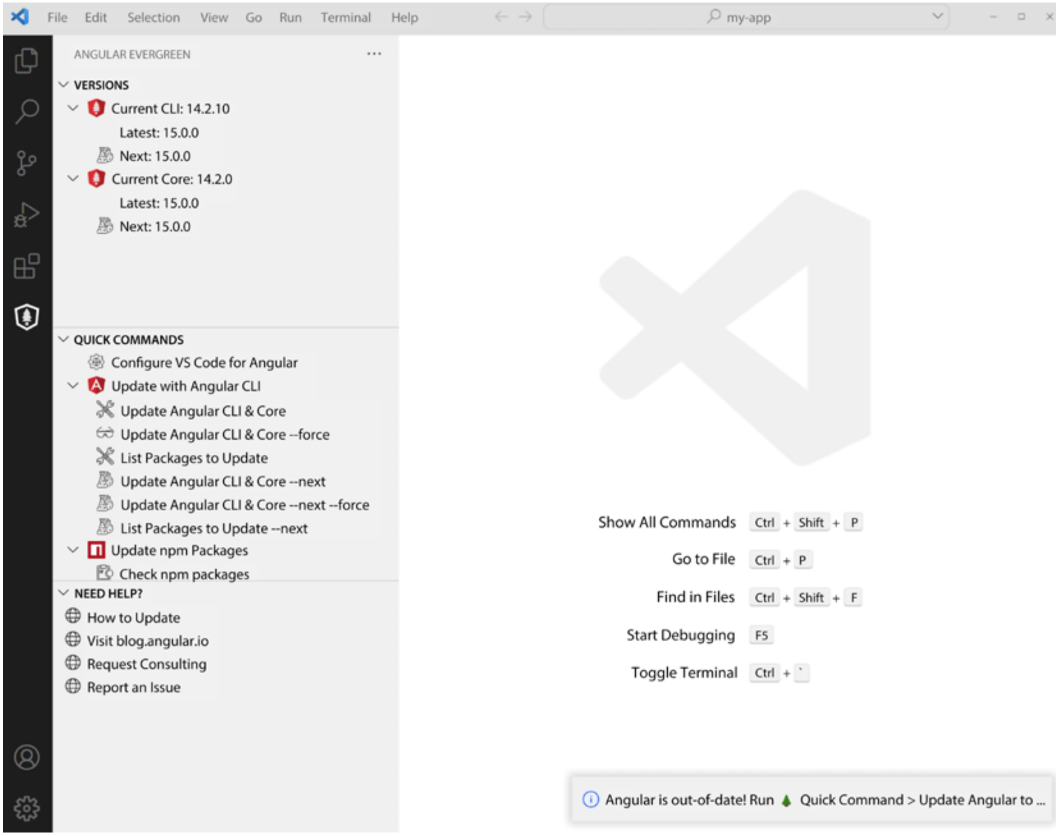


Figure 1.7 – Angular Evergreen

It provides an easy-to-use user interface to execute the following commands:

- Upgrading Angular dependencies to the *latest* version
- Upgrading Angular dependencies to the *next* version
- Upgrading all npm dependencies

Angular Evergreen is the perfect extension to always stay updated with your Angular projects.

Material Icon Theme

The last extension in the list adds little value regarding the productivity of the developer. Instead, it focuses on the discoverability and aesthetic point of view by modifying the icon theme of VS Code.

The **Material Icon Theme** contains a ton of icons that are based on **Google Material Design**. It can understand each file type in your project and display the related icon automatically. For example, Angular modules are indicated with a red Angular icon, whereas components are shown with a blue Angular icon.

VS Code has a default file icon theme called **Seti**. Once you've installed Material Icon Theme, it will prompt you to select which one you would like to activate:

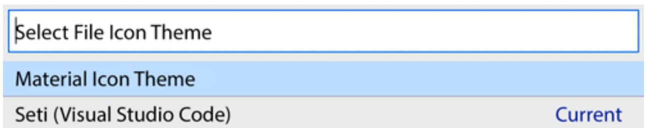


Figure 1.8 – Selecting a file icon theme

Selecting **Material Icon Theme** will automatically update the icons of your current Angular project.

> Material Icon Theme is installed and applied globally to VS Code, so you do not need to activate it separately for each Angular CLI project.

Now, when you open your Angular project, you will understand the type of each file at a glance, even if its name is not displayed wholly on the screen.

Project overview

In this project, we will use Angular CLI to create a new Angular application from scratch. Then, we will interact with the core functionality of the Angular framework to make a simple change to our application. Finally, we will learn how to use the Nx Console extension to build and serve our application.

Build time: 15 minutes.

Getting started

The following software tools are required to complete this project:

- **Git**: A free and open-source distributed version control system. You can download it from `https://git-scm.com`.
- **VS Code**: A code editor that you can download from `https://code.visualstudio.com`.
- **Angular CLI**: We introduced the command-line interface for Angular in the *Essential background theory and context* section.
- **GitHub material**: The code for this chapter, which you can find in the `Chapter01` folder at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition`.

Creating our first Angular application

To create a fresh new Angular application, we must execute the `ng new` command of the Angular CLI, passing the name of the application as an option:

```
ng new my-app
```

The `ng new` command is used to create a new Angular application or a new Angular workspace. An Angular workspace is an Angular CLI project containing one or more Angular applications, some of which can be Angular libraries. So, when we execute the `ng new` command, we create an Angular workspace with an Angular application by default.

In the previous command, the name of our Angular application is `my-app`. Upon executing the command, the Angular CLI will ask some questions to collect as much information as possible regarding the nature of the application we want to create:

1. Initially, it will ask if we want to enable Angular analytics:

   ```
   Would you like to share pseudonymous usage data about this project
   with the Angular Team at Google under Google's Privacy Policy at
   https://policies.google.com/privacy. For more details and how to
   change this setting, see https://angular.io/analytics. (y/N)
   ```

   The Angular CLI will only ask the previous question once, when we create our first Angular project, and apply it globally in your system. However, we can change the setting later in a specific Angular workspace.

2. Next, it will ask whether we want to enable routing in our Angular application:

```
Would you like to add Angular routing? (y/N)
```

Routing in Angular is all about navigating between the components of an Angular application using a URL. We are not concerned with routing in this project, so press *Enter* to accept the default value.

3. Then, the Angular CLI prompts us to select the style format that we want to use throughout the Angular application:

```
Which stylesheet format would you like to use? (Use arrow keys)
```

Select a format from the list of available stylesheets and press *Enter*.

The Angular CLI initiates the creation process of your Angular application, which consists of the following:

- Scaffolding the necessary folder structure of a typical Angular CLI project
- Installing the required npm dependencies and Angular packages
- Initializing Git in the Angular CLI project

This process may take some time, depending on the speed of your network. Once it has finished, you should have a new folder named `my-app` in the path where you ran the `ng new` Angular CLI command.

Now, the time has finally come to run our Angular application and see it in action:

1. Open a terminal window and navigate to the `my-app` folder.
2. Run the following Angular CLI command:

```
ng serve
```

The preceding command will build the Angular application and start a built-in web server that we can use to preview it. The web server is started in watch mode; it automatically rebuilds the Angular application whenever we change the code. The first time an Angular application is built, it takes considerable time to complete, so we must be patient. We will know when the process has finished with no errors when we see the following message in the terminal window:

```
** Angular Live Development Server is listening on localhost:4200, open your browser
on http://localhost:4200/ **

√ Compiled successfully.
```

Figure 1.9 – Angular build output

3. Fire up your favorite browser and navigate to `http://localhost:4200` to get a preview of your brand-new Angular application:

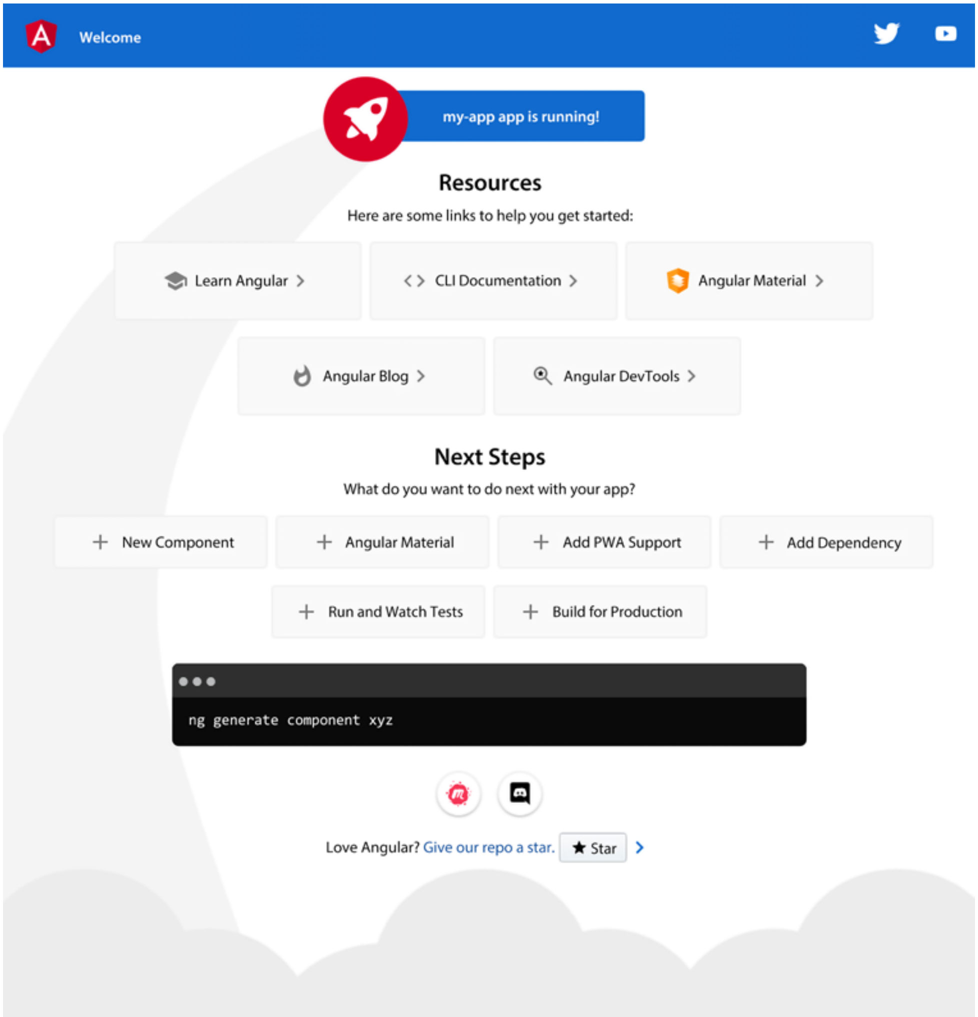


Figure 1.10 – Minimal Angular application

The Angular CLI creates a minimal Angular application by default to provide us with a starting point for our Angular project. It contains some ready-made CSS styles and HTML content, which we will learn how to change according to our specifications in the following section.

Interacting with the Angular framework

When working with Angular, the real fun starts when we get our hands dirty with the framework itself. After all, understanding how Angular works and writing the application code is what matters.

The application source code resides inside the `src\app` folder at the root of our Angular CLI project. It contains all the files needed to build and test our Angular application, including a component and a module. The component is the main component of the Angular application:

`app.component.ts`

```
import { Component } from '@angular/core';

@Component({
  selector: 'app-root',
  templateUrl: './app.component.html',
  styleUrls: ['./app.component.css']
})
export class AppComponent {
  title = 'my-app';
}
```

The following properties characterize an Angular component:

- `selector`: A unique name used to identify and declare the component inside HTML content. It is an HTML tag, just like any native HTML element, such as `<app-root></app-root>`.

  > The Angular CLI provides the `app-` prefix by default in component selectors. We can use a custom one using the `--prefix` option when creating a new Angular CLI application from scratch. A custom prefix can be based on the name of an organization or a particular product, and it helps avoid collisions with other libraries or modules.

- `templateUrl`: The path pointing to an HTML file that contains the HTML content of the component, which is called the component template.
- `styleUrls`: A list of paths where each one points to a stylesheet file containing the CSS styles of the component.

The preceding properties are defined using the `@Component` decorator. It is a function that decorates the TypeScript class of the component and recognizes it as an Angular component. The `title` property of the `AppComponent` class is a public property that contains a string value and can be used in the component template.

The main module of our Angular application uses a similar decorator called `@NgModule` to define its properties:

`app.module.ts`

```
import { NgModule } from '@angular/core';
import { BrowserModule } from '@angular/platform-browser';

import { AppComponent } from './app.component';

@NgModule({
  declarations: [
    AppComponent
  ],
  imports: [
    BrowserModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

The decorator of an Angular module defines a set of properties that can be used to configure the module. The most common ones are as follows:

- `declarations`: Defines Angular components that are part of the Angular module. Every component that exists in the Angular module *must* be added to the `declarations` array.
- `imports`: Defines other Angular modules that contain the functionality the Angular module needs.

Let's get our feet wet now by modifying the code of our Angular application. We will change the following greeting message, which is displayed at application startup, to something more meaningful:

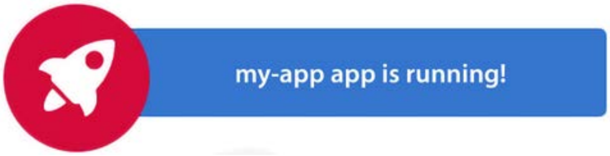


Figure 1.11 – Greeting message

First, we need to find where the message in the previous screenshot is declared. The main component of an Angular application is the component that is loaded at application startup by default.

> The `bootstrap` property of the main module of the application indicates the component that is displayed when an Angular application is bootstrapped. We rarely need to change this property. The selector of that component is used in the `index.html` file by default.

So, the message should be declared inside the `app.component.ts` file. Let's take a look:

1. Open the VS Code editor and select **File | Open folder...** from the main menu.
2. Find the `my-app` folder of the Angular application that we created and select it.
3. Navigate to the `src\app` folder from the **EXPLORER** pane and select the `app.component.ts` file.
4. Locate the `title` property in the `AppComponent` class and change its value to `Angular Projects`:

   ```
   title = 'Angular Projects';
   ```

5. Run `ng serve` from the terminal window if the application is not running, and navigate to `http://localhost:4200` using your browser. Our Angular application should now display the following greeting message:

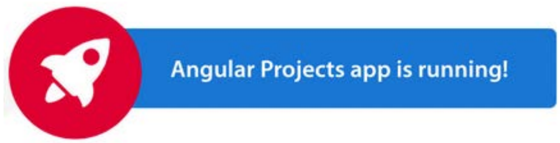


Figure 1.12 – Greeting message

The `title` property is bound to the template of the main component. If we open the `app.component.html` file and go to line 344, we will see the following HTML code:

```
<span>{{ title }} app is running!</span>
```

The `{{}}` syntax surrounding the `title` property is called **interpolation**. During interpolation, the Angular framework reads the enclosed component property value, converts it into text, and prints it on the screen.

The Angular CLI provides a rich collection of commands to assist us during our daily development routine. However, many developers struggle to use the command line and prefer a more graphical approach. In the next section, we will learn how to use the Nx Console, a graphical user interface for the Angular CLI.

Using Nx Console for automating Angular CLI commands

The Angular CLI is a command-line tool with a variety of commands. Each command can accept a wide range of options and parameters according to the task we want to accomplish. Remembering these commands and their options by heart is daunting and time-consuming. In such cases, the ecosystem of Angular tooling can come in handy. VS Code Marketplace contains many useful extensions that we can install to help us during Angular development. One of these extensions is the Nx Console, which provides a user interface over the Angular CLI. To install the Nx Console in your environment, follow these steps:

1. Open VS Code and click on the **Extensions** menu in the sidebar:

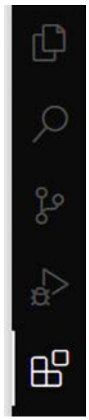


Figure 1.13 – VS Code Extensions

2. In the **EXTENSIONS** pane that appears, type `Nx Console`.
3. Click the **Install** button on the first item to install the Nx Console extension.

The Nx Console extension is now installed globally in our environment, so we can use it in any Angular project. It is a graphical representation of the most common Angular CLI commands. Currently, it supports the following commands (the related Angular CLI command is shown in parentheses):

- **generate**: Generate new Angular artifacts, such as components and modules (`ng generate`).
- **run**: Run an architect target, as defined in the `angular.json` configuration file of the Angular CLI workspace (`ng run`).
- **build**: Build an Angular application (`ng build`).
- **serve**: Build and serve an Angular application (`ng serve`).
- **test**: Run the unit tests of an Angular application (`ng test`).

The Nx Console can almost achieve whatever we can do with the Angular CLI. The real benefit is that the developer does not need to remember all the Angular CLI command options, as they are all represented in a graphical interface. Let's see how:

1. Open the `my-app` folder using VS Code and click on the **Nx Console** menu in the sidebar:

Figure 1.14 – Nx Console

2. Select the **serve** command from the **PROJECTS** pane and click the **play** button to execute it:

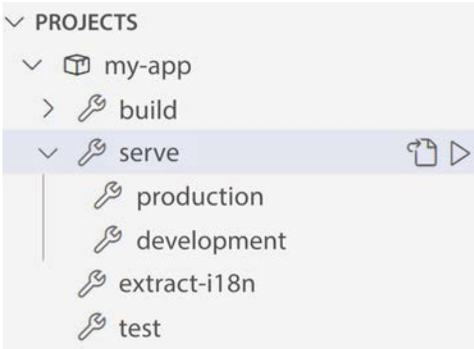


Figure 1.15 – The serve command

3. VS Code opens an integrated terminal at the bottom of the editor and executes the **ng serve** command:

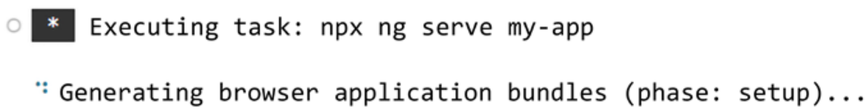


Figure 1.16 – VS Code integrated terminal

It is the same command we run when using the Angular CLI from a terminal window.

The Nx Console uses **tasks** internally to run Angular CLI commands. Tasks are a built-in mechanism of VS Code that allow us to run scripts or start external processes without interacting directly with the command line.

The Nx Console extension does a fantastic job of removing the burden of remembering Angular CLI commands by heart. The VS Code Marketplace contains many more extensions for Angular developers that supplement the job of the Nx Console.

Summary

In this chapter, we learned about the basic principles of the Angular framework and provided a brief overview of the Angular architecture. We saw some popular extensions for VS Code that we can use to enhance our development experience while working with Angular.

Then, we learned how to use the Angular CLI, a powerful tool of the Angular ecosystem, to scaffold and build a new Angular application from scratch. We also made our first interaction with Angular code by modifying the Angular component of a typical Angular CLI application. Finally, we installed the Nx Console extension and learned how to build our application.

In the next chapter, we will look at the Angular Router and learn how to use it to create a personal blog, using the Scully static website generator.

Practice questions

Let's take a look at a few practice questions:

1. What is the basic building block of an Angular application?
2. How do we group components of similar functionality?
3. Who handles business logic tasks in an Angular application?
4. Which Angular CLI command can we use to create a new Angular application?
5. Which Angular CLI command can we use to serve an Angular application?
6. How do we declare an Angular component in HTML?
7. How do we declare Angular components in a module?
8. What syntax do we use to bind text on HTML templates?
9. What is the benefit of using the Nx Console?
10. Which extension do we use to perform static analysis in our Angular code?

Further reading

Here are some links to build upon what we learned in the chapter:

- Introduction to Basic Angular Concepts: `https://angular.io/guide/architecture`
- Interpolation: `https://angular.io/guide/interpolation`
- Nx Console: `https://nx.dev/core-features/integrate-with-editors#vscode-plugin:-nx-console`
- Angular Essentials: `https://marketplace.visualstudio.com/items?itemName=johnpapa.angular-essentials`
- Angular Evergreen: `https://expertlysimple.io/get-evergreen`

2

Building an SPA Application with Scully and Angular Router

Angular applications follow the **Single-Page Application (SPA)** architecture, where different views of the web page can be activated using the URL in the browser. Any changes to that URL can be intercepted by the Angular router and translated to routes that can activate a particular Angular component.

Scully is a popular static website generator that is based on the **Jamstack** architecture. It can cooperate nicely with the Angular router to prerender the content of an Angular application according to each route.

In this chapter, we are going to combine Angular and Scully to create a personal blog. The following topics are going to be covered:

- Setting up routing in an Angular application
- Creating the basic layout of our blog
- Configuring routing for our application
- Adding blog capabilities with Scully
- Displaying blog posts on the home page

Essential background theory and context

In the old days of web development, client-side applications were highly coupled with the underlying server infrastructure. Much machinery was involved when we wanted to visit the page of a website using a URL.

The browser would send the requested URL to the server, and the server should respond with a matching HTML file for that URL. This was a complicated process that would result in delays and varying round-trip times.

Modern web applications eliminate these problems using the SPA architecture. A client needs to request a single HTML file only once from the server. Any subsequent changes to the URL of the browser are handled internally by the client infrastructure. In Angular, the router is responsible for intercepting in-app URL requests and handling them according to a defined route configuration.

Jamstack is a hot emerging technology that allows us to create fast and secure web applications. It can be used for any application type, ranging from an e-commerce website to a **Software as a Service (SaaS)** web application or even a personal blog. The architecture of Jamstack is based on the following pillars:

- **Performance**: Pages are generated and prerendered during production, eliminating the need to wait for content to load.
- **Scaling**: Content is static files that can be served from anywhere, even from a **Content Delivery Network (CDN)** provider that improves the performance of the application.
- **Security**: The serverless nature of server-side processes and the fact that content is already static eliminates potential attacks that target server infrastructures.

Scully is the first static website generator for Angular that embraces the Jamstack approach. It essentially generates pages of the Angular application during build time to be immediately available when requested.

Project overview

In this project, we will build a personal blog using the Angular framework and enhance it with Jamstack characteristics using the Scully site generator. Initially, we will scaffold a new Angular application and enable it for routing. We will then create the basic layout of our application by adding some barebones components. As soon as we have a working Angular application, we will add blog support to it using Scully. We will then create some blog posts using Markdown files and display them on the home page of our application. The following diagram depicts an architectural overview of the project:

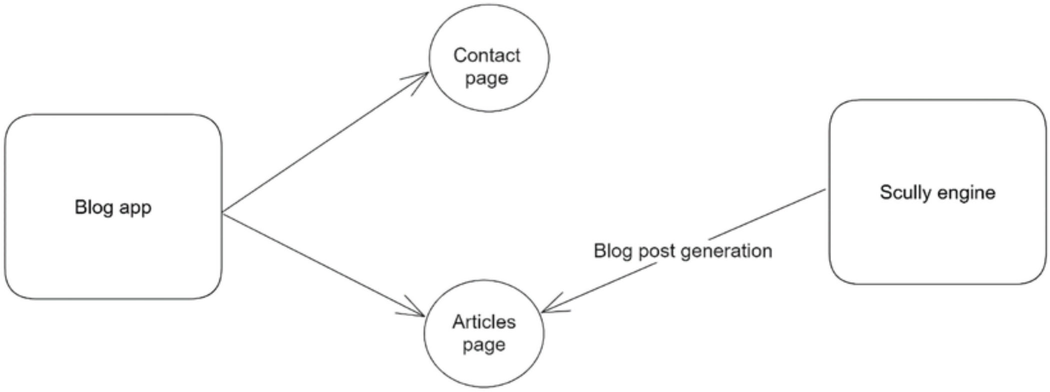


Figure 2.1 – Project architecture

Build time: 1 hour.

Getting started

The following software tools are required to complete this project:

- Angular CLI: A command-line interface for Angular that you can find at `https://angular.io/cli`.
- GitHub material: The related code for this chapter, which you can find in the `Chapter02` folder at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition`.

Setting up routing in an Angular application

We will kick off our project by creating a new Angular application from scratch. Execute the following Angular CLI command in a terminal window to create a new Angular application:

```
ng new my-blog --routing --style=scss
```

We use the `ng new` command to create a new Angular application, passing the following options:

- `my-blog`: The name of the Angular application that we want to create. The Angular CLI will create a `my-blog` folder in the path where we execute the command.

  > Every command that we run in the terminal window should be run inside this folder.

- `--routing`: Enables routing in the Angular application.

- `--style=scss`: Configures the Angular application to use the SCSS stylesheet format when working with CSS styles.

When we enable routing in an Angular application, the Angular CLI imports several artifacts from the **@angular/router** npm package in our application:

- It creates the `app-routing.module.ts` file, which is the main routing module of our application:

```
import { NgModule } from '@angular/core';
import { RouterModule, Routes } from '@angular/router';

const routes: Routes = [];

@NgModule({
  imports: [RouterModule.forRoot(routes)],
  exports: [RouterModule]
})
export class AppRoutingModule { }
```

- It imports `AppRoutingModule` into the main module of our application, `app.module.ts`:

```
import { NgModule } from '@angular/core';
import { BrowserModule } from '@angular/platform-browser';

import { AppRoutingModule } from './app-routing.module';
import { AppComponent } from './app.component';

@NgModule({
  declarations: [
    AppComponent
  ],
  imports: [
    BrowserModule,
    AppRoutingModule
  ],
  providers: [],
  bootstrap: [AppComponent]
```

```
})
export class AppModule { }
```

We configured our application to use the SCSS stylesheet format. Instead of creating the styles of our application manually, we will use the **Bootstrap CSS** library:

1. Execute the following command in a terminal window to install Bootstrap:

   ```
   npm install bootstrap
   ```

   In the preceding command, we use the `npm` executable to install the `bootstrap` package from the npm registry.

2. Add the following `import` statement at the top of the `styles.scss` file that exists in the `src` folder of our Angular application:

   ```
   @import "bootstrap/scss/bootstrap";
   ```

   The `styles.scss` file contains CSS styles that are applied globally in our application. In the previous snippet, we import all the styles from the Bootstrap library into our application. The `@import` CSS rule accepts the absolute path of the `bootstrap.scss` file as an option without adding the extension.

In the following section, we will learn how to create the basic layout of our blog by creating components, such as the header and the footer.

Creating the basic layout of our blog

A blog typically has a header containing all the primary website links and a footer containing copyright information and other useful links. In the world of Angular, both can be represented as separate components.

The header component is used only once since it is added when our application starts up, and it is always rendered as the main menu of the website. In Angular, we typically create a module, named `core` by convention, to keep such components or services central to our application. To create the module, we use the `generate` command of the Angular CLI:

```
ng generate module core
```

The preceding command will create the module in the `src\app\core` folder of our application. To create the header component, we will use the same command, passing a different set of options:

```
ng generate component header --path=src/app/core --module=core --export
```

The previous command will create all necessary component files inside the `src\app\core\header` folder. It will also declare `HeaderComponent` in the `core.module.ts` file and add it to the `exports` property so that other modules can use it:

```
import { NgModule } from '@angular/core';
import { CommonModule } from '@angular/common';
import { HeaderComponent } from './header/header.component';

@NgModule({
  declarations: [
    HeaderComponent
  ],
  imports: [
    CommonModule
  ],
  exports: [
    HeaderComponent
  ]
})
export class CoreModule { }
```

The header component should display the main links of our blog. Open the `header.component.html` template file of the header component and replace its content with the following snippet:

```
<nav class="navbar navbar-expand navbar-light bg-light">
  <div class="container-fluid">
    <a class="navbar-brand">Angular Projects</a>
    <ul class="navbar-nav me-auto">
      <li class="nav-item">
        <a class="nav-link">Articles</a>
      </li>
      <li class="nav-item">
        <a class="nav-link">Contact</a>
      </li>
    </ul>
  </div>
</nav>
```

The footer component can be used more than once in an Angular application. Currently, we want to display it on the main page of our application. In the future, we may want to have it also on a login page that will be available for blog visitors. In such a case, the footer component should be reusable. When we want to group components that will be reused throughout our application, we typically create a module named **shared** by convention. Use the Angular CLI `generate` command to create the module:

```
ng generate module shared
```

The previous command will create the `shared` module in the `src\app\shared` folder. The footer component can now be created using the following command:

```
ng generate component footer --path=src/app/shared --module=shared
--export
```

The previous command will create all necessary files of the footer component inside the `src\app\shared\footer` folder. It will also add `FooterComponent` in the `declarations` and `exports` properties in the `shared.module.ts` file:

```
import { NgModule } from '@angular/core';
import { CommonModule } from '@angular/common';
import { FooterComponent } from './footer/footer.component';

@NgModule({
  declarations: [
    FooterComponent
  ],
  imports: [
    CommonModule
  ],
  exports: [
    FooterComponent
  ]
})
export class SharedModule { }
```

The content of the footer component should contain copyright information about our blog.

Let's see how to add this information to our component:

1. Open the `footer.component.ts` file, add a `currentDate` property in the `FooterComponent` class, and initialize it to a new `Date` object:

   ```
   currentDate = new Date();
   ```

2. Open the `footer.component.html` template file of the footer component and replace its content with the following:

   ```
   <nav class="navbar fixed-bottom navbar-light bg-light">
     <div class="container-fluid">
       <p>Copyright @{{currentDate | date: 'y'}}. All
         Rights Reserved</p>
     </div>
   </nav>
   ```

   The preceding code uses interpolation to display the value of the `currentDate` property on the screen. It also uses the built-in `date` pipe to display only the year of the current date.

   > Pipes are a built-in feature of the Angular framework that apply transformations on the view representation of a component property. The underlying value of the property remains intact.

We have already created the essential components of our blog. Now it is time to display them on the screen:

1. Open the main module of the application, the `app.module.ts` file, and add `CoreModule` and `SharedModule` into the `imports` property of the `@NgModule` decorator:

   ```
   @NgModule({
     declarations: [
       AppComponent
     ],
     imports: [
       BrowserModule,
       AppRoutingModule,
       CoreModule,
       SharedModule
     ],
   ```

```
  providers: [],
  bootstrap: [AppComponent]
})
```

2. Add the appropriate `import` statements at the top of the file for each module:

```
import { CoreModule } from './core/core.module';
import { SharedModule } from './shared/shared.module';
```

3. Open the `app.component.html` template file of the main component and replace its content with the following HTML snippet:

```
<app-header></app-header>
<app-footer></app-footer>
```

   We added the header and the footer component in the preceding snippet by using their CSS selectors.

If we run the `serve` command of the Angular CLI to preview the application, we should get the following:

Figure 2.2 – Basic layout

We have already completed the basic layout of our blog application, and it looks great! But the header contains two additional links that we have not covered yet. We will learn how to use routing to activate those links in the following section.

Configuring routing for our application

The header component that we created in the previous section contains two links:

- **Articles**: Displays a list of blog articles
- **Contact**: Displays personal information about the blog owner

The previous links will also become the main features of our application. So, we need to create an Angular module for each one.

> When you design your website and need to decide upon the Angular modules that you will use, check out the main menu of the website. Each link of the menu should be a different feature and, thus, a different Angular module.

By convention, Angular modules that contain functionality for a specific feature are called **feature modules**.

Creating the contact page

Let's begin by creating our contact feature:

1. Create a module that will be the home for our contact feature:

```
ng generate module contact
```

2. Create a component that will be the main component of the `contact` module:

```
ng generate component contact --path=src/app/contact
--module=contact --export --flat
```

   We pass the `--flat` option to the `generate` command so that the Angular CLI will not create a separate folder for our component, as in previous cases. The `contact` component will be the only component in our module, so there is no point in having it separately.

3. Open the `contact.component.html` file and add the following HTML content:

```
<div class="card mx-auto text-center border-light" style="width:
18rem;">
  <img src="assets/angular.png" class="card-img-top"
```

```
    alt="Angular logo">
  <div class="card-body">
    <h5 class="card-title">Angular Projects</h5>
    <p class="card-text">
      A personal blog created with the Angular
      framework and the Scully static site generator
    </p>
    <a href="https://angular.io/" target="_blank"
      class="card-link">Angular</a>
    <a href="https://scully.io/" target="_blank"
      class="card-link">Scully</a>
  </div>
</div>
```

In the preceding code, we used the `angular.png` image, which you can find in the `src\assets` folder of the project from the accompanying GitHub repository.

The `assets` folder in an Angular CLI project is used for static content such as images, fonts, or JSON files.

We have already created our contact feature. The next step is to add it to the main page of our Angular application:

1. Open the `app-routing.module.ts` file and add a new route configuration object in the `routes` property:

```
import { NgModule } from '@angular/core';
import { RouterModule, Routes } from '@angular/router';
import { ContactComponent } from './contact/contact.component';

const routes: Routes = [
  { path: 'contact', component: ContactComponent }
];

@NgModule({
  imports: [RouterModule.forRoot(routes)],
```

```
  exports: [RouterModule]
})
export class AppRoutingModule { }
```

The preceding code indicates that when the URL of the browser points to the `contact` path, our application will activate and display `ContactComponent` on the screen. The `routes` property of a routing module contains the routing configuration of the respective feature module. It is an array of route configuration objects where each one defines the component class and the URL path that activates it.

2. Add `ContactModule` in the `imports` array of the `@NgModule` decorator of `AppModule` to be able to use it:

```
@NgModule({
  declarations: [
    AppComponent
  ],
  imports: [
    BrowserModule,
    AppRoutingModule,
    CoreModule,
    SharedModule,
    ContactModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
```

Do not forget to add the respective `import` statement for `ContactModule` at the top of the file.

3. Routed components, just like `ContactComponent`, need a place where they can be loaded. Open the `app.component.html` file and add the `<router-outlet>` directive:

```
<app-header></app-header>
<div class="container">
  <router-outlet></router-outlet>
</div>
<app-footer></app-footer>
```

Now, we need to wire up the route configuration that we created with the actual link on the header component:

1. Open the `header.component.html` file and add the `routerLink` directive to the respective anchor HTML element:

```
<li class="nav-item">
  <a routerLink="/contact" routerLinkActive="active"
    class="nav-link">Contact</a>
</li>
```

In the preceding snippet, the `routerLink` directive points to the `path` property of the route configuration object. We have also added the `routerLinkActive` directive, which sets the `active` class on the anchor element when the specific route is activated.

> Notice that the value of the `routerLink` directive contains a leading `/`, whereas the `path` property of the route configuration object that we defined does not. According to the case, omitting the `/` would give a different meaning to the route.

2. The `routerLink` and `routerLinkActive` directives are part of the Angular Router package. We need to import `RouterModule` in the `core.module.ts` file to use them:

```
import { NgModule } from '@angular/core';
import { CommonModule } from '@angular/common';
import { HeaderComponent } from './header/header.component';
import { RouterModule } from '@angular/router';

@NgModule({
  declarations: [
    HeaderComponent
  ],
  imports: [
    CommonModule,
    RouterModule
  ],
  exports: [
    HeaderComponent
  ]
```

```
})
export class CoreModule { }
```

We are now ready to preview our new contact page! If we run the application using `ng serve` and click on the **Contact** link, we should see the following output:

Figure 2.3 – Contact page

In the following section, we will build the functionality for the **Articles** link of the header in our blog.

Adding the articles page

The feature that is responsible for displaying articles in our blog will be the `articles` module. It will also be the module that connects the dots between Angular and Scully. We will use the `generate` command of the Angular CLI to create that module:

```
ng generate module articles --route=articles --module=app-routing
```

In the previous command, we pass some additional routing options:

- `--route`: Defines the URL path of our feature
- `--module`: Indicates the routing module that will define the route configuration object that activates our feature

The Angular CLI performs additional actions, instead of just creating the module, upon executing the command:

- It creates a routed component in the `src\app\articles` folder that will be activated by default from a route navigation object. It is the landing page of our feature, and it will display a list of blog posts, as we will see in the *Displaying blog data on the home page* section.
- It creates a routing module named `articles-routing.module.ts` that contains the routing configuration of our module.
- It adds a new route configuration object in the route configuration of the main application module that activates our module.

The `articles-routing.module.ts` file contains the routing configuration for the `articles` module:

```
import { NgModule } from '@angular/core';
import { RouterModule, Routes } from '@angular/router';
import { ArticlesComponent } from './articles.component';

const routes: Routes = [{ path: '', component: ArticlesComponent }];

@NgModule({
  imports: [RouterModule.forChild(routes)],
  exports: [RouterModule]
})
export class ArticlesRoutingModule { }
```

It imports `RouterModule` using the `forChild` method to pass the routing configuration to the Angular router. If we take a look at the main routing module of the application, we will see that it follows a slightly different approach:

`app-routing.module.ts`

```
import { NgModule } from '@angular/core';
import { RouterModule, Routes } from '@angular/router';
import { ContactComponent } from './contact/contact.component';
```

```
const routes: Routes = [
  { path: 'contact', component: ContactComponent },
  { path: 'articles', loadChildren: () => import('./articles/articles.
module').then(m => m.ArticlesModule) }
];

@NgModule({
  imports: [RouterModule.forRoot(routes)],
  exports: [RouterModule]
})
export class AppRoutingModule { }
```

The `forChild` method is used in feature modules, whereas the `forRoot` method should be used *only* in the main application module.

The route configuration of the `articles` module contains only one route that activates `ArticlesComponent`. The path of the route is set to an empty string to indicate that it is the default route of the routing module. It essentially means that `ArticlesComponent` will be activated whenever that module is loaded. But how is the `articles` module loaded in our application?

The second route of the main routing module contains a route configuration object that does not activate a component but rather a module. It uses the `loadChildren` method to load `ArticlesModule` dynamically when navigation triggers the `articles` path.

> The `import` function in the `loadChildren` property accepts the relative path of the TypeScript module file without the extension.

The previous approach is called **lazy loading** and improves the startup and the overall performance of an Angular application. It creates a separate bundle for each lazy-loaded module, which is loaded upon request, reducing the final bundle size and the memory consumption of your application. Let's wire up the new route to our header component:

1. Open the `header.component.html` file and add the following `routerLink` and `routerLinkActive` directives to the `Articles` anchor HTML element:

   ```
   <li class="nav-item">
     <a routerLink="/articles" routerLinkActive="active"
   ```

```
        class="nav-link">Articles</a>
    </li>
```

2. Run `ng serve` and use your favorite browser to preview your application.
3. Open the developer tools of your browser, click on the **Articles** link, and inspect the **Network** tab:

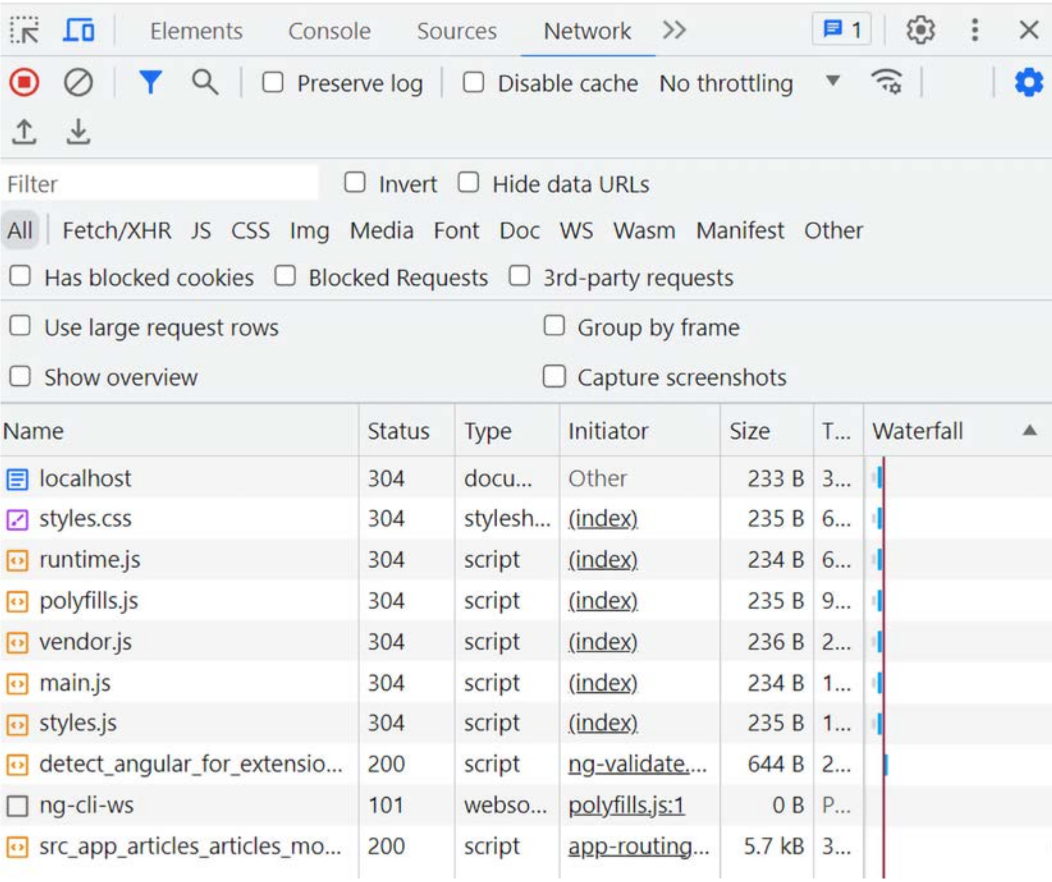


Figure 2.4 – Lazy loading Angular module

Among other requests, you should see one named `src_app_articles_articles_module_ts.js`. It is the bundle of the lazy-loaded articles module that was loaded when you clicked on the **Articles** link.

We are now ready to convert our amazing Angular application into a professional blog website.

Before we move on, let's add some additional routes to the `app-routing.module.ts` file:

```
const routes: Routes = [
  { path: 'contact', component: ContactComponent },
  { path: 'articles', loadChildren: () => import('./articles/articles.
module').then(m => m.ArticlesModule) },
  { path: '', pathMatch: 'full', redirectTo: 'articles' },
  { path: '**', redirectTo: 'articles' }
];
```

We added a default route to automatically redirect our blog users to the `articles` path upon visiting the blog. Additionally, we created a new route configuration object with its path set to `**` that also navigates to the `articles` path. The `**` syntax is called the **wildcard** route, and it is triggered when the router cannot match a requested URL with a defined route.

Define the most specific routes first and then add any generic ones, such as the default and the wildcard routes. The Angular router parses the route configuration in the order that we define and follows a first-match-wins strategy to select one.

We have already enabled and configured routing in our Angular application. In the following section, we will establish the infrastructure needed to add blogging capabilities to our application.

Adding blog capabilities with Scully

Our application currently does not have any specific logic regarding blog posts. It is a typical Angular application that uses routing. However, by adding a routing configuration, we have established the foundation for adding blog support using Scully.

Scully needs at least one route defined in an Angular application to work correctly.

First, we need to install Scully in our application.

Installing the Scully library

We will use the `install` command of the npm CLI to install Scully in our Angular application:

```
npm install @scullyio/init @scullyio/ng-lib @scullyio/scully @scullyio/
scully-plugin-puppeteer --force
```

The preceding command downloads and installs all the necessary npm packages for Scully to work correctly in our Angular application.

> The Scully library is not fully compatible with Angular 16, as of this writing. In the preceding command we use the `--force` option to ignore any warnings that come from the Angular version incompatibility.

Open the `app.module.ts` file and import `ScullyLibModule`:

```
import { NgModule } from '@angular/core';
import { BrowserModule } from '@angular/platform-browser';

import { AppRoutingModule } from './app-routing.module';
import { AppComponent } from './app.component';
import { ContactModule } from './contact/contact.module';
import { CoreModule } from './core/core.module';
import { SharedModule } from './shared/shared.module';
import { ScullyLibModule } from '@scullyio/ng-lib';

@NgModule({
  declarations: [
    AppComponent
  ],
  imports: [
    BrowserModule,
    AppRoutingModule,
    CoreModule,
    SharedModule,
    ContactModule,
    ScullyLibModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

`ScullyLibModule` is the main module of the Scully library; it contains various Angular services and directives that Scully will need.

Create a configuration file for the Scully library in the root folder of the Angular CLI workspace with the following contents:

`scully.my-blog.config.ts`

```
import { ScullyConfig } from '@scullyio/scully';
export const config: ScullyConfig = {
  projectRoot: "./src",
  projectName: "my-blog",
  outDir: './dist/static',
  routes: {
  }
};
```

The configuration file contains information about our Angular application that Scully will need along the way:

- `projectRoot`: The path containing the source code of the Angular application
- `projectName`: The name of the Angular application
- `outDir`: The output path of the Scully-generated files

> The Scully output path must be different from the path that the Angular CLI outputs for the bundle of your Angular application. The latter can be configured in the `angular.json` file.

- `routes`: It contains the route configuration that will be used for accessing our blog posts. Scully will populate it automatically, as we will see in the following section.

Since we have installed Scully successfully in our Angular application, we can now configure it to initialize our blog.

Initializing our blog page

Scully provides a specific Angular CLI schematic for initializing an Angular application, such as a blog, by using Markdown (.md) files:

```
ng generate @scullyio/init:markdown --project my-blog
```

The previous command will start the configuration process of our blog by going through a list of questions (default values are shown inside parentheses):

1. Type `posts` as the name of the blog module:

   ```
   What name do you want to use for the module? (blog)
   ```

   This will create a new Angular module named `posts`.

2. Leave the slug choice empty, and press *Enter* to accept the default value:

   ```
   What slug do you want for the markdown file? (id)
   ```

   The slug is a unique identifier for each post, and it is defined in the route configuration object of the module.

