

EXPERT INSIGHT

# Learning Angular

A practical guide to building web applications  
with modern Angular

**Forewords by:**

**Bonnie Brennan**

Founder of TechStackNation.com

**Pablo Deeleman**

Frontend Architect at GitKraken

**Fifth Edition**

**Aristeidis Bampakos**

**<packt>**



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Fifth Edition

**A practical guide to building web applications with modern  
Angular**

Aristeidis Bampakos



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## Fifth Edition

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# Contributors

## About the author

**Aristeidis Bampakos** has over 20 years of experience in the software development industry. He currently works as a web development team leader at Plex-Earth, specializing in the development of web applications using Angular. 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 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 the successful book titles *Learning Angular* and *Angular Projects* . He enjoys being speaking about Angular in meetups, conferences, and podcasts. He is also currently leading the effort to make Angular accessible to the Greek development community by maintaining the open-source Greek translation of the official Angular documentation.

*This book is dedicated to all people around the globe that strive with mental health issues.*

## About the reviewers

**Thomas Laforge** is a married father living in the French Alps. He is an Angular freelancer with more than 8 years of experience in the frontend world, particularly in Angular. He has been a **Google Developer Expert ( GDE )** for over a year and is well known for his open-source project, Angular Challenges. This project features more than 50 challenges designed to help developers improve their Angular skills. He is passionate about frontend technology and open-source projects. Outside of work, he enjoys sports and board games.

**Martina Kraus** has been active in the world of web development since her early years and, over time, has become an expert in the field of web security. As an Application Security Engineer, she focuses on integrating security best practices into all phases of software development. In her role as an Angular **Google Developer Expert ( GDE )**, she loves to spread knowledge about Angular and web security at national and international conferences, regularly organizes ngGirls events (free Angular workshops for women) and the German Angular conference NG-DE. She is currently working on a book titled *Authorization and Authentication for Web Developers: A Practical Guide*, where she aims to share her knowledge.

## Forewords

Dear Reader,

The book you're holding continues a journey of knowledge and discovery that began nearly a decade ago. The origins of *Learning Angular* date back to the summer of 2015. During that time, Packt Publishing, with whom I'd had several discussions over the years, approached me to write a book on any topic of my choosing that would appeal to the frontend web developer community.

In the summer of 2015, it was already well known that the Angular team at Google was working on a new version of its framework. This was not merely a continuation of what AngularJS had been up to that point, but a complete rewrite from scratch. AngularJS was showing signs of aging and facing criticism regarding its operability and performance. In contrast, libraries like React and Vue were gaining more acceptance,

and their future appeared bright and promising. Angular faced the significant challenge of winning back developers' hearts in a race it was late to enter—perhaps too late already.

With only that idea in mind, the task of writing a book seemed daunting, aggravated by the fact that there was no documentation available. In the summer of 2015, Angular was still in the alpha stage, and the only way to familiarize oneself with the framework's mechanics was to read the team's official blog, which dribbled out its posts, or to reverse-engineer code that changed radically every week with each new release.

Doubts abounded: Would the resulting book be accurate enough? Would it be embraced by the public given the expectations created? Would it stand the test of time? Despite these concerns, this was the crucial moment to author a book on an entirely new frontend technology. Ultimately, the first edition of *Learning Angular 2* (which later dropped the version number in favor of just *Learning Angular*) was released in May 2016, after much effort and over two dozen rewrites. I honestly thought that journey would end there: perhaps a couple of dozen books would be sold at most, it would receive some positive reviews, and probably many negative ones.

I doubted Angular itself would last much longer either; despite its beautifully crafted architecture, the framework had arrived late to the party and relied on principles the community intended to bury in favor of functional programming paradigms.

Nearly ten years later, I'm delighted to say my judgment was wrong. The collective effort put into this book has enabled thousands of developers worldwide to create wonderful projects, contributing to a better, more accessible world for everyone. *Learning Angular 2* became a success, and its subsequent editions have been no less successful.

Meanwhile, Angular has continued to evolve and has broken paradigms in its continuous pursuit of evolution. From signals to deferrable views, native server-side rendering, improved lightning-fast compilation tools, a revamped syntax, and an enhanced transition API, along with hundreds of major and minor additions, Angular has demonstrated an unparalleled commitment to the community and influenced the future path of our industry. Right after its inception, Angular was considered an ugly duckling in the industry. Now, it is the new white swan that once again sets the pace for the rest.

However, this poses a huge challenge: Can a book capture the greatness of Angular, help readers confidently initiate themselves in it, and remain accessible and engaging,

all while competing with the comprehensive information on [angular.dev](https://angular.dev), its official website? The answer is yes, as long as Aristeidis Bampakos is leading this endeavor.

Aristeidis has been the driving force behind this franchise's success and I owe him an infinite debt of gratitude. His perseverance in meeting the community's expectations, his enormous technical skill in deconstructing complex concepts, and his excellent narrative ability are the reasons why I consider the book you are now holding a powerful key that will open doors to a fascinating future for you and many others.