3. Enter `mdfiles` as the path that Scully will use to store our actual blog post files:

   ```
   Where do you want to store your markdown files?
   ```

   This will create an `mdfiles` folder inside the root path of our Angular CLI project. By default, it will also create a blog post for our convenience. We will learn how to create our own in the *Displaying blog data on the home page* section.

4. Type `posts` as the name of the route for accessing our blog posts:

   ```
   Under which route do you want your files to be requested?
   ```

   The name of the route is the `path` property of the route configuration object that will be created.

Scully performs various actions upon executing the preceding commands, including the creation of the routing configuration of the `posts` module:

`posts-routing.module.ts`

```
import {NgModule} from '@angular/core';
import {Routes, RouterModule} from '@angular/router';

import {PostsComponent} from './posts.component';
```

```
const routes: Routes = [
  {
    path: ':id',
    component: PostsComponent,
  },
  {
    path: '**',
    component: PostsComponent,
  }
];

@NgModule({
  imports: [RouterModule.forChild(routes)],
  exports: [RouterModule],
})
export class PostsRoutingModule {}
```

The `path` property for the first route is set to `:id` and activates `PostsComponent`. The colon character indicates that `id` is a route parameter. The `id` parameter is related to the `slug` property defined earlier in the Scully configuration. Scully works by creating one route for each blog post that we create. It uses the route configuration of the `posts` module and the main application module to build the `routes` property in the Scully configuration file:

```
routes: {
  '/posts/:id': {
    type: 'contentFolder',
    id: {
      folder: "./mdfiles"
    }
  },
}
```

`PostsComponent` is the Angular component that is used to render the details of each blog post. The template file of the component can be further customized according to your needs:

`posts.component.html`

```
<h3>ScullyIo content</h3>
<hr>
```

```
<!-- This is where Scully will inject the static HTML -->
<scully-content></scully-content>
<hr>
<h4>End of content</h4>
```

You can customize all content in the previous template file except the `<scully-content></scully-content>` line, which is used internally by Scully.

At this point, we have completed the installation and configuration of Scully in our Angular application. It is now time for the final part of the project! In the next section, we will get Angular and Scully to cooperate and display blog posts in our Angular application.

Displaying blog posts on the home page

We would like our users to see the list of available blog posts as soon as they land on our blog website. According to the default route path that we have defined, `ArticlesComponent` is the landing page of our blog. Scully provides `ScullyRoutesService`, an Angular service that we can use in our components to get information about the routes that it will create according to the blog posts. Let's put this service into action on our landing page:

1. Open the `articles.component.ts` file and modify the `import` statements as follows:

   ```
   import { Component, OnInit } from '@angular/core';
   import { ScullyRoute, ScullyRoutesService } from '@scullyio/ng-lib';
   import { Observable, map } from 'rxjs';
   ```

2. Add the `OnInit` interface to the list of implemented interfaces of the `ArticlesComponent` class:

   ```
   export class ArticlesComponent implements OnInit {
   }
   ```

3. Inject `ScullyRoutesService` in the `constructor` of the `ArticlesComponent` class:

   ```
   constructor(private scullyService: ScullyRoutesService) { }
   ```

4. Create the following component property:

   ```
   posts$: Observable<ScullyRoute[]> | undefined;
   ```

5. Implement the `ngOnInit` method:

   ```
   ngOnInit(): void {
   ```

```
    this.posts$ = this.scullyService.available$.pipe(
      map(posts => posts.filter(post => post.title))
    );
  }
```

6. Open the `articles.component.html` file and add the following HTML code:

```
<div class="list-group mt-3">
  <a *ngFor="let post of posts$ | async"
    [routerLink]="post.route" class="list-group-item
      list-group-item-action">
    <div class="d-flex w-100 justify-content-between">
      <h5 class="mb-1">{{post.title}}</h5>
    </div>
    <p class="mb-1">{{post['description']}}</p>
  </a>
</div>
```

There are many Angular techniques involved in the previous steps, so let's break them down piece by piece.

When we want to use an Angular service in a component, we just need to ask for it from the Angular framework. How? By adding it as a property in the `constructor` of the component. The component does not need to know anything about how the service is implemented.

The `ngOnInit` method is part of the `OnInit` interface, which is implemented by our component. It is called by the Angular framework when a component is initialized and provides us with a hook to add custom logic to be executed.

> Angular services that provide initialization logic to a component should be called inside the `ngOnInit` method and not in the `constructor` because it is easier to provide mocks about those services when unit testing the component.

The `available$` property of `ScullyRoutesService` is called an **observable** and returns all the available routes that were generated from Scully when we subscribe to it. To avoid displaying routes other than those related to blog posts, such as the `contact` route, we filter out the results from the `available$` property.

In the component template, we use the `*ngFor` Angular built-in directive and the `async` pipe to subscribe to the `posts$` observable inside HTML. We can then access each item using the `post` template reference variable and use interpolation to display `title` and `description`.

Finally, we add a `routerLink` directive to each anchor element to navigate to the respective blog post when clicked. Notice that `routerLink` is surrounded by `[]`. The `[]` syntax is called **property binding**, and we use it when we want to bind the property of an HTML element to a variable. In our case, we bind the `routerLink` directive to the `route` property of the `post` variable.

Now that we have finally completed all the pieces of the puzzle, we can see our blog website in action:

1. Run the `build` command of the Angular CLI to build our Angular application:

```
ng build
```

2. Execute the following command to build Scully and generate our blog routes:

```
npx scully --project my-blog
```

The preceding command will create a `scully-routes.json` file inside the `src\assets` folder. It contains the routes of our Angular application and is needed by the Scully runtime.

> Running the Scully executable for the first time will prompt you to collect anonymous errors to improve its services.

3. Run the following command to serve our blog:

```
npx scully serve --project my-blog
```

The preceding command will start two web servers: one that contains the static prerendered version of our website built using Scully and another that is the Angular live version of our application:

```
✓ Starting servers for project "my-blog"
✓ Started Scully static server on "http://localhost:1668/"
✓ Started Angular distribution server on "http://localhost:1864/"
```

Figure 2.5 – Serving our application

If we open our browser and navigate to `http://localhost:1668`, we will not see any blog posts. A blog post created with Scully is not returned in the `available$` property of `ScullyRoutesService` *unless* we publish it. To publish a blog post, we do the following:

1. Navigate to the `mdfiles` folder that Scully created and open the only `.md` file that you will find. The name and contents may vary for your file because it is based on the date Scully created it:

```
---
title: 2023-06-22-posts
description: 'blog description'
published: false
slugs:
    - ___UNPUBLISHED___lj738su6_7mqWyfNdmNCwovaCCi2tZItsDKMPJGcG
---

# 2023-06-22-posts
```

   Scully has defined a set of properties between the closing and ending `---` lines at the top of the file representing metadata about the blog post. You can also add your own as key-value pairs.

2. Delete the `slugs` property and set the `published` property to `true`:

```
---
title: 2023-06-22-posts
description: 'blog description'
published: true
---

# 2023-06-22-posts
```

3. Run the following command to force Scully to regenerate the routes of our application:

```
npx scully --project my-blog
```

   We need to execute the previous command *every time* we make a change in our blog-related files.

4. Execute the `npx scully serve --project my-blog` command and navigate to preview the generated website.

We can now see one blog post, the default one that was created when we installed Scully. Let's create another one:

1. Run the following `generate` command of the Angular CLI:

   ```
   ng generate @scullyio/init:post --name="Angular and Scully"
   ```

   In the preceding command, we use the `@scullyio/init:post` schematic, passing the name of the post that we want to create as an option.

2. Set the target folder for the new blog post to `mdfiles`:

   ```
   What's the target folder for this post? (blog)
   ```

3. Scully will create a Markdown file named `angular-and-scully.md` inside the specified folder. Open that file and update its content to be the same as the following:

   ```
   ---
   title: 'Angular and Scully'
   description: 'How to build a blog with Angular and Scully'
   published: true
   ---
   # Angular and Scully
   Angular is a robust JavaScript framework that we can use to build
   excellent and performant web applications.
   Scully is a popular static website generator that empowers the
   Angular framework with Jamstack characteristics.
   You can find more about them in the following links:
   - https://angular.io
   - https://scully.io
   - https://www.jamstack.org
   ```

4. Run `npx scully --project my-blog` to create a route for the newly created blog post. Scully will also update the `scully-routes.json` file with the new route.

If we preview our application now, it should look like the following:

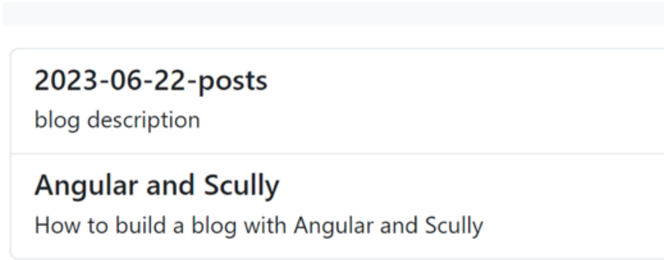


Figure 2.6 – List of blog posts

If we click on one of the blog items, we will navigate to the selected blog post. The content that is currently shown on the screen is a prerendered version of the blog post route:

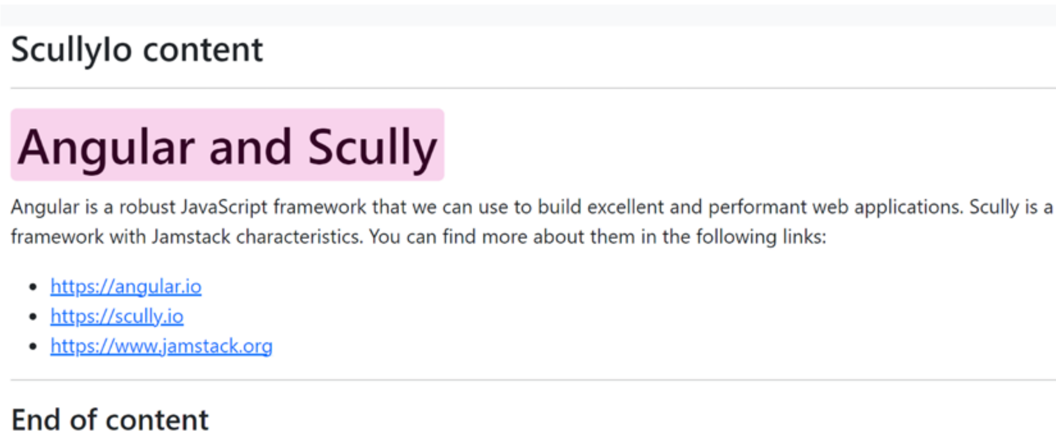


Figure 2.7 – Blog post details

To verify that, navigate to the `dist` folder of your Angular project, where you will find two folders:

- `my-blog`: This contains the Angular live version of our application. When we execute the `ng build` Angular CLI command, it builds our application and outputs bundle files in this folder.
- `static`: This contains a prerendered version of our Angular application generated from Scully when we run the `npx scully --project my-blog` command.

If we navigate to the `static` folder, we will see that Scully has created one folder for each route of our Angular application. Each folder contains an `index.html` file, which represents the component that is activated from that route.

The contents of the `index.html` file are auto-generated by Scully, and behave as if we run our application live and navigate to that component.

Now you can take your Angular application, upload it to the CDN or web server of your choice, and you will have your blog ready in no time! All you will have to do then will be to exercise your writing skills to create excellent blog content.

Summary

In this chapter, we learned how to combine the Angular framework with the Scully library to create a personal blog.

We saw how Angular uses the built-in router package to enhance web applications with in-app navigation. We also learned how to organize an Angular application into modules and how to navigate through these.

We introduced Jamstack to our Angular application using the Scully library and saw how easy it is to convert our application into a prerendered blog. We used the Scully interface to create some blog posts and display them on the screen.

In the following chapter, we will investigate another exciting feature of the Angular framework, forms. We are going to learn how to use them and build an issue-tracking system.

Practice questions

Let's take a look at a few practice questions:

1. Which library do we use for routing in an Angular application?
2. How do we add routing capabilities in an HTML anchor element?
3. Which Angular pipe do we use for date formatting?
4. What is the purpose of the `assets` folder in an Angular CLI application?
5. Which route property do we use for lazily loading a module?
6. Which npm CLI command do we use for installing Scully?
7. Which service do we use for fetching Scully routes?
8. What is property binding?
9. Which Angular directive do we use for iterating over an array in HTML?
10. What is the difference between a standard Angular application and a Scully one?

Further reading

Here are some links to build upon what we learned in this chapter:

- Angular routing: `https://angular.io/guide/router`
- Angular feature modules: `https://angular.io/guide/module-types`
- Lazy loading modules: `https://angular.io/guide/lazy-loading-ngmodules`
- Angular built-in pipes: `https://angular.io/api?type=pipe`
- Bootstrap CSS: `https://getbootstrap.com`
- Jamstack: `https://jamstack.org`
- Scully: `https://scully.io`
- Mastering Markdown: `https://guides.github.com/features/mastering-markdown`

3

Building an Issue Tracking System Using Reactive Forms

Web applications use HTML forms to collect data from users and validate them, such as when logging in to an application, performing a search, or completing an online payment. The Angular framework provides two types of forms, reactive and template-driven, that we can use in an Angular application.

In this chapter, we will build a system for managing and tracking issues. We will use Angular reactive forms for reporting new issues. We will also use **Clarity Design System** from VMware for designing our forms and displaying our issues.

We will cover the following topics:

- Installing Clarity Design System in an Angular application
- Displaying an overview of issues
- Reporting new issues
- Marking an issue as resolved
- Turning on suggestions for new issues

Essential background theory and context

The Angular framework provides two types of forms that we can use:

- **Template-driven**: They are easy to set up in an Angular application. Template-driven forms do not scale well and are difficult to test because they are defined in the component template.
- **Reactive**: They are based on the reactive programming approach. Reactive forms operate in the TypeScript class of the component, and they are easier to test and scale better than template-driven forms.

In this chapter, we will get hands-on with the reactive forms approach, which is the most popular in the Angular community.

Angular components can get data from external sources such as HTTP or other Angular components. In the latter case, they interact with components that have data using a public API:

- `@Input()`: This is used to pass data into a component.
- `@Output()`: This is used to get notified about changes or get data back from a component.

Clarity is a design system that contains a set of UX and UI guidelines for building web applications. It also comprises a proprietary HTML and CSS framework packed with these guidelines. Luckily, we do not have to use this framework since Clarity already provides various Angular-based UI components that we can use in our Angular applications.

Project overview

In this project, we will build an Angular application for managing and tracking issues using reactive forms and Clarity. Initially, we will display a list of issues in a table that we can sort and filter. We will then create a form for allowing users to report new issues. Finally, we will create a modal dialog for resolving an issue. We will also go the extra mile and turn on suggestions when reporting an issue to help users avoid duplicate entries. The following diagram depicts an architectural overview of the project:

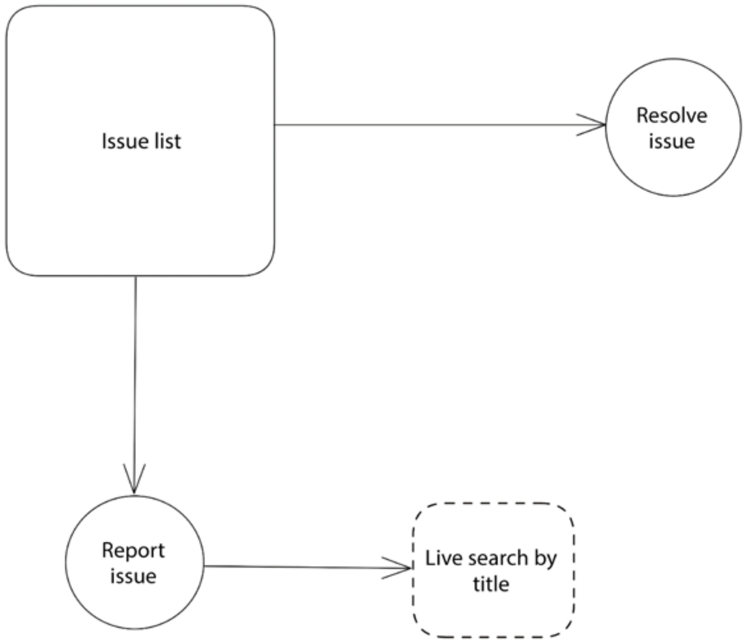


Figure 3.1 – Project architecture

Build time: 1 hour

Getting started

The following software tools are required to complete this project:

- **Angular CLI**: A command-line interface for Angular that you can find at `https://angular.io/cli`
- **GitHub material**: The related code for this chapter, which you can find in the `Chapter03` folder at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition`

Installing Clarity in an Angular application

Let's start creating our issue-tracking system by scaffolding a new Angular application:

```
ng new issue-tracker --defaults
```

We use the `ng new` command of the Angular CLI to create a new Angular application with the following characteristics:

- `issue-tracker`: The name of the Angular application.
- `--defaults`: This disables Angular routing for the application and sets the stylesheet format to CSS.

We now need to install the Clarity library in our Angular application:

1. Navigate to the `issue-tracker` folder that was created and run the following command to install it:

   ```
   npm install @cds/core @clr/angular @clr/ui --save
   ```

2. Open the `angular.json` file and add the Clarity CSS styles in the `styles` array:

   ```
   "styles": [
     "node_modules/@clr/ui/clr-ui.min.css",
     "src/styles.css"
   ]
   ```

3. Finally, import `ClarityModule` and `BrowserAnimationsModule` in the main application module, `app.module.ts`:

   ```
   import { NgModule } from '@angular/core';
   import { BrowserModule } from '@angular/platform-browser';

   import { AppComponent } from './app.component';
   import { ClarityModule } from '@clr/angular';
   import { BrowserAnimationsModule } from
     '@angular/platform-browser/animations';

   @NgModule({
     declarations: [
       AppComponent
     ],
   ```

```
  imports: [
    BrowserModule,
    ClarityModule,
    BrowserAnimationsModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

Now that we have completed installing Clarity in our application, we can start building beautiful designs with it. In the following section, we will begin by creating a list for displaying our issues.

Displaying an overview of issues

Our Angular application will be responsible for managing and tracking issues. When the application starts, we should display a list of all pending issues in the system. Pending issues are defined as those issues that have not been resolved. The process that we will follow can be further analyzed as the following:

- Fetching pending issues
- Visualizing issues using a data grid

Fetching pending issues

First, we need to create a mechanism for fetching all pending issues:

1. Use the `generate` command of the Angular CLI to create an Angular service named `issues`:

   ```
   ng generate service issues
   ```

   The preceding command will create an `issues.service.ts` file in the `src\app` folder of our Angular CLI project.

2. Every issue will have specific properties of a defined type. We need to create a TypeScript interface for that with the following Angular CLI command:

   ```
   ng generate interface issue
   ```

   The previous command will create an `issue.ts` file in the `src\app` folder of the project.

3. Open the `issue.ts` file and add the following properties in the `Issue` interface:

   ```
   export interface Issue {
   ```

```
  issueNo: number;
  title: string;
  description: string;
  priority: 'low' | 'high';
  type: 'Feature' | 'Bug' | 'Documentation';
  completed?: Date;
}
```

The `completed` property is the date that an issue is resolved. We define it as optional because new issues will not have this property set.

4. Open the Angular service we created in step 1 and add an `issues` property to hold our data. Also, create a `getPendingIssues` method that will return all issues that have not been completed:

```
import { Injectable } from '@angular/core';
import { Issue } from './issue';

@Injectable({
  providedIn: 'root'
})
export class IssuesService {
  private issues: Issue[] = [];

  constructor() { }

  getPendingIssues(): Issue[] {
    return this.issues.filter(issue => !issue.completed);
  }
}
```

In the preceding code, we initialize the `issues` property to an empty array. If you want to get started with sample data, you can use the `mock-issues.ts` file from the `src\assets` folder that exists in the GitHub material of this chapter and import it as follows:

```
import { issues } from '../assets/mock-issues';
```

In the following section, we will create a component for displaying those issues.

Visualizing issues in a data grid

We will use the data grid UI component of the Clarity library to display data in a tabular format. A data grid also provides mechanisms for filtering and sorting out of the box. Let's create the Angular component that will host the data grid first:

1. Use the `generate` command of the Angular CLI to create the component:

```
ng generate component issue-list
```

2. Open the template of the main component of our application, `app.component.html`, and replace its content with the following HTML code:

```
<div class="main-container">
  <div class="content-container">
    <div class="content-area">
      <app-issue-list></app-issue-list>
    </div>
  </div>
</div>
```

   The list of issues will be displayed in the main component of the Angular application as soon as it starts up.

3. Currently, the `<app-issue-list>` component displays no issue data. We must connect it with the Angular service we created in the *Fetching pending issues* section. Open the `issue-list.component.ts` file and inject `IssuesService` in the `constructor` of the `IssueListComponent` class:

```
import { Component } from '@angular/core';
import { IssuesService } from '../issues.service';

@Component({
  selector: 'app-issue-list',
  templateUrl: './issue-list.component.html',
  styleUrls: ['./issue-list.component.css']
})
export class IssueListComponent {
  constructor(private issueService: IssuesService) { }
}
```

4. Create a method named `getIssues` that will call the `getPendingIssues` method of the injected service and keep its returned value in the `issues` component property:

```
import { Component } from '@angular/core';
import { Issue } from '../issue';
import { IssuesService } from '../issues.service';

@Component({
  selector: 'app-issue-list',
  templateUrl: './issue-list.component.html',
  styleUrls: ['./issue-list.component.css']
})
export class IssueListComponent {
  issues: Issue[] = [];

  constructor(private issueService: IssuesService) { }

  private getIssues() {
    this.issues = this.issueService.getPendingIssues();
  }

}
```

5. Finally, call the `getIssues` method in the `ngOnInit` component method to get all pending issues upon component initialization:

```
import { Component, OnInit } from '@angular/core';
import { Issue } from '../issue';
import { IssuesService } from '../issues.service';

@Component({
  selector: 'app-issue-list',
  templateUrl: './issue-list.component.html',
  styleUrls: ['./issue-list.component.css']
})
export class IssueListComponent implements OnInit {
  issues: Issue[] = [];

  constructor(private issueService: IssuesService) { }
```

```
  ngOnInit(): void {
    this.getIssues();
  }

  private getIssues() {
    this.issues = this.issueService.getPendingIssues();
  }

}
```

We have already implemented the process for getting issue data in our component. All we have to do now is display it in the template. Open the `issue-list.component.html` file and replace its content with the following HTML code:

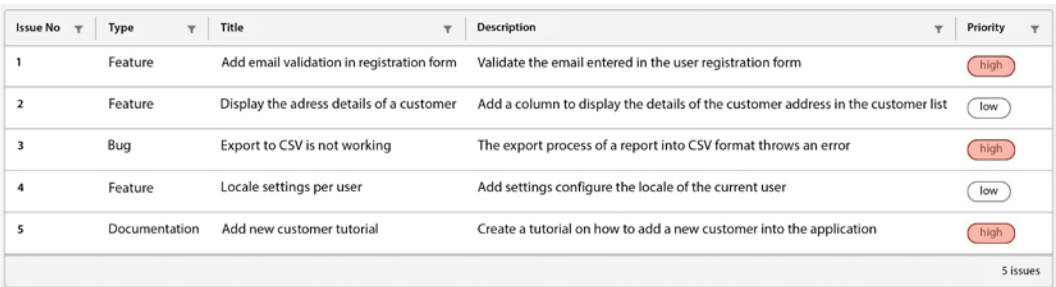
```
<clr-datagrid>
    <clr-dg-column [clrDgField]="'issueNo'"
[clrDgColType]="'number'">Issue No</clr-dg-column>
    <clr-dg-column [clrDgField]="'type'">Type</clr-dg-column>
    <clr-dg-column [clrDgField]="'title'">Title</clr-dg-column>
    <clr-dg-column [clrDgField]="'description'">Description</clr-dg-
column>
    <clr-dg-column [clrDgField]="'priority'">Priority</clr-dg-column>
    <clr-dg-row *clrDgItems="let issue of issues">
      <clr-dg-cell>{{issue.issueNo}}</clr-dg-cell>
      <clr-dg-cell>{{issue.type}}</clr-dg-cell>
      <clr-dg-cell>{{issue.title}}</clr-dg-cell>
      <clr-dg-cell>{{issue.description}}</clr-dg-cell>
      <clr-dg-cell>
       <span class="label" [class.label-danger]="issue.priority ===
'high'">{{issue.priority}}</span>
      </clr-dg-cell>
    </clr-dg-row>
    <clr-dg-footer>{{issues.length}} issues</clr-dg-footer>
</clr-datagrid>
```

In the preceding snippet, we use several Angular components of the Clarity library:

- `<clr-datagrid>`: Defines a table.

- `<clr-dg-column>`: Defines a column of a table. Each column uses the `clrDgField` directive to bind to the property name of the issue represented by that column. The `clrDgField` directive provides sorting and filtering capabilities without writing a single line of code in the TypeScript class file. Sorting works automatically only with string-based content. If we want to sort by a different primitive type, we must use the `clrDgColType` directive and specify the particular type.
- `<clr-dg-row>`: Defines a row of a table. It uses the `*clrDgItems` directive to iterate over the issues and create one row for each issue.
- `<clr-dg-cell>`: Each row contains a collection of `<clr-dg-cell>` components to display the value of each column using interpolation. In the last cell, we add the `label-danger` class when an issue has a high priority to indicate its importance.
- `<clr-dg-footer>`: Defines the footer of a table. In this case, it displays the total number of issues.

If we run our Angular application using `ng serve`, the output will look like the following:



Issue No	Type	Title	Description	Priority
1	Feature	Add email validation in registration form	Validate the email entered in the user registration form	high
2	Feature	Display the adress details of a customer	Add a column to display the details of the customer address in the customer list	low
3	Bug	Export to CSV is not working	The export process of a report into CSV format throws an error	high
4	Feature	Locale settings per user	Add settings configure the locale of the current user	low
5	Documentation	Add new customer tutorial	Create a tutorial on how to add a new customer into the application	high
				5 issues

Figure 3.2 – Overview of pending issues

> In the previous screenshot, the application uses sample data from the `mock-issues.ts` file.

The data grid component of the Clarity library has a rich set of capabilities that we can use in our Angular applications. In the following section, we will learn how to use reactive forms to report a new issue.

Reporting new issues

One of the main features of our issue-tracking system is the ability to report new issues. We will use Angular reactive forms to create a form for adding new issues. The feature can be further subdivided into the following tasks:

- Setting up reactive forms in an Angular application
- Creating the report issue form
- Displaying a new issue in the list
- Validating the details of an issue

Let's begin by introducing reactive forms in our Angular application.

Setting up reactive forms in an Angular application

Reactive forms are defined in the `@angular/forms` npm package of the Angular framework. To add them to our Angular application:

1. Open the `app.module.ts` file and import `ReactiveFormsModule`:

```
import { ReactiveFormsModule } from '@angular/forms';
```

2. Add `ReactiveFormsModule` into the `imports` array of the `@NgModule` decorator:

```
@NgModule({
  declarations: [
    AppComponent,
    IssueListComponent
  ],
  imports: [
    BrowserModule,
    ClarityModule,
    BrowserAnimationsModule,
    ReactiveFormsModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
```

`ReactiveFormsModule` contains all necessary Angular directives and services that we will need to work with forms, as we will see in the following section.

Creating the report issue form

Now that we have introduced reactive forms in our Angular application, we can start building our form:

1. Create a new Angular component named `issue-report`:

   ```
   ng generate component issue-report
   ```

2. Open the `issue-report.component.ts` file and add the following `import` statement:

   ```
   import { FormControl, FormGroup } from '@angular/forms';
   ```

   In this statement, `FormControl` represents a single control of a form and `FormGroup` is used to group individual controls into a logical form representation.

3. Create the following interface, which will represent the structure of our form:

   ```
   interface IssueForm {
     title: FormControl<string>;
     description: FormControl<string>;
     priority: FormControl<string>;
     type: FormControl<string>;
   }
   ```

4. Declare an `issueForm` property of the `FormGroup<IssueForm>` type in the TypeScript class:

   ```
   issueForm = new FormGroup<IssueForm>({
     title: new FormControl('', { nonNullable: true }),
     description: new FormControl('', { nonNullable: true }),
     priority: new FormControl('', { nonNullable: true }),
     type: new FormControl('', { nonNullable: true })
   });
   ```

   We initialize all controls to empty strings because the form will be used to create a new issue from scratch. We also explicitly state that all controls will not accept null values by default using the `nonNullable` property.

5. We must now associate the `FormGroup` object we created with the respective HTML elements. Open the `issue-report.component.html` file and replace its content with the following HTML code:

   ```
   <h3>Report an issue</h3>
   <form clrForm *ngIf="issueForm" [formGroup]="issueForm">
   ```

```
    <clr-input-container>
      <label>Title</label>
      <input clrInput formControlName="title" />
    </clr-input-container>
    <clr-textarea-container>
      <label>Description</label>
      <textarea clrTextarea
        formControlName="description"></textarea>
    </clr-textarea-container>
    <clr-radio-container clrInline>
      <label>Priority</label>
      <clr-radio-wrapper>
        <input type="radio" value="low" clrRadio
           formControlName="priority" />
        <label>Low</label>
      </clr-radio-wrapper>
      <clr-radio-wrapper>
        <input type="radio" value="high" clrRadio
          formControlName="priority" />
        <label>High</label>
      </clr-radio-wrapper>
    </clr-radio-container>
    <clr-select-container>
      <label>Type</label>
      <select clrSelect formControlName="type">
        <option value="Feature">Feature</option>
        <option value="Bug">Bug</option>
        <option value="Documentation">Documentation
          </option>
      </select>
    </clr-select-container>
  </form>
```

The `formGroup` and `clrForm` directives associate the HTML `<form>` element with the `issueForm` property and identify it as a Clarity form.

The `formControlName` directive is used to associate HTML elements with form controls using their name. Each control is also defined using a Clarity container element.

For example, the title input control is a <clr-input-container> component that contains an <input> HTML element.

Each native HTML element has a Clarity directive attached to it according to its type. For example, the <input> HTML element contains a clrInput directive.

6. Finally, add some styles to our issue-report.component.css file:

```
.clr-input, .clr-textarea {
    width: 30%;
}
button {
    margin-top: 25px;
}
```

Now that we have created the basics of our form, we will learn how to submit its details:

1. Add an HTML <button> element *before* the closing tag of the HTML <form> element:

```
<button class="btn btn-primary" type="submit">Create</button>
```

We set its type to submit to trigger form submission upon clicking the button.

2. Open the issues.service.ts file and add a createIssue method that inserts a new issue into the issues array:

```
createIssue(issue: Issue) {
  issue.issueNo = this.issues.length + 1;
  this.issues.push(issue);
}
```

We automatically assign a new issueNo property to the issue before adding it to the issues array.

> The issueNo property is currently calculated according to the length of the issues array. A better approach would be implementing a generator mechanism for creating unique and random issueNo values.

3. Return to the issue-report.component.ts file and add the following import statements:

```
import { Issue } from '../issue';
import { IssuesService } from '../issues.service';
```

4. Inject the `IssuesService` class into the `constructor` of the TypeScript class:

   ```
   constructor(private issueService: IssuesService) { }
   ```

5. Add a new component method that will call the `createIssue` method of the injected service:

   ```
   addIssue() {
     this.issueService.createIssue(this.issueForm.getRawValue() as
   Issue);
   }
   ```

   We pass the value of each form control using the `getRawValue` property of the `issueForm` object that will provide us access to the underlying form model. We are also typecasting it to the `Issue` interface since we already know that its values will represent the properties of an issue object.

6. Open the `issue-report.component.html` file and bind the `ngSubmit` event of the form to the `addIssue` component method:

   ```
   <form clrForm *ngIf="issueForm" [formGroup]="issueForm"
   (ngSubmit)="addIssue()">
   ```

   The `ngSubmit` event will be triggered when we click on the `Create` button of the form.

We have completed all the processes to add a new issue to the system. In the following section, we will learn how to display a newly created issue in the pending issue table.

Displaying a new issue in the list

Displaying and creating new issues are two tasks delegated to different Angular components. When we create a new issue with `IssueReportComponent`, we need to notify `IssueListComponent` to reflect that change in the table. First, let's see how we can configure `IssueReportComponent` to communicate that change:

1. Open the `issue-report.component.ts` file and use the `@Output()` decorator to add an `EventEmitter` property:

   ```
   @Output() formClose = new EventEmitter();
   ```

   `Output` and `EventEmitter` symbols can be imported from the `@angular/core` npm package.

2. Call the `emit` method of the `formClose` output property inside the `addIssue` component method right after creating the issue:

```
addIssue() {
  this.issueService.createIssue(this.issueForm.getRawValue() as
Issue);
  this.formClose.emit();
}
```

3. Add a second HTML `<button>` element in the component template and call the `formClose.emit` method on its `click` event:

```
<button class="btn" type="button" (click)="formClose.
emit()">Cancel</button>
```

`IssueListComponent` can now bind to the `formClose` event of `IssueReportComponent` and be notified when any buttons are clicked. Let's find out how:

1. Open the `issue-list.component.ts` file and add the following property in the `IssueListComponent` class:

```
showReportIssue = false;
```

   The `showReportIssue` property will toggle the appearance of the report issue form.

2. Add the following component method, which will be called when the report issue form emits the `formClose` event:

```
onCloseReport() {
  this.showReportIssue = false;
  this.getIssues();
}
```

   The preceding method will set the `showReportIssue` property to `false` so that the report issue form is no longer visible and the table of pending issues is displayed instead. It will also fetch issues again to refresh the data in the table.

3. Open the `issue-list.component.html` file and add an HTML `<button>` element at the top of the template. The button will display the report issue form when clicked:

```
<button class="btn btn-primary" (click)="showReportIssue = true">Add
new issue</button>
```

4. Group the button and the data grid inside an `<ng-container>` element. As indicated by the `*ngIf` Angular directive, the contents of the `<ng-container>` element will be displayed when the report issue form is not visible:

```
<ng-container *ngIf="showReportIssue === false">
    <button class="btn btn-primary" (click)="showReportIssue =
true">Add new issue</button>
    <clr-datagrid>
        <clr-dg-column [clrDgField]="'issueNo'"
[clrDgColType]="'number'">Issue No</clr-dg-column>
        <clr-dg-column [clrDgField]="'type'">Type</clr-dg-column>
        <clr-dg-column [clrDgField]="'title'">Title</clr-dg-column>
        <clr-dg-column [clrDgField]="'description'">Description</
clr-dg-column>
        <clr-dg-column [clrDgField]="'priority'">Priority</clr-dg-
column>
        <clr-dg-row *clrDgItems="let issue of issues">
            <clr-dg-cell>{{issue.issueNo}}</clr-dg-cell>
            <clr-dg-cell>{{issue.type}}</clr-dg-cell>
            <clr-dg-cell>{{issue.title}}</clr-dg-cell>
            <clr-dg-cell>{{issue.description}}</clr-dg-cell>
            <clr-dg-cell>
                <span class="label" [class.label-danger]="issue.
priority === 'high'">{{issue.priority}}</span>
            </clr-dg-cell>
        </clr-dg-row>
        <clr-dg-footer>{{issues.length}} issues</clr-dg-footer>
    </clr-datagrid>
</ng-container>
```

The `<ng-container>` element is an Angular component not rendered on the screen and used to group HTML elements.

5. Add the `<app-issue-report>` component at the end of the template and use the `*ngIf` directive to display it when the `showReportIssue` property is true. Also bind its `formClose` event to the `onCloseReport` component method:

```
<app-issue-report *ngIf="showReportIssue === true"
(formClose)="onCloseReport()"></app-issue-report>
```

We have successfully connected all the dots and completed the interaction between the report issue form and the table that displays issues. Now it is time to put them into action:

1. Run the Angular application using `ng serve`.
2. Click on the **ADD NEW ISSUE** button and enter the details of a new issue:

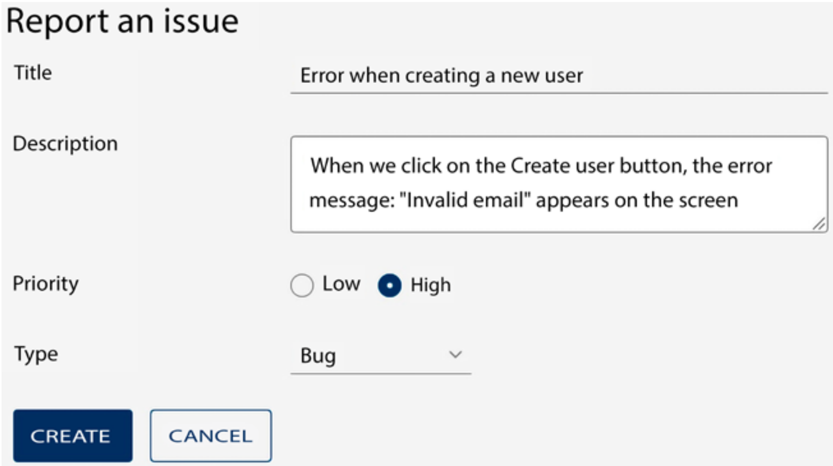


Figure 3.3 – Report issue form

3. Click on the **CREATE** button, and the new issue should appear in the table:

Figure 3.4 – Pending issues

4. Repeat steps 2 and 3 without filling in any details, and you will notice an empty issue added to the table.

An empty issue can be created because we have not defined any required fields on our report issue form. In the following section, we will learn how to accomplish this task and add validations to our form to avoid unexpected behaviors.

Validating the details of an issue

When we create an issue with the report issue form, we can leave the form control value empty since we have not added any validation rules yet. To add validations in a form control, we use the `Validators` class from the `@angular/forms` npm package. A validator is added in each form control instance when we build the form. In this case, we will use the **required** validator to indicate that a form control is required to have a value:

1. Open the `issue-report.component.ts` file and import `Validators` from the `@angular/forms` npm package:

   ```
   import { FormControl, FormGroup, Validators } from '@angular/forms';
   ```

2. Set the `Validators.required` static property in all controls except the `description` of the issue:

   ```
   issueForm = new FormGroup<IssueForm>({
     title: new FormControl('', { nonNullable: true, validators:
   Validators.required }),
     description: new FormControl('', { nonNullable: true }),
     priority: new FormControl('', { nonNullable: true, validators:
   Validators.required }),
     type: new FormControl('', { nonNullable: true, validators:
   Validators.required })
   });
   ```

   We can use various validators for a form control, such as **min**, **max**, and **email**. If we want to set multiple validators in a form control, we add them inside an array.

3. When we use validators in a form, we need to provide a visual indication to the user of the form. Open the `issue-report.component.html` file and add a `<clr-control-error>` component for each required form control:

   ```
   <clr-input-container>
       <label>Title</label>
       <input clrInput formControlName="title" />
       <clr-control-error>Title is required</clr-control-error>
   </clr-input-container>
   <clr-textarea-container>
   ```

```
    <label>Description</label>
    <textarea clrTextarea formControlName="description"></textarea>
</clr-textarea-container>
<clr-radio-container clrInline>
    <label>Priority</label>
    <clr-radio-wrapper>
      <input type="radio" value="low" clrRadio
formControlName="priority" />
      <label>Low</label>
    </clr-radio-wrapper>
    <clr-radio-wrapper>
      <input type="radio" value="high" clrRadio
formControlName="priority" />
      <label>High</label>
    </clr-radio-wrapper>
    <clr-control-error>Priority is required</clr-control-error>
</clr-radio-container>
<clr-select-container>
    <label>Type</label>
    <select clrSelect formControlName="type">
      <option value="Feature">Feature</option>
      <option value="Bug">Bug</option>
      <option value="Documentation">Documentation</option>
    </select>
    <clr-control-error>Type is required</clr-control-error>
</clr-select-container>
```

The `<clr-control-error>` Clarity component provides validation messages in forms. It is displayed when we touch an invalid control. A control is invalid when at least one of its validation rules is violated.

4. The user may only sometimes touch form controls to see the validation message. So, we need to consider that upon form submission and act accordingly. To overcome this case, we will mark all form controls as touched when the form is submitted:

```
addIssue() {
  if (this.issueForm && this.issueForm.invalid) {
    this.issueForm.markAllAsTouched();
    return;
```

```
  }
  this.issueService.createIssue(this.issueForm.getRawValue() as
Issue);
  this.formClose.emit();
}
```

In the preceding snippet, we use the `markAllAsTouched` method of the `issueForm` property to mark all controls as touched when the form is invalid. Marking controls as touched makes validation messages appear automatically. Additionally, we use a `return` statement to prevent the creation of the issue when the form is invalid.

5. Run `ng serve` to start the application. Click inside the **Title** input, and then move the focus out of the form control:

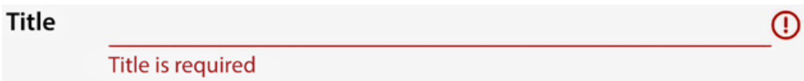


Figure 3.5 – Title validation message

A message should appear underneath the **Title** input stating that we have not entered any value yet. Validation messages in the Clarity library are indicated by text and an exclamation icon in red in the form control that is validated.

6. Now, click on the **CREATE** button:

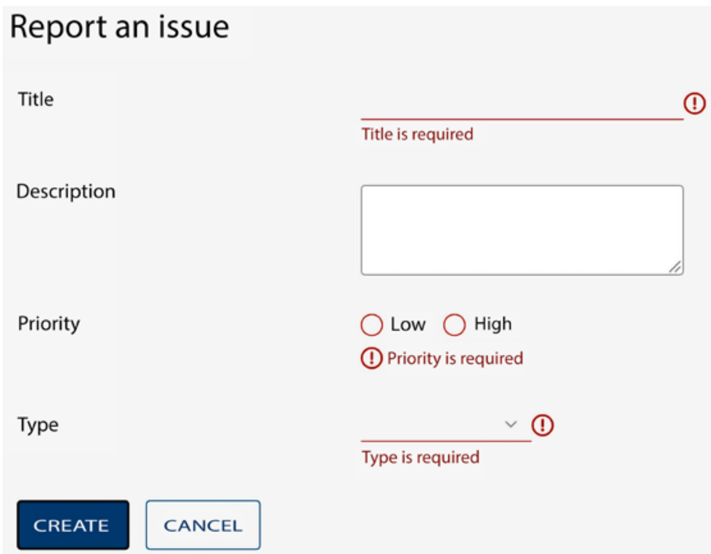


Figure 3.6 – Form validation messages

All validation messages will appear on the screen at once, and the form will not be submitted. Validations in reactive forms ensure a smooth UX for our Angular applications. In the following section, we will learn how to create a modal dialog with Clarity and use it to resolve issues from our list.

Resolving an issue

The main idea behind having an issue tracking system is that an issue should be resolved at some point. We will create a user workflow in our application to accomplish such a task. We will be able to resolve an issue directly from the list of pending issues. The application will ask for confirmation from the user before resolving with the use of a modal dialog:

1. Create an Angular component to host the dialog:

```
ng generate component confirm-dialog
```

2. Open the `confirm-dialog.component.ts` file and modify it as follows:

```
import { Component, EventEmitter, Input, Output } from '@angular/
core';

@Component({
  selector: 'app-confirm-dialog',
  templateUrl: './confirm-dialog.component.html',
  styleUrls: ['./confirm-dialog.component.css']
})
export class ConfirmDialogComponent {
  @Input() issueNo: number | null = null;
  @Output() confirm = new EventEmitter<boolean>();
}
```

We use the `@Input()` decorator to get the issue number and display it on the component template. The `confirm` event will emit a `boolean` value to indicate whether the user confirmed resolving the issue or not.

3. Create two methods that will call the `emit` method of the `confirm` output property, either with `true` or `false`:

```
agree() {
  this.confirm.emit(true);
  this.issueNo = null;
```

```
    }

    disagree() {
      this.confirm.emit(false);
      this.issueNo = null;
    }
```

Both methods will set the `issueNo` property to `null` because that property will also control whether the modal dialog is opened. So, we want to close the dialog in both cases.

We have set up the TypeScript class of our dialog component. Let's wire it up now with its template. Open the `confirm-dialog.component.html` file and replace its content with the following:

```
<clr-modal [clrModalOpen]="issueNo !== null" [clrModalClosable]="false">
    <h3 class="modal-title">
      Resolve Issue #
      {{issueNo}}
    </h3>
    <div class="modal-body">
      <p>Are you sure you want to close the issue?</p>
    </div>
    <div class="modal-footer">
      <button type="button" class="btn btn-outline"
(click)="disagree()">Cancel</button>
      <button type="button" class="btn btn-danger" (click)="agree()">Yes,
continue</button>
    </div>
</clr-modal>
```

A Clarity modal dialog consists of a `<clr-modal>` component and a collection of HTML elements with specific classes:

- `modal-title`: The dialog title that displays the current issue number.
- `modal-body`: The main content of the dialog.
- `modal-footer`: The footer of the dialog that is commonly used to add actions for that dialog. We currently add two HTML `<button>` elements and bind their `click` event to the `agree` and `disagree` component methods, respectively.

Whether it is opened or closed, the current status of the dialog is indicated by the `clrModalOpen` directive bound to the `issueNo` input property. When that property is null, the dialog is closed. The `clrModalClosable` directive indicates that the dialog cannot be closed by any means other than programmatically through the `issueNo` property.

According to our specs, we want the user to resolve an issue directly from the list. Let's find out how we can integrate the dialog that we created with the list of pending issues:

1. Open the `issues.service.ts` file and add a new method to set the `completed` property of an issue:

   ```
   completeIssue(issue: Issue) {
     const selectedIssue: Issue = {
       ...issue,
       completed: new Date()
     };
     const index = this.issues.findIndex(i => i === issue);
     this.issues[index] = selectedIssue;
   }
   ```

   The previous method first creates a clone of the issue we want to resolve and sets its `completed` property to the current date. It then finds the initial issue in the `issues` array and replaces it with the cloned instance.

2. Open the `issue-list.component.ts` file and add a `selectedIssue` property and an `onConfirm` method in the TypeScript class:

   ```
   selectedIssue: Issue | null = null;

   onConfirm(confirmed: boolean) {
     if (confirmed && this.selectedIssue) {
       this.issueService.completeIssue(this.selectedIssue);
       this.getIssues();
     }
     this.selectedIssue = null;
   }
   ```

The `onConfirm` method calls the `completeIssue` method of the `issueService` property only when the `confirmed` parameter is true. In this case, it also calls the `getIssues` method to refresh the table data. The `selectedIssue` property holds the `Issue` object that we want to resolve, and it is reset whenever the `onConfirm` method is called.

3. Open the `issue-list.component.html` file and add an action overflow component inside the `<clr-dg-row>` component:

```
<clr-dg-row *clrDgItems="let issue of issues">
    <clr-dg-action-overflow>
        <button class="action-item" (click)="selectedIssue =
issue">Resolve</button>
    </clr-dg-action-overflow>
    <clr-dg-cell>{{issue.issueNo}}</clr-dg-cell>
    <clr-dg-cell>{{issue.type}}</clr-dg-cell>
    <clr-dg-cell>{{issue.title}}</clr-dg-cell>
    <clr-dg-cell>{{issue.description}}</clr-dg-cell>
    <clr-dg-cell>
        <span class="label" [class.label-danger]="issue.priority ===
'high'">{{issue.priority}}</span>
    </clr-dg-cell>
</clr-dg-row>
```

The `<clr-dg-action-overflow>` Clarity component adds a drop-down menu in each table row. The menu contains a single button to set the `selectedIssue` property to the current issue when clicked.

4. Finally, add the `<app-confirm-dialog>` component at the end of the template:

```
<app-confirm-dialog *ngIf="selectedIssue" [issueNo]="selectedIssue.
issueNo" (confirm)="onConfirm($event)"></app-confirm-dialog>
```

We pass the `issueNo` property of `selectedIssue` to the input binding of the dialog component.

We also bind the `onConfirm` component method to the `confirm` event so that we can be notified when the user either agrees or not. The `$event` parameter is a reserved keyword in Angular and contains the event binding result, which depends on the HTML element type. In this case, it includes the `boolean` result of the confirmation.

We have put all the pieces into place to resolve an issue. Let's give it a try:

1. Run `ng serve` and open the application at `http://localhost:4200`.
2. If you don't have any issues, use the **ADD NEW ISSUE** button to create one.
3. Click on the action menu of one row and select **Resolve**. The menu is the three vertical dots icon next to the **Issue No** column:

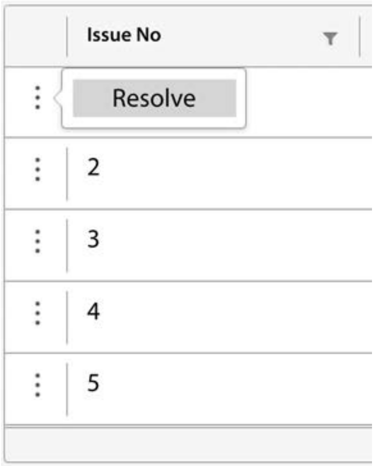


Figure 3.7 – Action menu

4. In the dialog that appears, click on the **YES, CONTINUE** button:

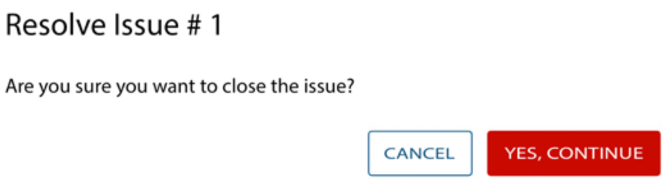


Figure 3.8 – Resolve Issue dialog

After clicking the button, the dialog will close, and the issue should no longer be visible on the list.

We have provided a way for users of our application to resolve issues. Our issue-tracking system is now complete and ready to put into action! Sometimes, users are in a hurry and may report an issue already reported. In the following section, we will learn how to leverage advanced reactive form techniques to help them in this case.

Turning on suggestions for new issues

The reactive forms API contains a mechanism for getting notified when the value of a particular form control changes. We will use it in our application to find related issues when reporting a new one. More specifically, we will display a list of suggested issues when the user starts typing in the title form control:

1. Open the `issues.service.ts` file and add the following method:

```
getSuggestions(title: string): Issue[] {
  if (title.length > 3) {
    return this.issues.filter(issue =>
      issue.title.indexOf(title) !== -1);
  }
  return [];
}
```

   The preceding method takes the title of an issue as a parameter and searches for any issues that contain the same title. The search mechanism is triggered when the `title` parameter is more than three characters long to limit results to a reasonable amount.

2. Open the `issue-report.component.ts` file and import the `OnInit` artifact from the `@angular/core` npm package:

```
import { Component, EventEmitter, OnInit, Output } from '@angular/
core';
```

3. Create a new component property to hold the suggested issues:

```
suggestions: Issue[]= [];
```

4. Add the `OnInit` interface to the list of implemented interfaces of the `IssueReportComponent` class:

```
export class IssueReportComponent implements OnInit {
```

5. The `controls` property of a `FormGroup` object contains all form controls as a key-value pair. The key is the name of the control, and the value is the actual form control object. We can get notified about changes in the value of a form control by accessing its name, in this case, `title`, in the following way:

```
ngOnInit(): void {
  this.issueForm.controls.title.valueChanges.subscribe(title => {
```

```
    this.suggestions = this.issueService.getSuggestions(title);
  });
}
```

Each control exposes a `valueChanges` observable that we can subscribe to and get a continuous stream of values. The `valueChanges` observable emits new values as soon as the user starts typing in the `title` control of the form. When that happens, we set the result of the `getSuggestions` method in the `suggestions` component property.

6. To display the suggested issues on the template of the component, open the `issue-report.component.html` file and add the following HTML code right after the `<clr-input-container>` element:

```
<div class="clr-row" *ngIf="suggestions.length">
    <div class="clr-col-lg-2"></div>
    <div class="clr-col-lg-6">
      <clr-stack-view>
        <clr-stack-header>Similar issues</clr-stack-header>
        <clr-stack-block *ngFor="let issue of suggestions">
            <clr-stack-label>#{{issue.issueNo}}:{{issue.title}}</
clr-stack-label>
            <clr-stack-content>{{issue.description}}</clr-stack-
content>
        </clr-stack-block>
      </clr-stack-view>
    </div>
</div>
```

We use the `<clr-stack-view>` component from the Clarity library to display suggested issues in a key-value pair representation. The key is indicated by the `<clr-stack-header>` component and displays the title and the number of the issue. The `<clr-stack-content>` component indicates the value and displays the issue description.

We display similar issues only when there are any available suggested ones.

Run `ng serve` and open the report issue form to create a new issue. When you start typing in the **Title** input, the application will suggest any issues related to the one that you are trying to create:

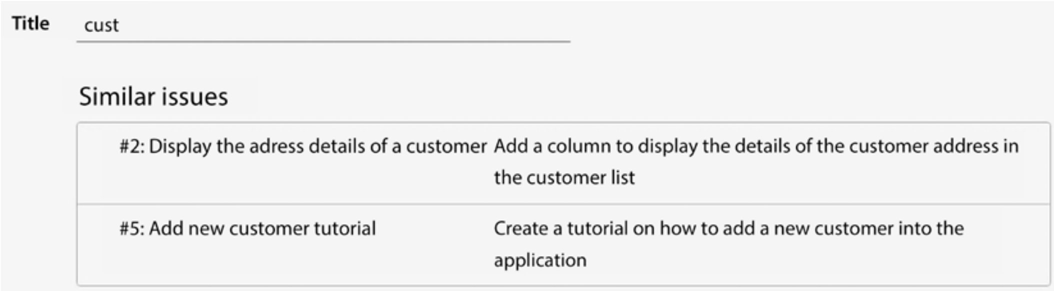


Figure 3.9 – Similar issues

The user will now see if there are any similar issues and avoid reporting a duplicate issue.

Summary

In this chapter, we built an Angular application for managing and tracking issues using reactive forms and Clarity Design System.

First, we installed Clarity in an Angular application and used a data grid component to display a list of pending issues. Then, we introduced reactive forms and used them to build a form for reporting a new issue. We added validations in the form to give our users a visual indication of the required fields and guard against unwanted behavior.

An issue-tracking system is only efficient if our users can resolve them. We built a modal dialog using Clarity to resolve a selected issue. Finally, we improved the UX of our application by suggesting related issues when reporting a new one.

In the next chapter, we will build a progressive web application for the weather using the Angular service worker.

Exercise

Create an Angular component to edit the details of an existing issue. The component should display the issue number and allow the user to change the title, description, and priority. The title and the description should be required fields.

The user should be able to access the previous component using the action menu in the list of pending issues. Add a new action menu button to open the edit issue form.

After the user has completed updating an issue, the form should be closed, and the list of pending issues should be refreshed.

You can find the solution to the exercise in the `Chapter03` folder of the `exercise` branch at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition/tree/exercise`.

Further reading

- Angular forms: `https://angular.io/guide/forms-overview`
- Reactive forms: `https://angular.io/guide/reactive-forms`
- Validating reactive forms: `https://angular.io/guide/form-validation#validating-input-in-reactive-forms`
- Passing data to a component: `https://angular.io/guide/component-interaction#pass-data-from-parent-to-child-with-input-binding`
- Getting data from a component: `https://angular.io/guide/component-interaction#parent-listens-for-child-event`
- Getting started with Clarity: `https://clarity.design/documentation/get-started`

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

`https://packt.link/AngularProjects3e`

4

Building a PWA Weather Application Using Angular Service Worker

We can access a web application using different types of devices, such as a desktop, mobile, or tablet, and over various types of network, such as broadband, Wi-Fi, and cellular. A web application should work seamlessly and provide the same user experience independently of the device and the network of the user.

Progressive Web Apps (PWAs) are applications built with a collection of techniques with the previous considerations in mind. One popular technique is the **service worker**, which improves the loading time of a web application. In this chapter, we will use the service worker implementation of the Angular framework to build a PWA that displays the weather of a city using the **OpenWeather API**.

We will cover the following topics in detail:

- Setting up the OpenWeather API
- Displaying weather data
- Enabling offline mode with the service worker
- Staying up to date with in-app notifications
- Deploying our app with **Firebase Hosting**

Essential background theory and context

Traditional web applications are usually hosted in a web server and are immediately available to any user at any given time. Native applications are installed on the device of the user, have access to its native resources, and can work seamlessly with any network. PWAs straddle the two worlds of web and native applications and share characteristics from both, summarized by the following pillars:

- **Capable**: It can access locally saved data and interact with peripheral hardware that is connected to the device of the user.
- **Reliable**: It can have the same performance and experience in any network connection, even in areas with low connectivity and coverage.
- **Installable**: It can be installed on the device of the user, can be launched directly from the home screen, and interact with other installed native applications.

Converting a web application into a PWA involves several steps and techniques. The most essential one is configuring a service worker. The service worker is a mechanism that runs on the web browser and acts as a proxy between the application and an external HTTP endpoint or other in-app resources such as JavaScript and CSS files. The main job of the service worker is to intercept requests to those resources and act on them by providing a cached or live response.

> The service worker is persisted after the tab of the browser is closed.

The Angular framework provides an implementation for the service worker that we can use to convert our Angular applications into PWAs.

It also contains a built-in HTTP client that we can use to communicate with a server over HTTP. The Angular HTTP client exposes an observable-based API with all standard HTTP methods, such as POST and GET. Observables are based on the **observer pattern**, the core of reactive programming. In the observer pattern, multiple objects called **observers** can subscribe to an observable and get notified about any changes to its state. Observables dispatch changes to observers by emitting event streams asynchronously. The Angular framework uses a library called **RxJS** that contains various artifacts for working with observables. One of these artifacts is a set of functions called **operators** that can apply various actions on observables, such as transformations and filtering. Next, let's get an overview of our project.

Project overview

In this project, we will build a PWA to display the weather conditions of a city. Initially, we will learn how to configure the OpenWeather API, which we will use to get weather data. We will then learn how to use the API to display weather information in an Angular component. We will see how to convert our Angular application into a PWA using a service worker. We will also implement a notification mechanism for our application updates. Finally, we will deploy our PWA into the Firebase Hosting provider. The following diagram presents an architectural overview of the project:

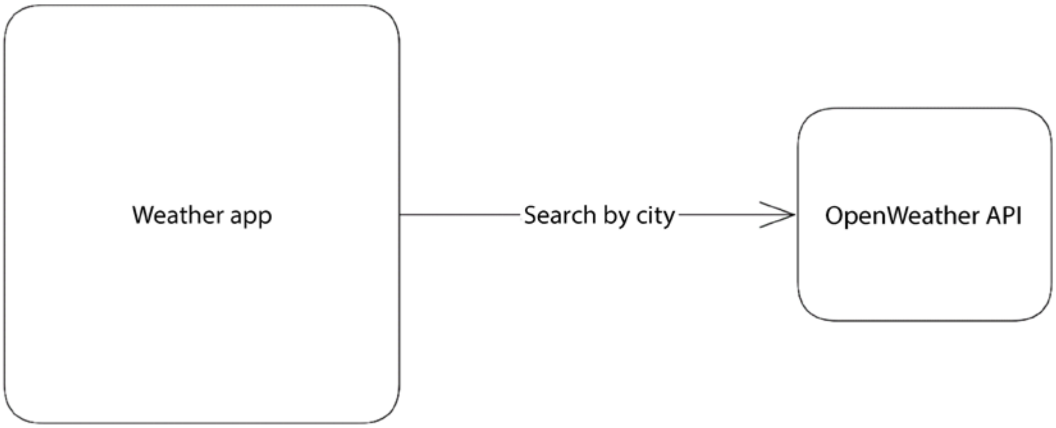

Figure 4.1 – Project architecture

Build time: 90 minutes

Getting started

The following software tools are required to complete this project:

- **Angular CLI**: A command-line interface for Angular that you can find at `https://angular.io/cli`.
- **GitHub material**: The related code for this chapter can be found in the `Chapter04` folder at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition`.

Setting up the OpenWeather API

The OpenWeather team created the OpenWeather API, which contains current and historical weather information from over 200,000 cities worldwide. It also supports forecast weather data for more detailed information.

We need to get an API key first to start using the OpenWeather API:

1. Navigate to the OpenWeather API website at `https://openweathermap.org/api`.

   You will see a list of all available APIs from the OpenWeather team.

2. Find the **Current Weather Data** section and click the **Subscribe** button.

   You will be redirected to the page with the available pricing schemes of the service. Each scheme supports a different combination of API calls per minute and month. For this project, we are going to use the **Free** tier.

3. Click on the **Get API key** button.

   You will be redirected to the sign-up page of the service.

4. Complete all the required details and click the **Create Account** button.

   A confirmation message will be sent to the email address you used to create your account.

5. Find the confirmation email and click the **Verify your email** button to complete your registration.

   You will shortly receive another email from OpenWeather with details about your current subscription, including your API key and the HTTP endpoint you will use to communicate with the API.

> The API key may take some time to be activated, usually a couple of hours before you can use it.

Once the API key has been activated, we can use it within an Angular application. We will learn how to do this in the following section.

Displaying weather data

In this section, we will create an Angular application to display weather information for a given city. The user will enter the name of the city in an input field, and the application will use the OpenWeather API to get weather data for the specified city. We will cover the following topics in more detail:

- Setting up the Angular application
- Communicating with the OpenWeather API
- Displaying weather information for a city

Let's start by creating the Angular application first in the following section.

Setting up the Angular application

We will use the `ng new` command of the Angular CLI to create a new Angular application from scratch:

```
ng new weather-app --style=scss --routing=false
```

The preceding command will create a new Angular CLI application with the following properties:

- `weather-app`: The name of the Angular application
- `--style=scss`: Indicates that our Angular application will use the SCSS stylesheet format
- `--routing=false`: Disables Angular routing in the application

The user should be able to enter the name of the city in an input field, and the weather information of the city should be visualized in a card layout. The **Angular Material** library provides a set of UI components for our needs, including an input and a card.

Angular Material components adhere to the **Material Design** principles and are maintained by the **Components** team of Angular. We can install the Angular Material library using the following command of the Angular CLI:

```
ng add @angular/material --theme=indigo-pink --animations=enabled
--typography
```

The preceding code uses the `ng add` command of the Angular CLI, passing additional configuration options:

- `@angular/material`: The npm package name of the Angular Material library. It will also install the **Angular CDK** package, a set of behaviors and interactions used to build Angular Material. Both packages will be added to the `dependencies` section of the `package.json` file of the application.
- `--theme=indigo-pink`: The name of the Angular Material theme we want to use. Adding a theme involves modifying several files of the Angular CLI workspace. It adds entries of the CSS theme file to the `angular.json` configuration file:

  ```
  @angular/material/prebuilt-themes/indigo-pink.css
  ```

  It also includes the Material Design icons in the `index.html` file:

  ```
  <link href="https://fonts.googleapis.com/icon?family=Material+Icons"
  rel="stylesheet">
  ```

Angular Material comes with a set of predefined themes that we can use. Alternatively, we can build a custom one that fits our specific needs.

- `--animations=enabled`: Enables browser animations in our application by importing `BrowserAnimationsModule` into the main application module, `app.module.ts`:

```
import { NgModule } from '@angular/core';
import { BrowserModule } from '@angular/platform-browser';

import { AppComponent } from './app.component';
import { BrowserAnimationsModule } from '@angular/platform-browser/
animations';

@NgModule({
  declarations: [
    AppComponent
  ],
  imports: [
    BrowserModule,
    BrowserAnimationsModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

- `--typography`: Enables Angular Material typography globally in our application. Typography defines how text content is displayed and uses the **Roboto** font by default, which is included in the `index.html` file:

```
<link href="https://fonts.googleapis.com/
css2?family=Roboto:wght@300;400;500&display=swap" rel="stylesheet">
```

It adds the following class to the `<body>` tag of the HTML file:

```
<body class="mat-typography">
  <app-root></app-root>
</body>
```

It also adds some CSS styles to the global `styles.scss` file of our application:

```
html, body { height: 100%; }
```

```
body { margin: 0; font-family: Roboto, "Helvetica Neue", sans-serif;
}
```

We now have all the moving parts to build our Angular application. In the following section, we will create a mechanism for interacting with the OpenWeather API.

Communicating with the OpenWeather API

The application should interact with the OpenWeather API over HTTP to get weather data. Let's see how we can set up this type of communication in our application:

1. First, we must create an interface describing the data type we will get from the API. Use the following command of the Angular CLI to create one:

   ```
   ng generate interface weather
   ```

   The preceding command will create the `weather.ts` file in the `src\app` folder of our Angular CLI project.

2. Open the `weather.ts` file and modify it as follows:

   ```
   export interface Weather {
     weather: WeatherInfo[],
     main: {
       temp: number;
       pressure: number;
       humidity: number;
     };
     wind: {
       speed: number;
     };
     sys: {
       country: string
     };
     name: string;
   }

   interface WeatherInfo {
     main: string;
     icon: string;
   }
   ```

Each property corresponds to a weather field in the OpenWeather API response. You can find a description for each one at `https://openweathermap.org/current#parameter`.

Then, we must set up the built-in HTTP client provided by the Angular framework.

3. Open the `app.module.ts` file and add `HttpClientModule` to the `imports` array of the `@NgModule` decorator:

```
import { HttpClientModule } from '@angular/common/http';
import { NgModule } from '@angular/core';
import { BrowserModule } from '@angular/platform-browser';

import { AppComponent } from './app.component';
import { BrowserAnimationsModule } from '@angular/platform-browser/
animations';

@NgModule({
  declarations: [
    AppComponent
  ],
  imports: [
    BrowserModule,
    BrowserAnimationsModule,
    HttpClientModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

4. Use the following command of the Angular CLI to create a new Angular service:

```
ng generate service weather
```

The preceding command will create the `weather.service.ts` file in the `src\app` folder of our Angular CLI project.

5. Open the `weather.service.ts` file and inject the `HttpClient` service into its `constructor`:

```
import { HttpClient } from '@angular/common/http';
import { Injectable } from '@angular/core';
@Injectable({
```

```
  providedIn: 'root'
})
export class WeatherService {

  constructor(private http: HttpClient) { }
}
```

6. Add the following properties to define the endpoint URL of the OpenWeather API and our API key:

```
private apiUrl = 'https://api.openweathermap.org/data/2.5/';
private apiKey = '<Your API key>';
```

   Replace the value of the `apiKey` property with the API key that you have.

7. Add a method in the service that accepts the name of the city as a single parameter and queries the OpenWeather API for that city:

```
getWeather(city: string): Observable<Weather> {
  const options = new HttpParams()
    .set('units', 'metric')
    .set('q', city)
    .set('appId', this.apiKey);
  return this.http.get<Weather>(this.apiUrl + 'weather', { params:
options });
}
```

   The `getWeather` method uses the `get` method of the `HttpClient` service that accepts two parameters. The first one is the URL endpoint of the OpenWeather API. The second parameter is an `options` object used to pass additional configuration to the request, such as URL query parameters with the `params` property.

   We use the constructor of the `HttpParams` object and call its `set` method for each query parameter we want to add to the URL. In our case, we pass the `q` parameter for the city name, the `appId` for the API key, and the type of `units` we want to use. You can learn more about supported units at `https://openweathermap.org/current#data`.

> We used the `set` method to create query parameters because the `HttpParams` object is immutable. Calling the constructor for each parameter you want to pass will throw an error.

We also set the response data type as `Weather` in the `get` method. Notice that the `getWeather` method does not return `Weather` data but instead an `Observable` of this type.

8. Add the following `import` statements at the top of the file:

```
import { HttpClient, HttpParams } from '@angular/common/http';
import { Injectable } from '@angular/core';
import { Observable } from 'rxjs';
import { Weather } from './weather';
```

The Angular service that we created contains all the necessary artifacts for interacting with the OpenWeather API. In the following section, we will create an Angular component for initiating requests and displaying data from it.

Displaying weather information for a city

The user should be able to use the UI of our application and enter the name of a city for which they want to view weather details. The application will use that information to query the OpenWeather API, and the request result will be displayed on the UI using a card layout. Let's start building an Angular component for creating all these types of interactions:

1. Use the following command of the Angular CLI to create an Angular component:

```
ng generate component weather
```

2. Open the template of the main component, `app.component.html`, and replace its content with the selector of the new component, `<app-weather>`:

```
<app-weather></app-weather>
```

3. Open the `app.module.ts` file and add the following modules from the Angular Material library to the `imports` array of the `@NgModule` decorator:

```
@NgModule({
  declarations: [
    AppComponent,
    WeatherComponent
  ],
  imports: [
    BrowserModule,
    BrowserAnimationsModule,
    HttpClientModule,
```

```
    MatIconModule,
    MatInputModule,
    MatCardModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
```

Also, add the necessary `import` statements at the top of the file:

```
import { MatCardModule } from '@angular/material/card';
import { MatIconModule } from '@angular/material/icon';
import { MatInputModule } from '@angular/material/input';
```

4. Open the `weather.component.ts` file, create a `weather` property of the `Weather` type, and inject `WeatherService` into the `constructor` of the `WeatherComponent` class:

```
import { Component } from '@angular/core';
import { Weather } from '../weather';
import { WeatherService } from '../weather.service';

@Component({
  selector: 'app-weather',
  templateUrl: './weather.component.html',
  styleUrls: ['./weather.component.scss']
})
export class WeatherComponent {
  weather: Weather | undefined;

  constructor(private weatherService: WeatherService){ }
}
```

5. Create a component method that subscribes to the `getWeather` method of `WeatherService` and assigns the result to the `weather` component property:

```
search(city: string) {
  this.weatherService.getWeather(city).subscribe(weather => this.
weather = weather);
}
```

We have already finished working with the TypeScript class file of our component. Let's wire it up to its template. Open the `weather.component.html` file and replace its content with the following HTML code:

```
<mat-form-field>
    <input matInput placeholder="Enter city" #cityCtrl (keydown.enter)="search(cityCtrl.value)">
    <mat-icon matSuffix (click)="search(cityCtrl.value)">search</mat-icon>
</mat-form-field>
<mat-card *ngIf="weather">
    <mat-card-header>
        <mat-card-title>{{weather.name}}, {{weather.sys.country}}</mat-card-title>
        <mat-card-subtitle>{{weather.weather[0].main}}</mat-card-subtitle>
    </mat-card-header>
    <img mat-card-image src="https://openweathermap.org/img/wn/{{weather.weather[0].icon}}@2x.png" [alt]="weather.weather[0].main">
    <mat-card-content>
      <h1>{{weather.main.temp | number:'1.0-0'}} &#8451;</h1>
      <p>Pressure: {{weather.main.pressure}} hPa</p>
      <p>Humidity: {{weather.main.humidity}} %</p>
      <p>Wind: {{weather.wind.speed}} m/s</p>
    </mat-card-content>
</mat-card>
```

The preceding template consists of several components from the Angular Material library, including a `<mat-form-field>` component that contains the following child elements:

- An `<input>` HTML element for entering the name of the city. When the user has finished editing and presses the *Enter* key, it calls the `search` component method passing the value property of the `cityCtrl` variable as a parameter. The `cityCtrl` variable is a **template reference variable** and indicates the actual object of the native HTML `<input>` element.
- A `<mat-icon>` component displays a magnifier icon at the end of the input element, as indicated by the `matSuffix` directive. It also calls the `search` component method when clicked.

> The `cityCtrl` template reference variable is indicated by a `#` and is accessible everywhere inside the component template.

A `<mat-card>` component presents information in a card layout and is displayed only when the `weather` component property has a value. It consists of the following child elements:

- `<mat-card-header>`: The header of the card. It consists of a `<mat-card-title>` component that displays the name of the city and the country code and a `<mat-card-subtitle>` component that displays the current weather conditions.
- `mat-card-image`: The image of the card that displays the icon of the weather conditions, along with a description as an alternate text.
- `<mat-card-content>`: The main content of the card. It displays the temperature, pressure, humidity, and wind speed of the current weather. The temperature is displayed without any decimal points, as indicated by the `number` pipe.

Let's now spice things up a bit by adding some styles to our component:

`weather.component.scss`

```
:host {
  display: flex;
  align-items: center;
  justify-content: center;
  flex-direction: column;
  padding-top: 25px;
}
mat-form-field {
  width: 20%;
}
mat-icon {
  cursor: pointer;
}
mat-card {
  margin-top: 30px;
  width: 250px;
}
h1 {
  text-align: center;
  font-size: 2.5em;
}
```

The `:host` selector is an Angular unique CSS selector that targets the HTML element hosting our component, which in our case, is the `<app-weather>` HTML element.

If we run our application using `ng serve`, navigate to `http://localhost:4200`, and search for weather information in `Athens`, we should get the following output on the screen:

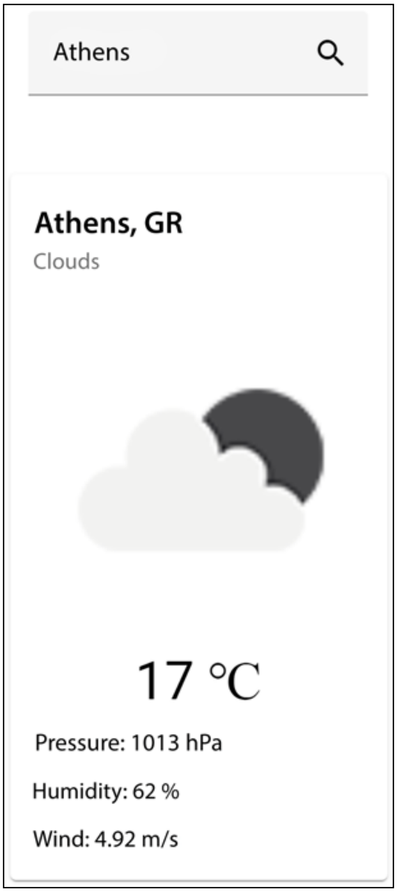

Figure 4.2 – Application output

Congratulations! Now, you have a fully working Angular application that displays weather information for a specific city. The application consists of a single Angular component that communicates with the OpenWeather API using an Angular service through HTTP. We learned how to style our component using Angular Material and give our users a pleasant experience with our app. But what happens when we are offline? Does the application work as expected? Does the user's experience remain the same? Let's find out in the following section.

Enabling offline mode with the service worker

Users from anywhere can now access our Angular application to get weather information for any city they are interested in. When we say *anywhere*, we mean any network type, such as broadband, cellular (3G/4G/5G), and Wi-Fi. Consider the case where a user is in a place with low coverage or frequent network outages. How is our application going to behave? Let's find out by experimenting:

1. Run the Angular application using the `ng serve` command of the Angular CLI.
2. Open your favorite browser and navigate to `http://localhost:4200`, the default address and port number for an Angular CLI project. You should see the input field for entering the name of the city:

Figure 4.3 – Entering the name of a city

3. Open the developer tools of your browser and navigate to the **Network** tab. Set the value of the **Throttling** dropdown to **Offline**:

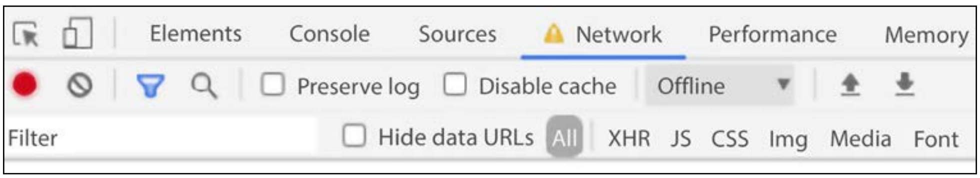

Figure 4.4 – Offline network mode

4. Try to refresh your browser. You will see an indication that you are disconnected from the internet, as shown in the following screenshot:

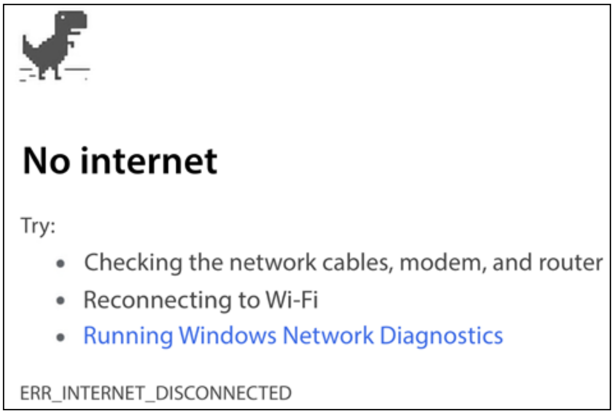

Figure 4.5 – No internet connection (Google Chrome)

The previous case is standard in areas with low-quality internet connections. So, what can we do for our users in such places? Luckily, the Angular framework contains an implementation of a service worker that can significantly enhance the UX of our application when running in offline mode. It can cache certain application parts and deliver them accordingly instead of making real requests.

> The Angular service worker can also be used in environments with large network latency connections. Consider using a service worker in this type of network also to improve the experience of your users.

Run the following command of the Angular CLI to enable the service worker in our Angular application:

```
ng add @angular/pwa
```

The preceding command will transform the Angular CLI workspace accordingly for PWA support:

- It adds the `@angular/service-worker` npm package to the `dependencies` section of the `package.json` file of the application.
- It creates the `manifest.webmanifest` file in the `src` folder of the application. The manifest file contains information about the application needed to install and run it natively. It also adds it to the `assets` array of the `build` options in the `angular.json` file.

- It creates the `ngsw-config.json` file at the root of the project, which is the service worker configuration file. We use it to define configuration-specific artifacts, such as which resources are cached and how they are cached. You can find more details about the configuration of the service worker at the following link: `https://angular.io/guide/service-worker-config#service-worker-configuration`.
- The configuration file is also set in the `ngswConfigPath` property of the `build` configuration in the `angular.json` file.
- It sets the `serviceWorker` property to `true` in the `build` configuration of the `angular.json` file.
- It registers the service worker in the `app.module.ts` file:

```
@NgModule({
  declarations: [
    AppComponent,
    WeatherComponent
  ],
  imports: [
    BrowserModule,
    BrowserAnimationsModule,
    HttpClientModule,
    MatIconModule,
    MatInputModule,
    MatCardModule,
    ServiceWorkerModule.register('ngsw-worker.js', {
      enabled: !isDevMode(),
      // Register the ServiceWorker as soon as the application is
stable
      // or after 30 seconds (whichever comes first).
      registrationStrategy: 'registerWhenStable:30000'
    })
  ],
  providers: [],
  bootstrap: [AppComponent]
})
```

- The `ngsw-worker.js` file is the JavaScript file that contains the actual implementation of the service worker. It is created automatically for us when we build our application. Angular uses the `register` method of the `ServiceWorkerModule` class to register it within our application.
- It creates several icons to be used when the application is installed as a native one on the device of the user.
- It includes the manifest file and a `<meta>` tag for `theme-color` in the `<head>` element of the `index.html` file:

```
<link rel="manifest" href="manifest.webmanifest">
<meta name="theme-color" content="#1976d2">
```

Now that we have completed the service worker installation, it is time to test it! Before moving on, we should install an external web server because the built-in function of the Angular CLI does not work with service workers. A good alternative is **http-server**:

1. Run the `install` command of the npm client to install `http-server`:

```
npm install -D http-server
```

   The preceding command will install `http-server` as a development dependency of our Angular CLI project.

2. Build the Angular application using the `ng build` command of the Angular CLI.
3. Open the `package.json` file of the Angular CLI workspace and add the following entry to the `scripts` property:

```
"scripts": {
  "ng": "ng",
  "start": "ng serve",
  "build": "ng build",
  "watch": "ng build --watch --configuration development",
  "test": "ng test",
  "server": "http-server -p 8080 -c-1 dist/weather-app"
}
```

4. Start the HTTP web server using the following command:

```
npm run server
```

   The preceding command will start http-server at port 8080 and have caching disabled.

5. Open your browser and navigate to `http://localhost:8080`.

> Prefer opening the page in private or incognito mode to avoid unexpected behavior from the service worker.

6. Repeat the process we followed at the beginning of the section for switching to offline mode.
7. If you refresh the page now, you will notice that the application is working as expected.

   The service worker did all the work for us, and the process was so seamless that we could not tell whether we were online or offline. You can verify that by inspecting the **Network** tab:

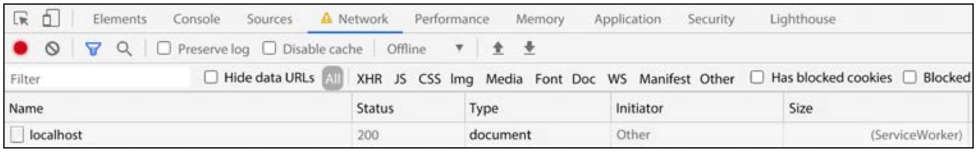

Figure 4.6 – Service worker (offline mode)

The **(ServiceWorker)** value in the **Size** column indicates that the service worker served a cached version of our application.

We have successfully installed the service worker and moved closer to converting our application into a PWA. In the following section, we will learn how to notify users of the application about potential updates.

Staying up to date with in-app notifications

When we want to apply a change in a web application, we make the change and build a new version of our application. The application is then deployed to a web server, and every user can access the latest version immediately. But PWAs are different.

When we deploy a new version of our PWA, the service worker must act accordingly and apply a specific update strategy. It should notify the user of the new version or install it immediately. Which update strategy we follow depends on our requirements. In this project, we want to show a prompt to the user and let them decide whether they want to update the app. Let's see how to implement this feature in our application:

1. Open the `app.module.ts` file and add `MatSnackBarModule` to the `imports` array of the `@NgModule` decorator:

```
import { MatSnackBarModule } from '@angular/material/snack-bar';

@NgModule({
  declarations: [
    AppComponent,
    WeatherComponent
  ],
  imports: [
    BrowserModule,
    BrowserAnimationsModule,
    HttpClientModule,
    MatIconModule,
    MatInputModule,
    MatCardModule,
    MatSnackBarModule,
    ServiceWorkerModule.register('ngsw-worker.js', {
      enabled: !isDevMode(),
      // Register the ServiceWorker as soon as the application is
stable
      // or after 30 seconds (whichever comes first).
      registrationStrategy: 'registerWhenStable:30000'
    })
  ],
  providers: [],
  bootstrap: [AppComponent]
})
```

   `MatSnackBarModule` is an Angular Material module that allows us to interact with **snack bars**. A snack bar is a pop-up window that usually appears on the bottom of the page and is used for notification purposes.

2. Open the `app.component.ts` file and add the `OnInit` interface to the implemented interfaces of the `AppComponent` class:

```
import { Component, OnInit } from '@angular/core';
```

```
@Component({
  selector: 'app-root',
  templateUrl: './app.component.html',
  styleUrls: ['./app.component.scss']
})
export class AppComponent implements OnInit {
  title = 'weather-app';
}
```

3. Inject the `MatSnackBar` and `SwUpdate` services in the `constructor` of the `AppComponent` class:

```
import { Component, OnInit } from '@angular/core';
import { MatSnackBar } from '@angular/material/snack-bar';
import { SwUpdate, VersionReadyEvent } from '@angular/service-
worker';


@Component({
  selector: 'app-root',
  templateUrl: './app.component.html',
  styleUrls: ['./app.component.scss']
})
export class AppComponent implements OnInit {
  title = 'weather-app';

  constructor(private updates: SwUpdate, private snackbar:
MatSnackBar) {}
}
```

The `MatSnackBar` service is an Angular service exposed from `MatSnackBarModule`. The `SwUpdate` service is part of the service worker and contains observables that we can use to notify the user on the update process of our application.

4. Create the following `ngOnInit` method:

```
ngOnInit() {
  this.updates.versionUpdates.pipe(
    filter((evt): evt is VersionReadyEvent => evt.type === 'VERSION_
READY'),
```

```
    switchMap(() => this.snackbar.open('A new version is
available!', 'Update now').afterDismissed()),
    filter(result => result.dismissedByAction),
    map(() => this.updates.activateUpdate().then(() => location.
reload()))
  ).subscribe();
}
```

The `ngOnInit` method is an implementation method of the `OnInit` interface and is called upon component initialization. The `SwUpdate` service contains a `versionUpdates` observable property that we can use to get notified when a new version of our application is available. Typically, we tend to subscribe to observables, but in this case, we don't. Instead, we subscribe to the `pipe` method, an RxJS operator for composing multiple operators.

5. Add the following `import` statements at the top of the `app.component.ts` file:

```
import { filter, map, switchMap } from 'rxjs';
```

A lot is going on inside the `ngOnInit` method that we defined previously, so let's break it down into pieces to understand it further. The `pipe` operator combines four RxJS operators:

- `filter:` We use it to filter out any emitted values from the `versionUpdates` observable other than the one that indicates when the version is ready to be installed.
- `switchMap`: This is called when a new version of our application is available. It uses the `open` method of the `snackbar` property to show a snack bar with an action button and subscribes to its `afterDismissed` observable. The `afterDismissed` observable emits when the snack bar is closed either by clicking the action button or programmatically using its API methods.
- `filter`: This is called when the snack bar is dismissed using the action button.
- `map`: This calls the `activateUpdate` method of the `updates` property to apply the new version of the application. Once the application has been updated, it reloads the browser window for the changes to take effect.

Let's see the whole process of updating to a new version in action:

1. Run the following command of the Angular CLI to build the Angular application:

```
ng build
```

2. Start the HTTP server to serve the application:

```
npm run server
```

3. Open a private or incognito browser window and navigate to `http://localhost:8080`.
4. Without closing the browser window, let's introduce a change in our application and add a UI header. Run the `generate` command of the Angular CLI to create a component:

```
ng generate component header
```

5. Open the `app.module.ts` file and import the following Angular Material modules:

```
import { MatButtonModule } from '@angular/material/button';
import { MatToolbarModule } from '@angular/material/toolbar';

@NgModule({
  declarations: [
    AppComponent,
    WeatherComponent,
    HeaderComponent
  ],
  imports: [
    BrowserModule,
    BrowserAnimationsModule,
    HttpClientModule,
    MatIconModule,
    MatInputModule,
    MatCardModule,
    MatSnackBarModule,
    MatButtonModule,
    MatToolbarModule,
    ServiceWorkerModule.register('ngsw-worker.js', {
      enabled: !isDevMode(),
      // Register the ServiceWorker as soon as the application is
stable
      // or after 30 seconds (whichever comes first).
      registrationStrategy: 'registerWhenStable:30000'
    })
  ],
  providers: [],
  bootstrap: [AppComponent]
})
```

6. Open the `header.component.html` file and create a `<mat-toolbar>` component with two HTML `<button>` elements, each one containing a `<mat-icon>` component:

```
<mat-toolbar color="primary">
  <span>Weather App</span>
  <span class="spacer"></span>
  <button mat-icon-button>
    <mat-icon>refresh</mat-icon>
  </button>
  <button mat-icon-button>
    <mat-icon>share</mat-icon>
  </button>
</mat-toolbar>
```

7. Add the following CSS style to the `header.component.scss` file to position buttons at the far-right end of the header:

```
.spacer {
  flex: 1 1 auto;
}
```

8. Open the `app.component.html` file and add the `<app-header>` component at the top:

```
<app-header></app-header>
<app-weather></app-weather>
```

9. Repeat steps 1 and 2 and refresh the browser window that points to `http://localhost:8080`. You should see the following notification at the bottom of the page after a few seconds:

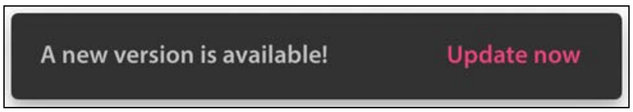

Figure 4.7 – New version notification

10. Click on the **Update now** button, wait for the browser window to reload, and you should see your change:

Figure 4.8 – Application output

Our Angular application has begun to transform into a PWA one. Along with the caching mechanism that the Angular service worker provides, we have added a mechanism for installing new versions of our application. In the following section, we will learn how to deploy and install our application natively on our device.

Deploying our app with Firebase Hosting

Firebase is a hosting solution provided by Google that we can use to deploy our Angular applications. The Firebase team has put much effort into creating an Angular CLI schematic for deploying an Angular application using one single command. Before diving deeper, let's learn how to set up Firebase Hosting:

1. Use a Google account to log in to Firebase at `https://console.firebase.google.com`.
2. Click the **Add project** button to create a new Firebase project.
3. Enter the name of the project, `weather-app`, and click the **Continue** button.

> Firebase generates a unique identifier for your project, such as *weather-app-b11a2*, underneath the name of the project. The identifier will be used in the hosting URL of your project later on.

4. Disable the use of **Google Analytics** for your project and click the **Create project** button.
5. Once the project has been created, the following will appear on the screen:

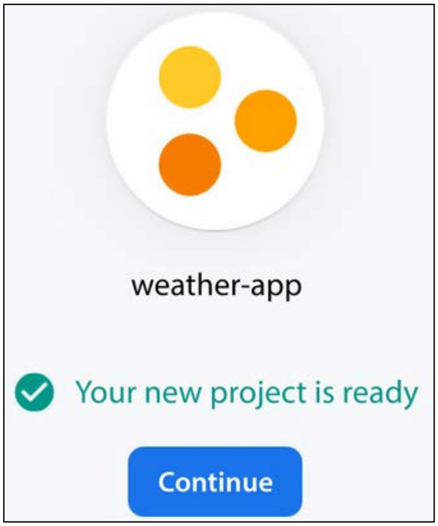

Figure 4.9 – Firebase project creation

6. Click on the **Continue** button, and you will be redirected to the dashboard of your new Firebase project.

We have now completed the configuration of Firebase Hosting. It is now time to integrate it with our Angular application:

1. Run the following command in a terminal window to install **Firebase tools**:

   ```
   npm install -g firebase-tools
   ```

2. Run the following command in the same terminal window to authenticate with the Firebase CLI:

   ```
   firebase login
   ```

3. Finally, run the following command of the Angular CLI to install the `@angular/fire` npm package in your Angular CLI project:

   ```
   ng add @angular/fire
   ```

   The preceding command will find the latest version of the library and prompt us to install it.

4. First, it will ask what features of Firebase we want to enable:

   ```
   ? What features would you like to setup?
   ```

   Ensure the `ng deploy -- hosting` option is selected, and press *Enter*.

5. Then, it will ask us to select which Firebase account we want to use:

   ```
   ? Which Firebase account would you like to use?
   ```

   Ensure the account you used earlier is selected, and press *Enter*.

6. In the next question, we will choose the project with which we are going to deploy our application:

   ```
   ? Please select a project:
   ```

   Select the `weather-app` project that we created earlier and press *Enter*.

7. Finally, we must choose the site that will host our application:

   ```
   ? Please select a hosting site:
   ```

Select the hosting website that we created earlier and press *Enter*.

The previous process will modify the Angular CLI workspace accordingly to accommodate its deployment to Firebase:

- It will create a `.firebaserc` file in the root folder that contains details of the selected Firebase project.
- It will create a `firebase.json` file in the root folder, which is the Firebase configuration file. The configuration file specifies settings such as the folder that will be deployed to Firebase and any rewrite rules.

> The folder deployed by default is the `dist` output folder created by the Angular CLI when we run the `ng build` command.

- It will add a `deploy` target in the `angular.json` configuration file.

To deploy the application, we only need to run a single Angular CLI command, and the Angular CLI will take care of the rest:

```
ng deploy
```

The preceding command will build and deploy the application to the selected Firebase project. Once deployment is complete, the Angular CLI will report back the following information:

- **Project Console**: The dashboard of the Firebase project.
- **Hosting URL**: The URL of the deployed version of the application. It consists of the unique identifier of the Firebase project and the `.web.app` suffix that is added automatically from Firebase.

> The service worker requires an application to be served with HTTPS to work properly as a PWA, except in the localhost that is used for development. Firebase hosts web applications with HTTPS by default.

Now that we have deployed our application, let's see how we can install it as a PWA on our device:

1. Navigate to the hosting URL and click on the **Install weather-app** button next to the address bar of the browser:

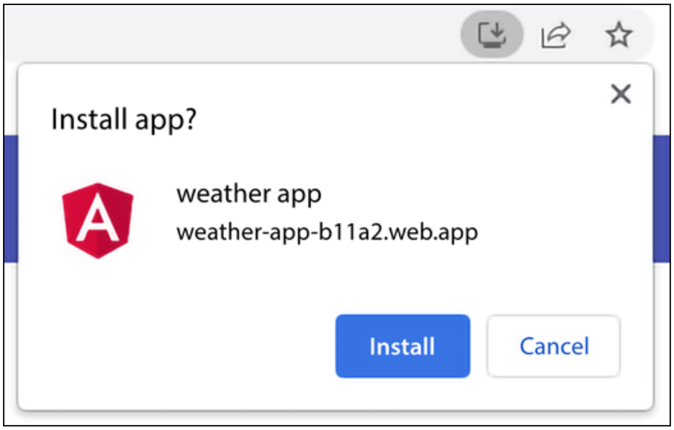

Figure 4.10 – Installing the application (Google Chrome)

The installation button may be found in different locations in other browsers.

The browser will prompt us to install the application.

2. Click the **Install** button, and the application will open as a native window on our device:

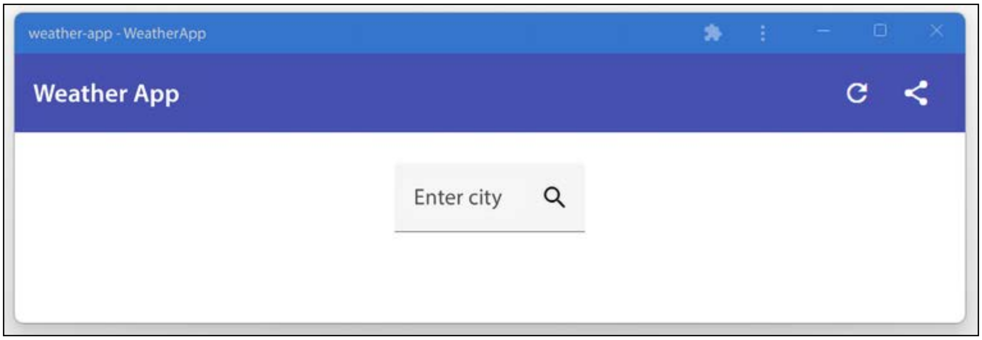

Figure 4.11 – PWA

It will also install a shortcut for launching the application directly from our device. Congratulations! We now have a full PWA that displays weather information for a city.

Summary

In this chapter, we built a PWA that displays weather information for a given city.

Initially, we set up the OpenWeather API to get weather data and created an Angular application from scratch to integrate it. We learned how to use the built-in HTTP client of the Angular framework to communicate with the OpenWeather API. We also installed the Angular Material library and used some ready-made UI components for our application.

After creating the Angular application, we introduced the Angular service worker and enabled it to work offline. We learned how to interact with the service worker and provide notifications for updates in our application. Finally, we deployed a production version of our application into Firebase Hosting and installed it locally on our device.

In the next chapter, we will learn how to create an Angular desktop application with Electron, the big rival of PWAs.

Exercise

Use the OpenWeather API to display a weekly forecast for the selected city. The OpenWeather API provides the **5 Day / 3 Hour Forecast** collection that can be used. The collection returns a forecast every 3 hours for each day, so, for a weekly forecast, you should just focus on the weather at 12:00pm each day. The forecast should be displayed as a grid list of card components and should be positioned below the current weather of the city.

You can find the solution to the exercise in the `Chapter04` folder of the `exercise` branch at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition/tree/exercise`.

Further reading

- PWAs: `https://web.dev/progressive-web-apps`
- OpenWeather API: `https://openweathermap.org/api`
- Angular Material: `https://material.angular.io`
- Angular HTTP client: `https://angular.io/guide/http`
- Angular service worker: `https://angular.io/guide/service-worker-getting-started`

- Communicating with the Angular service worker: `https://angular.io/guide/service-worker-communications`
- HTTP server: `https://www.npmjs.com/package/http-server`
- Firebase Hosting: `https://firebase.google.com/docs/hosting`
- Deployment in Angular: `https://angular.io/guide/deployment#automatic-deployment-with-the-cli`

5

Building a WYSIWYG Editor for the Desktop Using Electron

Web applications are traditionally built with HTML, CSS, and JavaScript. Their use has also widely spread to server development using **Node.js**. Various tools and frameworks have emerged in recent years that use HTML, CSS, and JavaScript to create applications for desktop and mobile. In this chapter, we will investigate how to create desktop applications using Angular and **Electron**.

Electron is a JavaScript framework used to build native desktop applications with web technologies. Combining it with the Angular framework allows us to create fast and highly performant web applications. In this chapter, we will build a desktop **WYSIWYG** editor and cover the following topics:

- Adding a WYSIWYG editor library for Angular
- Integrating Electron in the workspace
- Communicating between Angular and Electron
- Packaging a desktop application

Essential background theory and context

Electron is a cross-platform framework used to build Windows, Linux, and Mac desktop applications. Many popular applications, such as Visual Studio Code, Skype, and Slack, are made with Electron. The Electron framework is built on top of Node.js and Chromium. Web developers can leverage their existing HTML, CSS, and JavaScript skills to create desktop applications without learning a new language like C++ or C#.

Electron applications have many similarities with PWA applications. Consider building an Electron application for scenarios such as advanced filesystem manipulation or when you need a more native look and feel for your application. Another use case is when you build a complementary tool for your primary desktop product and want to ship them together.

An Electron application consists of two processes:

- **Main**: This interacts with the native local resources using the Node.js API.
- **Renderer**: This is responsible for managing the user interface of the application.

An Electron application can have only one main process that communicates with one or more renderer processes. Each renderer process operates in complete isolation from the others.

The Electron framework provides the **ipcMain** and **ipcRenderer** interfaces, which we can use to interact with these processes. The interaction is accomplished using **Inter-Process Communication (IPC)**, a mechanism that exchanges messages securely and asynchronously over a common channel via a Promise-based API.

Project overview

In this project, we will build a desktop WYSIWYG editor that keeps its content local to the filesystem. Initially, we will build it as an Angular application using **ngx-wig**, a popular WYSIWYG Angular library. We will then convert it to a desktop application using Electron and learn how to synchronize content between Angular and Electron. We will also see how to persist the content of the editor into the filesystem. Finally, we will package our application as a single executable file that can be run in a desktop environment. The following diagram describes an architectural overview of the project:

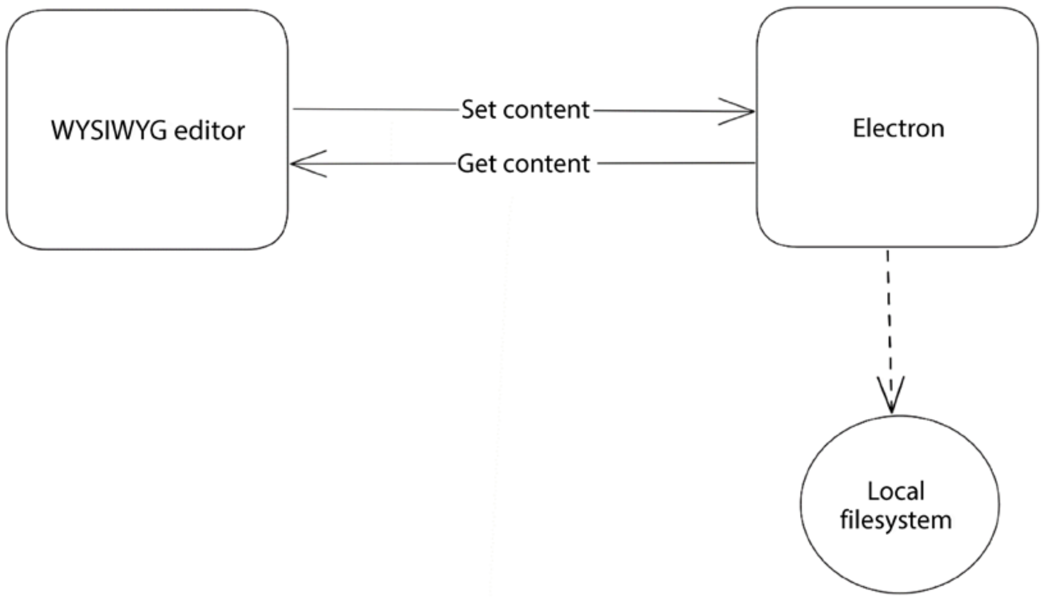

Figure 5.1 – Project architecture

Build time: 1 hour.

Getting started

The following software tools are required to complete this project:

- **Angular CLI**: A command-line interface for Angular that you can find at `https://angular.io/cli`.
- **Visual Studio Code**: A code editor that you can download from `https://code.visualstudio.com`.
- **GitHub material**: The code for this chapter can be found in the `Chapter05` folder at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition`.

Adding a WYSIWYG editor library for Angular

We will kick off our project by creating a WYSIWYG editor as a Angular application. Use the Angular CLI to create a new Angular application from scratch:

```
ng new my-editor --defaults
```

We pass the following options to the `ng new` command:

- `my-editor`: Defines the name of the application
- `--defaults`: Defines CSS as the preferred stylesheet format of the application and disables routing because our application will consist of a single component that will host the editor

A WYSIWYG editor is a rich text editor, such as Microsoft Word. We could create one from scratch using the Angular framework, but it would be time-consuming, and we would only reinvent the wheel. The Angular ecosystem contains a wide variety of libraries for this purpose. One of them is the ngx-wig library, which has no external dependencies, just Angular! Let's add the library to our application and learn how to use it:

1. Use the `npm` client to install `ngx-wig` from the npm package registry:

   ```
   npm install ngx-wig
   ```

2. Open the `app.module.ts` file and add `NgxWigModule` to the `imports` array of the `@NgModule` decorator:

   ```
   import { NgModule } from '@angular/core';
   import { BrowserModule } from '@angular/platform-browser';
   import { NgxWigModule } from 'ngx-wig';

   import { AppComponent } from './app.component';

   @NgModule({
     declarations: [
       AppComponent
     ],
     imports: [
       BrowserModule,
       NgxWigModule
     ],
   ```

```
  providers: [],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

`NgxWigModule` is the main module of the ngx-wig library.

3. Create a new Angular component that will host our WYSIWYG editor:

```
ng generate component editor
```

4. Open the template file of the newly generated component, `editor.component.html`, and replace its content with the following HTML snippet:

```
<ngx-wig placeholder="Enter your content"></ngx-wig>
```

`NgxWigModule` exposes a set of Angular services and components we can use in our application. The main component of the module is the `<ngx-wig>` component, which displays the actual WYSIWYG editor. It exposes a collection of input properties that we can set, such as the placeholder of the editor.

5. Open the `app.component.html` file and replace its content with the `<app-editor>` component:

```
<app-editor></app-editor>
```

6. Open the `styles.css` file, which contains global styles for the Angular application, and add the following styles to make the editor dockable and take up the full page:

```
html, body {
  margin: 0;
  width: 100%;
  height: 100%;
}
.ng-wig, .nw-editor-container, .nw-editor  {
  display: flex !important;
  flex-direction: column;
  height: 100% !important;
  overflow: hidden;
}
```

7. Open the main HTML file of the Angular application, `index.html`, and remove the `<base>` tag from the `<head>` element. The browser uses the `<base>` tag to reference scripts and CSS files with a relative URL. Leaving it as is will make our desktop application fail because it will load all necessary assets directly from the local filesystem. We will learn more in the *Integrating Angular with Electron* section.

Let's see what we have achieved so far. Run `ng serve` and navigate to `http://localhost:4200` to preview the application:

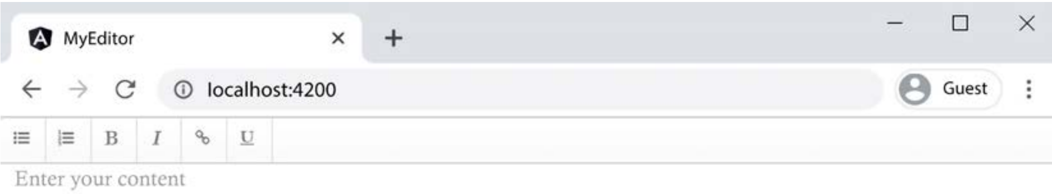

Figure 5.2 – Application output

Our application consists of the following:

- A toolbar with buttons that allows us to apply different styles to the content of the editor
- A text area that is used as the main container to add content to the editor

We have now created a web application using Angular with a fully operational WYSIWYG editor. In the following section, we will learn how to convert it into a desktop one using Electron.

Integrating Electron in the workspace

The Electron framework is an npm package that we can install using the following command:

```
npm install -D electron
```

The previous command will install the latest version of the `electron` npm package in the Angular CLI workspace. It will also add a respective entry into the `devDependencies` section of the `package.json` file of our project.

> Electron is added to the `devDependencies` section of the `package.json` file because it is a development dependency of our application. It is used only to prepare and build our application as a desktop one and not during runtime.

Electron applications run on the Node.js runtime and use the Chromium browser to render. A Node.js application has at least a JavaScript file, usually called `index.js` or `main.js`, which is the main entry point of the application. Since we are using Angular and TypeScript as our development stack, we will start by creating a separate TypeScript file that will be finally compiled in JavaScript:

1. Create a folder named `electron` inside the `src` folder of the Angular CLI workspace. The `electron` folder will contain any source code that is related to Electron.

   > We can think of our application as two different platforms. The web platform is the Angular application, which resides in the `src\app` folder. The desktop platform is the Electron application, which resides in the `src\electron` folder. This approach has many benefits, including that it enforces the separation of concerns in our application and allows each one to develop independently from the other. From now on, we will refer to them as the Angular and Electron applications.

2. Create a `main.ts` file inside the `electron` folder with the following content:

```
import { app, BrowserWindow } from 'electron';

function createWindow () {
  const mainWindow = new BrowserWindow({
    width: 800,
    height: 600
  });
  mainWindow.loadFile('index.html');
}

app.whenReady().then(() => {
  createWindow();
});
```

In the preceding code, we first import the `BrowserWindow` and `app` artifacts from the `electron` npm package. The `BrowserWindow` class is used to create a desktop window for our application. We define the window dimensions, passing an `options` object in its constructor that sets the `width` and `height` values of the window. We then call the `loadFile` method, passing the HTML file we want to load inside the window as a parameter.

The `index.html` file that we pass in the `loadFile` method is the main HTML file of the Angular application. It is loaded using the **file** protocol, which is why we removed the `<base>` tag in the *Adding a WYSIWYG editor library for Angular* section.

The app object is the global object of our desktop application, just like the `window` object on a web page. It exposes a `whenReady` Promise that, when resolved, allows us to run any initialization logic for our application, including creating the window.

3. Create a `tsconfig.json` file inside the `electron` folder and add the following contents:

```
{
  "extends": "../../tsconfig.json",
  "compilerOptions": {
    "importHelpers": false
  },
  "include": [
    "**/*.ts"
  ]
}
```

The `main.ts` file must be compiled into JavaScript because browsers do not understand TypeScript. The compilation process is called **transpilation** and requires a TypeScript configuration file. The configuration file contains options that drive the TypeScript **transpiler**, which is responsible for the transpilation process.

The preceding TypeScript configuration file defines the path of the Electron source code files, using the `include` property, and sets the `importHelpers` property to `false`.

If we enable the `importHelpers` flag, it will include helpers from the **tslib** library in our application, resulting in a larger bundle size.

4. Run the following command to install the **Webpack CLI**:

```
npm install -D webpack-cli
```

The Webpack CLI invokes **webpack**, a popular module bundler, from the command line. We will use webpack to build and bundle our Electron application.

5. Install the `ts-loader` npm package using the following command:

   ```
   npm install -D ts-loader
   ```

   The **ts-loader** library is a webpack plugin that can load TypeScript files.

We have created all the pieces needed to convert our Angular application into a desktop one using Electron. We only need to put them together to build and run our desktop application. The main piece that orchestrates the Electron application is the webpack configuration file that we need to create in the root folder of our Angular CLI workspace:

`webpack.config.js`

```
const path = require('path');
const src = path.join(process.cwd(), 'src', 'electron');

module.exports = {
  mode: 'development',
  devtool: 'source-map',
  entry: path.join(src, 'main.ts'),
  output: {
    path: path.join(process.cwd(), 'dist', 'my-editor'),
    filename: 'shell.js'
  },
  module: {
    rules: [
      {
        test: /\.ts$/,
        loader: 'ts-loader',
        options: {
          configFile: path.join(src, 'tsconfig.json')
        }
      }
    ]
  },
  target: 'electron-main'
};
```

The preceding file configures webpack in our application using the following options:

- `mode`: Indicates that we are currently running in a `development` environment.
- `devtool`: Enables source map file generation for debugging purposes.
- `entry`: Indicates the main entry point of the Electron application, which is the `main.ts` file.
- `output`: Defines the path and the filename of the Electron bundle that will be generated from webpack. The `path` property points to the same folder used by the Angular CLI to create the bundle of the Angular application. The `filename` property is set to `shell.js` because the default one generated from webpack is `main.js`, and it will cause a conflict with the `main.js` file generated from the Angular application.
- `module`: Instructs webpack to load the `ts-loader` plugin to handle TypeScript files.
- `target`: Indicates that we are currently running in the main process of Electron.

The webpack module bundler now contains all the information needed to build and bundle the Electron application. On the other hand, the Angular CLI takes care of building the Angular application. Let's see how we can combine them and run our desktop application:

1. Run the following command to install the `concurrently` npm package:

   ```
   npm install -D concurrently
   ```

   The **concurrently** library enables us to execute multiple processes together. In our case, it will allow us to run the Angular and Electron applications in parallel.

2. Open the `package.json` file and add a new entry in the `scripts` property:

   ```
   "scripts": {
     "ng": "ng",
     "start": "ng serve",
     "build": "ng build",
     "watch": "ng build --watch --configuration development",
     "test": "ng test",
     "start:desktop": "concurrently \"ng build --delete-output-path=false --watch\" \"webpack --watch\""
   }
   ```

   The `start:desktop` script builds the Angular application, using the `ng build` command of the Angular CLI, and the Electron application, using the `webpack` command. Both applications run in watch mode using the `--watch` option, so every time we change the code, the application will rebuild to reflect the change.

The Angular CLI will delete the `dist` folder by default whenever we modify the Angular application. We can prevent this behavior using the `--delete-output-path=false` option because the Electron application is also built in the same folder.

> We did not pass the webpack configuration file to the `webpack` command because it assumes the `webpack.config.js` filename by default.

3. Click on the **Run** menu that exists in the sidebar of Visual Studio Code:

Figure 5.3 – Run menu

4. In the **RUN AND DEBUG** pane that appears, select the **Add Configuration...** option from the drop-down menu:

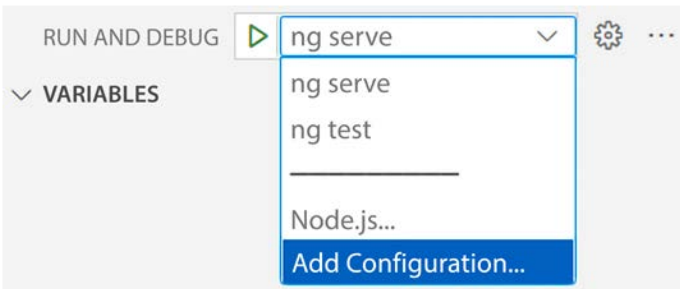

Figure 5.4 – RUN AND DEBUG pane

5. Visual Studio Code will open a drop-down menu that allows us to select the environment to run our application. Select the **{} Node.js: Electron Main** configuration.
6. In the `launch.json` file that opens, set the value of the `program` property to `${workspaceFolder}/dist/my-editor/shell.js`. The `program` property points to the absolute path of the Electron bundle file.

We are now ready to run our desktop application and preview it. Run the following command to build the application:

```
npm run start:desktop
```

The previous command will first build the Electron application and then the Angular one. Wait for the Angular build to finish, select the **Electron Main** option from the drop-down menu of the **RUN AND DEBUG** pane, and click the *Play* button to preview the application:

Figure 5.5 – Application window

In the preceding screenshot, we can see that our Angular application with the WYSIWYG editor is hosted inside a native desktop window. It contains the following characteristics that we usually find in desktop applications:

- The header with an icon
- The main menu
- The minimize, maximize, and close buttons

The Angular application is rendered inside the Chromium browser. To verify that, click the **View** menu item and select the **Toggle Developer Tools** option.

Well done! You have successfully managed to create your own desktop WYSIWYG editor. In the following section, we will learn how to interact between Angular and Electron.

Communicating between Angular and Electron

According to the specifications of the project, the content of the WYSIWYG editor needs to be persisted in the local filesystem. Additionally, the content will be loaded from the filesystem upon application startup.

The Angular application handles any interaction between the WYSIWYG editor and its data using the renderer process, whereas the Electron application manages the filesystem with the main process. Thus, we need to establish an IPC mechanism to communicate between the two Electron processes as follows:

- Configuring the Angular CLI workspace
- Interacting with the editor
- Interacting with the filesystem

Let's start by setting up the Angular CLI project to support the desired communication mechanism.

Configuring the Angular CLI workspace

We need to modify several files to configure the workspace of our application:

1. Open the `main.ts` file that exists in the `src\electron` folder and set the `webPreferences` property in the `BrowserWindow` constructor accordingly:

   ```
   function createWindow () {
     const mainWindow = new BrowserWindow({
       width: 800,
       height: 600,
       webPreferences: {
         nodeIntegration: true,
         contextIsolation: false
       }
     });
     mainWindow.loadFile('index.html');
   }
   ```

   The preceding flags will enable Node.js in the renderer process and expose the `ipcRenderer` interface, which we will need to communicate with the main process.

2. Run the following command to install the `ngx-electronyzer` npm package:

   ```
   npm install ngx-electronyzer
   ```

   The **ngx-electronyzer** library allows us to integrate the Electron API into an Angular application.

The Angular and Electron applications are now ready to interact with each other using the IPC mechanism. Let's start implementing the necessary logic in the Angular application first.

Interacting with the editor

The Angular application is responsible for managing the WYSIWYG editor. The content of the editor is kept in sync with the filesystem using the renderer process of Electron. Let's find out how to use the renderer process:

1. Create a new Angular service using the following command of the Angular CLI:

```
ng generate service editor
```

2. Open the `editor.service.ts` file and inject the `ElectronService` class from the `ngx-electronyzer` npm package:

```
import { Injectable } from '@angular/core';
import { ElectronService } from 'ngx-electronyzer';

@Injectable({
  providedIn: 'root'
})
export class EditorService {

  constructor(private electronService: ElectronService) { }
}
```

The `ElectronService` class exposes part of the Electron API, including the `ipcRenderer` interface we are currently interested in.

3. Create a method that will be called to get the content of the editor from the filesystem:

```
getContent(): Promise<string> {
  return this.electronService.ipcRenderer.invoke('getContent');
}
```

We use the `invoke` method of the `ipcRenderer` property, passing the name of the communication channel as a parameter. The result of the `getContent` method is a `Promise` object of the `string` type, since the content of the editor is raw text data. The `invoke` method initiates a connection with the main process through the `getContent` channel. In the *Interacting with the filesystem* section, we will see how to set up the main process to respond to the `invoke` method call in that channel.

4. Create a method that will be called to save the content of the editor to the filesystem:

   ```
   setContent(content: string) {
     this.electronService.ipcRenderer.invoke('setContent', content);
   }
   ```

   The `setContent` method calls the `invoke` method of the `ipcRenderer` object again but with a different channel name. It also uses the second parameter of the `invoke` method to pass data to the main process. In this case, the `content` parameter will contain the content of the editor. We will see how to configure the main process to handle data in the *Interacting with the filesystem* section.

5. Open the `editor.component.ts` file and create a `myContent` property to hold editor data. Also, inject `EditorService` in the `constructor` of the `EditorComponent` class, and add the `OnInit` interface from the `@angular/core` npm package:

   ```
   import { Component, OnInit } from '@angular/core';
   import { EditorService } from '../editor.service';

   @Component({
     selector: 'app-editor',
     templateUrl: './editor.component.html',
     styleUrls: ['./editor.component.css']
   })
   export class EditorComponent implements OnInit {
     myContent = '';

     constructor(private editorService: EditorService) {}
   }
   ```

6. Create a method that calls the `getContent` method of the `editorService` variable and executes it inside the `ngOnInit` method:

   ```
   ngOnInit(): void {
     this.getContent();
   }

   private async getContent() {
     this.myContent = await this.editorService.getContent();
   }
   ```

We use the `async/await` syntax, which allows the synchronous execution of our code in Promise-based method calls.

7. Create a method that calls the `setContent` method of the `editorService` variable:

```
saveContent(content: string) {
  this.editorService.setContent(content);
}
```

8. Let's bind those methods that we have created with the template of the component. Open the `editor.component.html` file and add the following bindings:

```
<ngx-wig placeholder="Enter your content" [ngModel]="myContent"
(contentChange)="saveContent($event)"></ngx-wig>
```

We use the `ngModel` directive to bind the model of the editor to the `myContent` component property, which will be used to display the content initially. We also use the `contentChange` event binding to save the content of the editor whenever it changes, that is, while the user types.

9. The `ngModel` directive is part of the `@angular/forms` npm package. Import `FormsModule` into the `app.module.ts` file to use it:

```
import { NgModule } from '@angular/core';
import { BrowserModule } from '@angular/platform-browser';
import { FormsModule } from '@angular/forms';
import { NgxWigModule } from 'ngx-wig';

import { AppComponent } from './app.component';
import { EditorComponent } from './editor/editor.component';

@NgModule({
  declarations: [
    AppComponent,
    EditorComponent
  ],
  imports: [
    BrowserModule,
    NgxWigModule,
    FormsModule
  ],
```

```
  providers: [],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

We have implemented all the logic for our Angular application to communicate with the main process. It is time to implement the other end of the communication mechanism, the Electron application, and its main process.

Interacting with the filesystem

The main process interacts with the filesystem using the **fs** library, which is built into the Electron framework. Let's see how we can use it:

1. Open the `main.ts` file that exists in the `src\electron` folder and import the following artifacts:

   ```
   import { app, BrowserWindow, ipcMain } from 'electron';
   import * as fs from 'fs';
   import * as path from 'path';
   ```

   The `fs` library is responsible for interacting with the filesystem. The `path` library provides utilities for working with file and folder paths. The `ipcMain` object allows us to work with the main process of Electron.

2. Create a variable that holds the path of the file containing the content of the editor:

   ```
   const contentFile = path.join(app.getPath('userData'), 'content.
   html');
   ```

   The file that keeps the content of the editor is the `content.html` file that exists inside the reserved `userData` folder. The `userData` folder is an alias for a special purpose system folder, different for each OS, and it is used to store application-specific files such as configuration. You can find more details about the `userData` folder and other system folders at `https://www.electronjs.org/docs/api/app#appgetpathname`.

   The `getPath` method of the app object works cross-platform and is used to get the path of special folders, such as the home directory of a user or the application data.

3. Call the `handle` method of the `ipcMain` object to start listening for requests in the `getContent` channel:

```
ipcMain.handle('getContent', () => {
  if (fs.existsSync(contentFile)) {
    const result = fs.readFileSync(contentFile);
    return result.toString();
  }
  return '';
});
```

When the main process receives a request in this channel, it uses the `existsSync` method of the `fs` library to check whether the file with the content of the editor exists already. If it exists, it reads it using the `readFileSync` method and returns its content to the renderer process.

4. Call the `handle` method again, but this time for the `setContent` channel:

```
ipcMain.handle('setContent', ({}, content: string) => {
  fs.writeFileSync(contentFile, content);
});
```

In the preceding snippet, we use the `writeFileSync` method of the `fs` library to write the value of the `content` property in the file.

Now that we have connected the Angular and the Electron application, it is time to preview our WYSIWYG desktop application:

1. Execute the `start:desktop` npm script, and press *F5* to run the application.
2. Use the editor and its toolbar to enter some content, such as the following:

Figure 5.6 – Editor content

3. Close the application window and rerun the application. If everything worked correctly, you should see the content you entered inside the editor.

Congratulations! You have enriched your WYSIWYG editor by adding persistence capabilities to it. In the following section, we will take the last step toward creating our desktop application and learn how to package and distribute it.

Packaging a desktop application

Web applications are usually bundled and deployed to a hosting web server. On the other hand, desktop applications are bundled and packaged as a single executable file that can be easily distributed. Packaging our WYSIWYG application requires the following steps:

- Configuring webpack for production mode
- Using an Electron bundler

We will look at them in more detail in the following sections.

Configuring webpack for production

We have already created a webpack configuration file for the development environment. We now need to create a new one for production. Both configuration files will share some functionality, so let's start by creating a common one:

1. Create a `webpack.dev.config.js` file in the root folder of the Angular CLI workspace with the following content:

```
const path = require('path');
const baseConfig = require('./webpack.config');

module.exports = {
  ...baseConfig,
  mode: 'development',
  devtool: 'source-map',
  output: {
    path: path.join(process.cwd(), 'dist', 'my-editor'),
    filename: 'shell.js'
  }
};
```

2. Remove the `mode`, `devtool`, and `output` properties from the `webpack.config.js` file.

3. Open the `package.json` file and pass the new webpack development configuration file at the `start:desktop` script:

```
"start:desktop": "concurrently \"ng build --delete-output-path=false
--watch\" \"webpack --config webpack.dev.config.js --watch\""
```

4. Create a `webpack.prod.config.js` file in the root folder of the Angular CLI workspace with the following content:

```
const path = require('path');
const baseConfig = require('./webpack.config');

module.exports = {
  ...baseConfig,
  output: {
    path: path.join(process.cwd(), 'dist', 'my-editor'),
    filename: 'main.js'
  }
};
```

The main difference with the webpack configuration file for the development environment is that we changed the `filename` of the `output` bundle to `main.js`. The Angular CLI adds a hashed number in the `main.js` file of the Angular application in production, so there will be no conflicts.

5. Add a new entry in the `scripts` property of the `package.json` file to build our application in production mode:

```
"scripts": {
  "ng": "ng",
  "start": "ng serve",
  "build": "ng build",
  "watch": "ng build --watch --configuration development",
  "test": "ng test",
  "start:desktop": "concurrently \"ng build --delete-output-
path=false --watch\" \"webpack --config webpack.dev.config.js
--watch\"",
  "build:electron": "ng build && webpack --config webpack.prod.
config.js"
}
```

The `build:electron` script builds the Angular and Electron application in production mode simultaneously.

We have completed all the configurations needed to package our desktop application. In the following section, we will learn how to convert it into a single bundle specific to each OS.

Using an Electron bundler

The Electron framework has various tools created and maintained by the open-source community. One of these tools is the **electron-packager** library, which we can use to package our desktop application as a single executable file for each OS (Windows, Linux, and macOS). Let's see how we can integrate it into our development workflow:

1. Run the following command to install `electron-packager` as a development dependency for our project:

```
npm install -D electron-packager
```

2. Add a new entry in the `scripts` property of the `package.json` file to package our application:

```
"scripts": {
  "ng": "ng",
  "start": "ng serve",
  "build": "ng build",
  "watch": "ng build --watch --configuration development",
  "test": "ng test",
  "start:desktop": "concurrently \"ng build --delete-output-
path=false --watch\" \"webpack --config webpack.dev.config.js
--watch\"",
  "build:electron": "ng build && webpack --config webpack.prod.
config.js",
  "package": "electron-packager dist/my-editor --out=dist --asar"
}
```

In the preceding script, `electron-packager` will read all files in the `dist/my-editor` folder, package them, and output the final bundle in the `dist` folder. The `--asar` option instructs the packager to archive all files in the **ASAR** format, similar to a ZIP or TAR file.

3. Create a `package.json` file in the `src\electron` folder and add the following content:

```
{
  "name": "my-editor",
  "main": "main.js"
}
```

The `electron-packager` library requires a `package.json` file to be present in the output folder, which points to the main entry file of the Electron application.

4. Open the `webpack.prod.config.js` file and add the `CopyWebpackPlugin` in the `plugins` property:

```
const path = require('path');
const baseConfig = require('./webpack.config');
const CopyWebpackPlugin = require('copy-webpack-plugin');

module.exports = {
  ...baseConfig,
  output: {
    path: path.join(process.cwd(), 'dist', 'my-editor'),
    filename: 'main.js'
  },
  plugins: [
    new CopyWebpackPlugin({
      patterns: [
        {
          context: path.join(process.cwd(), 'src',
           'electron'),
          from: 'package.json'
        }
      ]
    })
  ]
};
```

We use the `CopyWebpackPlugin` to copy the `package.json` file from the `src\electron` folder into the `dist\my-editor` folder while building the application in production mode.

5. Run the following command to build the application in production mode:

```
npm run build:electron
```

6. Now run the following `npm` command to package it:

```
npm run package
```

   The preceding command will package the application for the OS you currently run on, which is the default behavior of the `electron-packager` library. You can alter this behavior by passing additional options, which you will find in the GitHub repository of the library, listed in the *Further reading* section.

7. Navigate to the `dist` folder of the Angular CLI workspace. You will find a folder called `my-editor-{OS}`, where `{OS}` is your current OS and its architecture. For example, in Windows, it will be `my-editor-win32-x64`. Open the folder, and you will get the following files:

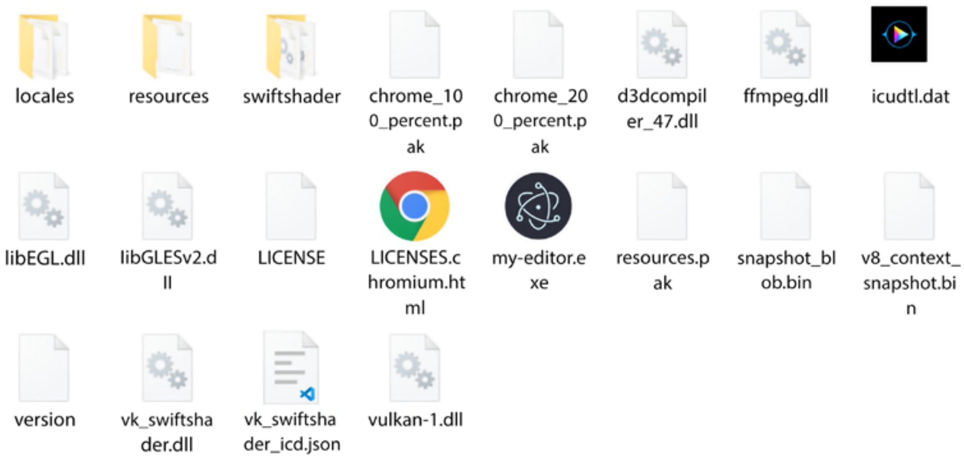

Figure 5.7 – Application package (Windows)

In the preceding screenshot, the `my-editor.exe` file is the executable file of our desktop application. Our application code is not included in this file but in the `app.asar` file, which exists in the `resources` folder.

Run the executable file, and the desktop application should open normally. You can take the whole folder and upload it to a server, or distribute it by any other means. Your WYSIWYG editor can now reach many more users, such as those that are offline most of the time. Awesome!

Summary

In this chapter, we built a WYSIWYG editor for the desktop using Angular and Electron. Initially, we created an Angular application and added `ngx-wig`, a popular Angular WYSIWYG library. Then, we learned how to build an Electron application and implemented a communication mechanism to exchange data between the Angular and Electron applications. Finally, we learned how to bundle our application for packaging and get it ready for distribution.

In the next chapter, we will learn how to build a mobile photo geotagging application with Angular and Ionic.

Practice questions

Let's take a look at a few practice questions:

1. Which class is responsible for creating a desktop window in Electron?
2. How do we communicate between the main and renderer processes in Electron?
3. Which flags enable the use of Node.js in the renderer process?
4. How do we load Electron in an Angular application?
5. Which interface do we use to interact with Electron in an Angular application?
6. How do we pass data to the main Electron process from an Angular application?
7. Which package do we use for filesystem manipulation in Electron?
8. Which library do we use to package an Electron application?

Further reading

Here are some links to build upon what we learned in the chapter:

- Electron: `https://www.electronjs.org`
- Electron quick start: `https://www.electronjs.org/docs/tutorial/quick-start`
- `ngx-wig`: `https://www.npmjs.com/package/ngx-wig`
- Webpack configuration: `https://webpack.js.org/configuration`
- `ts-loader`: `https://webpack.js.org/guides/typescript`
- `ngx-electronyzer`: `https://www.npmjs.com/package/ngx-electronyzer`
- Filesystem API: `https://nodejs.org/api/fs.html`
- `electron-packager`: `https://www.npmjs.com/package/electron-packager`
- `concurrently`: `https://www.npmjs.com/package/concurrently`

6

Building a Mobile Photo Geotagging Application Using Capacitor and 3D Maps

Angular is a cross-platform JavaScript framework that can be used to build applications for different platforms such as web, desktop, and mobile. Moreover, it allows developers to use the same code base and apply the same web techniques to each platform, enjoying the same experience and performance. In this chapter, we will investigate how we can build mobile applications using Angular.

Ionic is a popular UI toolkit that allows us to build mobile applications using web technologies such as Angular. The **Capacitor** library greatly enhances Ionic applications by enabling them to run natively on Android and iOS devices. In this chapter, we will use both technologies to build a mobile application to take geotagged photos and display them on a 3D map.

We will cover the following topics in detail:

- Creating a mobile application with Ionic
- Taking photos with Capacitor
- Storing data in **Firebase**
- Previewing photos with **CesiumJS**

Essential background theory and context

Capacitor is a native mobile runtime that enables us to build Android and iOS applications with web technologies, including Angular. It provides an abstraction API layer for web applications to interact with the native resources of a mobile OS. It does not include a UI layer or any other way of interacting with the user interface.

Ionic is a mobile framework containing a collection of UI components we can use in an application built with Capacitor. The main advantage of Ionic is that we maintain a single code base across all native mobile platforms. That is, we write the code once, and it works everywhere. Ionic supports all popular JavaScript frameworks, including Angular.

Firebase is a **Backend-as-a-Service (BaaS)** platform provided by Google that contains tools and services for building applications. **Cloud Firestore** is a database solution provided by Firebase that features a flexible and scalable NoSQL document-oriented database that can be used in web and mobile applications. **Firebase Storage** is a service that allows us to interact with a storage mechanism and upload or download files.

CesiumJS is a JavaScript library for creating interactive 3D maps in the browser. It is an open-source, cross-platform library that uses WebGL and allows us to share geospatial data on multiple platforms. It is powered by **Cesium**, a platform for building high-quality and performant 3D geospatial applications.

Project overview

In this project, we will build a mobile application that can take photos according to the current location and preview them on a map. Initially, we will learn how to create a mobile application using Angular and Ionic. We will then use Capacitor to take photos using the camera of the mobile device and tag them with the current location via GPS. We will upload those photos to Firebase along with their location data. Finally, we will use CesiumJS to load location data on a 3D globe along with a preview of the photo. The following diagram depicts an architectural overview of the project:

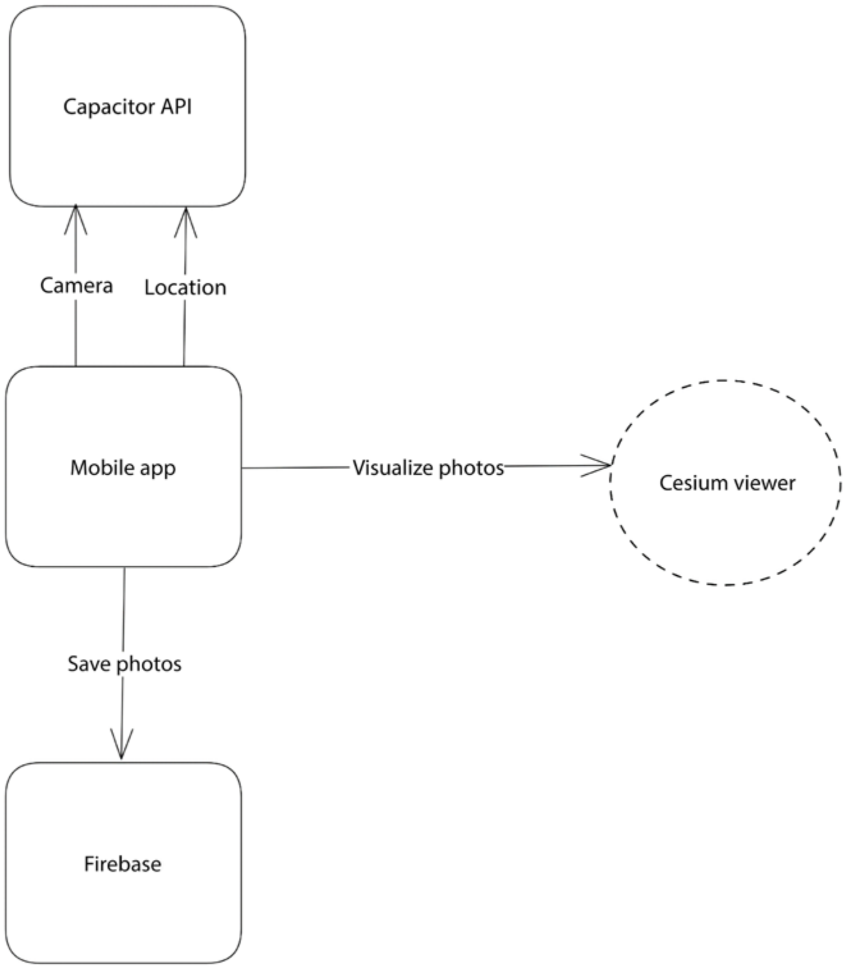

Figure 6.1 – Project architecture

In this chapter, you will learn how to build a mobile application with Angular and Ionic. To follow up with the project and preview your application, you must follow the getting started guide for your development environment (Android or iOS), which you can find in the *Further reading* section.

Build time: 2 hours

Getting started

You will need the following software and tools to complete the project:

- For Android development: **Android Studio** with the latest Android SDK.
- For iOS development: **Xcode** with the iOS SDK and Xcode Command Line Tools.
- A physical mobile device.
- Angular CLI: A command-line interface for Angular that you can find at `https://angular.io/cli`.
- GitHub material: The related code for this chapter can be found in the `Chapter06` folder at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition`.

Creating a mobile application with Ionic

The first step toward building our application is creating a new mobile application using the Ionic toolkit. We will start building our application with the following tasks:

- Scaffolding the application
- Building the main menu

Ionic has a pretty straightforward process for creating a new mobile application from scratch without entering a single line of code.

Scaffolding the application

To create a new Ionic application, complete the following steps:

1. Install the Ionic tooling that we will need using the following command:

   ```
   npm install -g @ionic/cli native-run cordova-res
   ```

   The **Ionic CLI** is used to build and run an Ionic mobile application. The `native-run` library is used to run native libraries on mobile devices and emulators. The `cordova-res` library generates the icons and splash screens of our application for native mobile devices.

2. Run the following command to create a new Angular application that uses the `sidemenu` starter template from Ionic and also adds Capacitor:

   ```
   ionic start phototag sidemenu --type=angular --capacitor
   ```

3. The preceding command will ask you if you want to use Angular modules or standalone components. Select `Standalone` and press *Enter*.

Ionic will create a sample application for us with some ready-made data. In the following section, we will learn how to modify it according to our needs.

Building the main menu

We will start building the main menu of our application according to our specifications:

1. Load the Ionic project we built in the previous section within VSCode and open the main HTML file of the application, `index.html`.
2. Add the name of your application in the `<title>` tag:

```
<title>Phototag App</title>
```

3. Open the template file of the main component, `app.component.html`, and remove the second `<ion-list>` element. An `<ion-list>` element displays items in a list view.
4. Add the name of your application in the `<ion-list-header>` element and change the text of the `<ion-note>` element accordingly:

```
<ion-list-header>Phototag</ion-list-header>
<ion-note>Capture geotagged photos</ion-note>
```

An `<ion-list-header>` element is the header of a list. An `<ion-note>` element is a text element used to provide additional information, such as the subtitle of a list.

5. Open the TypeScript file of the main component, `app.component.ts`, and modify the `AppComponent` class as follows:

```
export class AppComponent {
  public appPages = [
    {
      title: 'Take a photo',
      url: '/capture',
      icon: 'camera'
    },
    {
      title: 'View gallery',
      url: '/view',
      icon: 'globe'
    }
  ];
  constructor() {}
}
```

The `appPages` property contains all the pages of our application. Each page has a `title`, a `url` from which it is accessible, and an `icon`. Our application will consist of two pages, one that will be used for taking photos using the camera and another for displaying them on a map.

6. Run the `serve` command of the Ionic CLI to start the application:

```
ionic serve
```

The preceding command will build your application and open your default browser at `http://localhost:8100`.

You should see the following output in the side menu of the application:

Figure 6.2 – Main menu

> Suppose you adjust your browser window size to achieve a more realistic view for a mobile device or use an emulator like the device toolbar in the Google Chrome developer tools. In that case, you must click the application menu button to see the preceding image.

We have learned how to create a new Ionic application using the Ionic CLI and make modifications according to our needs.

If we try to click on a menu item, we will notice that nothing happens since we have not created the necessary pages to be activated in each case. In the following section, we will learn how to complete this task by building the functionality of the first page.

Taking photos with Capacitor

The first page of our application will allow the user to take photos using the camera. We will use the Capacitor runtime to get access to the native resource of the camera. To implement the page, we need to take the following actions:

- Create the user interface.
- Interact with Capacitor.

Let's start building the user interface of the page.

Creating the user interface

Each page in our application is a different Angular component. To create an Angular component in Ionic, we can use the `generate` command of the Ionic CLI:

```
ionic generate page capture
```

The previous command will perform the following actions:

- Create an Angular component named `capture`.
- Create a related routes file.

Let's start building the logic of our new page now:

1. First, make our page the default when the user opens the application. Open the `app.routes.ts` file and change the first entry of the `routes` property to:

   ```
   {
     path: '',
     redirectTo: 'capture',
     pathMatch: 'full',
   }
   ```

   The empty path is called the **default** routing path and is activated when our application starts up. The `redirectTo` property tells Angular to redirect to the `capture` path, which will load the page we created.

   > You can also remove the `folder/:id` path as it is no longer needed and the whole `src\app\folder` directory from the application, which is part of the Ionic template layout.

2. Open the `capture.page.html` file and replace the contents of the first `<ion-toolbar>` element as follows:

```
<ion-header [translucent]="true">
  <ion-toolbar>
    <ion-buttons slot="start">
      <ion-menu-button color="primary"></ion-menu-button>
    </ion-buttons>
    <ion-title>Take a photo</ion-title>
  </ion-toolbar>
</ion-header>
```

The `<ion-toolbar>` element is part of the `<ion-header>` element, which is the top navigation bar of the page. It contains an `<ion-menu-button>` element for toggling the main menu of the application and an `<ion-title>` element that depicts the title of the page.

3. Modify the title of the second `<ion-toolbar>` element as follows:

```
<ion-title size="large">Take a photo</ion-title>
```

The second `<ion-header>` element will be displayed when the page is expanded, and the main menu is displayed on the screen.

4. Add the following HTML code immediately after the second header:

```
<div id="container">
  <strong class="capitalize">Take a nice photo with your camera</
strong>
  <ion-fab vertical="center" horizontal="center" slot="fixed">
    <ion-fab-button>
      <ion-icon name="camera"></ion-icon>
    </ion-fab-button>
  </ion-fab>
</div>
```

It contains an `<ion-fab-button>` element, which, when clicked, will open the camera of the device to take a photo.

5. Finally, let's add some cool styles to our page. Open the `capture.page.scss` file and enter the following CSS styles:

```
#container {
    text-align: center;
```

```
    position: absolute;
    left: 0;
    right: 0;
    top: 50%;
    transform: translateY(-50%);
}
#container strong {
    font-size: 20px;
    line-height: 26px;
}
#container ion-fab {
    margin-top: 60px;
}
```

Let's run the application using `ionic serve` to get a quick preview of what we have built so far:

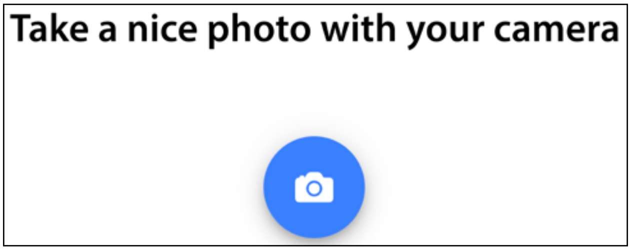

Figure 6.3 – Capture page

The camera button on the page needs to open the camera to take a photo. In the following section, we will learn how to use Capacitor to interact with the camera.

Interacting with Capacitor

Taking photos in our application involves using two APIs from the Capacitor library. The **Camera API** will open the camera to take a photo, and the **Geolocation API** will read the current location from the GPS. Let's see how we can use both in our application:

1. Execute the following `npm` command to install both APIs:

```
npm install @capacitor/camera @capacitor/geolocation
```

2. Create an Angular service using the following Ionic CLI command:

```
ionic generate service photo
```

3. Open the `photo.service.ts` file and add the following `import` statements:

```
import { Camera, CameraResultType, CameraSource } from '@capacitor/
camera';
import { Geolocation } from '@capacitor/geolocation';
```

4. Create a method in the `PhotoService` class to read the current position from the GPS device:

```
private async getLocation() {
  const location = await Geolocation.getCurrentPosition();
  return location.coords;
}
```

The `getCurrentPosition` method of the `Geolocation` object contains a `coords` property with various location-based data such as the latitude and the longitude.

5. Create another method that calls the `getLocation` method and opens the camera of the device to take a photo:

```
async takePhoto() {
  await this.getLocation();
  await Camera.getPhoto({
    resultType: CameraResultType.DataUrl,
    source: CameraSource.Camera,
    quality: 100
  });
}
```

We use the `getPhoto` method of the `Camera` object and pass a configuration object to define the properties for each photo. The `resultType` property indicates that the photo will be in a **data URL** format to save it to Firebase later easily. The `source` property indicates that we will use the camera device to get the photo, and the `quality` property defines the quality of the actual photo.

6. Open the `capture.page.ts` file and inject `PhotoService` in the `constructor` of the `CapturePage` class:

```
import { Component, OnInit } from '@angular/core';
import { CommonModule } from '@angular/common';
import { FormsModule } from '@angular/forms';
import { IonicModule } from '@ionic/angular';
import { PhotoService } from '../photo.service';
```

```
@Component({
  selector: 'app-capture',
  templateUrl: './capture.page.html',
  styleUrls: ['./capture.page.scss'],
  standalone: true,
  imports: [IonicModule, CommonModule, FormsModule]
})
export class CapturePage implements OnInit {

  constructor(private photoService: PhotoService) { }

  ngOnInit() {
  }

}
```

7. Create a component method that will call the `takePhoto` method of the `photoService` variable:

```
openCamera() {
  this.photoService.takePhoto();
}
```

8. Open the `capture.page.html` file and bind the `click` event of the `<ion-fab-button>` element to the `openCamera` component method:

```
<ion-fab-button (click)="openCamera()">
  <ion-icon name="camera"></ion-icon>
</ion-fab-button>
```

We have now added all the necessary pieces to take a photo using the camera of the device. Let's try to run the application on a real device to test the interaction with the camera:

1. First, we need to build our application using the following Ionic CLI command:

```
ionic build
```

The preceding command will create a `www` folder in the root folder of your project that contains your application bundle.

2. Run the following command to open the application in the development environment of your chosen platform:

```
ionic cap open <os>
```

In the previous command, `<os>` can be either **android** or **ios**. Upon execution, it will open the native mobile project in the respective IDE, Android Studio, or Xcode, depending on the platform that you are targeting. The IDE must then be used to run the native application.

> Whenever you want to rebuild the application, you must run the `ionic cap copy` command to copy the application bundle from the `www` folder into the native mobile project.

3. Click on the camera button. The application may ask your permission to use the GPS and the camera. Alternatively, you may need to enable location settings on your device before continuing.

> You will probably need to add additional permissions in the native mobile project of your development environment. Check the respective documentation of the APIs on the Capacitor website.

The first page of our application now has a sleek interface that allows the user to interact with the camera. We have also created an Angular service that ensures a seamless interaction with Capacitor to get location-based data and take photos. In the following section, we will see how to save them in the cloud using Firebase.

Storing data in Firebase

The application will be able to store photos and their location in Firebase. We will use the Storage service to upload our photos and the Cloud Firestore database to keep their location. We will further expand our application in the following tasks:

- Creating a Firebase project
- Integrating the **AngularFire** library

First, we must set up a new Firebase project for our application.

Creating a Firebase project

We can set up and configure a Firebase project using the **Firebase console** at `https://console.firebase.google.com`:

1. Click on the **Add project** button to create a new Firebase project:

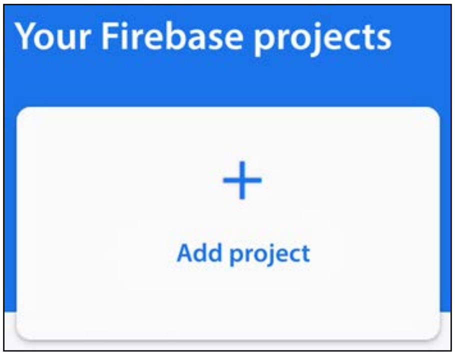

Figure 6.4 – Create a new Firebase project

2. Enter a name for your project and click the **Continue** button:

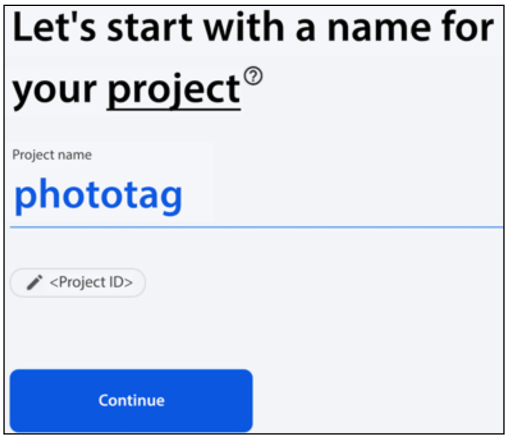

Figure 6.5 – Enter the project name

> Firebase generates a unique identifier for your project, which is located underneath the project name and is used in various Firebase services.

3. Disable **Google Analytics** for this project and click on the **Create project** button:

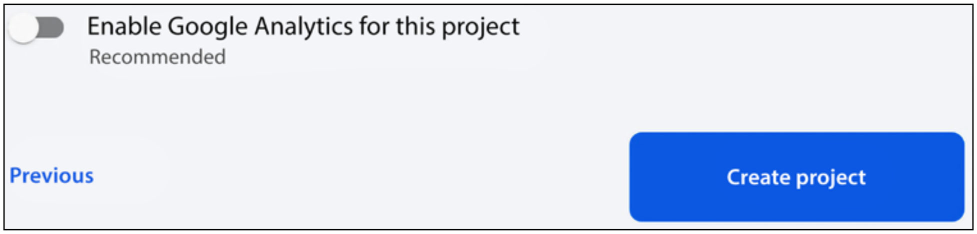

Figure 6.6 – Disable Google Analytics

4. Wait for the new project to be created and click the **Continue** button. You will be redirected to the dashboard of your new project, which contains a list of options:

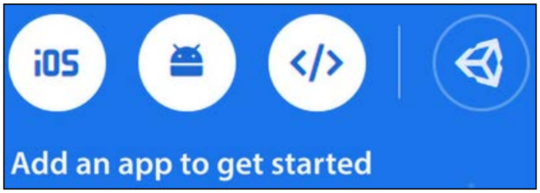

Figure 6.7 – Select the type of your application

Click the third option with the *code* icon to add Firebase to a web application.

5. Enter a name for your application in the **App nickname** field and click on the **Register app** button:

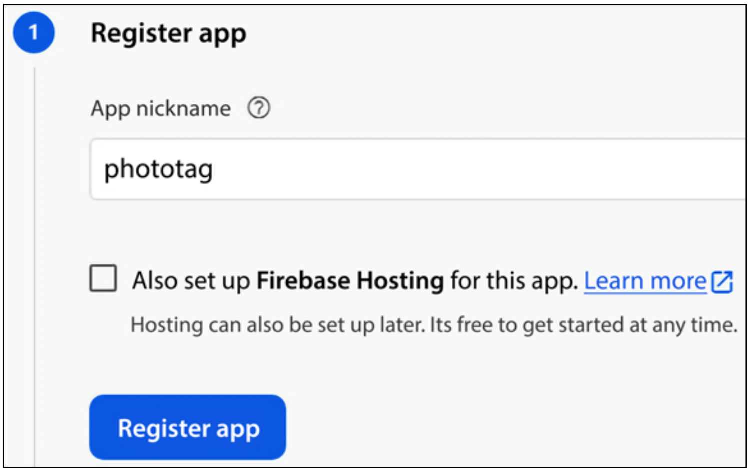

Figure 6.8 – Application registration

6. Firebase will generate a configuration that we will use later in the mobile application:

```
const firebaseConfig = {
  apiKey: "<Your API key>",
  authDomain: "<Your project auth domain>",
  projectId: "<Your project ID>",
  storageBucket: "<Your storage bucket>",
  messagingSenderId: "<Your messaging sender ID>",
  appId: "<Your application ID>"
};
```

Copy the `firebaseConfig` object and click the **Continue to console** button.

> The Firebase configuration can also be accessed later at `https://console.firebase.google.com/project/<project-id>/settings/general`, where `project-id` is the ID of your Firebase project.

7. Back in the dashboard console, select the **Cloud Firestore** option to enable Cloud Firestore in your application.
8. Click on the **Create database** button to create a new Cloud Firestore database:

Figure 6.9 – Create a database

9. Select the operation mode of your database. Choose **Start in Test mode** for development purposes and click the **Next** button:

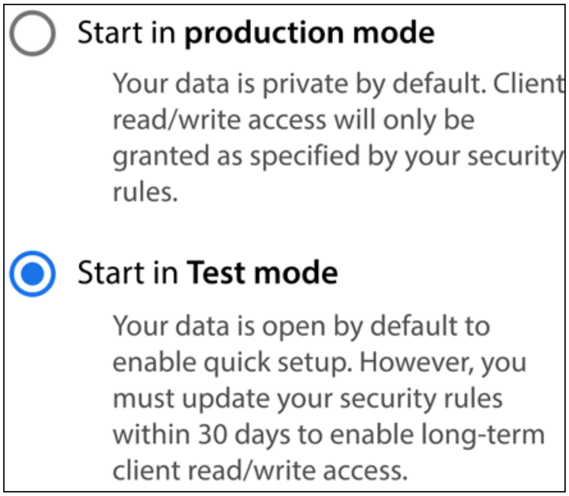

Figure 6.10 – Select operation mode

Choosing a mode is nothing less than setting rules for your database. Test mode allows faster setup and keeps your data public for 30 days. When you are ready to move your application into production, you can modify the rules of your database accordingly to make your data private.

10. Choose a location for your database according to your regional settings and click the **Enable** button.

Congratulations! You have created a new Cloud Firestore database. In the next section, we will learn how to use the new database for saving data with our mobile application.

Integrating the AngularFire library

The AngularFire library is an Angular library that we can use in an Angular application to interact with Firebase family products such as Cloud Firestore and the Storage service. To install it in our application:

1. Run the following command in a terminal window to install **Firebase tools**:

```
npm install -g firebase-tools
```

2. Run the following command in the same terminal window to authenticate with the Firebase CLI:

```
firebase login
```

3. Finally, run the following command of the Angular CLI to install the `@angular/fire` npm package in your Angular CLI project:

   ```
   ng add @angular/fire
   ```

   The preceding command will find the latest version of the library and prompt us to install it.

4. First, it will ask what features of Firebase we want to enable:

   ```
   ? What features would you like to setup?
   ```

   Make sure that you select *only* the `Firestore` option and press *Enter*.

5. Then, it will ask us to select which Firebase account we want to use:

   ```
   ? Which Firebase account would you like to use?
   ```

   Ensure the account you used earlier is selected, and press *Enter*.

6. In the next question, we will choose for which project we are going to use Firestore:

   ```
   ? Please select a project:
   ```

   Select the `phototag` project that we created earlier and press *Enter*.

7. Finally, we must choose the app that has Firestore enabled:

   ```
   ? Please select an app:
   ```

   Select the `phototag` app that we created earlier and press *Enter*.

   > The preceding command may throw an error stating that the `app.module.ts` file does not exist. Please ignore it and continue with the next step.

8. Open the `main.ts` file and add the following `import` statements:

   ```
   import { provideFirebaseApp, initializeApp } from '@angular/fire/app';
   import { getFirestore, provideFirestore } from '@angular/fire/firestore';
   import { getStorage, provideStorage } from '@angular/fire/storage';
   ```

9. Finally, modify the `providers` array in the `bootstrapApplication` method as follows:

```
bootstrapApplication(AppComponent, {
  providers: [
    { provide: RouteReuseStrategy, useClass: IonicRouteStrategy },
    importProvidersFrom(IonicModule.forRoot({})),
    provideRouter(routes),
    importProvidersFrom(provideFirebaseApp(() =>
initializeApp(<firebaseConfig>))),
    importProvidersFrom(provideFirestore(() => getFirestore())),
    importProvidersFrom(provideStorage(() => getStorage()))
  ]
});
```

Replace `<firebaseConfig>` with the Firebase configuration object that you copied in the previous section.

Let's see now how we can use the AngularFire library in our application:

1. Open the `photo.service.ts` file and add the following `import` statements:

```
import { Firestore, collection, addDoc } from '@angular/fire/
firestore';
import { Storage, ref, uploadString, getDownloadURL } from '@
angular/fire/storage';
```

The `Firestore` service contains all the necessary methods that we will need to interact with our Cloud Firestore database. The `Storage` service contains methods for uploading files to the Storage service.

2. Inject both services into the `constructor` of the `PhotoService` class:

```
constructor(private firestore: Firestore, private storage: Storage)
{}
```

3. Create the following method to save a photo in Firebase:

```
private async savePhoto(dataUrl: string, latitude: number,
longitude: number) {
  const name = new Date().getUTCMilliseconds().toString();
  const storageRef = ref(this.storage, name);
  await uploadString(storageRef, dataUrl, 'data_url');
  const photoUrl = await getDownloadURL(storageRef);
```

```
    const photoCollection = collection(this.firestore, 'photos');
    await addDoc(photoCollection, {
      url: photoUrl,
      lat: latitude,
      lng: longitude
    })
  }
```

First, we create a random `name` for our photo and use the `uploadString` method to upload it to Firebase storage. As soon as uploading has been completed, we get a downloadable URL using the `getDownloadURL` method, which can be used to access that photo. Finally, we use the `addDoc` method to add a new photo in the `photocollection` property of the Firestore database.

4. Modify the `takePhoto` method to call the `savePhoto` method that we created in the previous step:

```
async takePhoto() {
  const {latitude, longitude} = await this.getLocation();
  const cameraPhoto = await Camera.getPhoto({
    resultType: CameraResultType.DataUrl,
    source: CameraSource.Camera,
    quality: 100
  });

  if (cameraPhoto.dataUrl) {
    await this.savePhoto(cameraPhoto.dataUrl, latitude, longitude);
  }
}
```

We are now ready to check the full functionality of the photo-shooting process:

1. Run the following command of Capacitor to copy the application bundle to the native mobile project:

```
ionic cap copy
```

2. Open the native mobile project using the `open` command of Capacitor and run the project using the respective IDE.

3. Open the Firebase console of your application and select the **Storage** option in the **Build** section. Click on the **Get started** button, select the **Start in Test mode** option, and click **Next**. Finally, click **Done** to complete the process of setting up cloud storage.
4. Use the application to take a nice photo. To verify that your photo has been successfully uploaded to Firebase, refresh the page in the Firebase console. You should see an entry like the following:

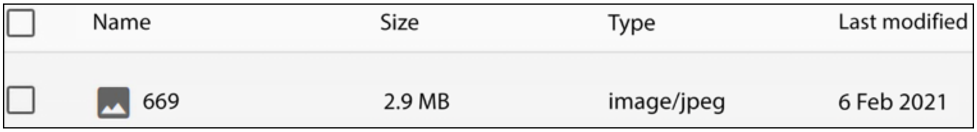

Figure 6.11 – Firebase storage

5. Similarly, select the **Firestore Database** option in the **Build** section, and you should see something like the following:

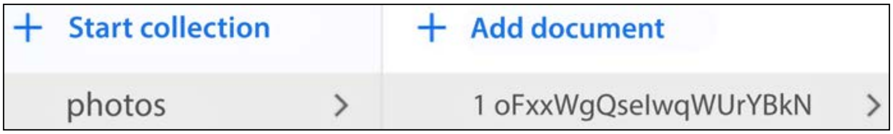

Figure 6.12 – Cloud Firestore

In the preceding screenshot, the **1oFxxWgQseIwqWUrYBkN** entry is the logical object of the photo that contains the URL of the actual file and its location data.

The first page of our application is now feature-complete. We have gone through the full process of taking and uploading a photo to Firebase, along with its location data. We started by setting up and configuring a Firebase project and finished by learning how to use the AngularFire library to interact with that project. In the next section, we will reach our final destination by implementing the second page of our application.

Previewing photos with CesiumJS

The next feature of our application will be to display all the photos we have taken with the camera on a 3D map. The CesiumJS library provides a viewer with a 3D globe that we can use to visualize various things, such as images in specific locations. This new feature of our application will consist of the following:

- Configuring CesiumJS
- Displaying photos on the viewer

We will begin by learning how to set up the CesiumJS library.

Configuring CesiumJS

The CesiumJS library is an npm package that we can install to start working with 3D maps and visualizations:

1. Run the following `npm` command to install CesiumJS:

```
npm install cesium
```

2. Open the `angular.json` configuration file and add the following entries in the `assets` array of the `build` architect option:

```
{
  "glob": "**/*",
  "input": "node_modules/cesium/Build/Cesium/Workers",
  "output": "/assets/cesium/Workers"
},
{
  "glob": "**/*",
  "input": "node_modules/cesium/Build/Cesium/ThirdParty",
  "output": "/assets/cesium/ThirdParty"
},
{
  "glob": "**/*",
  "input": "node_modules/cesium/Build/Cesium/Assets",
  "output": "/assets/cesium/Assets"
},
{
  "glob": "**/*",
  "input": "node_modules/cesium/Build/Cesium/Widgets",
  "output": "/assets/cesium/Widgets"
}
```

The preceding entries will copy all CesiumJS source files into a `cesium` folder inside the `assets` folder of our application.

3. Also, add the CesiumJS widgets style sheet file into the `styles` array of the `build` section:

```
"styles": [
  "node_modules/cesium/Build/Cesium/Widgets/widgets.css",
  "src/theme/variables.scss",
  "src/global.scss"
]
```

   The viewer of CesiumJS contains a toolbar with widgets, including a search bar and a dropdown for selecting a specific type of map, such as Bing Maps or Mapbox.

4. Open the main entry point file of our application, `main.ts`, and add the following line:

```
(window as Record<string, any>)['CESIUM_BASE_URL'] = '/assets/
cesium/';
```

   The `CESIUM_BASE_URL` global variable indicates the location of the CesiumJS source files.

5. Install a custom webpack builder using the following `npm` command:

```
npm install -D @angular-builders/custom-webpack
```

   A **builder** is an Angular library that extends the default functionality of the Angular CLI. The `@angular-builders/custom-webpack` builder allows us to provide an additional webpack configuration file while building our application. It is beneficial in cases where we want to include other webpack plugins or override existing functionality.

6. Create a new webpack configuration file named `extra-webpack.config.js` in the root folder of the project and add the following content:

```
module.exports = {
  resolve: {
    fallback: {
      "https": false,
      "zlib": false,
      "http": false,
      "url": false
    }
  },
  module: {
    unknownContextCritical: false
  }
};
```

The configuration file will ensure that webpack will only try to load CesiumJS code that it can understand. CesiumJS uses modules in a format that cannot be statically analyzed using webpack.

7. Open the `angular.json` file and change the `builder` property of the `build` architect section to use the custom webpack builder:

```
"builder": "@angular-builders/custom-webpack:browser"
```

8. Define the path of the custom webpack configuration file in the `options` property of the `build` section:

```
"customWebpackConfig": {
  "path": "./extra-webpack.config.js"
}
```

9. Also configure the `serve` architect section to use the custom webpack builder:

```
"serve": {
  "builder": "@angular-builders/custom-webpack:dev-server",
  "configurations": {
    "production": {
      "browserTarget": "app:build:production"
    },
    "development": {
      "browserTarget": "app:build:development"
    },
    "ci": {
      "progress": false
    }
  },
  "defaultConfiguration": "development"
}
```

Now that we have completed the configuration of the CesiumJS library, we can start creating the page for our feature:

1. Run the following command of the Ionic CLI to create a new page:

```
ionic generate page view
```

2. Open the `view.page.html` file and modify the first `<ion-header>` element so that it includes a menu toggle button:

```
<ion-header [translucent]="true">
  <ion-toolbar>
    <ion-buttons slot="start">
      <ion-menu-button color="primary"></ion-menu-button>
    </ion-buttons>
    <ion-title>View gallery</ion-title>
  </ion-toolbar>
</ion-header>
```

3. Change the title of the `<ion-content>` element and add a `<div>` element that will be the container for our viewer:

```
<ion-content [fullscreen]="true">
  <ion-header collapse="condense">
    <ion-toolbar>
      <ion-title size="large">View gallery</ion-title>
    </ion-toolbar>
  </ion-header>
  <div #mapContainer></div>
</ion-content>
```

The `#mapContainer` is a **template reference variable** we use to declare an alias for an element in our template.

4. Open the `view.page.scss` file and set the size of the map container element:

```
div {
  height: 100%;
  width: 100%;
}
```

5. Let's create our viewer now. Open the `view.page.ts` file and modify it as follows:

```
import { AfterViewInit, Component, ElementRef, OnInit, ViewChild }
from '@angular/core';
import { CommonModule } from '@angular/common';
import { FormsModule } from '@angular/forms';
```

```
import { IonicModule } from '@ionic/angular';
import { Viewer } from 'cesium';

@Component({
  selector: 'app-view',
  templateUrl: './view.page.html',
  styleUrls: ['./view.page.scss'],
  standalone: true,
  imports: [IonicModule, CommonModule, FormsModule]
})
export class ViewPage implements OnInit, AfterViewInit {

  @ViewChild('mapContainer') content: ElementRef | undefined;

  constructor() { }

  ngOnInit() {
  }

  ngAfterViewInit() {
    const viewer = new Viewer(this.content?.nativeElement);
  }

}
```

We create a new `Viewer` object inside the `ngAfterViewInit` method of the component. The `ngAfterViewInit` method is called when the view of the component has finished loading, and it is defined in the `AfterViewInit` interface. The constructor of the `Viewer` class accepts as a parameter the native HTML element on which we want to create the viewer. In our case, we want to attach it to the map container element that we created earlier. Thus, we use the `@ViewChild` decorator to reference that element by passing the template reference variable name as a parameter.

6. Run the application using `ionic serve` and click on the **View gallery** option from the main menu. You should see the following output:

Figure 6.13 – View gallery page

We have now successfully configured the CesiumJS library in our application. In the next section, we will see how to benefit from it and display our photos on the 3D globe of the CesiumJS viewer.

Displaying photos on the viewer

The next thing we need to do for our application to be ready is display our photos on the map. We will get all the photos from Firebase and add them to the viewer in the specified locations. Let's see how we can accomplish that:

1. Create a new Angular service using the following command of the Ionic CLI:

```
ionic generate service cesium
```

2. Open the `cesium.service.ts` file and add the following `import` statements:

```
import { Firestore, collection, getDocs } from '@angular/fire/
firestore';
import { Cartesian3, Color, PinBuilder, Viewer } from 'cesium';
import { Observable } from 'rxjs';
import { map } from 'rxjs/operators';
```

3. Inject the `Firestore` service in the `constructor` of the `CesiumService` class and create a `viewer` property, which we will use to store our `Viewer` object:

```
export class CesiumService {
  private viewer: Viewer | undefined;

  constructor(private firestore: Firestore) { }
}
```

4. Create a `register` method to set the `viewer` property:

```
register(viewer: Viewer) {
  this.viewer = viewer;
}
```

5. Create a method to get the `photos` collection from Cloud Firestore:

```
private async getPhotos() {
  const photoCollection = collection(this.firestore, 'photos');
  return await getDocs(photoCollection);
}
```

In the preceding method, we call the `getDocs` method to get the data of the `photos` collection.

6. Create the following method for adding all the photos to the viewer:

```
async addPhotos() {
  const pinBuilder = new PinBuilder();
  const photos = await this.getPhotos();
  photos.forEach(photo => {
```

```
    const entity = {
      position: Cartesian3.fromDegrees(photo.get('lng'), photo.
get('lat')),
      billboard: {
        image: pinBuilder.fromColor(Color.
fromCssColorString('#de6b45'), 48).toDataURL()
      },
      description: `<img width="100%" style="margin:auto; display:
block;" src="${photo.get('url')}" />`
    };
    this.viewer?.entities.add(entity);
  });
}
```

The location of each photo on the viewer will be displayed as a **pin**. Thus, we need to initialize a `PinBuilder` object first. The preceding method calls the `getPhotos` method to get all photos from Cloud Firestore. For each photo, it creates an `entity` object that contains the `position`, which is the location of the photo in degrees, and a `billboard` property that displays a pin of 48 pixels in size. It also defines a `description` property that will show the actual image of the photo when we click on the pin.

Each `entity` object is added to the `entities` collection of the viewer using its `add` method.

7. The description of each photo is displayed inside an **info box**. Open the `global.scss` file that contains the global styles of the application and add the following CSS styles for the info box:

```
.cesium-infoBox, .cesium-infoBox-iframe {
  height: 100% !important;
  width: 100%;
}
```

8. Now, let's use `CesiumService` from our page. Open the `view.page.ts` file and inject the `CesiumService` class into the `constructor` of the `ViewPage` class:

```
import { AfterViewInit, Component, ElementRef, OnInit, ViewChild }
from '@angular/core';
import { CommonModule } from '@angular/common';
import { FormsModule } from '@angular/forms';
import { IonicModule } from '@ionic/angular';
```

```
import { Viewer } from 'cesium';
import { CesiumService } from '../cesium.service';

@Component({
  selector: 'app-view',
  templateUrl: './view.page.html',
  styleUrls: ['./view.page.scss'],
  standalone: true,
  imports: [IonicModule, CommonModule, FormsModule]
})
export class ViewPage implements OnInit, AfterViewInit {

  @ViewChild('mapContainer') content: ElementRef | undefined;

  constructor(private cesiumService: CesiumService) { }

  ngOnInit() {
  }

  ngAfterViewInit() {
    const viewer = new Viewer(this.content?.nativeElement);
  }

}
```

9. Modify the `ngAfterViewInit` method to register the viewer and add the photos:

```
ngAfterViewInit() {
  this.cesiumService.register(new Viewer(this.content?.
nativeElement));
  this.cesiumService.addPhotos();
}
```

We are now ready to view our photos on the map:

1. Run the application using the `ionic serve` command.
2. Use the application to take nice photos, preferably in different locations.

3. Select the **View gallery** option from the main menu, and you should get an output like the following:

Figure 6.14 – Photos on the map

4. Click on one of the pins on the map, and you should see your photo:

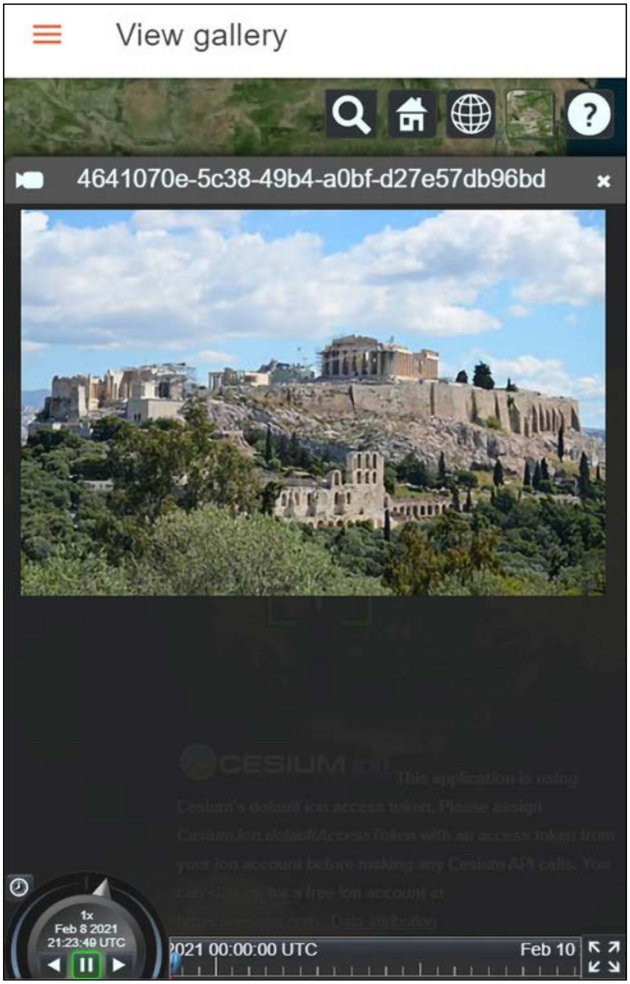

Figure 6.15 – Photo display

We now have a complete mobile application for taking geotagged photos and displaying them on a map. We saw how to set up the CesiumJS library and get our photos from Cloud Firestore. The API of the CesiumJS viewer provided us with an easy way to visualize our photos on the map and interact with them.

Summary

In this chapter, we built a mobile application for taking photos, tagging them with the current location, and displaying them on a 3D map. Initially, we learned how to create a new mobile application using the Ionic framework. We built the application locally and integrated Capacitor to interact with the camera and the GPS device. The camera was used to take photos, and the GPS to mark them with the location.

Later on, we used Firebase services to store our photo files and data in the cloud. Finally, we learned how to retrieve the stored photos from Firebase and display them on a 3D globe using the CesiumJS library.

In the next chapter, we will investigate another way to prerender content in Angular. We will use server-side rendering techniques to create a GitHub portfolio website.

Practice questions

1. Which toolkit can we use to create a UI in a Capacitor application?
2. Which method do we use to take photos with the camera in a Capacitor application?
3. How do we read the current location in a Capacitor application?
4. How do we add a menu toggle button with Ionic?
5. Which Capacitor command do we use to sync the application bundle with native mobile projects?
6. What is the difference between test and production modes in Cloud Firestore?
7. How do we initialize an application with the AngularFire library?
8. Which method do we use to fetch data from a Cloud Firestore collection?
9. How do we create a pin using the CesiumJS library?
10. How do we convert latitude and longitude to degrees using CesiumJS?

Further reading

- Getting started with Capacitor: `https://capacitorjs.com/docs/getting-started`
- Android getting started guide for Capacitor: `https://capacitorjs.com/docs/android#getting-started`
- iOS getting started guide for Capacitor: `https://capacitorjs.com/docs/ios#getting-started`

- Angular development with Ionic: `https://ionicframework.com/docs/angular/overview`
- AngularFire library documentation: `https://firebaseopensource.com/projects/angular/angularfire2`
- CesiumJS quick start guide: `https://cesium.com/docs/tutorials/quick-start`
- CesiumJS and Angular article: `https://cesium.com/blog/2018/03/12/cesium-and-angular`

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`https://packt.link/AngularProjects3e`

7

Building an SSR Application for a GitHub Portfolio Using Angular

A typical Angular application follows the **Single-Page Application (SPA)** approach, where each page is created in the DOM of the browser while the user interacts with the application. A web server hosts the application and serves only the main page, usually called `index.html`, at application startup.

Server-Side Rendering (SSR) is a technique that follows an entirely different approach for application rendering than SPA. It uses the server to prerender pages when the user requests them at runtime. Rendering content on the server dramatically enhances the performance of a web application and improves its **Search Engine Optimization (SEO)** capabilities. To perform SSR in an Angular application, we use a library called **Angular Universal**.

In this chapter, we will learn how to benefit from Angular Universal by building a portfolio application using the **GitHub API**. We will cover the following topics:

- Building an Angular application with the GitHub API
- Integrating Angular Universal
- Prerendering content during build
- Enhancing SEO capabilities

Essential background theory and context

An Angular application consists of several pages created dynamically in the DOM of the browser by the Angular framework while we use the application. Angular Universal enables the Angular framework to create these pages on the server statically during application runtime. In other words, it can create a fully static version of an Angular application that can run even without needing to have JavaScript enabled. Prerendering an application on the server has the following advantages:

- It allows web crawlers to index the application and make it discoverable and linkable on social media websites.
- It makes the application usable on mobile and other low-performant devices that cannot afford to execute JavaScript on their side.
- It improves the user experience by loading the first page quickly and, at the same time, loading the actual client page in the background (**First Contentful Paint (FCP)**).

The GitHub API is an HTTP REST API for interacting with GitHub data. It can be used publicly or privately using an authentication mechanism provided out of the box.

> Unauthorized requests to the GitHub API are limited to 60 requests per hour. For an overview of the available authentication methods, you can find more details at `https://docs.github.com/en/rest/overview/authenticating-to-the-rest-api`.

We use the built-in HTTP client available in the `@angular/common/http` npm package to communicate over HTTP in Angular. Interacting with HTTP in SSR applications may result in duplicated HTTP requests due to the page prerendering at the FCP. However, Angular Universal can overcome this type of duplication using a mechanism called **TransferState**.

Project overview

In this project, we will build a portfolio application for our GitHub user profile. We will initially use the Angular CLI to scaffold an Angular application that interacts with the GitHub API. We will learn how to use the GitHub API and fetch user-specific data. We will also use the **Bootstrap CSS** library to style our application and create a beautiful user interface.

After creating our Angular application, we will turn it into a server-side-rendered application using Angular Universal. We will see how to install and configure Angular Universal, and we will learn how to prerender it during build time.

Then, we will configure our application to render using SEO in the most popular social platforms correctly. The following diagram depicts an architectural overview of the project:

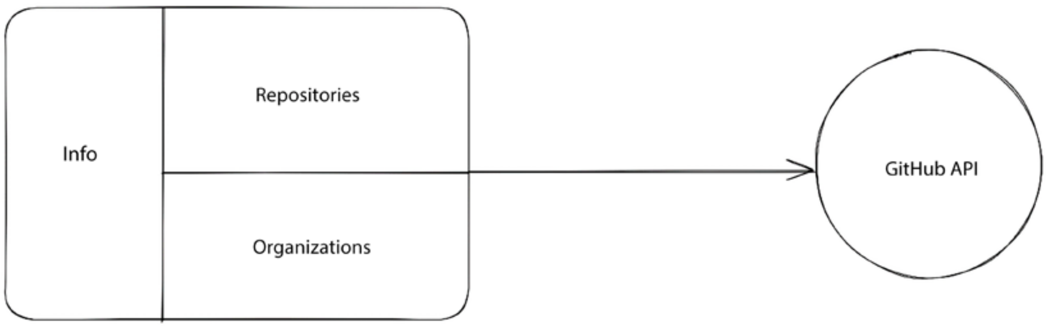

Figure 7.1 – Project architecture

Build time: 2 hours

Getting started

The following prerequisites and software tools are required to complete this project:

- **GitHub account**: A valid GitHub user account.
- **Angular CLI**: A CLI for Angular that you can find at `https://angular.io/cli`.
- **GitHub material**: The related code for this chapter can be found in the `Chapter07` folder at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition`.

Building an Angular application with the GitHub API

GitHub contains an API that we can use to fetch various information about the profile of a GitHub user. The Angular application we are building will communicate with the GitHub API and display a brief portfolio for our GitHub profile. Our application will consist of the following features:

- **Dashboard**: This will be the landing page of the application, and it will display a summary of our GitHub profile.
- **Info**: This will display personal information about us.
- **Repositories**: This will display a list of our *public* repositories.
- **Organizations**: This will display a list of GitHub organizations of which we are members.

The resulting output of each feature that is displayed in the screenshots of this chapter will be different according to your GitHub profile.

The dashboard will be the main page of the application, and it will contain all the other features. We will learn how to build the dashboard page in the following section.

Building the dashboard

Before we can start creating the main features of our application, we need to scaffold and configure an Angular application by running the following command:

```
ng new gh-portfolio --routing=false --style=scss
```

The preceding command will use the `ng new` command of the Angular CLI, passing the following options:

- `gh-portfolio`: The name of the Angular application that we want to create
- `--routing=false`: Disables routing because our application will consist of a single page
- `--style=scss`: Configures the Angular application to use the SCSS stylesheet format when working with CSS styles

We will use the Bootstrap CSS library for styling our portfolio application. Let's see how to install and configure it in the Angular CLI application that we have just created:

1. Execute the following `npm` command to install the Bootstrap CSS library:

   ```
   npm install bootstrap
   ```

2. Open the `src\styles.scss` file and import the Bootstrap SCSS stylesheet:

   ```
   @import "bootstrap/scss/bootstrap";
   ```

   The `styles.scss` file contains CSS styles that are applied globally to the application. The `@import` CSS rule accepts the absolute path of a stylesheet file we want to load.

   When we import a stylesheet format using the `@import` rule, we omit the extension of the file.

3. Execute the following command to install **Bootstrap Icons**, a free and open-source icon library:

```
npm install bootstrap-icons
```

Bootstrap Icons can be used in various formats, such as SVG or font. In this project, we are going to use the latter.

4. Import the font icon format of the Bootstrap Icons library into the `styles.scss` file:

```
@import "bootstrap/scss/bootstrap";
@import "bootstrap-icons/font/bootstrap-icons";
```

We have already created the Angular application and added the necessary artifacts for styling it. We are now ready to start creating the main page of our Angular application:

1. Download an Angular logo of your choice from the **press kit** of the official Angular documentation at `https://angular.io/presskit`.
2. Copy the downloaded logo file into the `src\assets` folder of the Angular CLI workspace. The `assets` folder is used for static files such as images, fonts, and JSON files.
3. Open the `app.component.ts` file and create a `username` property in the `AppComponent` class that holds your GitHub login as a value:

```
export class AppComponent {
  title = 'gh-portfolio';
  username = '<Your GitHub login>';
}
```

4. Open the `app.component.html` file and replace its content with the following HTML template:

```
<div class="toolbar d-flex align-items-center">
  <img width="40" alt="Angular Logo" src="assets/angular.png" />
  <span>Welcome to my GitHub portfolio</span>
  <a class="ms-auto p-2" target="_blank" rel="noopener"
href="https://github.com/{{username}}" title="GitHub">
    <i class="bi-github"></i>
  </a>
</div>
```

In the preceding template, we define the header of our application. It contains an anchor element that links to our GitHub profile. We have also added the GitHub icon using the `bi-github` class from the Bootstrap Icons set.

5. Insert the following HTML snippet after the header of the application:

```
<div class="content d-flex flex-column">
  <div class="row">
    <div class="col-sm-3"></div>
    <div class="col-sm-9">
      <div class="row">
        <div class="col-12 col-sm-12"></div>
      </div>
      <div class="row">
        <div class="col-12 col-sm-12"></div>
      </div>
    </div>
  </div>
</div>
```

In the preceding snippet, we create the container element for the basic features of our application. The element with the `col-sm-3` class selector will display the *personal information* feature. The element with the `col-sm-9` class selector will be split into two rows, one for the *repositories* and another for the *organizations* features.

6. Open the `app.component.scss` file and add the following CSS styles for the header and the content of our application:

```
.toolbar {
  height: 60px;
  background-color: #1976d2;
  color: white;
  font-weight: 600;
}
.toolbar img {
  margin: 0 16px;
}
.toolbar i {
  font-size: 1.5rem;
  color: white;
```

```
    margin: 0 16px;
  }
  .toolbar a {
    margin-bottom: 5px;
  }
  .toolbar i:hover {
    opacity: 0.8;
  }
  .content {
    margin: 52px auto 32px;
    padding: 0 16px;
  }
```

7. Run `ng serve` to start the application and navigate to `http://localhost:4200`. The header of the application should look like the following:

Figure 7.2 – Application header

The main page of our portfolio application is now ready. It contains a header and an empty container element for adding the main features. In the following section, we will start building the *personal information* feature of our application.

Displaying personal information

The first feature of our application will be to display personal information from our GitHub profile, such as the full name, the profile photo, and some social media links. Before creating the feature, we first need to configure our application so that it can communicate with the GitHub API:

1. Open the main module of the application, the `app.module.ts` file, and add the `HttpClientModule` class to the `imports` array of the `@NgModule` decorator:

```
import { NgModule } from '@angular/core';
import { BrowserModule } from '@angular/platform-browser';
import { HttpClientModule } from '@angular/common/http';

import { AppComponent } from './app.component';

@NgModule({
```

```
  declarations: [
    AppComponent
  ],
  imports: [
    BrowserModule,
    HttpClientModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

The `HttpClientModule` class is the main Angular module of the built-in HTTP library that exports all the necessary services for interacting with an HTTP resource.