It is an honor to write this foreword and a privilege to have shared this journey with Aristeidis Bampakos and the Packt team over nearly a decade. The journey doesn't end here. It is now up to you, dear reader, to take the next steps, and this book will be your best guide.

Bon voyage.

*Pablo Deeleman*

*Frontend Architect at GitKraken, and previous author of Learning Angular*

Hello friends,

I am honored to introduce an exceptional book written by one of my all-time favorite Angular experts, Aristeidis Bampakos. He is an established bestselling author, a well-respected Angular Google Developer Expert, a principal enterprise architect, and an open-source author. Over the years, Aris has become a trusted figure in the Angular community, having not only mastered the framework, but also contributed directly to translations and other improvements. His dedication to the Angular ecosystem is reflected not only in his contributions, but also in his passion for helping others grow their knowledge and skills.

For those looking to level up their Angular expertise, this book offers a comprehensive yet approachable overview of the framework. Aris has a unique ability to break down complex concepts into digestible content, making learning Angular accessible and enjoyable for developers of all levels. Whether you're just beginning your journey or architecting a production app, this guide will undoubtedly help you advance your understanding of Angular.

Beyond his Angular contributions, Aris has been a beloved and influential leader in our Tech Stack Nation community from the very start. His contributions go beyond just code; he brings wisdom, humility, and a genuine passion for sharing knowledge. I



encourage you to visit one of our live events, where Aris can often be found sharing his insights—not only as a brilliant teacher and author who never stops asking questions and learning new things, but also as a caring and supportive friend to us all.

In the constantly evolving world of open-source tech, resources we can trust are increasingly valuable, and it's even more valuable to have someone like Aris to guide us through the ever-changing landscape of Angular. I have no doubt that you'll find this book priceless, as I have found Aris' contributions to our community over the years.

Enjoy your journey through Angular! If you have questions or comments after reading, I encourage you to reach out to Aris, as he's super friendly. You can also stop by Tech Stack Nation and ask for him, I bet he'd love to meet you!

Miles of smiles,

*Bonnie Brennan*

*Founder of TechStackNation.com, Enterprise Architect, and Angular GDE*

## Join us on Discord

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

<https://packt.link/LearningAngular5e>



# Preface

As Angular continues to reign as one of the top JavaScript frameworks, more developers are seeking out the best way to get started with this extraordinarily flexible and secure framework. *Learning Angular*, now in its fifth edition, will show you how you can use Angular to achieve cross-platform high performance with the latest web techniques, extensive integration with modern web standards, and **integrated development environments ( IDEs )**.

This book is especially useful for those new to Angular and will help you to get to grips with the bare bones of the framework needed to start developing Angular apps. You'll learn how to develop apps by harnessing the power of the Angular **command-line interface ( CLI )**, write unit tests, style your apps by following the Material Design guidelines, and finally, build them for production.

Updated for Angular 19, this new edition covers lots of new features and practices that address the current frontend web development challenges. You'll find new dedicated chapters on signals and optimization, as well as more on error handling and debugging in Angular, and new real-life examples. By the end of this book, you'll not only be able to create Angular applications with TypeScript from scratch, but also enhance your coding skills with best practices.

## Who this book is for

This book is for web developers that want to get started with frontend development, and frontend developers that want to expand their knowledge of JavaScript frameworks. You'll need prior exposure to JavaScript, basic knowledge of the command line, and to be comfortable with using IDEs to get started with this book.

# What this book covers

## *Chapter 1 , Building Your First Angular Application*

In this chapter, we set up the development environment by installing the Angular CLI and learn how to use schematics (commands) to automate tasks such as code generation and application building. We create a new simple application using the Angular CLI and build it. We also learn about some of the most useful Angular tools that are available in Visual Studio Code.

## *Chapter 2 , Introduction to TypeScript*

In this chapter, we learn what TypeScript is, the language that is used when creating Angular applications, and what the most basic building blocks are, such as types and classes. We take a look at some of the advanced types available and the latest features of the language.

## *Chapter 3 , Structuring User Interfaces with Components*

In this chapter, we learn how a component is connected to its template and use a decorator to configure it. We take a look at how components communicate with each other by passing data from one component to another using input and output bindings and learn about the different strategies to detect changes in a component. We also learn how to execute custom logic during the component lifecycle.

## *Chapter 4 , Enriching Applications Using Pipes and Directives*

In this chapter, we take a look at Angular's built-in pipes and we build our own custom pipe. We learn how to create directives and leverage them through an Angular application that demonstrates their use.

## *Chapter 5 , Managing Complex Tasks with Services*

In this chapter, we learn how the dependency injection mechanism works, create and use services in components into components, and how to create providers in an Angular application.

## *Chapter 6 , Reactive Patterns in Angular*

In this chapter, we learn what reactive programming is and how we can use observables in the context of an Angular application through the RxJS library. We also take a tour of all the common RxJS operators that are used in an Angular application.

### *Chapter 7 , Tracking Application State with Signals*

In this chapter, we learn the basic concepts of the Signals API and the rationale behind its use. We explore how to use signals for tracking the state of an Angular application. We also take a look at signals interoperability with RxJS and how they can play nicely together in a sample application.