2. Create a new Angular service using the following Angular CLI command:

```
ng generate service github
```

3. Open the `github.service.ts` file and inject the `HttpClient` service into the `constructor` of the `GithubService` class:

```
import { HttpClient } from '@angular/common/http';
import { Injectable } from '@angular/core';

@Injectable({
  providedIn: 'root'
})
export class GithubService {

  constructor(private http: HttpClient) { }
}
```

The `HttpClient` class is an Angular service of the built-in HTTP client that provides all the primary methods for interacting with HTTP, such as **GET**, **POST**, and **PUT**.

4. Add the following properties in the `GithubService` class:

```
readonly username = '<Your GitHub login>';
private apiUrl = 'https://api.github.com';
```

Make sure that you set the value of the `username` property to your GitHub login.

5. Modify the `app.component.ts` file so that it uses the `username` property from `GithubService`:

```
import { Component, OnInit } from '@angular/core';
import { GithubService } from './github.service';

@Component({
  selector: 'app-root',
  templateUrl: './app.component.html',
  styleUrls: ['./app.component.scss']
})
export class AppComponent implements OnInit {
  title = 'gh-portfolio';
  username = '';

  constructor(private githubService: GithubService) {}

  ngOnInit(): void {
    this.username = this.githubService.username;
  }
}
```

All interaction between our application and the GitHub API will be delegated to `GithubService`. Now, let's focus on building our feature:

1. Execute the following command of the Angular CLI to create a new Angular component for our feature:

```
ng generate component personal-info
```

2. Create a `user` interface to define the data model of our component using the following Angular CLI command:

```
ng generate interface user
```

3. Open the `user.ts` file and add the following properties to the `User` interface:

```
export interface User {
  avatar_url: string;
  name: string;
  blog: string;
  location: string;
```

```
  bio: string;
  twitter_username: string;
  followers: number;
}
```

4. Open the `github.service.ts` file and add the following `import` statements:

```
import { Observable } from 'rxjs';
import { User } from './user';
```

5. Create a new method to get the details of our profile from the GitHub API:

```
getUser(): Observable<User> {
  return this.http.get<User>(`${this.apiUrl}/users/${this.
username}`);
}
```

6. Open the `personal-info.component.ts` file and modify the `import` statements accordingly:

```
import { Component, OnInit } from '@angular/core';
import { Observable } from 'rxjs';
import { GithubService } from '../github.service';
import { User } from '../user';
```

7. Inject `GithubService` into the `constructor` of the `PersonalInfoComponent` class and create a component property to get the result of the `getUser` method:

```
export class PersonalInfoComponent implements OnInit {
  user$: Observable<User> | undefined;

  constructor(private githubService: GithubService) {}

  ngOnInit(): void {
    this.user$ = this.githubService.getUser();
  }

}
```

8. Open the `personal-info.component.html` file and replace its content with the following HTML template:

```
<div class="card" *ngIf="user$ | async as user">
  <img [src]="user.avatar_url" class="card-img-top" alt="{{user.
name}} photo">
  <div class="card-body">
    <h5 class="card-title">{{user.name}}</h5>
    <p class="card-text">{{user.bio}}</p>
  </div>
  <ul class="list-group list-group-flush">
    <li class="list-group-item" title="Location">
      <i class="bi-geo me-2"></i>{{user.location}}
    </li>
    <li class="list-group-item" title="Followers">
      <i class="bi-people me-2"></i>{{user.followers}}
    </li>
  </ul>
  <div class="card-body">
    <a href="https://www.twitter.com/{{user.twitter_username}}"
class="card-link">Twitter</a>
    <a [href]="user.blog" class="card-link">Personal blog</a>
  </div>
</div>
```

In the preceding template, we use the `async` pipe because the `user$` property is an observable, and we need to subscribe to it to get its values. The main advantage of the async pipe is that it unsubscribes from the observable automatically when a component is destroyed, avoiding potential memory leaks.

We also create the `user` alias for the observable to reference it easily in various locations around the component template.

9. Open the `app.component.html` file and add the `<app-personal-info>` component to the element with the `col-sm-3` class selector:

```
<div class="col-sm-3">
  <app-personal-info></app-personal-info>
</div>
```

If we run `ng serve` to preview the application, we should see the personal information panel on the left side of the page:

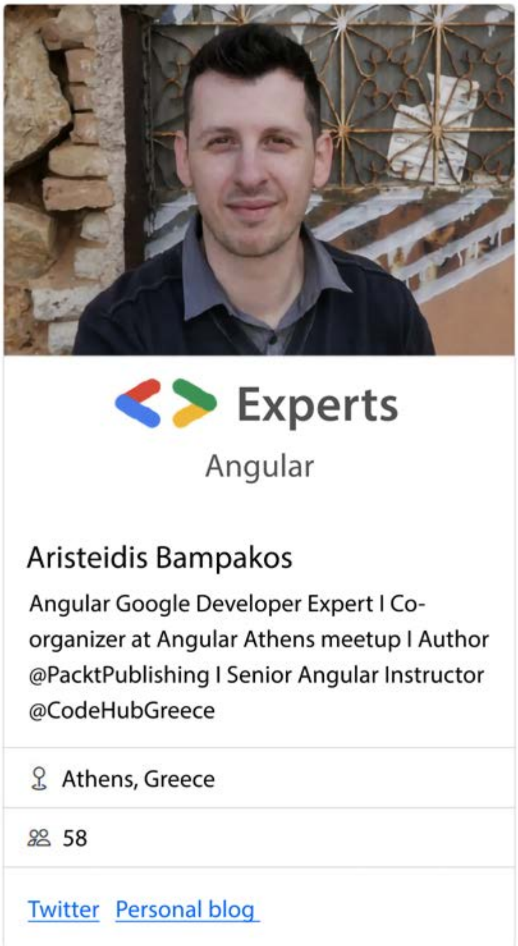

Figure 7.3 – Personal information

The first feature of our portfolio application is now complete. It displays the personal information of our GitHub profile along with a short bio and some social network links. In the next section, we will build the *repositories* feature of our application.

Listing user repositories

The GitHub user profile contains a list of repositories the user owns, called **sources**, and another list of repositories that contribute, called **forks**.

The repositories feature of our application will only display the source repositories.

The *repositories* and *organizations* features will have a similar user interface. Thus, we need to create a component for both features:

1. Execute the following command of the Angular CLI to create a new component:

```
ng generate component panel
```

2. Open the `panel.component.ts` file and define two input properties using the `@Input` decorator:

```
import { Component, Input } from '@angular/core';

@Component({
  selector: 'app-panel',
  templateUrl: './panel.component.html',
  styleUrls: ['./panel.component.scss']
})
export class PanelComponent {
  @Input() caption = '';
  @Input() icon = '';
}
```

3. Open the `panel.component.html` file and replace its content with the following HTML template:

```
<div class="card mb-4">
  <div class="card-header">
    <i class="bi bi-{{icon}} me-1"></i>
    {{caption}}
  </div>
  <div class="card-body">
    <ng-content></ng-content>
  </div>
</div>
```

The panel component is a Bootstrap card element that consists of a header and a body. The header uses the `caption` and `icon` input properties to display text with an icon. The body uses the `<ng-content>` Angular component to define a placeholder where the content from our features will be displayed.

We can now start using the panel component to create our feature:

1. Create an interface for representing the data model of a GitHub repository:

```
ng generate interface repository
```

2. Open the `repository.ts` file and add the following properties in the `Repository` interface:

```
export interface Repository {
  name: string;
  html_url: string;
  description: string;
  fork: boolean;
  stargazers_count: number;
  language: string;
  forks_count: number;
}
```

3. Open the `github.service.ts` file and import the `Repository` interface:

```
import { Repository } from './repository';
```

4. Now, it is time for some refactoring in our service. The URL we will use for getting repositories is similar to that of the `getUser` method. Extract the URL of that method in a property of the `GithubService` class:

```
export class GithubService {

  readonly username = '<Your GitHub login>';
  private userUrl = 'https://api.github.com/users/' + this.username;

  constructor(private http: HttpClient) { }

  getUser(): Observable<User> {
    return this.http.get<User>(this.userUrl);
  }

}
```

5. Create a new method to fetch repositories of the current GitHub user:

```
getRepos(): Observable<Repository[]> {
```

```
  return this.http.get<Repository[]>(this.userUrl + '/repos');
}
```

Now that we have created the prerequisites for fetching the user repositories from the GitHub API, we can start building the component that will display those repositories:

1. Execute the following command to create a new Angular component using the Angular CLI:

```
ng generate component repositories
```

2. Open the `repositories.component.ts` file and modify the `import` statements accordingly:

```
import { Component, OnInit } from '@angular/core';
import { Observable } from 'rxjs';
import { map } from 'rxjs/operators';
import { GithubService } from '../github.service';
import { Repository } from '../repository';
```

3. Inject `GithubService` into the `constructor` of the `RepositoriesComponent` class and create a component property to get the result of the `getRepos` method:

```
export class RepositoriesComponent implements OnInit {
  repos$: Observable<Repository[]> | undefined;

  constructor(private githubService: GithubService) { }

  ngOnInit(): void {
    this.repos$ = this.githubService.getRepos().pipe(
      map(repos => repos.filter(repo => !repo.fork))
    );
  }
}
```

In the preceding class, we use the `pipe` RxJS operator to combine the observable returned from the `getRepos` method with the `map` operator to filter out `fork` repositories and get only sources. Filtering is accomplished using the standard `filter` method for arrays.

4. Open the `repositories.component.html` file and replace its content with the following HTML template:

```
<app-panel caption="Repositories" icon="archive">
  <div class="row row-cols-1 row-cols-md-3 g-4">
```

```
    <div class="col p-2" *ngFor="let repo of repos$ | async">
      <div class="card h-100">
        <div class="card-body">
          <h5 class="card-title">
            <a [href]="repo.html_url">{{repo.name}}</a>
          </h5>
          <p class="card-text">{{repo.description}}</p>
        </div>
      </div>
    </div>
  </div>
</app-panel>
```

In the preceding template, we wrap the main content of the component inside the `<app-panel>` component and set the `caption` and `icon` properties for the header.

Our component iterates over the `repos$` observable and displays the `name` and the `description` of each repository. The name is an anchor element that points to the actual GitHub URL of the repository.

5. Add the following list immediately after the element with the `card-body` class selector:

```
<ul class="list-group list-group-flush list-group-horizontal">
  <li class="list-group-item border-0">
    <i class="bi-code me-2"></i>
    {{repo.language}}
  </li>
  <li class="list-group-item border-0">
    <i class="bi-star me-2"></i>
    {{repo.stargazers_count}}
  </li>
  <li class="list-group-item border-0">
    <i class="bi-diagram-2 me-2"></i>
    {{repo.forks_count}}
  </li>
</ul>
```

In the preceding snippet, we display the `language` of each repository, how many have starred it, and how many have forked it.

6. Open the app.component.html file and add the <app-repositories> component in the first HTML element with the col-12 col-sm-12 class selector:

```
<div class="col-sm-9">
  <div class="row">
    <div class="col-12 col-sm-12">
      <app-repositories></app-repositories>
    </div>
  </div>
  <div class="row">
    <div class="col-12 col-sm-12"></div>
  </div>
</div>
```

7. Run ng serve to preview the application, and you should see the new panel next to the *personal information* feature:

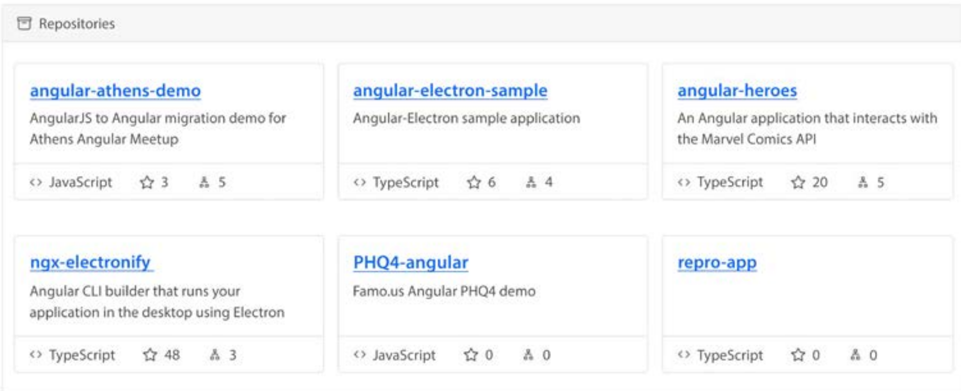

Figure 7.4 – Repositories

The second feature of our application has been completed. It displays a list of public repositories that exist in our GitHub profile. Our application now also features a panel component that we can use to build the organizations feature of our application in the following section.

Visualizing the organization membership

A GitHub user can be a member of a GitHub organization. Our application will display a list of user organizations and additional information about each.

Let's start building our organization list:

1. Create an interface to define the properties of an organization:

```
ng generate interface organization
```

2. Open the `organization.ts` file and add the following properties in the `Organization` interface:

```
export interface Organization {
  login: string;
  description: string;
  avatar_url: string;
}
```

3. Open the `github.service.ts` file and import the `Organization` interface:

```
import { Organization } from './organization';
```

4. Create a new method to get organizations of the current GitHub user:

```
getOrganizations(): Observable<Organization[]> {
  return this.http.get<Organization[]>(this.userUrl + '/orgs');
}
```

5. Execute the following command to create an Angular component for our feature:

```
ng generate component organizations
```

6. Open the `organizations.component.ts` file and modify the `import` statements accordingly:

```
import { Component, OnInit } from '@angular/core';
import { Observable } from 'rxjs';
import { GithubService } from '../github.service';
import { Organization } from '../organization';
```

7. Inject `GithubService` into the `constructor` of the `OrganizationsComponent` class and set the result of its `getOrganizations` method to an observable component property:

```
export class OrganizationsComponent implements OnInit {
  orgs$: Observable<Organization[]> | undefined;

  constructor(private githubService: GithubService) { }
```

```
  ngOnInit(): void {
    this.orgs$ =
     this.githubService.getOrganizations();
  }
}
```

8. Open the `organizations.component.html` file and replace its content with the following HTML template:

```
<app-panel caption="Organizations" icon="diagram-3">
  <div class="list-group">
    <a href="https://www.github.com/{{org.login}}" class="list-group-item list-group-item-action" *ngFor="let org of orgs$ | async">
      <div class="row">
        <img [src]="org.avatar_url">
        <div class="col-sm-9">
          <div class="d-flex w-100 justify-content-between">
            <h5 class="mb-1">{{org.login}}</h5>
          </div>
          <p class="mb-1">{{org.description}}</p>
        </div>
      </div>
    </a>
  </div>
</app-panel>
```

In the preceding HTML template, we place the main content of our component inside the `<app-panel>` component, passing an appropriate `caption` and `icon`. We display the `login` and `description` of each organization. Each organization is wrapped in an anchor element that points to the GitHub page of the organization.

9. Open the `organizations.component.scss` file and add the following CSS styles for the organization logos:

```
img {
  width: 60px;
  height: 40px;
}
```

10. Open the `app.component.html` file and add the `<app-organizations>` component in the second element with the `col-12 col-sm-12` class selector:

```
<div class="col-sm-9">
  <div class="row">
    <div class="col-12 col-sm-12">
      <app-repositories></app-repositories>
    </div>
  </div>
  <div class="row">
    <div class="col-12 col-sm-12">
      <app-organizations></app-organizations>
    </div>
  </div>
</div>
```

11. Run `ng serve` to start the application, and you should see the organization list under the *repositories* feature:

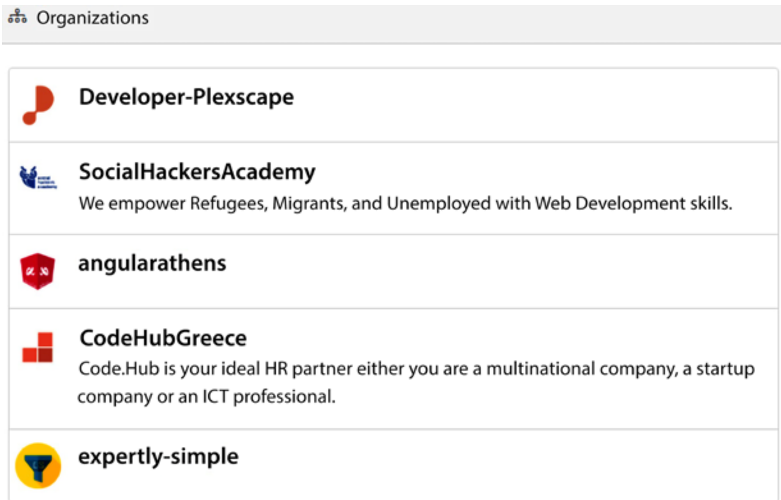

Figure 7.5 – Organizations

Our application now features a complete portfolio for the profile of a GitHub user. It displays the following:

- Personal information, a short biography, and social media links
- A list of public user repositories that contains links to each one for more information

- A list of organizations where the user is a member with links to each one for further details

In the next section, we will learn how to integrate Angular Universal and render our application on the server.

Integrating Angular Universal

Angular Universal is an Angular library that enables an Angular CLI application to be rendered on the server. An SSR application increases the loading speed of an Angular application and improves the loading of the first page.

To install Angular Universal in an existing Angular CLI application, we will use the following command of the Angular CLI:

```
ng add @nguniversal/express-engine
```

The previous command uses the `ng add` command of the Angular CLI to install the `@nguniversal/express-engine` npm package. The `@nguniversal/express-engine` package is the heart of the Angular Universal library and consists of a **Node.js Express** web server at its core.

When we execute the preceding command to install Angular Universal, we are not only installing the library but also modifying our Angular CLI workspace with the following files:

- `angular.json`: This creates new entries in the `architect` section to build and enable our Angular Universal application. One of these entries is the `server` property, which is responsible for building our application with SSR. It outputs the generated bundle into a separate `server` folder inside the standard output folder of the Angular CLI application:

```
"server": {
  "builder": "@angular-devkit/build-angular:server",
  "options": {
    "outputPath": "dist/gh-portfolio/server",
    "main": "server.ts",
    "tsConfig": "tsconfig.server.json",
    "inlineStyleLanguage": "scss"
  },
  "configurations": {
    "production": {
      "outputHashing": "media"
    },
    "development": {
```

```
        "buildOptimizer": false,
        "optimization": false,
        "sourceMap": true,
        "extractLicenses": false,
        "vendorChunk": true
      }
    },
    "defaultConfiguration": "production"
  }
```

The original application bundle is now generated into the `browser` folder inside the standard output folder of the Angular CLI application, as described in the `outputPath` property of the `build` section.

Thus, an Angular Universal application generates two versions of the same Angular application, one for the server and another for the browser.

- `package.json`: This adds all the necessary npm dependencies and creates a handful set of npm `scripts` to start building with Angular Universal:

```
"scripts": {
  "ng": "ng",
  "start": "ng serve",
  "build": "ng build",
  "watch": "ng build --watch --configuration development",
  "test": "ng test",
  "dev:ssr": "ng run gh-portfolio:serve-ssr",
  "serve:ssr": "node dist/gh-portfolio/server/main.js",
  "build:ssr": "ng build && ng run gh-portfolio:server",
  "prerender": "ng run gh-portfolio:prerender"
}
```

Scripts that contain the `:ssr` suffix are related to building and serving the Angular Universal application. The `prerender` script will create a prerendered version of an Angular application during build time. We will learn about the `prerender` script in the *Prerendering content during build* section.

- `server.ts`: This contains the Node.js Express application that will host the server-side-rendered version of our portfolio application.
- `main.server.ts`: This is the main entry point of our Angular Universal application.

- `app.server.module.ts`: This is the main application module of the server-side-rendered application.
- `tsconfig.server.json`: This is the TypeScript configuration for our Angular Universal application.

> Global JavaScript objects such as `window` and `document` are unavailable when rendering an Angular application in the server because there is no browser. Angular provides abstraction APIs for some objects, such as the `DOCUMENT` injection token. If you need to enable them conditionally, you can inject the `PLATFORM_ID` token and use the `isPlatformServer` or `isPlatformBrowser` methods from the `@angular/common` npm package to check on which platform your application is currently running:
>
> ```
> import { Inject, PLATFORM_ID } from '@angular/core';
> import { isPlatformBrowser } from '@angular/common';
> export class CheckPlatformComponent {
>   isBrowser: boolean;
>
>   constructor( @Inject(PLATFORM_ID) platformId: any) {
>     this.isBrowser = isPlatformBrowser(platformId);
>   }
> }
> ```

We can now run our GitHub portfolio application on the server using the following `npm` command:

```
npm run dev:ssr
```

To preview your GitHub portfolio application on the server, open your browser at `http://localhost:4200`.

You should typically see the application as it was before. So, what have we gained here? Angular Universal applications do not reveal their full potential when running on a development machine with a powerful processor and a lot of memory. Instead, we need to run and preview them in real-world cases like a slow network. We can use Google Chrome developer tools to emulate a slow network in a development environment:

1. Open the Google Chrome browser.
2. Toggle the developer tools and select the **Network** tab.

3. Select the **Slow 3G** option from the **Throttling** dropdown.
4. Enter `http://localhost:4200` in the address bar of your browser.

The server first loads a static version of your application to display to the user until the actual Angular application loads in the background. When fully loaded in the background, Angular Universal will switch to the complete application.

In the following section, we will investigate how to improve the loading speed of our application even more, using prerendering.

Prerendering content during build

The `package.json` file of our Angular CLI workspace contains the `prerender` npm script, which we can use to improve the first loading of our application. The script runs the `prerender` command from the `architect` section of the `angular.json` configuration file and prerenders the content of our application during build time. Let's see the effect that prerendering will have on our GitHub portfolio application:

1. Execute the following `npm` command to generate a prerendered version of the application:

   ```
   npm run prerender
   ```

   The preceding command will output a production bundle of the application into the `dist\gh-portfolio\browser` folder.

2. Navigate to the `dist\gh-portfolio\browser` folder and you should see two HTML files, the `index.html` and `index.original.html` files.
3. Open the `index.original.html` file and locate the `<app-root>` HTML element. This is the main component of our Angular application, where Angular will render the content of our application in the browser.
4. Open the `index.html` file now and look again at the `<app-root>` element.

   The main component is not empty this time. Angular Universal has made all HTTP requests to the GitHub API and prefetched the content of our application during runtime. All component templates and styles have been prerendered in the main HTML file, meaning we can view our application on a browser even without JavaScript enabled!

5. Execute the following command to start the prerendered version of our GitHub portfolio application:

   ```
   npm run serve:ssr
   ```

The preceding command will start a Node.js Express server that hosts our application at `http://localhost:4000`.

6. Disable JavaScript from the settings of your browser and navigate to `http://localhost:4000`.

Our GitHub portfolio application remains fully operational without having JavaScript enabled. The main page of the application is also rendered instantly without having the user wait for the application to load.

The previous scenario is a perfect fit for users who cannot afford to enable JavaScript on their devices. But what happens when a user with JavaScript enabled uses the same prerendered version of the application? Let's learn more about that:

1. Enable JavaScript in your browser and toggle the developer tools.
2. Navigate to `http://localhost:4000`. Nothing different seems to happen at first sight. Nevertheless, the application loads instantly due to the prerendered content.
3. Inspect the **Network** tab, and you will notice the following:

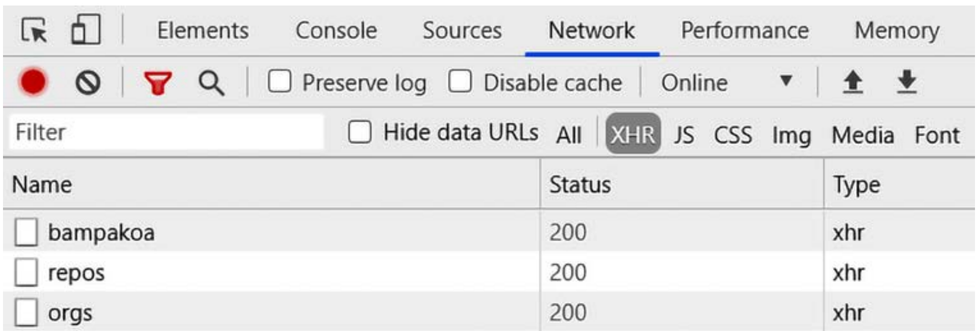

Figure 7.6 – Network tab (Google Chrome)

Our application initiates all HTTP requests to the GitHub API as if it were rendered from a browser. It duplicates all HTTP requests the application needs, even if data has already been prerendered on the HTML page. Why is that?

The application makes one HTTP request for the browser-rendered version and another for the SSR application because both versions have a different state. We can prevent the previous behavior by sharing the state between the server and the browser. More specifically, we can transfer the state of the server to the browser using a special-purpose Angular module of the Angular Universal library called `TransferHttpCacheModule`.

If we use `TransferHttpCacheModule`, the server will cache responses from the GitHub API, and the browser will use the cache instead of initiating a new request. `TransferHttpCacheModule` solves the problem by installing an **HTTP interceptor** in the Angular application that ignores HTTP requests that have been handled by the server initially.

> An HTTP interceptor is an Angular service that intercepts HTTP requests and responses originating from the built-in HTTP client of the Angular framework.

To install `TransferHttpCacheModule` in our GitHub portfolio application, follow these steps:

1. Open the main module file of the Angular application, `app.module.ts`, and import `TransferHttpCacheModule` from the `@nguniversal/common` npm package:

```
import { TransferHttpCacheModule } from '@nguniversal/common';
```

2. Add the `TransferHttpCacheModule` class to the `imports` array of the `@NgModule` decorator:

```
@NgModule({
  declarations: [
    AppComponent,
    PersonalInfoComponent,
    PanelComponent,
    RepositoriesComponent,
    OrganizationsComponent
  ],
  imports: [
    BrowserModule,
    HttpClientModule,
    TransferHttpCacheModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
```

3. Execute the following command to prerender your application:

```
npm run prerender
```

4. Run the following command to start your prerendered application:

```
npm run serve:ssr
```

If you preview the portfolio application and inspect the **Network** tab of your browser, you will notice that it does not make additional HTTP requests. `TransferHttpCacheModule` intercepted all HTTP requests and stored them in the **TransferState** store of our application. TransferState is a key-value store that can be transferred from the server to the browser. The browser version of the application can later read the HTTP responses directly from the store without making an extra call.

We now have a fully prerendered version of our GitHub portfolio. But how can we optimize it further to share it on a social media platform? We will learn more about SEO optimization techniques in the following section.

Enhancing SEO capabilities

SEO optimizes a website to be correctly indexed by a **web crawler**. A web crawler is special-purpose software on most search engines and can identify and index websites so that they are easily discoverable and linkable through their platforms.

Angular Universal does a great job of SEO by prerendering content during build time. Some web crawlers cannot execute JavaScript and build the dynamic content of an Angular application. Prerendering with Angular Universal eliminates the need for JavaScript, thus allowing web crawlers to do their best to identify the web application.

We can also help SEO by defining several tags in the `<head>` element of the main `index.html` file of an Angular application, such as `title`, `viewport`, and `charset`:

```
<head>
  <meta charset="utf-8">
  <title>GhPortfolio</title>
  <base href="/">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <link rel="icon" type="image/x-icon" href="favicon.ico">
</head>
```

You can find a list of available tags at `https://developer.mozilla.org/docs/Web/HTML/Element/meta/name`.

However, setting a tag in the `index.html` file is inadequate, especially when an Angular application has routing enabled and contains several routes. The Angular framework provides a couple of handy services that we can use to set tags programmatically. First, let's see how to set the title tag in our application:

1. Open the `app.component.ts` file and add the following `import` statement:

```
import { Title } from '@angular/platform-browser';
```

2. Inject the `Title` service into the `constructor` of the `AppComponent` class:

```
constructor(private githubService: GithubService, private
titleService: Title) {}
```

3. Call the `setTitle` method of the `titleService` variable in the `ngOnInit` method:

```
ngOnInit(): void {
  this.username = this.githubService.username;
  this.titleService.setTitle('GitHub portfolio app');
}
```

4. Run `npm run dev:ssr` to preview the application, and you should see the title in the browser tab:

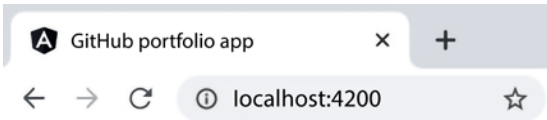

Figure 7.7 – Browser tab title

Similar to the `Title` service, we can use the `Meta` service to set meta tags for our application:

1. Open the `app.component.ts` file and import `Meta` from the `@angular/platform-browser` npm package:

```
import { Meta, Title } from '@angular/platform-browser';
```

2. Inject the `Meta` service into the `constructor` of the `AppComponent` class:

```
constructor(private githubService: GithubService, private
titleService: Title, private meta: Meta) {}
```

3. Use the `addTags` method of the `meta` variable to add some meta tags to the `ngOnInit` method:

```
ngOnInit(): void {
  this.username = this.githubService.username;
  this.titleService.setTitle('GitHub portfolio app');
  this.meta.addTags([
    {
      name: 'description',
      content: `${this.username}'s GitHub portfolio`
    },
    {
      name: 'author',
      content: this.username
    }
  ]);
}
```

In the preceding code, we added two meta tags. The first one sets the `description` that contains the username of the current GitHub profile. The second one sets the `author` tag to be the same as the username of the GitHub profile.

4. Run `npm run dev:ssr` to start the application and navigate to `http://localhost:4200`.
5. Use your browser to inspect the page, and you should see the following meta tags in the **<head>** element of the page:

Figure 7.8 – Application head element

Each popular social platform, such as Twitter, Facebook, and LinkedIn, requires its own meta tags so that the URL of an SSR application can be correctly displayed on their platforms.

Summary

In this project, we built a portfolio application for our GitHub profile. Initially, we learned how to interact with the GitHub API in a new Angular application. We also used Bootstrap CSS and Bootstrap Icons to provide a beautiful user interface for our portfolio application.

We then saw how to convert our Angular application into an SSR application using Angular Universal. We learned how to benefit from prerendering content when users have low-end and slow-performing devices and some of the potential pitfalls of this technique.

We used some of the available SEO techniques that the Angular framework offers to improve the discoverability of our application.

In the next chapter, we will learn about the monorepo architecture and how we can manage the state of an Angular application.

Practice questions

Let's take a look at a few practice questions:

1. How do we subscribe to an observable in the template of a component?
2. What command do we use to install Angular Universal?
3. How can we differentiate programmatically between browser and server platforms?
4. What command generates a prerendered version of an SSR application?
5. What Angular module do we use to transfer the state from the server to the browser?
6. What Angular service do we use to set the title of an Angular application?
7. What Angular service do we use to set meta tags in an Angular application?

Further reading

Here are some links to build upon what we learned in the chapter:

- Angular Univeral guide: `https://angular.io/guide/universal`
- GitHub REST API: `https://docs.github.com/rest`
- Bootstrap CSS: `https://getbootstrap.com`
- Bootstrap Icons: `https://icons.getbootstrap.com`

- Angular HTTP guide: `https://angular.io/guide/http`
- `TransferHttpCacheModule`: `https://github.com/angular/universal/blob/master/docs/transfer-http.md`

8

Building an Enterprise Portal Using Nx Monorepo Tools and NgRx

Typical enterprise applications usually consist of a backend and a frontend system. The backend is responsible for interacting with a database for data persistence and exposes a REST API. The frontend communicates with the backend system via the REST interface to exchange data. The frontend system can sometimes consist of multiple applications, including a web interface or a mobile application. Keeping all these applications and systems in separate source control repositories scales poorly and is difficult to maintain and build. Alternatively, we can follow a **monorepo** architecture for large enterprise applications, where each application resides in a separate location inside the same repository.

A popular tool in the Angular ecosystem that embraces monorepo architecture is **Nx**. Combining an Nx monorepo application with a state management library can significantly improve your application. **NgRx**, a popular state management library for Angular applications, can help us maintain a consistent and manageable global state.

In this chapter, we will investigate both technologies by building an enterprise portal application for visiting **points of interest (POIs)**. We will cover the following topics:

- Creating a monorepo application using Nx
- Creating user-specific portals

- Managing application state with NgRx
- Visualizing data with graphs

Essential background theory and context

Nx is a suite of development tools and libraries for building web applications based on monorepo architecture. A typical Nx application can contain many applications and shared libraries inside a single workspace. The flexibility of monorepo architecture allows any application, backend or frontend, to use the same libraries inside the workspace.

> In this project, we will consider only frontend applications built with the Angular framework.

Nx provides developers with the following features:

- **Centralized management of application dependencies**: Each application has the same version of the Angular framework, making it easy to update all at once.
- **Fast builds**: The build process of an Nx application involves only those artifacts that have been changed and does not do a complete rebuild of the entire monorepo.
- **Distributed caching**: Each application build can be cached locally or to the cloud, using **Nx Cloud**, to improve the build process of other developers that build similar artifacts.

Maintaining a consistent global state is tedious in a large Angular enterprise application. Using `@Input` and `@Output` decorators to communicate between Angular components is not always viable, especially when many components need to share the same state.

NgRx is a library that efficiently manages the global application state powered by the **RxJS** library. The main building blocks of NgRx are the following:

- **Store**: The central storage that keeps the global state of the application.
- **Reducer**: A function that listens to a specific event and interacts directly with the store. Reducers derive a new application state based on the existing one from the store.
- **Action**: A unique event dispatched from components and services that triggers a reducer. Actions can be any interaction initiated by the user or an external source, such as an HTTP call.

- **Effect**: Handles interaction with external sources, such as making an HTTP call or exchanging data with the local storage. Effects take care of side effects in an application by hiding the business logic from components.
- **Selector**: A function that selects the application state or a specific part of it (*slice*) from the store. Selectors support **memoization**, a technique where they can return the same state if called with the same parameters, greatly enhancing the performance of an application.

Project overview

In this project, we will build an Angular enterprise application to manage POI visits on a map. The application will consist of two portals, where one will allow a visitor to select a POI from a list and view its location on a map. Another portal will enable an administrator to view the visiting traffic of each POI.

First, we will build an Angular application from scratch using Nx. We will then create the skeleton of each portal by adding the essential components of our application. After we have scaffolded our application, we will start adding the functionality of the visitor portal using NgRx. Finally, we will implement the administrator portal and learn how to use an Angular library to visualize data in a graph. The following diagram describes an architectural overview of the project:

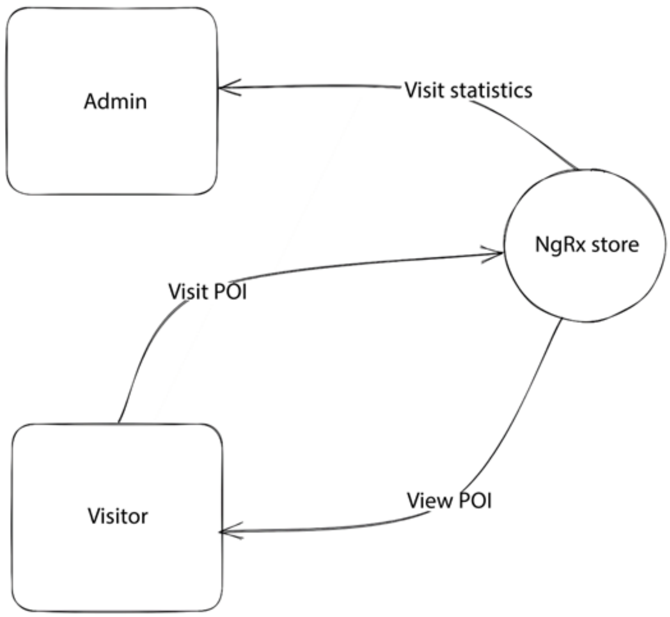

Figure 8.1 – Project architecture

Build time: 3 hours

Getting started

The following software tools are required to complete this project:

- **Nx Console**: A VSCode extension that provides a graphical interface to work with Nx. You can learn more about installing it in *Chapter 1, Creating Your First Web Application in Angular*.
- **GitHub material**: The code related to this chapter can be found in the `Chapter08` folder at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition`.

Creating a monorepo application using Nx

Nx provides developers with tools to work with monorepos, including the following:

- **create-nx-workspace**: An npm package that scaffolds a new Nx monorepo application.
- **Nx CLI**: A command-line interface that runs commands against a monorepo application. The Nx CLI extends the Angular CLI to provide more commands, which is faster due to the distributed caching mechanism.

It is recommended to use the **Quick Open** feature of VSCode when working with Nx monorepos. The number of generated folders and files will significantly increase, and it will be challenging to navigate through them. You can find out more at `https://code.visualstudio.com/docs/editor/editingevolved#_quick-file-navigation`.

To install the Nx CLI, run the following command in a terminal:

```
npm install -g nx
```

The preceding command will install the `nx` npm package globally on our system. We can now scaffold a new Nx monorepo workspace using the following command:

```
npx create-nx-workspace packt --appName=tour --preset=angular-monorepo
--style=css --linter=eslint --nx-cloud=false --routing
```

The preceding command will do the following:

1. Find the latest version of the `create-nx-workspace` npm package and request us to install it.
2. Ask if we want to use standalone components in the application. Ensure that `No` is selected and press *Enter* to continue.

> Standalone Angular components are a simpler and modern approach to a more component-centric Angular application without using Angular modules. In this project, we will use Angular modules by default.

The execution of the `create-nx-workspace` package involves the following options:

- `packt`: The name of the Nx monorepo workspace. In large enterprise environments, we typically use the organization name.
- `--appName=tour`: The name of the application.
- `--preset=angular-monorepo`: Nx supports applications built with various JavaScript frameworks. The `preset` option defines what type of application we want to build.
- `--style=css`: Indicates that our application will use the CSS style sheet format.
- `--linter=eslint`: Configures our application to use ESLint as the default linter.
- `--nx-cloud=false`: Disables Nx Cloud for our application.
- `--routing`: Enables Angular routing in the application.

> Creating a new Nx workspace may take some time, as it installs all the necessary packages for an enterprise environment.

After the creation of the workspace has been completed, we can run it to verify that everything has been set up correctly:

1. Open the project in the VSCode editor and click on the **Nx Console** menu in the VSCode sidebar.

2. Select the **serve** command from the **PROJECTS** pane and click the play button to execute it:

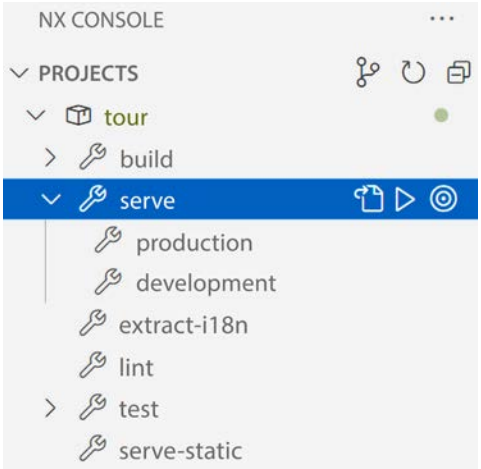

Figure 8.2 – Serve option

3. Open your browser at `http://localhost:4200`, and you should see the following output:

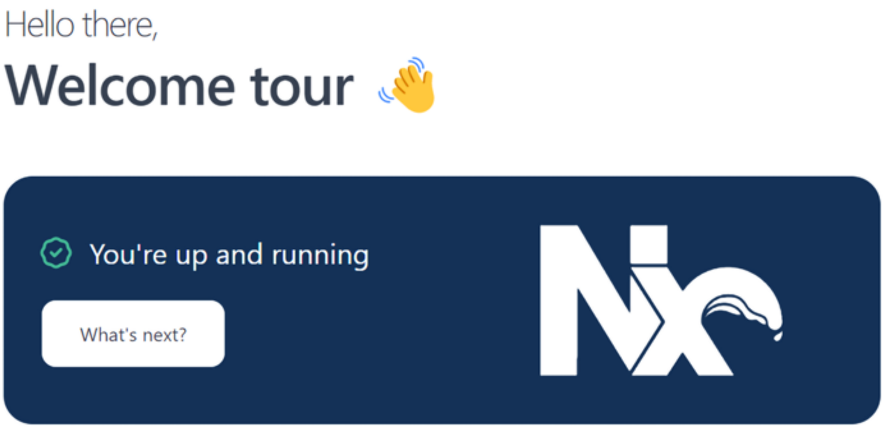

Figure 8.3 – Minimal Nx application

Congratulations! Your new application has been configured correctly! Nx creates a minimal skeleton application, just like Angular CLI does, for our convenience so that we can build our features on top of that.

In the next section, we will dive deeper into Nx by creating the administrator and visitor portals in our workspace.

Creating user-specific portals

Our application will consist of two portals that different users will use. Visitors will be able to view a list of POIs and select them on a map. Administrators will be able to view statistics for each POI. We will learn more about how to use Nx in the following sections:

- Building the visitor portal
- Building the administrator portal

Each portal will be a separate Nx library that will be loaded according to the URL entered in the address bar of the browser. Organizing our code in libraries allows us to reuse it between different applications and build and test it individually. We will start building the visitor portal in the following section.

Building the visitor portal

The visitor portal will be a library inside the Nx workspace that will be loaded by default. Let's see how we can build that library with Nx Console:

1. Run Nx Console from the VSCode sidebar and select the **generate** option from the **GENERATE & RUN TARGET** pane:

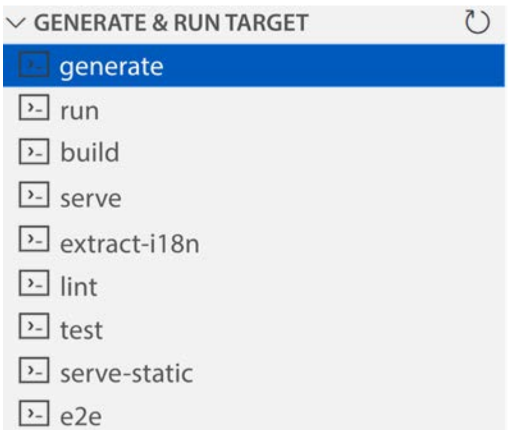

Figure 8.4 – The generate option

2. Select the **@nrwl/angular – library** option from the dialog that appears. The **@nx/angular** namespace contains schematics we can execute in an Nx monorepo for Angular applications.

3. Enter `visitor` as the name of the library and click the **Run** button:

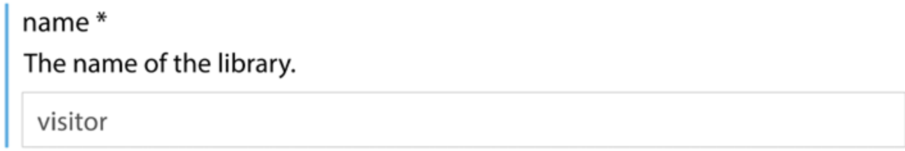

Figure 8.5 – Library name

> When you were typing the name of the library, you may have noticed that Nx was running the **generate** command in the terminal. Well, it did not run it. Instead, it mimicked the effect of running the command in your system, a technique called a **dry run**.

Nx will create the `visitor` library inside the `libs` folder of our workspace. The library does not contain any components yet. According to the project specifications, the visitor portal will have a list of POIs where users can select and view their location on a map. Thus, we need to create an Angular component with the following layout:

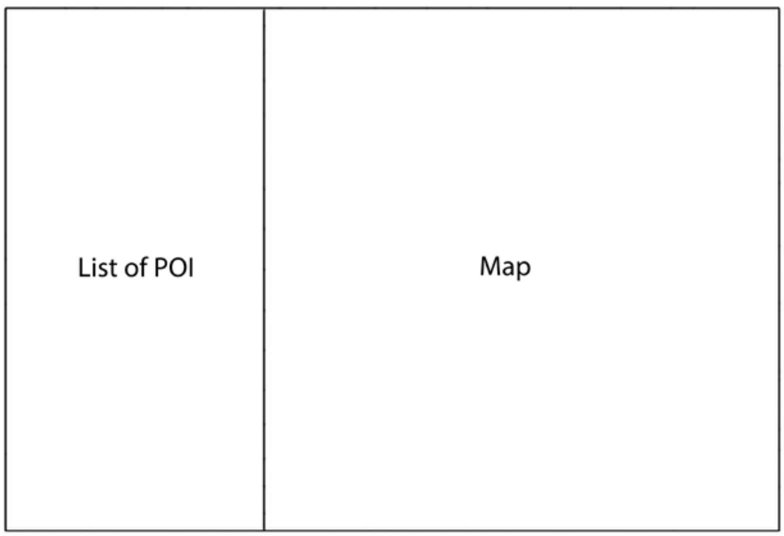

Figure 8.6 – Visitor portal layout

In the previous diagram, the portal consists of the sidebar that displays a POI list and the main content area to display the map. Instead of creating the layout from scratch, we will use Angular Material, which contains a handful of ready-made layouts, including one with a sidebar.

Before working with Angular Material, we need to install it in our application with the following command:

```
npm install @angular/material
```

After the installation completes successfully, we can configure Angular Material in our Nx workspace using the following command:

```
nx generate @angular/material:ng-add --project=tour --theme=deeppurple-
amber --animations=enabled --typography
```

The preceding command will configure the `@angular/material` npm package for use in our workspace, passing additional options. You can learn more about these options in *Chapter 4*, *Building a PWA Weather Application Using Angular Service Worker*.

Configuring Angular Material in our project will also install the `@angular/cdk` npm package, which contains specific behaviors and interactions used to build Angular Material.