### *Chapter 8 , Communicating with Data Services over HTTP*

In this chapter, we learn how to interact with a remote backend API and perform CRUD operations with data in Angular. We also investigate how to set additional headers to an HTTP request and intercept it before sending the request or upon completion.

### *Chapter 9 , Navigating through Applications with Routing*

In this chapter, we learn how to use the Angular router in order to activate different parts of an Angular application. We find out how to pass parameters through the URL and how to break an application into child routes that can be lazy loaded. We then learn how to guard against our components and how to prepare data prior to initialization of the component.

### *Chapter 10 , Collecting User Data with Forms*

In this chapter, we learn how to use Angular forms in order to integrate HTML forms into an application and how to set them up using FormGroup and FormControl. We track the interaction of the user in the form and validate input fields.

### *Chapter 11 , Handling Application Errors*

In this chapter, we learn how to handle different types of errors in an Angular application and learn about errors that come from the framework itself.

### *Chapter 12 , Introduction to Angular Material*

In this chapter, we learn how to integrate Google Material Design guidelines in to an Angular application using a library called Angular Material, developed by the Angular team. We take a look at some of the core components of the library and how to use them. We discuss the themes that are bundled with the library and how to install them.

### *Chapter 13 , Unit Testing Angular Applications*

In this chapter, we learn how to test Angular artifacts and override them in a test, what the different parts of a test are, and which parts of a component should be tested.

### *Chapter 14 , Bringing Applications to Production*

In this chapter, we learn how to use the Angular CLI to build and deploy an Angular application. We take a look at how to pass environment variables during the build and how to perform build optimizations prior to deployment.

*Chapter 15 , Optimizing Application Performance*

In this chapter, we learn what **Core Web Vitals** ( **CWV** ) are and how they affect the performance of an Angular application. We explore three different ways to improve CWV metrics: how to render an application server-side, how to benefit from hydration, and how to optimize our images.

## To get the most out of this book

You will need a version of Angular 19 installed on your computer, preferably the latest one. All code examples have been tested using Angular 19.0.0 on Windows, but they should work with any future release of Angular 19 as well.

We advise you to type the code for this book yourself or access the code via the GitHub repository (the link is in the next section). Doing so will help you avoid any potential errors related to the copying and pasting of code.

## Download the example code files

You can download the example code files for this book from your account at <http://www.packtpub.com>. If you purchased this book elsewhere, you can visit <http://www.packtpub.com/support> and register to have the files emailed directly to you.

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The code bundle for the book is also hosted on GitHub at <https://github.com/PacktPublishing/Learning-Angular-Fifth-Edition>. We also have other code bundles from our rich catalog of books and videos available at <https://github.com/PacktPublishing/>. Check them out!

## Download the color images

We also provide a PDF file that has color images of the screenshots/diagrams used in

this book. You can download it here: <https://packt.link/gbp/9781835087480> .

## 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 social media 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:

```
[default]
exten => s,1,Dial(Zap/1|30)
exten => s,2,Voicemail(u100)
exten => s,102,Voicemail(b100)
exten => i,1,Voicemail(s0)
```

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

```
[default]
exten => s,1,Dial(Zap/1|30)
exten => s,2,Voicemail(u100)
exten => s,102,Voicemail(b100)
exten => i,1,Voicemail(s0)
```

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

```
# cp /usr/src/asterisk-addons/configs/cdr_mysql.conf.sample
/etc/asterisk/cdr_mysql.conf
```

**Bold** : Indicates a new term, an important word, or words that you see on the screen, for example, in menus or dialog boxes. For example: “Select **System info** from the **Administration** panel.”



Warnings or important notes appear like this.



Tips and tricks appear like this.



# Get in touch

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

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# 1

## Building Your First Angular Application

Web development has undergone huge growth during the last decade. Frameworks, libraries, and tools have emerged that enable developers to build great web applications. Angular has paved the way by creating a framework focusing on application performance, development ergonomics, and modern web techniques.

Before developing Angular applications, we need to learn some basic but essential things to have a great experience with the Angular framework. One of the primary things we should know is what Angular is and why we should use it for web development. We will also take a tour in this chapter of Angular history to understand how the framework has evolved.

Another important but sometimes challenging introductory topic is setting up our development environment. It must be done at the beginning of a project and getting this right early can reduce friction as our application grows. Therefore, a large part of this chapter is dedicated to the **Angular CLI**, a tool developed by the Angular team that provides scaffolding and automation tasks in an Angular application, eliminating configuration boilerplate and enabling developers to focus on the coding process. We will use the Angular CLI to create our first application from scratch, get a feel for the anatomy of an Angular application, and take a sneak peek at how Angular works under the hood.

Working on an Angular project without help from development tools, such as an **Integrated Development Environment (IDE)**, can be painful. Our favorite code editor can provide an agile development workflow that includes compilation at runtime, static type checking, introspection, code completion, and visual assistance to debug and build our application. We will highlight some of the most popular tools in the Angular ecosystem in this chapter, such as **Angular DevTools** and **Visual Studio Code (VSCode)**.

To sum up, here are the main topics that we will explore in this chapter:

- What is Angular?