> The **Angular CDK** can be used to build custom UI libraries without relying on Angular Material. We will learn how to build such libraries in *Chapter 9*, *Building a Component UI Library Using Angular CLI and Angular CDK*.

The Angular Material library contains the following component templates that we can use:

- **address-form**: This uses Angular Material form controls to enter address information.
- **navigation**: This contains a side navigation component along with a content placeholder and a title bar.
- **dashboard**: This consists of multiple Angular Material card and menu components organized in a grid layout.
- **table**: This displays an Angular Material table with sorting and filtering enabled.
- **tree**: This represents a visual folder structure in a tree view.

In our case, we will use the **navigation** component because we need a sidebar. Let's see how we can generate that component:

1. Open Nx Console from the VSCode sidebar and select the **generate** option.
2. Select the **@angular/material – navigation** option from the dialog that appears. The **@angular/material** namespace contains schematics that we can run to create Angular Material components.

3. Enter the name of the component:

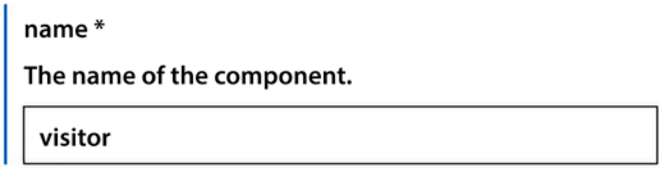

Figure 8.7 – Component name

4. Select the **visitor** library from the **project** dropdown that we created earlier:

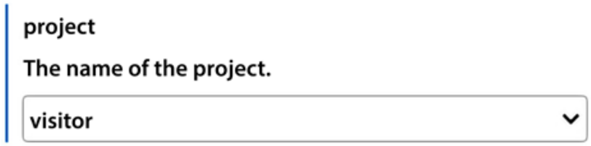

Figure 8.8 – Project selection

> Click the **Show more** button if the option is not displayed.

5. Check the **flat** option so that the component will not be generated in a separate folder:

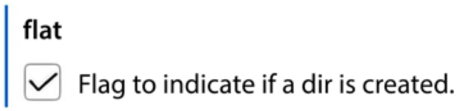

Figure 8.9 – The flat option

The component will be the main one of the library, so we want to have it in the same folder with its related module file.

6. Enter the folder where the component will be created:

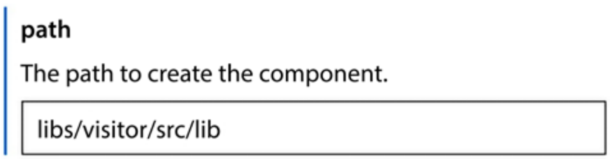

Figure 8.10 – Component folder

> There is no need to define the module where the component will be created because the Angular CLI can deduce it directly from the **path** option.

7. Click the **Run** button to generate the component.

Nx Console will create the **visitor** component in the **visitor** library of the Nx workspace. We now need to connect it with the main application of the workspace:

1. Open the `app.component.html` file and remove the `<packt-nx-welcome>` selector.
2. Open the `app.routes.ts` file and add a route configuration that will load the visitor portal when the URL contains the `tour` path:

```
export const appRoutes: Route[] = [
  {
    path: 'tour',
    loadChildren: () => import('@packt/visitor').then(m =>
m.VisitorModule)
  },
  {
    path: '',
    pathMatch: 'full',
    redirectTo: 'tour'
  }
];
```

   The route configuration contains two paths. The **default** path, denoted by the empty string, redirects to the `tour` path. The `tour` path lazily loads the module of the **visitor** library.

3. Open the `visitor.module.ts` file and add a route configuration to load the **visitor** component that we created:

```
import { NgModule } from '@angular/core';
import { CommonModule } from '@angular/common';
import { VisitorComponent } from './visitor.component';
import { MatToolbarModule } from '@angular/material/toolbar';
import { MatButtonModule } from '@angular/material/button';
import { MatSidenavModule } from '@angular/material/sidenav';
import { MatIconModule } from '@angular/material/icon';
```

```
import { MatListModule } from '@angular/material/list';
import { RouterModule } from '@angular/router';

@NgModule({
  imports: [CommonModule, MatToolbarModule, MatButtonModule,
MatSidenavModule, MatIconModule, MatListModule,
    RouterModule.forChild([
      { path: '', component: VisitorComponent }
    ])
  ],
  declarations: [
    VisitorComponent
  ],
})
export class VisitorModule {}
```

The route configuration will activate `VisitorComponent` by default as soon as `VisitorModule` is loaded, using the `tour` path described in described in the step 3.

If we now run the **serve** command from Nx Console and navigate to `http://localhost:4200`, we should see the following output:

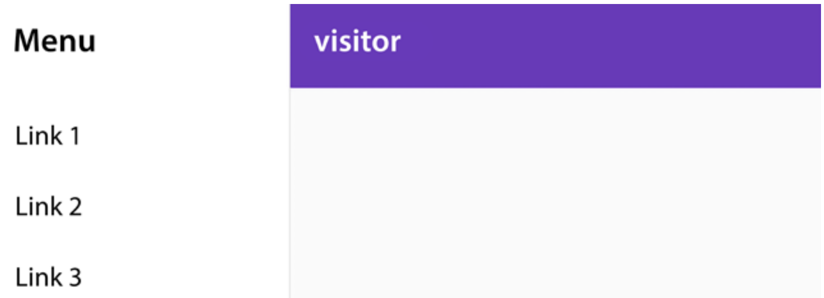

Figure 8.11 – Visitor portal

The Angular router will redirect us to `http://localhost:4200/tour` and display the visitor portal. It currently contains some demo data that Angular Material entered when we generated the navigation component. We will revisit it in the *Managing application state with NgRx* section to implement the full functionality using NgRx. For now, we will continue building the administrator portal in the next section.

Building the administrator portal

The administrator portal will be an Nx library with a single component, just like the visitor portal, except it will not be based on an Angular Material template. Let's start scaffolding the structure of the library using Nx Console:

1. Run Nx Console from the VSCode sidebar and select the **generate** option.
2. In the dialog that appears, select the **@nx/angular – library** option.
3. Enter `admin` as the library name and click the **Run** button:

Figure 8.12 – Library name

4. Click the **generate** option again and select the **@schematics/angular – component** option. The **@schematics/angular** namespace contains schematics that we can run in an Angular application using the Angular CLI.
5. Enter the same name for the component as in step 3:

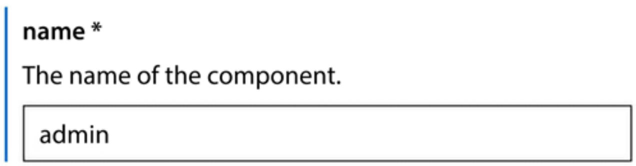

Figure 8.13 – Component name

6. Select the library that we created from the **project** drop-down list:

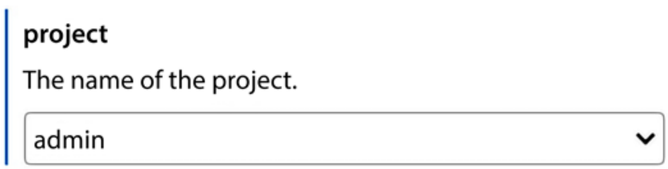

Figure 8.14 – Project selection

7. Check the **flat** option so that the component will be created in the same folder as the module file of the library:

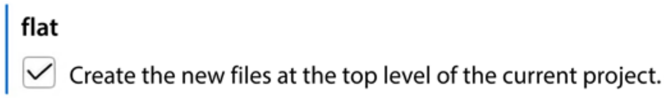

Figure 8.15 – The flat option

> Click the **Show more** button if the option is not displayed.

8. Enter the folder where the component will be created and click the **Run** button:

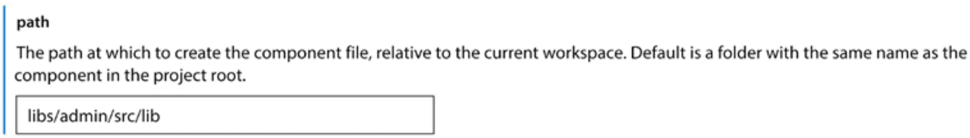

Figure 8.16 – Component folder

The Angular CLI will create the **admin** component inside the folder of the **admin** library. We now need to wire it up to the main application:

1. Open the `app.routes.ts` file and add a new route configuration object for the `admin` path:

```
export const appRoutes: Route[] = [
  {
    path: 'admin',
    loadChildren: () => import('@packt/admin').then(m =>
m.AdminModule)
  },
  {
    path: 'tour',
    loadChildren: () => import('@packt/visitor').then(m =>
m.VisitorModule)
  },
  {
    path: '',
```

```
    pathMatch: 'full',
    redirectTo: 'tour'
  }
];
```

2. Open the `admin.module.ts` file and add a route configuration to activate `AdminComponent` by default:

```
import { NgModule } from '@angular/core';
import { CommonModule } from '@angular/common';
import { AdminComponent } from './admin.component';
import { RouterModule } from '@angular/router';

@NgModule({
  imports: [
    CommonModule,
    RouterModule.forChild([
      { path: '', component: AdminComponent }
    ])
  ],
  declarations: [
    AdminComponent
  ],
})
export class AdminModule {}
```

3. Use the **serve** option of Nx Console to run the application, and navigate to `http://localhost:4200/admin`:

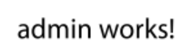

Figure 8.17 – Administrator portal

The page will display the default template of the main component of the **admin** library.

We have now completed the scaffolding of our enterprise application. First, we created the Nx monorepo workspace that will host the portals of the application. Then, we used Nx Console to generate our portals and their main components. We also installed Angular Material to use its UI elements in our components.

In the next section, we will implement the functionality of the visitor portal using NgRx.

Managing application state with NgRx

The visitor portal will allow the user to see a list of available POIs and select one to view its location on a map. The list of available POIs and the selection of a POI is the global state of our application. We will integrate NgRx to manage the application state in the visitor portal by completing the following tasks:

- Configuring the state
- Interacting with the store

Let's begin by configuring the state of our application in the following section.

Configuring the state

Our application will consist of a `root` state for the whole application and a feature state for the visitor portal. We will start by executing the following command to create the `root` state:

```
nx generate @nx/angular:ngrx app --root --no-interactive --parent=apps/
tour/src/app/app.module.ts
```

The preceding command uses the `generate` command of the Nx CLI, passing the following options:

- `@nx/angular:ngrx`: Indicates that we want to set up an NgRx state
- `app`: The name of the state
- `--root`: Indicates that we want to configure a root state
- `--no-interactive`: Disables interactive input prompts
- `--parent=apps/tour/src/app/app.module.ts`: Registers the state with the main Angular module of our application

The previous command will add all necessary NgRx npm packages in the `package.json` file and install them. It will also modify the `app.module.ts` file to configure all NgRx-related artifacts, such as the store and effects.

The **visitor** library will not manage the data for the state of the visitor portal. Instead, we will create a new library in our Nx workspace to fetch and store data in the feature state. Execute the following command of the Nx CLI to create a new library:

```
nx generate @nrwl/angular:library poi
```

The preceding command will generate the poi library in our Nx monorepo. Now, we can set up the feature state using the following command:

```
nx generate @nx/angular:ngrx poi --no-interactive --parent=libs/poi/src/
lib/poi.module.ts --barrels
```

The preceding command uses the `generate` command of the Nx CLI to register a feature state, passing additional options:

- `@nx/angular:ngrx`: Indicates that we want to set up an NgRx state.
- `poi`: The name of the state.
- `--no-interactive`: Disables interactive input prompts.
- `--parent=libs/poi/src/lib/poi.module.ts`: Registers the state with the Angular module of our library.
- `--barrels`: Indicates using barrel files to re-export NgRx artifacts such as selectors and state. The name of a barrel file is usually `index.ts` by convention.

The preceding command will create a folder, named `+state` by convention, inside our library, which contains the following files:

- `poi.actions.ts`: Defines NgRx actions for the feature state
- `poi.effects.ts`: Defines NgRx effects for the feature state
- `poi.models.ts`: Defines an entity interface for POI data
- `poi.reducer.ts`: Defines NgRx reducers for the feature state
- `poi.selectors.ts`: Defines NgRx selectors for the feature state

The Nx CLI has done most of the job by adding the necessary content in the previous files, eliminating the boilerplate code for us. We now need to create an Angular service in the library that will fetch the POI data:

1. Open the `poi.models.ts` file and add the following properties to the `PoiEntity` interface:

```
export interface PoiEntity {
  id: string | number; // Primary ID
  name: string;
  lat: number;
  lng: number;
  description: string;
  imgUrl: string;
}
```

2. Execute the following command to generate the Angular service:

```
nx generate service poi --project=poi
```

   The preceding command will create an Angular service called `poi` in the **poi** library.

3. Open the `poi.service.ts` file and add the following `import` statements:

```
import { HttpClient } from '@angular/common/http';
import { Observable } from 'rxjs';
import { PoiEntity } from '..';
```

4. Inject `HttpClient` in the `constructor` of the `PoiService` class and create a method to get POI data from the `assets/poi.json` file:

```
export class PoiService {

  constructor(private http: HttpClient) {}

  getAll(): Observable<PoiEntity[]> {
    return this.http.get<PoiEntity[]>('assets/poi.json');
  }
}
```

   We use the built-in HTTP client of the Angular framework to get POI data by initiating a GET HTTP request.

   You can get the `poi.json` file from the GitHub repository in the *Getting started* section and copy it to the `apps\tour\src\assets` folder of your workspace.

5. Open the `poi.effects.ts` file and import the `map` and `PoiService` artifacts:

```
import { Injectable, inject } from '@angular/core';
import { createEffect, Actions, ofType } from '@ngrx/effects';
import { switchMap, catchError, of, map } from 'rxjs';
import * as PoiActions from './poi.actions';
import * as PoiFeature from './poi.reducer';
import { PoiService } from '../poi.service';
```

6. Inject `PoiService` in the `PoiEffects` class:

```
private poiService = inject(PoiService);
```

7. Modify the `init$` property to use the `poiService` variable:

```
init$ = createEffect(() =>
  this.actions$.pipe(
    ofType(PoiActions.initPoi),
    switchMap(() => this.poiService.getAll()),
    switchMap(pois => of(PoiActions.loadPoiSuccess({ poi: pois }))),
    catchError((error) => {
      console.error('Error', error);
      return of(PoiActions.loadPoiFailure({ error }));
    })
  )
);
```

An NgRx effect is responsible for listening to all actions dispatched in the store. When a `PoiActions.initPoi` action is dispatched, the `init$` property is triggered and calls the `getAll` method of the `poiService` variable. The `init$` property knows which action to listen for by the parameters in the `ofType` operator.

> The `ofType` operator can accept more than one action.

If the data is fetched successfully, the effect will dispatch a new action in the store, `PoiActions.loadPoiSuccess`, with POI data as the payload. If there is a failure when getting the data, it will dispatch a `PoiActions.loadPoiFailure` action in the store.

8. Open the `app.module.ts` file and import `HttpClientModule` from the `@angular/common/http` namespace. Also add the `HttpClientModule` class in the `imports` array of the `@NgModule` decorator.

The global state of our application is now configured and ready to be used. In the following section, we will create additional Angular components in the visitor library that will interact with the feature state of our application.

Interacting with the store

The visitor portal will interact with the feature state of our application through two Angular components. One component will display the list of POIs and allow the user to select one. The other component will display the selected POI inside Google Maps.

Initially, we will build the component that displays the list of POIs:

1. Open the `visitor.module.ts` file and add the following `import` statement:

```
import { PoiModule } from '@packt/poi';
```

2. Add `PoiModule` in the `imports` array of the `@NgModule` decorator:

```
@NgModule({
  imports: [CommonModule, MatToolbarModule, MatButtonModule,
MatSidenavModule, MatIconModule, MatListModule,
    RouterModule.forChild([
      { path: '', component: VisitorComponent }
    ]),
    PoiModule
  ],
  declarations: [
    VisitorComponent
  ],
})
```

We import `PoiModule` so that the **poi** feature state is registered in the store as soon as the visitor portal is loaded.

3. Execute the following command of the Nx CLI to create the Angular component:

```
nx generate @schematics/angular:component poi-list --project=visitor
```

4. Open the `poi-list.component.ts` file and modify the `import` statements accordingly:

```
import { Component, OnInit } from '@angular/core';
import { Store } from '@ngrx/store';
import { PoiActions, PoiSelectors } from '@packt/poi';
```

5. Modify the `PoiListComponent` class so that it dispatches the `PoiActions.initPoi` action in the store to fetch POI data when the component is initialized:

```
export class PoiListComponent implements OnInit {

  constructor(private store: Store) {}

  ngOnInit(): void {
    this.store.dispatch(PoiActions.initPoi());
  }
}
```

We execute the action as a method and pass its result to the `dispatch` method of the `store` variable.

6. Create a component property that invokes the `PoiSelectors.selectAllPoi` selector to list POI data from the store:

```
pois$ = this.store.select(PoiSelectors.selectAllPoi);
```

We use the `select` method of the `store` variable to execute the selector.

> We did not create the `PoiSelectors.selectAllPoi` selector. NgRx did it for us when we generated the feature state in the **poi** library.

7. Open the `poi-list.component.html` file and replace its content with the following HTML template:

```
<mat-action-list *ngFor="let poi of pois$ | async">
  <button mat-list-item>{{poi.name}}</button>
</mat-action-list>
```

We use the `<mat-action-list>` component of the Angular Material library to display each POI as a single action item. We subscribe to the `pois$` property using the `async` pipe and create a `<button>` element with the `mat-list-item` directive for each POI.

8. Open the `visitor.component.html` file and replace the `<mat-nav-list>` component with the `<packt-poi-list>` component we created.

Use Nx Console to start the application, and you should see the following output in the menu sidebar:

Figure 8.18 – List of POIs

We have already created the Angular component to display the available POIs. Let's see now how to create the component to display a POI on the map using Google Maps.

The Angular Material library contains a component for Google Maps that we can use in our application:

1. Run the following command of the `npm` client to install the Google Maps component:

```
npm install @angular/google-maps
```

2. Open the `visitor.module.ts` file and add the following `import` statement:

```
import { GoogleMapsModule } from '@angular/google-maps';
```

3. Add `GoogleMapsModule` to the `imports` array of the `@NgModule` decorator:

```
@NgModule({
  imports: [CommonModule, MatToolbarModule, MatButtonModule,
MatSidenavModule, MatIconModule, MatListModule,
    RouterModule.forChild([
      { path: '', component: VisitorComponent }
    ]),
    PoiModule,
    GoogleMapsModule
  ],
  declarations: [
    VisitorComponent,
    PoiListComponent
```

```
  ],
})
```

4. Open the `index.html` file of the application and add the Google Maps JavaScript API inside the `<head>` element:

```
<script src="https://maps.googleapis.com/maps/api/js"></script>
```

Now that we have installed and registered Google Maps in our application, let's create the Angular component that will host it:

1. Execute the following command of the Nx CLI to create a new Angular component:

```
nx generate @schematics/angular:component map --project=visitor
```

2. Open the `map.component.ts` file and add the following `import` statements:

```
import { Store } from '@ngrx/store';
import { PoiSelectors } from '@packt/poi';
```

3. Inject the `Store` service in the `constructor` of the `MapComponent` class and declare a property to get the selected POI from the store:

```
export class MapComponent {
  poi$ = this.store.select(PoiSelectors.selectEntity);

  constructor(private store: Store) { }
}
```

4. Open the `map.component.html` file and replace its content with the following HTML template:

```
<google-map height="100%" width="auto" *ngIf="poi$ | async as poi"
[center]="poi">
  <map-marker [position]="poi"></map-marker>
</google-map>
```

In the preceding template, we subscribe to the `poi$` property using the `async` pipe. As soon as we get a selected POI from the store, we display a `<google-map>` component and set the center of the map to the POI coordinates. Furthermore, we add a marker on the map in the specified POI coordinates.

5. Open the `visitor.component.html` file and replace the `<!-- Add Content Here -->` comment with the `<packt-map>` selector.

The Angular component we created will show the location of a POI on the map as soon as we select it from the list. If you try to choose a POI from the list, you will notice that nothing happens. Why is that?

The global state of the application does not currently know when a POI has been selected. We need to add the necessary code to set the selected POI and interact with the store:

1. Open the `poi.actions.ts` file and add a new action to pass the ID of the selected POI:

```
export const selectPoi = createAction(
  '[Poi/API] Select Poi',
  props<{ poiId: string | number }>()
);
```

2. Open the `poi.reducer.ts` file and add a new statement in the `reducer` property that will listen to the `selectPoi` action and save the selected POI in the store:

```
const reducer = createReducer(
  initialPoiState,
  on(PoiActions.initPoi, (state) => ({ ...state, loaded: false,
error: null })),
  on(PoiActions.loadPoiSuccess, (state, { poi }) =>
    poiAdapter.setAll(poi, { ...state, loaded: true })
  ),
  on(PoiActions.loadPoiFailure, (state, { error }) => ({ ...state,
error })),
  on(PoiActions.selectPoi, (state, { poiId }) => ({ ...state,
selectedId: poiId }))
);
```

3. Open the `poi-list.component.ts` file and import the `PoiEntity` interface:

```
import { PoiActions, PoiEntity, PoiSelectors } from '@packt/poi';
```

4. Create a new method to dispatch the `selectPoi` action to the store along with the selected `PoiEntity`:

```
selectPoi(poi: PoiEntity) {
  this.store.dispatch(PoiActions.selectPoi({poiId: poi.id}));
}
```

5. Open the `poi-list.component.html` file and bind the `selectPoi` method to the `click` event of the `<button>` element:

```
<mat-action-list *ngFor="let poi of pois$ | async">
  <button mat-list-item (click)="selectPoi(poi)">{{poi.name}}</
button>
</mat-action-list>
```

To see the new functionality in action, run the application using the **serve** option from Nx Console and select a POI from the list. The output of the application should look like the following:

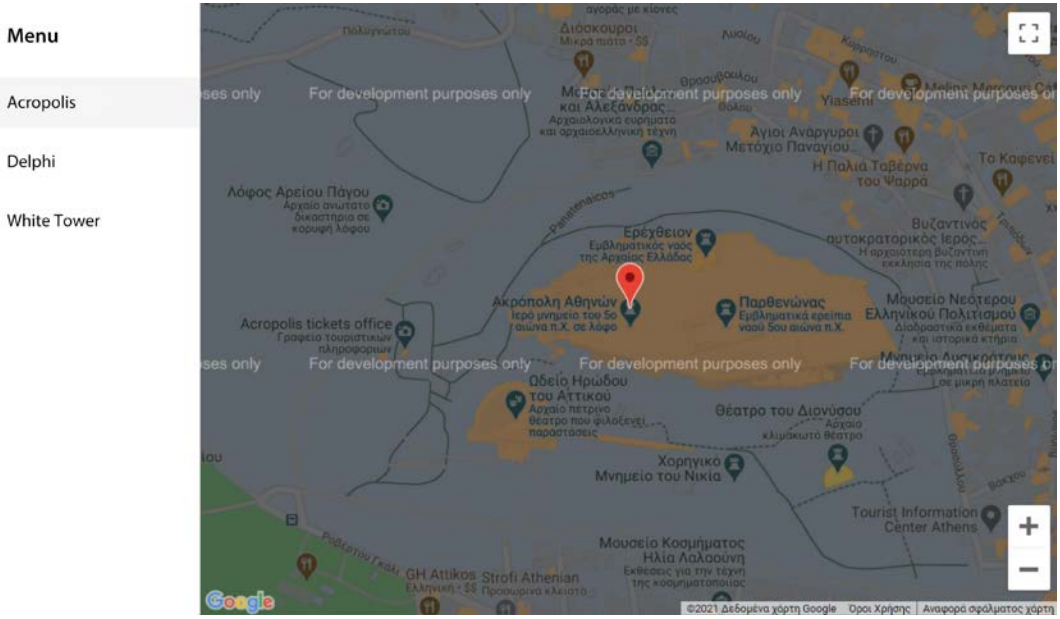

Figure 8.19 – POI selection

In this project, we use Google Maps in development mode. For production environments, you should get an API key from `https://developers.google.com/maps/get-started` and include it in the Google Maps JavaScript API script that you load in the `index.html` file as `<script src="https://maps.googleapis.com/maps/api/js?key=YOUR_API_KEY"></script>`.

We have now completed all the required features for the portal of our visitors. Well done! Implementing the basic functionality of the visitor portal required interacting with NgRx to manage the global state of our application.

The global state was separated into the root state for the application and the feature state for the visitor portal. The **visitor** library used the latter to create Angular components to display a POI list and select one to view in Google Maps.

In the next section, we will build the administrator portal to get visit statistics for each POI.

Visualizing data with graphs

The administrator portal will display traffic visits for each POI using a chart. When visitors visit a POI by clicking its marker on the map, traffic will be generated. The application will persist visit data in the local storage of the browser. It will keep a record for each visit containing the ID of the POI and the total visits. The administrator portal will consist of the following features:

- Persisting visit data in the store
- Displaying visit statistics

In the following section, we will start building the administrator portal by implementing the mechanism to keep track of visits.

Persisting visit data in the store

Our application does not record traffic statistics for POIs yet. Let's see how we can accomplish this task:

1. Open the `map.component.html` file and add a `<map-info-window>` component:

```
<google-map height="100%" width="auto" *ngIf="poi$ | async as poi"
[center]="poi">
  <map-marker [position]="poi"></map-marker>
  <map-info-window>
    <mat-card>
      <mat-card-header>
        <mat-card-title>{{poi.name}}</mat-card-title>
      </mat-card-header>
      <img mat-card-image [src]="poi.imgUrl">
      <mat-card-content>
        <p>{{poi.description}}</p>
      </mat-card-content>
    </mat-card>
  </map-info-window>
</google-map>
```

The <map-info-window> component is a pop-up window that displays additional information about the current map marker. It shows the title, image, and description of a POI as an Angular Material card component.

The <mat-card> component contains a header denoted by the <mat-card-header> component and an image denoted by the <img> element with the `mat-card-image` directive. The <mat-card-content> component indicates the main content of the card.

2. Open the `visitor.module.ts` file and add the following `import` statement:

```
import { MatCardModule } from '@angular/material/card';
```

3. Add the `MatCardModule` class in the `imports` array of the `@NgModule` decorator:

```
@NgModule({
  imports: [CommonModule, MatToolbarModule, MatButtonModule,
MatSidenavModule, MatIconModule, MatListModule,
    RouterModule.forChild([
      { path: '', component: VisitorComponent }
    ]),
    PoiModule,
    GoogleMapsModule,
    MatCardModule
  ],
  declarations: [
    VisitorComponent,
    PoiListComponent,
    MapComponent
  ],
})
```

The `MatCardModule` class is an Angular Material module that exposes all the components we need to create a card component.

4. Open the `map.component.ts` file and modify the `import` statements accordingly:

```
import { Component, ViewChild } from '@angular/core';
import { Store } from '@ngrx/store';
import { PoiSelectors } from '@packt/poi';
import { MapInfoWindow, MapMarker } from '@angular/google-maps';
```

5. Declare a component property to get a reference for the information window using the `@ViewChild` decorator:

```
@ViewChild(MapInfoWindow) info: MapInfoWindow | undefined;
```

6. Create a method to open the information window:

```
showInfo(marker: MapMarker) {
  this.info?.open(marker);
}
```

In the preceding code, we call the `open` method of the information window reference, passing the associated map `marker` as a parameter.

7. Open the `map.component.html` file and bind the `showInfo` component method to the `mapClick` event of the `<map-marker>` component:

```
<map-marker #marker="mapMarker" (mapClick)="showInfo(marker)"
[position]="poi"></map-marker>
```

We create the `marker` template reference variable to get a reference to the `mapMarker` object and pass it as a parameter in the `showInfo` method.

8. Run the application using the **serve** option of Nx Console and select a POI from the list.
9. Click on the POI marker on the map, and you should get output similar to the following:

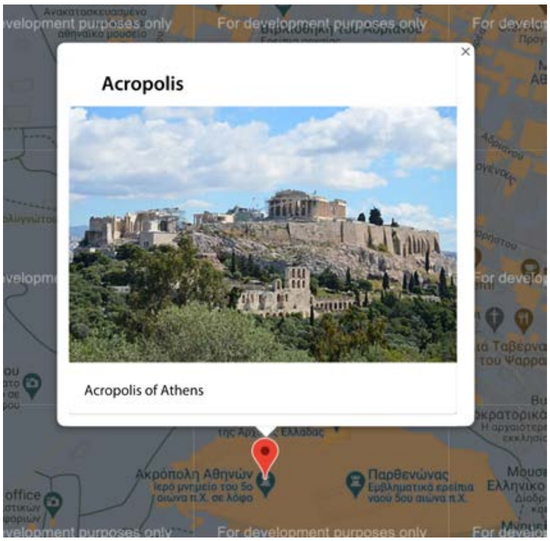

Figure 8.20 – Map information window

We consider that a POI is visited when the visitor clicks on the map marker and the information window appears. Our application will then notify the store of that action to save it in the local storage. Let's create the logic to interact with the store:

1. Open the `poi.actions.ts` file and create the following actions for the feature of visiting a POI:

```
export const visitPoi = createAction(
  '[Poi/API] Visit Poi',
  props<{ poiId: string | number }>()
)
export const visitPoiSuccess = createAction('[Poi/API] Visit Poi
Success');

export const visitPoiFailure = createAction(
  '[Poi/API] Visit Poi Failure',
  props<{ error: any }>()
);
```

2. Open the `poi.effects.ts` file, and create a new effect that listens to the `visitPoi` action and increases the total visits of the specified `poiId` by one:

```
visit$ = createEffect(() =>
  this.actions$.pipe(
    ofType(PoiActions.visitPoi),
    switchMap(action => {
      const stat = localStorage.getItem('tour-' + action.poiId);
      const total = stat ? Number(stat) + 1 : 1;
      localStorage.setItem('tour-' + action.poiId, total.
toString());
      return of(PoiActions.visitPoiSuccess())
    }),
    catchError((error) => {
      console.error('Error', error);
      return of(PoiActions.visitPoiFailure({ error }));
    })
  )
);
```

In the preceding code, we fetch the local storage key that begins with the word `tour-`, followed by the POI ID. If this is located, we increment it by one and update the local storage. Otherwise, we initialize it to one.

> In a real case, it would be better to abstract the logic of local storage in an Angular service that would act as a wrapper over the global `localStorage` object. We encourage you to create such a service while building this project.

3. Open the `map.component.ts` file and import `PoiActions` from the `@packt/poi` namespace:

```
import { PoiActions, PoiSelectors } from '@packt/poi';
```

4. Modify the `showInfo` component method so that it dispatches a `visitPoi` action to the store:

```
showInfo(marker: MapMarker, poiId: string | number) {
  this.store.dispatch(PoiActions.visitPoi({ poiId }));
  this.info?.open(marker);
}
```

5. Finally, open the `map.component.html` file and pass the selected POI ID into the `showInfo` method:

```
<map-marker #marker="mapMarker" (mapClick)="showInfo(marker, poi.
id)" [position]="poi" ></map-marker>
```

Our application can now record the visits of each POI and keep them in the local storage of the browser. In the following section, we will create the main component of the administrator portal that leverages visit data.

Displaying visit statistics

The administrator portal will display visit statistics on its main component with a graph. We will use the **ng2-charts** library to visualize data on a pie chart. Let's see how to add the required functionality in that component:

1. Install the `ng2-charts` library using the following command:

```
npm install ng2-charts chart.js
```

The preceding command will also install the `chart.js` library, which is at the core of the `ng2-charts` library.

2. Open the `admin.module.ts` file, and import `PoiModule` from the `@packt/poi` namespace and `NgChartsModule` from the `ng2-charts` npm package:

```
import { NgModule } from '@angular/core';
import { CommonModule } from '@angular/common';
import { AdminComponent } from './admin.component';
import { RouterModule } from '@angular/router';
import { PoiModule } from '@packt/poi';
import { NgChartsModule } from 'ng2-charts';

@NgModule({
  imports: [
    CommonModule,
    RouterModule.forChild([
      { path: '', component: AdminComponent }
    ]),
    PoiModule,
    NgChartsModule
  ],
  declarations: [
    AdminComponent
  ],
})
export class AdminModule {}
```

3. Open the `admin.component.ts` file and modify the `import` statements accordingly:

```
import { Component, OnDestroy, OnInit } from '@angular/core';
import { Store } from '@ngrx/store';
import { PoiActions, PoiEntity, PoiSelectors } from '@packt/poi';
import { Subscription } from 'rxjs';
```

4. Modify the `AdminComponent` class so that it interacts with the application store to get POI data:

```
export class AdminComponent implements OnInit, OnDestroy {
  private subscription: Subscription | undefined;

  constructor(private store: Store) { }
```

```
  ngOnInit(): void {
    this.subscription = this.store.select(PoiSelectors.
selectAllPoi).subscribe();
    this.store.dispatch(PoiActions.initPoi());
  }

  ngOnDestroy() {
    this.subscription?.unsubscribe();
  }
}
```

In the preceding code, we manually subscribe to the `selectAllPoi` selector using a `subscription` property instead of an `async` pipe. In this case, we must also unsubscribe manually in the `ngOnDestroy` life cycle hook of the component using the `unsubscribe` method. If we fail to do so, we may introduce a memory leak to our application.

Now that we have set up the interaction with the store, we can get statistics from the local storage and create our pie chart:

1. Execute the following command of the Nx CLI to create a service in the `admin` library:

```
nx generate service admin --project=admin
```

2. Open the `admin.service.ts` file and add the following `import` statement:

```
import { PoiEntity } from '@packt/poi';
```

3. Create a method to get all saved traffic statistics from the local storage of the browser:

```
getStatistics(pois: PoiEntity[]): number[] {
  return pois.map(poi => {
    const stat = localStorage.getItem('tour-' + poi.id) ?? 0;
    return +stat;
  });
}
```

In the preceding method, we get the traffic of each POI based on its `id` property. We then convert the `stat` property to a number by adding the + prefix.

4. Open the `admin.component.ts` file and add the following `import` statements:

```
import { AdminService } from './admin.service';
import { ChartDataset } from 'chart.js';
```

5. Declare component properties for the labels and the actual data that we will display on the pie graph, and inject `AdminService` into the `constructor` of the `AdminComponent` class:

```
export class AdminComponent implements OnInit, OnDestroy {
  private subscription: Subscription | undefined;
  dataSets: ChartDataset[] = [];
  labels: string[] = [];

  constructor(private store: Store, private adminService: 
AdminService) { }

  ngOnInit(): void {
    this.subscription = this.store.select(PoiSelectors.
selectAllPoi).subscribe();
    this.store.dispatch(PoiActions.initPoi());
  }

  ngOnDestroy() {
    this.subscription?.unsubscribe();
  }
}
```

6. Create a component method to set the labels and the data of the graph:

```
private buildChart(pois: PoiEntity[]) {
  this.labels = pois.map(poi => poi.name);
  this.dataSets = [{
    data: this.adminService.getStatistics(pois)
  }]
}
```

The graph labels are the titles of the POI, and the data comes from the `getStatistics` method of the `adminService` variable.

7. Call the `buildChart` method inside the `subscribe` method of the `selectAllPoi` selector:

```
ngOnInit(): void {
  this.subscription = this.store.select(PoiSelectors.selectAllPoi).
subscribe(pois => this.buildChart(pois));
  this.store.dispatch(PoiActions.initPoi());
}
```

8. Finally, open the `admin.component.html` file and replace its content with the following HTML template:

```
<div class="chart" *ngIf="dataSets.length">
  <canvas
    height="100"
    baseChart
    [datasets]="dataSets"
    [labels]="labels"
    type="pie">
  </canvas>
</div>
```

In the preceding template, we use the `baseChart` directive to convert the `<canvas>` element to a graph. The graph is set to `pie` using the `type` property.

If we now run our application using Nx Console, visit a POI from the map, and switch to the `http://localhost:4200/admin` URL, we should see the following output:

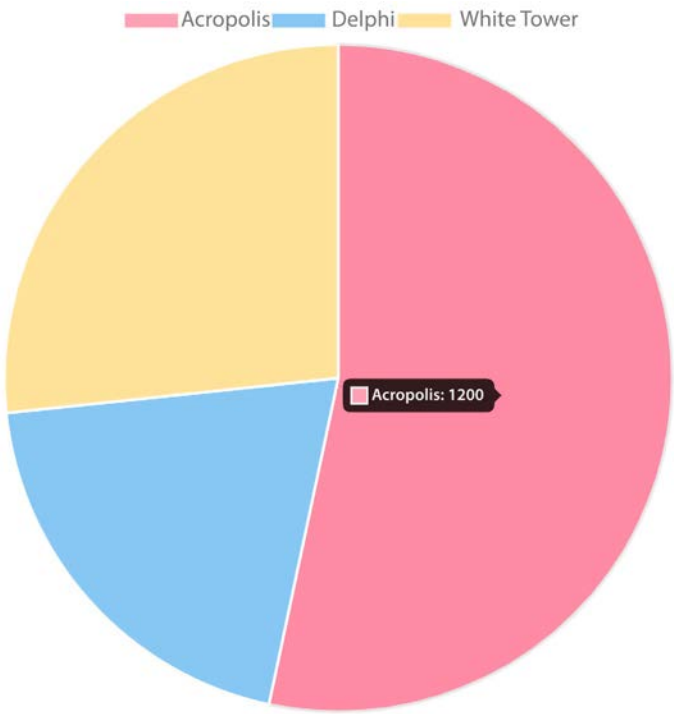

Figure 8.21 – POI statistics

An administrator can now have a complete overview of how each POI does from a visit perspective. Our administrator portal has now been completed. The visitor portal can interact with the store and save visit statistics for each POI in the local storage of the browser. The administrator portal can then fetch and display that data on a pie chart.

Summary

In this project, we built an enterprise portal application to visit POIs on a map and display visit statistics for each one. First, we saw how to use Nx to scaffold a new Nx monorepo application. Then, we created two different portals for our application, a visitor and an administrator. We learned how to use the NgRx library in the visitor portal to maintain and manage the state of our application. Finally, we saw how to use a chart library in the administrator portal to display statistics for each POI.

In the next chapter, we will use the Angular CLI to build a UI component library using the Angular CDK.

Practice questions

Let's take a look at a few practice questions:

1. Which npm package creates an Nx monorepo application?
2. What are the differences between the Angular CLI and Nx CLI?
3. How can we enable NgRx in the library of a monorepo?
4. How do we select data from the store?
5. How do we interact with HTTP in NgRx?
6. Where do we modify the state of an NgRx store?
7. What is the difference between a root and a feature state?
8. Which npm package can we use for Google Maps in an Angular application?
9. How can we subscribe to an NgRx selector manually?
10. Which component do we use to display additional information on Google Maps?

Further reading

Here are some links to build upon what we learned in the chapter:

- Nx: `https://nx.dev`
- NgRx: `https://ngrx.io`

- NgRx store guide: `https://ngrx.io/guide/store`
- Angular Material card component: `https://material.angular.io/components/card/overview`
- Angular Google Maps: `https://github.com/angular/components/tree/main/src/google-maps`
- `ng2-charts`: `https://valor-software.com/ng2-charts`
- `create-nx-workspace`: `https://www.npmjs.com/package/create-nx-workspace`

9

Building a Component UI Library Using Angular CLI and Angular CDK

An Angular application consists of Angular components that are organized into modules. When components need to share a similar appearance or behavior across modules, we extract their functionality into reusable components and group them in a shared module. Reusable components may vary from complex UI structures with many controls, such as forms, to single native HTML elements, such as buttons.

A component UI library is a collection of reusable components that can be used outside a specific application domain. A large enterprise application built with a monorepo architecture can use these components across all its applications. A project outside an organization can also use the same component library as an external dependency.

The Angular CLI includes all the necessary tooling for creating libraries with Angular. The Angular **Component Dev Kit** (**CDK**) provides a broad range of functionalities for creating accessible and high-performant UI components. In this chapter, we will combine them with **Bulma**, a modern CSS framework, to create a simple component UI library from scratch.

In this chapter, we will cover the following topics in more detail:

- Creating a library with the Angular CLI
- Building a draggable card list
- Interacting with the clipboard

- Publishing an Angular library to `npm`
- Using components as **Angular elements**

Essential background theory and context

The Angular CDK contains a collection of common interactions and behaviors that we can apply to Angular components. It is at the heart of the Angular Material library but can be used with any CSS framework in an Angular application. The Angular CDK is available from the `@angular/cdk` npm package.

The Angular CLI supports creating Angular libraries out of the box. The functionality of an Angular library can be used only in Angular applications, and it is decoupled from specific business logic. If we want to use an Angular library in a non-Angular application, we must convert it into an Angular element.

Custom elements are a web standard that allows the creation of HTML elements independent of any JavaScript framework. It works by declaring a custom HTML tag and associating it with a JavaScript class. The browser can identify the HTML tag and execute the JavaScript code defined inside the class.

Angular elements are Angular components converted into custom elements using the `@angular/elements` library. Packaging an Angular component as a custom element connects the Angular framework to the DOM of the element, enriching it with data binding, a component life cycle, and change detection features.

Project overview

In this project, we will build a component UI library for our Angular projects. Initially, we will use the Angular CLI to scaffold a new Angular workspace for our library. We will then use the Angular CDK and the Bulma CSS framework to create the following components:

- A list of cards that we can rearrange using drag-and-drop features
- A button that will allow us to copy arbitrary content to the clipboard

We will learn how to deploy the library into a package registry such as **npm**. Finally, we will convert one of our components into an Angular element to share it with non-Angular applications using the `ngx-build-plus` library. The following diagram provides an architectural overview of the project:

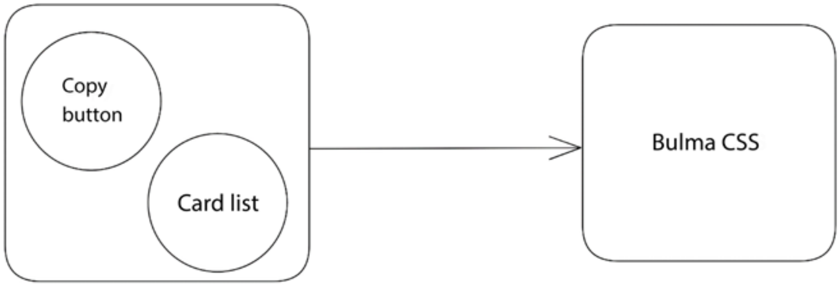

Figure 9.1 – Project architecture

Build time: 1½ hours

Getting started

The following prerequisites and software tools are required to complete this project:

- Angular CLI: A CLI for Angular, which you can find at `https://angular.io/cli`.
- GitHub material: The related code for this chapter can be found in the `Chapter09` folder at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition`.

Creating a library with the Angular CLI

Before we can start working with Angular libraries using the Angular CLI, we need to create an Angular CLI workspace. The Angular CLI workspace will contain our Angular library and an Angular application for testing the library.

Use the following command to generate a new Angular CLI workspace:

```
ng new my-components --defaults
```

The preceding command will create a new Angular CLI workspace that contains an Angular application named `my-components`. Navigate to the `my-components` folder and execute the following command to generate a new Angular library:

```
ng generate library ui-controls
```

The preceding command will create a `ui-controls` library inside the `projects` folder of the workspace. It will contain various files and folders similar to those when creating an Angular application, including the following:

- `src\lib`: This contains the source code of the library, such as modules, components, and services.

- `src\public-api.ts`: This exports artifacts from the library that we want to make publicly available in other Angular applications.
- `ng-package.json`: This contains a configuration for the `ng-packagr` library that the Angular CLI uses under the hood for building libraries.
- `tsconfig.lib.json`: The TypeScript configuration file for our library, which also contains several Angular compiler options.
- `tsconfig.lib.prod.json`: The TypeScript configuration file used when building our library in production mode.

The Angular CLI will generate a module, a component, and a service in the `src\lib` folder for us by default. It will also export them so that they can be used by any Angular application that will use the library. You can see an example of this here:

```
public-api.ts
/*
* Public API Surface of ui-controls
*/

export * from './lib/ui-controls.service';
export * from './lib/ui-controls.component';
export * from './lib/ui-controls.module';
```

Now that we have set up our Angular CLI workspace, we can go ahead and install the Bulma and Angular CDK libraries as follows:

1. Execute the following command to install the Angular CDK:

   ```
   npm install @angular/cdk
   ```

2. Run the following command to install the Bulma CSS framework:

   ```
   npm install bulma
   ```

3. Open the `angular.json` configuration file and add the CSS style sheet file of the Bulma library to the `styles` section of the `build` architect entry, as follows:

   ```
   "options": {
     "outputPath": "dist/my-components",
     "index": "src/index.html",
     "main": "src/main.ts",
   ```

```
    "polyfills": [
      "zone.js"
    ],
    "tsConfig": "tsconfig.app.json",
    "assets": [
      "src/favicon.ico",
      "src/assets"
    ],
    "styles": [
      "src/styles.css",
      "./node_modules/bulma/css/bulma.css"
    ],
    "scripts": []
  }
```

4. Open the `package.json` file of the `projects\ui-controls` folder and modify it accordingly:

```
{
  "name": "ui-controls",
  "version": "0.0.1",
  "peerDependencies": {
    "@angular/common": "^16.0.0",
    "@angular/core": "^16.0.0",
    "@angular/cdk": "^16.0.3",
    "bulma": "^0.9.4"
  },
  "dependencies": {
    "tslib": "^2.3.0"
  },
  "sideEffects": false
}
```

We add the Angular CDK and the Bulma library to the `peerDependencies` section to ensure that any consuming application has a specific version of the packages to run our library.

> The version number of each package may vary if you follow along with this project. To ensure you have the correct versions, copy them from the `package.json` file of the root folder of the workspace.

We have now completed the basic setup of our UI components library. We have also configured the Angular application that comes with the Angular CLI workspace to preview and test the library. In the following section, we will build the first component of our library—a card list that can be re-ordered.

Building a draggable card list

The first component of our UI library will be a list of Bulma card elements. Each card will display a title, a description, and an anchor link element. We will also be able to drag a card and change the order of the card list using the Angular CDK. Building our component will consist of the following tasks:

- Displaying card data
- Adding drag-and-drop functionality

In the following section, we will first see how to display data on the card list.

Displaying card data

Our Angular application should pass a list of cards as an input property to the component for displaying them. Let's see how we can create a draggable card component as follows:

1. Execute the following Angular CLI command to create an Angular component:

   ```
   ng generate component card-list --project=ui-controls --export
   ```

   The preceding command will create a `card-list` component in the `ui-controls` project of our Angular CLI workspace. The `--export` option will also export the component from `UiControlsModule`.

   The `UiControlsModule` class is already exported from the `public-api.ts` file. So, when our Angular application imports `UiControlsModule`, it will also have our component available.

2. Use the `generate` command of the Angular CLI to create an interface for the structure of card data, as follows:

   ```
   ng generate interface card --project=ui-controls
   ```

3. The preceding command will create a `card.ts` file in the `ui-controls` project of our workspace.
4. Open the `card.ts` file and add the following properties to the `Card` interface:

   ```
   export interface Card {
   ```

```
  title: string;
  description: string;
  link: string;
}
```

5. Open the `public-api.ts` file and add the following `export` statements to make the component and the interface available to the library consumers:

```
export * from './lib/card-list/card-list.component';
export * from './lib/card';
```

6. Open the `card-list.component.ts` file and use the `@Input` decorator to define an `input` property as follows:

```
import { Component, Input } from '@angular/core';
import { Card } from '../card';

@Component({
  selector: 'lib-card-list',
  templateUrl: './card-list.component.html',
  styleUrls: ['./card-list.component.css']
})
export class CardListComponent {
  @Input() cards: Card[] = [];
}
```

The `cards` property will be set later from the Angular application with the card data we want to display.

7. Open the `card-list.component.html` file and replace its content with the following HTML template:

```
<div>
  <div class="card m-4" *ngFor="let card of cards">
    <header class="card-header">
      <p class="card-header-title">{{card.title}}</p>
    </header>
    <div class="card-content">
      <div class="content">{{card.description}}</div>
    </div>
    <footer class="card-footer">
```

```
      <a [href]="card.link" class=
        "card-footer-item">View on Wikipedia</a>
    </footer>
  </div>
</div>
```

The preceding template uses the Bulma `card` component and iterates over the `cards` component property to display each one, using the `*ngFor` directive.

8. Open the `card-list.component.css` file and add the following CSS styles:

```
:host > div {
  display: grid;
  grid-auto-flow: column;
  overflow: auto;
}
.card {
  width: 200px;
}
```

In the preceding styles, we use the `:host` selector to target the `div` element in the `host` element of our component and apply a `grid` style to display all cards in a single row.

9. Open the `ui-controls.module.ts` file and add `CommonModule` to the `imports` array of the `@NgModule` decorator, as follows:

```
import { CommonModule } from '@angular/common';
import { NgModule } from '@angular/core';
import { UiControlsComponent } from './ui-controls.component';
import { CardListComponent } from './card-list/card-list.component';

@NgModule({
  declarations: [
    UiControlsComponent,
    CardListComponent
  ],
  imports: [
    CommonModule
  ],
  exports: [
    UiControlsComponent,
```

```
    CardListComponent
  ]
})
export class UiControlsModule { }
```

The `CommonModule` class is needed for the `*ngFor` directive in the card list component template.

Our component is ready to accept and display data in a card list representation. Let's see how to consume it from the Angular application as follows:

1. First, execute the following command to build the component UI library:

```
ng build ui-controls
```

The Angular CLI will start building the library, and it will have been completed as soon as you see the following output on the terminal:

```
------------------------------------------------------------------------------
Building entry point 'ui-controls'
------------------------------------------------------------------------------
✓ Compiling with Angular sources in Ivy partial compilation mode.
✓ Generating FESM2020
✓ Generating FESM2015
✓ Copying assets
✓ Writing package manifest
```

Figure 9.2 – Library build output

2. Open the `app.module.ts` file and add the `UiControlsModule` class to the `imports` array of the `@NgModule` decorator, as follows:

```
import { NgModule } from '@angular/core';
import { BrowserModule } from '@angular/platform-browser';

import { AppComponent } from './app.component';
import { UiControlsModule } from 'ui-controls';

@NgModule({
  declarations: [
    AppComponent
  ],
  imports: [
```

```
    BrowserModule,
    UiControlsModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

> We import `UiControlsModule` from the `ui-controls` namespace, which is the library name, and not from the full absolute path in our workspace.

3. Open the `app.component.ts` file and declare a `component` property of the `Card[]` type, as follows:

```
import { Component } from '@angular/core';
import { Card } from 'ui-controls';
import { assassins } from './assassins';

@Component({
  selector: 'app-root',
  templateUrl: './app.component.html',
  styleUrls: ['./app.component.css']
})
export class AppComponent {
  title = 'my-components';
  cards: Card[] = assassins;
}
```

We initialize the `cards` component property using demo data from the `assassins.ts` file, which you can find in the GitHub repository of the *Getting started* section.

4. Open the `app.component.html` file and replace its content with the following HTML template:

```
<div class="container is-fluid">
  <h1 class="title">Assassins Creed Series</h1>
  <lib-card-list [cards]="cards"></lib-card-list>
</div>
```

5. To preview the application, run `ng serve` and open your browser at `http://localhost:4200`. You should then see something like this:

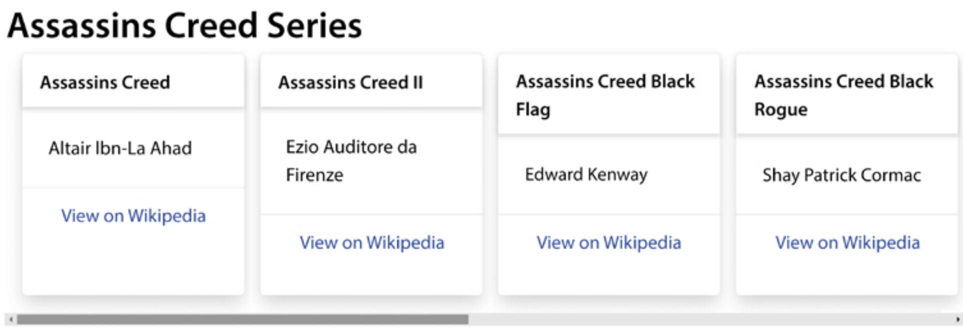

Figure 9.3 – Card list component

The card list component displays data that a consumer application passed using the `cards` input property. In the following section, we will take our component a step further and make our cards able to change their location in the list.

Adding drag-and-drop functionality

A feature of the card list component is that we will be able to change the location of a card by dragging and dropping it into the list. The order of the card list should be emitted back to the consumer application using an output property binding.

The Angular CDK contains a drag-and-drop module that we can use for this purpose. To do so, follow these steps:

1. Open the `ui-controls.module.ts` file and import `DragDropModule` from the `@angular/cdk/drag-drop` namespace, like this:

```
import { DragDropModule } from '@angular/cdk/drag-drop';
```

2. Add the `DragDropModule` class to the `imports` array of the `@NgModule` decorator like this:

```
@NgModule({
  declarations: [
    UiControlsComponent,
    CardListComponent
  ],
  imports: [
    CommonModule,
```

```
      DragDropModule
    ],
    exports: [
      UiControlsComponent,
      CardListComponent
    ]
})
```

3. Open the `card-list.component.html` file and modify the template as follows:

```
<div cdkDropListOrientation="horizontal" cdkDropList
(cdkDropListDropped)="sortCards($event)">
  <div cdkDrag class="card m-4" *ngFor="let card of cards">
    <header class="card-header">
      <p class="card-header-title">{{card.title}}</p>
    </header>
    <div class="card-content">
      <div class="content">{{card.description}}</div>
    </div>
    <footer class="card-footer">
      <a [href]="card.link" class="card-footer-item">View on
Wikipedia</a>
    </footer>
  </div>
</div>
```

First, we add the `cdkDrag` directive to each card element to be able to move it by dragging it. Then, we add the `cdkDropList` directive to the container element to mark it as a drop list. A drop list in the Angular CDK indicates that its contents can be re-ordered using drag-and-drop actions. We set the drag-and-drop orientation to `horizontal` because our card list is rendered in a single row, and we also bind a `sortCards` component method to the `cdkDropListDropped` event of the drop list.

4. Open the `card-list.component.ts` file and modify the `import` statements accordingly:

```
import { Component, Input, Output, EventEmitter } from '@angular/
core';
import { Card } from '../card';
import { CdkDragDrop, moveItemInArray } from '@angular/cdk/drag-
drop';
```

5. Create an output property using the `@Output` decorator and use it in the `sortCards` component method to emit the re-ordered list to the consumer of the component, as follows:

```
export class CardListComponent {
  @Input() cards: Card[] = [];
  @Output() cardChange = new EventEmitter<Card[]>();

  sortCards(event: CdkDragDrop<string[]>): void {
    moveItemInArray(this.cards, event.previousIndex, event.
currentIndex);
    this.cardChange.emit(this.cards);
  }
}
```

In the previous code snippet, we use the `moveItemInArray` built-in method of `DragDropModule` to change the order of the `cards` property. We pass the `event` parameter to the `moveItemInArray` method containing the previous and current index of the moved card. We also use the `emit` method of the `cardChange` property to propagate the change back to the Angular application.

The card list component has now acquired drag-and-drop superpowers. Let's give it a try, as follows:

1. Open the `app.component.html` file and add an event binding to the `cardChange` event of the `<lib-card-list>` component, as follows:

```
<div class="container is-fluid">
  <h1 class="title">Assassins Creed Series</h1>
  <lib-card-list [cards]="cards"
(cardChange)="onCardChange($event)">
  </lib-card-list>
</div>
```

2. Open the `app.component.ts` file and create an `onCardChange` method to log the new card list as follows:

```
onCardChange(cards: Card[]) {
  console.log(cards);
}
```

3. Run the following command to build the library:

```
ng build ui-controls
```

4. Execute the `serve` command of the Angular CLI to start your application like this:

```
ng serve
```

5. Try to drag and drop some of the cards from the list and notice the output in the **Console** window of your browser and the actual application.

The first component of our UI library is now packed with all the functionality to make it a drag-and-drop list. It can display a list passed from our Angular application in a Bulma card format. It can also change the order of each item in the list using the Angular CDK drag-and-drop module, and propagate the change back to our application.

In the following section, we will create a second component of our library for copying data to the clipboard.

Interacting with the clipboard

The Angular CDK library contains a collection of Angular artifacts that we can use to interact with the system clipboard. Specifically, it includes a directive for copying data to the clipboard and an event binding for taking additional action when the content has been copied. Let's see how we can integrate both in to our component library, as follows:

1. Execute the following command of the Angular CLI to create a new Angular component in the library:

```
ng generate component copy-button --project=ui-controls --export
```

2. Export the newly generated component from the `public-api.ts` file as follows:

```
export * from './lib/copy-button/copy-button.component';
```

3. Open the `ui-controls.module.ts` file and import `ClipboardModule` from the `@angular/cdk/clipboard` namespace, like this:

```
import { ClipboardModule } from '@angular/cdk/clipboard';
```

4. Add the `ClipboardModule` class to the `imports` array of the `@NgModule` decorator like this:

```
@NgModule({
  declarations: [
```

```
    UiControlsComponent,
    CardListComponent,
    CopyButtonComponent
  ],
  imports: [
    CommonModule,
    DragDropModule,
    ClipboardModule
  ],
  exports: [
    UiControlsComponent,
    CardListComponent,
    CopyButtonComponent
  ]
})
```

5. Open the `copy-button.component.ts` file and declare the following component properties:

```
import { Component, EventEmitter, Input, Output } from '@angular/
core';

@Component({
  selector: 'lib-copy-button',
  templateUrl: './copy-button.component.html',
  styleUrls: ['./copy-button.component.css']
})
export class CopyButtonComponent {
  @Input() data = '';
  @Output() copied = new EventEmitter<void>();
}
```

The `data` property will be used to set clipboard data, and the `copied` event will fire when the data is successfully copied to the clipboard.

6. Create a component method to trigger a `copied` output event, as follows:

```
onCopy() {
  this.copied.next();
}
```

7. Open the `copy-button.component.html` file and replace its content with the following HTML template:

```
<button class="button is-light is-primary"
[cdkCopyToClipboard]="data" (cdkCopyToClipboardCopied)="onCopy()">
  Copy
</button>
```

   In the preceding template, we use a Bulma `button` component and attach two Angular CDK bindings to it. The `cdkCopyToClipboard` property binding indicates that the `data` component property will be copied to the clipboard when the button is clicked. The `cdkCopyToClipboardCopied` event binding will call the `onCopy` component method as soon as data has been copied to the clipboard successfully.

Now that we have set up our component, let's find out how to use it in our Angular application, as follows:

1. Open the `app.component.html` file and add a `<div>` element that consists of an `<input>` element and the `<lib-copy-button>` component, as follows:

```
<div class="container is-fluid">
  <h1 class="title">Assassins Creed Series</h1>
  <lib-card-list [cards]="cards"
(cardChange)="onCardChange($event)"></lib-card-list>
  <h1 class="title mt-5">Clipboard interaction</h1>
  <div class="field has-addons">
    <div class="control">
      <input class="input" type="text" [(ngModel)]="title">
    </div>
    <div class="control">
      <lib-copy-button [data]="title" (copied)="log()"></lib-copy-
button>
    </div>
  </div>
</div>
```

   In the previous template, we bind the `title` property of the component to the `<input>` element using the `ngModel` directive. We also bind it to the `data` property of the `<lib-copy-button>` component to copy the contents of the `<input>` element to the clipboard. We also bind the `copied` event to the `log` component method.

2. Open the `app.component.ts` file and create a `log` method for displaying an information message when data is copied to the clipboard, as follows:

```
log() {
  alert(this.title + ' copied to the clipboard');
}
```

3. Open the `app.module.ts` file and import `FormsModule`, like this:

```
import { NgModule } from '@angular/core';
import { BrowserModule } from '@angular/platform-browser';
import { FormsModule } from '@angular/forms';

import { AppComponent } from './app.component';
import { UiControlsModule } from 'ui-controls';

@NgModule({
  declarations: [
    AppComponent
  ],
  imports: [
    BrowserModule,
    UiControlsModule,
    FormsModule
  ],
  providers: [],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

The `FormsModule` class is part of the `@angular/forms` npm package and is required when we want to use `ngModel` in our application.

4. Execute the following command to build the library so that our application can recognize the new component:

```
ng build ui-controls
```

5. Run the application using `ng serve`, and you should get the following output:

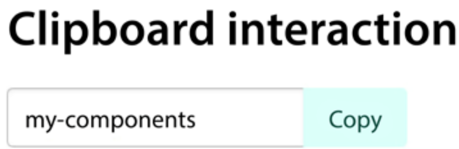

Figure 9.4 – Clipboard interaction

6. Enter the value `my awesome library` into the textbox and click on the **Copy** button. You should get the following output:

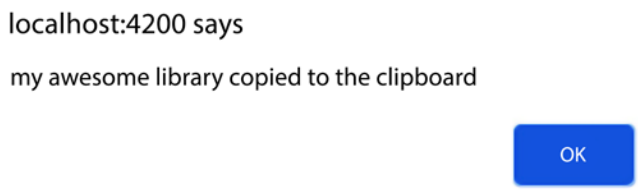

Figure 9.5 – Alert message

We have successfully created a button that we can attach to an Angular application and use to interact with the clipboard directly!

The Angular CDK contains various other components and behaviors that we can use in our Angular applications. When combined with a highly customizable CSS framework such as Bulma, it can create compelling and unique interfaces. Try them in your Angular projects and build a library with a rich set of components. In the following section, we will learn how to publish a library in the **npm package registry**.

Publishing an Angular library to npm

We have already seen how to build an Angular library and consume it in an Angular application when both exist in the same repository or organization. However, there are cases where you may want to make your library available to Angular projects outside your infrastructure via a public package registry such as npm. A usual case is when you want to make your library open source so that other members of the development community can benefit from this. Let's see how to publish our `ui-controls` library to npm, as follows:

1. If you do not have an npm account, navigate to `https://www.npmjs.com/signup` to create one.

2. Open the `package.json` file that exists in the `projects\ui-controls` folder of the Angular CLI workspace and set the value of the `version` property to `1.0.0`.

> It is considered a good practice to follow **semantic versioning** in your library and publish it as version *1.0.0* for the first time. Angular also follows semantic versioning, and you can learn more about this at `https://semver.org`.

3. Open a terminal window and run the following Angular CLI command to build your library:

```
ng build ui-controls
```

4. Navigate to the `dist` folder where the Angular CLI has generated the final bundle of our library, as illustrated in the following code snippet:

```
cd dist\ui-controls
```

5. Execute the following `npm` command to log in to the npm registry from the terminal:

```
npm login
```

6. After you have successfully authenticated with npm, run the following command to publish your library:

```
npm publish
```

> Running the preceding command will throw an error because the npm package registry already contains a `ui-controls` package. If you want to preview the result of the previous command, make sure that you change the `name` field in the `package.json` file of the library.

Well done! Your library is now on the public npm registry and can be used by other developers in their Angular applications.

> Always remember to change the `version` number in the `package.json` file of your library before publishing it. Otherwise, the npm registry will throw an error stating that the version you are trying to publish already exists.

In the following section, we will learn how to use our library in non-Angular applications using Angular elements.

Using components as Angular elements

We have already learned how to use the Angular CLI to create an Angular library. We also saw how to publish our library to the npm registry so that other Angular projects can use it and benefit from it. In this section, we will go the extra mile and learn how to build our Angular library to be used in non-Angular environments.

As we have already pointed out, the Angular framework is a cross-platform JavaScript framework in many ways. It can run on the server using **Angular Universal** and on mobile platforms. It can also run on a native desktop environment. In addition to those platforms, it can even run on web applications that are not built with Angular, using Angular elements.

Let's see how we can convert our clipboard component into an Angular element, as follows:

1. Execute the following Angular CLI command to generate a new Angular application in our workspace:

   ```
   ng generate application ui-elements --defaults
   ```

   The preceding command will generate the `ui-elements` Angular application in the `projects` folder using default options.

   > The Angular CLI does not currently support the use of Angular elements directly on an Angular library. Thus, we need to create an Angular application whose only purpose will be to export our components as Angular elements.

2. Navigate to the `projects\ui-elements` folder and run the following command to install the `@angular/elements` package:

   ```
   npm install @angular/elements
   ```

3. Open the `app.module.ts` file of the `ui-elements` application and modify it accordingly:

   ```
   import { Injector, NgModule } from '@angular/core';
   import { createCustomElement } from '@angular/elements';
   import { BrowserModule } from '@angular/platform-browser';
   import { UiControlsModule, CopyButtonComponent } from 'ui-controls';

   @NgModule({
     imports: [
       BrowserModule,
   ```

```
    UiControlsModule
  ],
  providers: []
})
export class AppModule { }
```

4. Add a `constructor` to the `AppModule` class and inject the `Injector` service as follows:

   ```
   constructor(private injector: Injector) {}
   ```

5. Implement an `ngDoBootstrap` method to create the custom element for the `CopyButtonComponent` class, as follows:

   ```
   ngDoBootstrap() {
     const el = createCustomElement(CopyButtonComponent, { injector:
   this.injector });
     customElements.define('copy-button', el);
   }
   ```

   The `ngDoBootstrap` method is used to hook in the manual bootstrap process of the Angular application. We use the `createCustomElement` method from the `@angular/elements` npm package to create a custom element, passing the class of the component and the injector. Finally, we use the `define` method of the `customElements` object to declare the custom element, passing the HTML selector that we want to use and the custom element as parameters.

Now that we have put into practice all the workings for converting an Angular component into an Angular element, it's time to build it so that we can use it in a web application.

Building an Angular element differs from a standard build of an Angular application. When we build an Angular application, the Angular CLI generates different JavaScript bundles that contain the application source code, the Angular framework, and any third-party libraries. In an Angular element scenario, we only want to generate one bundle file containing our component. For this purpose, we will use the `ngx-build-plus` library, which can generate a single bundle, among other things. Let's see how to install it and use it in our application, as follows:

1. Execute the following command of the Angular CLI to install the `ngx-build-plus` package:

   ```
   ng add ngx-build-plus --project=ui-elements
   ```

   The preceding command will modify the `angular.json` file of the Angular CLI workspace to use the `ngx-build-plus` library to build the `ui-elements` application.

2. Run the following command of the Angular CLI to build the application:

```
ng build ui-elements --single-bundle
```

The previous command will build the `ui-elements` application and produce a single bundle for all application code.

3. Copy the `dist\ui-elements` folder to another location of your choice on your hard disk and open the `index.html` file, using your editor.
4. Remove the `<base>` tag from the `<head>` element and add the Bulma CSS minified file using a **content delivery network** (**CDN**), as follows:

```
<link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/
bulma@0.9.4/css/bulma.min.css">
```

5. Replace the `<app-root>` selector with the following HTML snippet in the `<body>` element:

```
<div class="container is-fluid">
  <h1 class="title">My Angular Element</h1>
  <copy-button></copy-button>
</div>
```

In the preceding snippet, we added a `<div>` element styled with Bulma CSS classes and the selector of the Angular element that we defined in `AppModule`.

6. Insert the following JavaScript code *after* the `<div>` element:

```
<script>
  const el = document.getElementsByTagName('copy-button')[0];
  el.setAttribute('data', 'Some data');
  el.addEventListener('copied', () => alert('Copied to clipboard'));
</script>
```

In the preceding script, we communicate with the component that is hidden behind the Angular element using vanilla JavaScript. First, we query the global `document` object to get a reference to the Angular element. Then, we set the `data` input property using the `setAttribute` method of the element. Finally, we listen for the `copied` output event by attaching an event listener using the `addEventListener` method.

7. Use a web server to serve the `ui-elements` folder and open the `index.html` file using your browser. You should see the following output:

Figure 9.6 – Angular element

If you do not want to install a separate web server, you can use the Live Server VSCode extension.

8. Click on the **Copy** button, and you should see the following alert dialog:

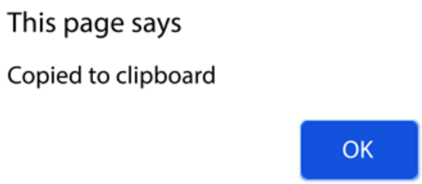

Figure 9.7 – Alert dialog

We have managed to use an Angular component from our UI component library as a native HTML element in a web application that has nothing to do with Angular! The custom element looks and behaves the same as its Angular counterpart. The only difference is how we set up and configure the custom element in our web application using plain JavaScript.

Summary

In this project, we built a component UI library that we can use in our Angular applications. Initially, we learned how to use the Angular CLI to create an Angular library. We scaffolded a new Angular CLI workspace that contained our Angular library, along with an Angular application for testing it.

We then used the Angular CDK with the Bulma CSS framework to build the UI components of our library. We created a card list that can be re-ordered using drag-and-drop features and a button for copying content to the clipboard.

We also saw how to publish our library in the npm registry to use it in other Angular projects. Finally, we converted it into custom elements using Angular elements for distribution to non-Angular applications.

In the next project, which will be the final project in the book, we will learn how to customize the Angular CLI to create our generation schematics.

Practice questions

Let's take a look at a few practice questions:

1. How do we generate a new Angular library using the Angular CLI?
2. How do we make an Angular artifact of our library public?
3. Which CSS selector do we use to target the `host` element of an Angular component?
4. How do we mark an element as draggable in the Angular CDK?
5. Which method do we use to re-order a draggable list of items?
6. Which Angular CDK directive is responsible for passing data to the clipboard?
7. How do we create a single bundle using the `ngx-build-plus` library?
8. How do we pass data to and from an Angular element?

Further reading

Here are some links to build upon what we learned in the chapter:

- Angular libraries overview: `https://angular.io/guide/libraries`
- Creating Angular libraries: `https://angular.io/guide/creating-libraries`
- Bulma CSS: `https://bulma.io`
- Angular CDK: `https://material.angular.io/cdk/categories`
- Drag-and-drop module: `https://material.angular.io/cdk/drag-drop/overview`
- Clipboard module: `https://material.angular.io/cdk/clipboard/overview`
- Angular elements overview: `https://angular.io/guide/elements`
- `ngx-build-plus`: `https://www.npmjs.com/package/ngx-build-plus`

Join our community on Discord

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

`https://packt.link/AngularProjects3e`

10

Customizing Angular CLI Commands Using Schematics

The Angular CLI is a powerful tool and the de facto solution for working with Angular applications. It eliminates most of the boilerplate code and configuration from the developer and allows them to focus on the fun stuff, which is building awesome Angular applications. Apart from enhancing the Angular development experience, it can be easily customized to the needs of each developer.

The Angular CLI contains a set of useful commands for building, bundling, and testing Angular applications. It also provides a collection of special commands, called **schematics**, that generate various Angular artifacts such as components, modules, and services. Schematics expose a public API that developers can use to create their own Angular CLI commands or extend the existing ones.

In this chapter, we will cover the following details about schematics:

- Installing the **Schematics CLI**
- Creating a **Tailwind CSS** component
- Creating an HTTP service

Essential background theory and context

Angular schematics are libraries that can be installed using `npm`. They are used in various situations, including creating components that share a standard user interface or enforcing conventions and coding guidelines inside an organization. A schematic can be used as a standalone or as a companion for an existing Angular library.

Angular schematics are packaged into collections and reside in the `@schematics/angular` npm package. When we use the Angular CLI to run the `ng add` or the `ng build` command, it runs the appropriate schematic from that package. The Angular CLI currently supports the following types of schematics:

- **Add**: Installs an Angular library in an Angular CLI workspace using the `ng add` command.
- **Update**: Updates an Angular library using the `ng update` command.
- **Generate**: Generates Angular artifacts in an Angular CLI workspace using the `ng generate` command.

In this project, we will focus on generating schematics, but the same rules apply to all the other commands.

Project overview

In this project, we will learn how to use the Schematics API to build custom Angular CLI generation schematics for creating components, services, and directives. First, we will build a schematic for creating an Angular component that uses the Tailwind CSS framework in its template. Then, we will create a schematic to generate an Angular service that injects the built-in HTTP client by default and creates one method for each HTTP request in a CRUD operation. The following diagram describes an architectural overview of the project:

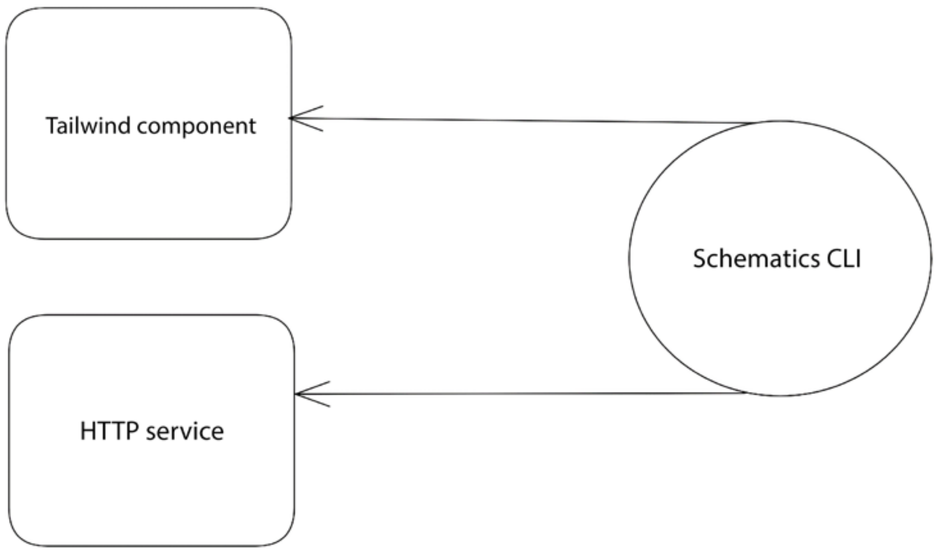

Figure 10.1 – Project architecture

Build time: 1 hour

Getting started

The following prerequisites and software tools are required to complete this project:

- Angular CLI: A command-line interface for Angular, which you can find at `https://angular.io/cli`.
- GitHub material: The code for this chapter can be found in the `Chapter10` folder at `https://github.com/PacktPublishing/Angular-Projects-Third-Edition`.

Installing the Schematics CLI

The Schematics CLI is a command-line interface that we can use to interact with the Schematics API. To install it, run the following `npm` command:

```
npm install -g @angular-devkit/schematics-cli
```

The preceding command will install the `@angular-devkit/schematics-cli` npm package globally on our system. We can then use the `schematics` executable to create a new collection for the schematics:

```
schematics blank my-schematics
```

The previous command will generate a schematics project called `my-schematics`. It contains a schematic with the same name by default inside the `src` folder. A schematic includes the following files:

- `collection.json`: A JSON schema that describes the schematics that belong to the `my-schematics` collection.
- `my-schematics\index.ts`: The main entry point of the schematic.
- `my-schematics\index_spec.ts`: The unit test file of the main entry point of the schematic.

The JSON schema file of the collection contains one entry for each schematic associated with that collection:

```
collection.json
{
  "$schema": "../node_modules/@angular-devkit/schematics/collection-
schema.json",
  "schematics": {
```

```
    "my-schematics": {
      "description": "A blank schematic.",
      "factory": "./my-schematics/index#mySchematics"
    }
  }
}
```

Each schematic in the collection contains a short description, as indicated by the `description` property, and a `factory` property that points to the main entry point of the schematic using a special syntax. It contains the filename `./my-schematics/index`, followed by the `#` character, and the name of the function exported by that file, named `mySchematics`.

The main entry point of a schematic contains a rule factory method that is exported by default and returns a `Rule` object, as described in the `index.ts` file:

```
export function mySchematics(_options: any): Rule {
  return (tree: Tree, _context: SchematicContext) => {
    return tree;
  };
}
```

A schematic does not interact directly with the filesystem. Instead, it creates a virtual filesystem represented by a `Tree` object. The virtual filesystem contains a *staging* area where all transformations from schematics happen. This area aims to make sure that any transformations that are not valid will not propagate to the actual filesystem. As soon as the schematic is valid to execute, the virtual filesystem will apply the changes to the real one. All transformations of a schematic operate in a `SchematicContext` object.

In the following section, we will learn how to use the Schematics CLI and create a component generation schematic.

Creating a Tailwind CSS component

Tailwind is a very popular CSS framework that enforces a utility-first core principle. It contains classes and styles that can be used in Angular applications to create easily composable user interfaces.

We will use the Schematics API of the Angular CLI to build a generation schematic for Angular components. The schematic will generate a new Angular component styled with a Tailwind container layout.

> The schematic we will build does not need Tailwind CSS installed by default. However, the application in which we will use the schematic does require it.

Let's see how we can accomplish that:

1. Execute the following command to add a new schematic to our collection:

   ```
   schematics blank tailwind-container
   ```

   The preceding command will update the `collection.json` file to contain a new entry for the `tailwind-container` schematic. It will also create a `tailwind-container` folder in the `src` folder of our workspace.

2. Create a `schema.json` file inside the `tailwind-container` folder and add the following content:

   ```
   {
     "$schema": "http://json-schema.org/schema",
     "$id": "TailwindContainerSchema",
     "title": "My Tailwind Container Schema",
     "type": "object",
     "properties": {
       "name": {
         "description": "The name of the component.",
         "type": "string"
       },
       "path": {
         "type": "string",
         "format": "path",
         "description": "The path to create the component.",
         "visible": false
       }
     },
     "required": ["name"]
   }
   ```

   Each schematic can have a JSON schema file that defines the options available when running the schematic. Since we want to create a component generation schematic, we need a `name` and a `path` property for our component.

Each property has associated metadata, such as the `type` and the `description`. The name of the component is required when invoking the schematic, as indicated by the `required` array property.

3. Open the `collection.json` file and set the properties of the `tailwind-container` schematic as follows:

```
"tailwind-container": {
  "description": "Generate a Tailwind container component.",
  "factory": "./tailwind-container/index#tailwindContainer",
  "schema": "./tailwind-container/schema.json"
}
```

In the preceding file, we set a proper description for our schematic. We also add the `schema` property, which points to the absolute path of the `schema.json` file we created in the previous step.

4. Create a `schema.ts` file inside the `tailwind-container` folder and add the following content:

```
export interface Schema {
    name: string;
    path: string;
}
```

The preceding file defines the `Schema` interface with mapping properties to those described in the `schema.json` file.

We have now created all the underlying infrastructure we will use to create our schematic. Let's see how to write the actual code that will run our schematic:

1. Create a folder named `files` inside the `tailwind-container` folder.
2. Create a file called `__name@dasherize__.component.html.template` inside the `files` folder and add the following contents:

```
<div class="container mx-auto"></div>
```

The preceding file denotes the component template that our schematic will generate. The `__name` prefix will be replaced by the name of the component that we will pass as an option in the schematic. The `@dasherize__` syntax indicates that the name will be separated with dashes and converted in to lowercase if passed in camel case.

3. Create a file called `__name@dasherize__.component.ts.template` and add the following contents:

```
import { Component } from '@angular/core';

@Component({
    selector: 'my-<%= dasherize(name) %>',
    templateUrl: './<%= dasherize(name) %>.component.html'
})
export class My<%= classify(name) %>Component {}
```

   The preceding file contains the TypeScript class of the component that will be generated. The `selector` and the `templateUrl` properties of the `@Component` decorator are built using the `dasherize` method and the name of the component. The class name contains a different method called `classify`, which takes the name of the component as a parameter and converts it in to title case.

4. Open the `index.ts` file of the `tailwind-container` folder, set the option type to `Schema`, and remove the `return` statement. The resulting file should be the following:

```
import { Rule, SchematicContext, Tree } from '@angular-devkit/
schematics';
import { Schema } from './schema';

export function tailwindContainer(_options: Schema): Rule {
  return (_tree: Tree, _context: SchematicContext) => {
  };
}
```

5. Modify the `import` statements at the top of the file as follows:

```
import { normalize, strings } from '@angular-devkit/core';
import { apply, applyTemplates, chain, mergeWith, move, Rule,
SchematicContext, Tree, url } from '@angular-devkit/schematics';
import { Schema } from './schema';
```

6. Insert the following code into the `tailwindContainer` function:

```
_options.path = _options.path ?? normalize('src/app/' + _options.
name as string);
    const templateSource = apply(url('./files'), [
```

```
        applyTemplates({
          classify: strings.classify,
          dasherize: strings.dasherize,
          name: _options.name
        }),
        move(normalize(_options.path as string))
      ]);
```

In the preceding code, first, we set the `path` property of the component in case one is not passed in the schematic. By default, we create a folder inside the `src\app` folder with the same name as the component. We then use the `apply` method to read the template files from the `files` folder and pass the `dasherize`, `classify`, and `name` properties using the `applyTemplates` function. Finally, we call the `move` method to create the generated component files in the provided path.

7. Add the following statement to the end of the factory function:

```
return chain([
  mergeWith(templateSource)
]);
```

In the preceding snippet, we call the `chain` method to execute our schematic, passing the result of the `mergeWith` function, which uses the `templateSource` variable we created in the previous step.

Now we can go ahead and test our new component schematic:

1. Execute the following `npm` command to build the schematic:

```
npm run build
```

The preceding command will invoke the TypeScript compiler and transpile the TypeScript source files into JavaScript. It will generate the JavaScript output files into the same folders, side by side, as the TypeScript ones.

2. Run the following command to install the schematics library into our global npm cache:

```
npm link
```

The preceding command will allow us to install the schematic without querying the public npm registry.

3. Execute the following Angular CLI command in a folder of your choice outside the workspace to scaffold a new Angular application with the default options:

```
ng new my-app --defaults
```

4. Navigate to the `my-app` folder and run the following command to install our schematics:

```
npm link my-schematics
```

The previous `npm` command will install the `my-schematics` library in the current Angular CLI workspace.

> The `npm link` command is like running `npm install my-schematics`, except that it downloads the npm package from the global npm cache of our machine and does not add it to the `package.json` file.

5. Use the `generate` command of the Angular CLI to create a `dashboard` component:

```
ng generate my-schematics:tailwind-container --name=dashboard
```

In the preceding command, we use our custom schematic by passing the name of our collection, `my-schematics`, followed by the specific schematic name, `tailwind-container`, separated by a colon. We also pass a name for our component using the `--name` option of the schematic.

6. We can verify that our schematic worked correctly by observing the output in the terminal or opening our component with VS Code:

```
CREATE src/app/dashboard/dashboard.component.html (39 bytes)
CREATE src/app/dashboard/dashboard.component.ts (178 bytes)
```

Figure 10.2 – Generate Angular component

We have successfully created a new schematic to craft custom Angular components according to our needs. The schematic that we built generates a new Angular component from scratch. The Angular CLI is so extensible that we can hook into the execution of built-in Angular schematics and modify them accordingly.

In the following section, we will investigate this by building a schematic for Angular HTTP services.

Creating an HTTP service

We will create a schematic for our schematics library that scaffolds an Angular service. It will generate a service that imports the built-in HTTP client. It will also contain one method for each HTTP request involved in a CRUD operation.

The generation schematic we will build will not stand on its own. Instead, we will combine it with the existing generation schematic of the Angular CLI for services. Thus, we do not need a separate JSON schema.

Let's get started by creating the schematic:

1. Execute the following command to add a new schematic to our collection:

```
schematics blank crud-service
```

2. Run the following command to install the `@schematics/angular` npm package:

```
npm install @schematics/angular
```

3. Open the `collection.json` file and modify the `crud-service` schematic:

```
"crud-service": {
  "description": "Generate a CRUD HTTP service.",
  "factory": "./crud-service/index#crudService",
  "schema": "../node_modules/@schematics/angular/service/schema.
json"
}
```

We set a short description for the schematic and add a `schema` property pointing to the original `schema.json` file of Angular services.

4. Create a folder named `files` inside the `crud-service` folder of the workspace.
5. Create a file named `__name@dasherize__.service.ts.template` inside the `files` folder and add the following code:

```
import { Injectable } from '@angular/core';
import { HttpClient } from '@angular/common/http';
import { Observable } from 'rxjs';

@Injectable({
  providedIn: 'root'
})
```

```
export class <%= classify(name) %>Service {
  constructor(private http: HttpClient) { }
}
```

The preceding file is the template of the Angular service file that our schematic will generate. It injects the `HttpClient` service into the `constructor` of the class by default.

6. Define a service property that will represent the URL of the API with which we want to communicate:

```
apiUrl = '/api';
```

7. Add the following methods for each HTTP request of a CRUD operation:

```
create(obj) {
  return this.http.post(this.apiUrl, obj);
}

read() {
  return this.http.get(this.apiUrl);
}

update(obj) {
  return this.http.put(this.apiUrl, obj);
}

delete(id) {
  return this.http.delete(this.apiUrl + id);
}
```

Creating all the methods beforehand eliminates much of the boilerplate code. The developer that uses the schematic will only need to modify these methods and add the actual implementation for each one.

We have almost finished our schematic except for creating the factory function that will invoke the generation of the service:

1. Open the `index.ts` file of the `crud-service` folder and modify the `import` statements as follows:

```
import { normalize, strings } from '@angular-devkit/core';
```

```
import { apply, applyTemplates, chain, externalSchematic,
MergeStrategy, mergeWith, move, Rule, SchematicContext, Tree, url }
from '@angular-devkit/schematics';
```

2. Rename the tree parameter and remove it from the return statement because we will not use it. The resulting factory function should look like the following:

```
export function crudService(_options: any): Rule {
  return (_tree: Tree, _context: SchematicContext) => {};
}
```

3. Add the following snippet to the crudService function:

```
const templateSource = apply(url('./files'), [
  applyTemplates({
    ..._options,
    classify: strings.classify,
    dasherize: strings.dasherize
  }),
  move(normalize(_options.path ?? normalize('src/app/')))
]);
```

The previous snippet looks identical to the one we used for our component schematic. The main differences are that the default path is the src\app folder and that we pass all available options using the _options parameter to the schematic.

Knowing which options will be used to generate the Angular service beforehand is impossible. Thus, we use the **spread** operator to pass all available options to the templateSource method. That is also why the _options parameter is of type any.

4. Add the following return statement to the end of the function:

```
return chain([
  externalSchematic('@schematics/angular', 'service', _options),
  mergeWith(templateSource, MergeStrategy.Overwrite)
]);
```

In the preceding statement, we use the `externalSchematic` method to call the built-in generation schematic for creating Angular services. Then, we merge the result from executing that schematic with our `templateSource` variable. We also define the strategy of the merge operation using `MergeStrategy.Overwrite` so that any changes made by our schematic will overwrite the default ones.

Our schematic for creating CRUD services is now complete. Let's use it in our sample application:

1. Execute the following command to build the schematics library:

```
npm run build
```

> We do not need to link the schematics library again. Our application will be automatically updated as soon as we make a new build of our schematics.

2. Navigate to the `my-app` folder in which our application resides.
3. Execute the following command to generate an Angular service using our new schematic:

```
ng generate my-schematics:crud-service --name=customers
```

   We use the `generate` command of the Angular CLI, passing the name of our schematics collection again but targeting the `crud-service` schematic this time.

4. The new Angular service is created in the `src\app` folder, as indicated by the output in the terminal window:

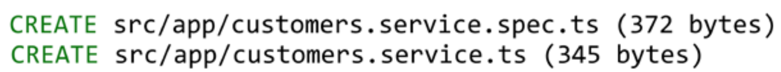

Figure 10.3 – Generating an Angular service

Notice that the schematic has generated a unit test file for us automatically. How is this possible? Recall that we merged our schematic with the built-in generation schematic of the Angular CLI. So, whatever the default schematic does, it reflects directly on the execution of the custom schematic.

We have just added a new helpful command to our schematics collection. We can generate an Angular service that interacts with HTTP endpoints. Moreover, we have added the fundamental methods needed for communicating with the endpoint.

Summary

In this project, we used the Schematics API of the Angular CLI to create custom schematics for our needs. We built a schematic for generating Angular components that contain Tailwind CSS styles in their templates. We also built another schematic that creates an Angular service to interact with the built-in HTTP client. The service includes all the necessary artifacts for working with an HTTP CRUD application.

The Angular CLI is a flexible and extensible tool that enhances the development experience dramatically. The imagination of each developer is all that limits what can be done with such an asset in their toolchain. The CLI and the Angular framework allow developers to create excellent web applications.

As we have learned throughout this book, the popularity of the Angular framework in the web developer world is so great that it is straightforward to integrate it today with any technology and create fast and scalable Angular applications. So, we encourage you to get the latest version of Angular and create amazing applications today.

Exercise

Use the Schematics CLI to create an Angular schematic for generating an Angular directive. The directive should inject the `ElementRef` and `Renderer2` services from the `@angular/core` npm package in to the constructor of the TypeScript class.

> You should follow the same approach as we did for the component schematic in the *Creating a Tailwind CSS component* section.

You can find the solution in the `Chapter10` folder of the `exercise` branch in the GitHub repository for this chapter.

Further reading

- Schematics overview: `https://angular.io/guide/schematics`
- Authoring schematics: `https://angular.io/guide/schematics-authoring`
- Schematics for libraries: `https://angular.io/guide/schematics-for-libraries`
- Angular CLI built-in schematics: `https://github.com/angular/angular-cli/tree/master/packages/schematics/angular`

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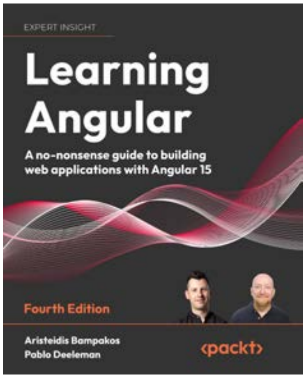

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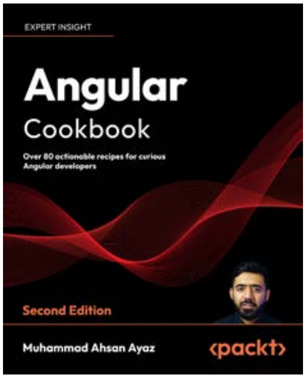

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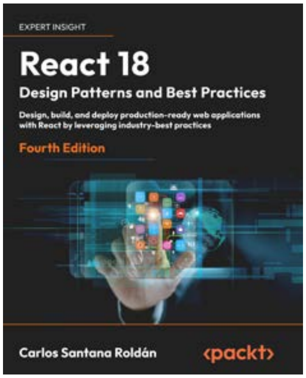

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