React Development using TypeScript

Modern web app development using advanced React techniques

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Agnihotri Family

—Ketan Agnihotri

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About the Authors

- **Ketan Agnihotri** is a proud Indian, working as a Software Engineer 2 at Microsoft, driven by a passion for creating meaningful professional connections. He is a Senior Full Stack developer with 12+ years of experience and a proven track record of team leadership. His expertise spans various industries, including Real Estate, Travel, Automobile, Healthcare, Insurance, Media Marketing, and Public Sector projects.

  Ketan's enthusiasm for technology extends beyond his professional experience. As an author, speaker, blogger, and trainer, he actively engages with individuals worldwide, sharing his insights and knowledge. Ketan likes to solve complex problems, learning new every day, and constantly challenging himself to acquire new skills.

  Ketan is actively involved in social work and collaborates with NGOs. Whether it is software development, customer satisfaction, or technology engagement, Ketan's goal is to empower others and build innovative solutions that drive success.

- **Pranali Dahale** is a seasoned software engineer with a passion for web development, working as Azure Consultant at Microsoft. With over 12+ years of industry experience, Pranali has worked on a wide range of projects, from small-scale web applications to enterprise-level solutions.

  Pranali has developed a deep understanding of back-end and front-end technologies like JavaScript, React, C#, HTML, CSS, Azure. She is an active contributor to the developer's community. She regularly shares their knowledge and insights through blog posts, tutorials and like to follow best practices, write clean code, and adopt efficient development workflows.

  Pranali shares her knowledge and experience, providing readers with a comprehensive resource to master React development with TypeScript. Her practical approach, attention to detail, and passion for teaching make this book an asset for anyone looking to build professional-grade applications.

About the Reviewers

- **Juan Sebastian Flor Usma** is a Software Development Engineer with over five years of experience and a proven track record of writing high-quality code across different industries. He is currently focused on, and working with, mobile-native solutions and tools including React Native, Expo, and EAS. He is also focused on cloud solutions such as Serverless from AWS with a passion for automating everything and avoiding doing anything that resembles manual work.

- **Sarju Hansaliya** is a seasoned full-stack developer with over a decade of experience, specializing in the React ecosystem. With expertise in React, React Native, Node.js, and cutting-edge technologies like Next.js, GraphQL, and Prisma, Sarju delivers high-quality, seamless applications built with clean, maintainable, and high-quality code. Driven by excellence, responsibility, and an unwavering passion, he approaches projects with diligence and enthusiasm, consistently exceeding client expectations. His core competencies include React, React Native, Next.js, Electron, GraphQL, CI/CD, SPAs, building APIs, and sdks. Sarju is committed to staying ahead of emerging trends, ensuring innovative and effective solutions that meet clients' evolving needs.

- **George Lugo** is a seasoned software engineer with over five years of professional experience in web development. He has honed his skills in creating robust and scalable applications using modern technologies such as React, Laravel, and Node.js. George has a unique blend of technical expertise and business acumen, having spent two years in sales. This combination enables him to understand client needs deeply and deliver tailored solutions that drive business growth. His recent projects include developing a sophisticated CRM application and a banking API tailored for small businesses. George is passionate about serverless architecture and is currently exploring its potential in modern application development. Known for his problem-solving skills and innovative approach, George is dedicated to building high-quality software that meets user needs and exceeds expectations.

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  Lastly, I want to thank you, the readers. Your passion for learning and improving your skills is what drives us to write. I hope this book helps you on your journey to mastering React and TypeScript.

  — *Ketan Agnihotri*

- First and foremost, I want to thank the main author, Ketan Agnihotri, my husband. Assisting you on this project has been an invaluable learning experience. Your knowledge and guidance have significantly helped me to grow and improve as a developer.

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  Finally, thank you to the readers. Your commitment to learning and growing as developers is inspiring. I hope this book serves as a valuable resource in your quest to master React and TypeScript.

  I am grateful for all your support, especially to our daughter, Shriya Agnihotri. Thank you.

  — *Pranali Dahale*

Preface

React is great for building interfaces, and TypeScript adds typing and better tools. **React Development using TypeScript** is a complete guide that combines React and TypeScript to help you become a skilled React developer. This book teaches you everything you need to know.

You will start with a refresher on JavaScript and then learn about React basics like components, JSX, state, and props. As you progress, you will explore advanced topics like React Hooks, context, error handling, React Router for navigation, Server-side rendering in Next.js, Redux for state management, and React Native for mobile app development.

Each chapter has key points to help you learn better. You will also learn about code organization, quality, performance optimization, and testing React apps. Plus, you will see how to use React with GraphQL, and learn about future trends.

By the end, you will be confident in building scalable React apps, using tools like React Router and Redux, and integrating React with other technologies. Whether you are new to React or experienced, this book will make you an expert React developer, ready for real projects. We hope you will find this book informative and helpful.

Chapter 1: Getting Started with React 18 and TypeScript - In this chapter, you will be introduced to the world of React.js and its significance in modern web development. You will gain an understanding of the core principles behind React and why it has become a popular choice for building user interfaces. Additionally, you will learn about the advantages of using Typescript in conjunction with React, and how it enhances development productivity and code maintainability.

Chapter 2: JavaScript Refresher - Before diving into React 18 development with TypeScript, it is essential to have a solid understanding of JavaScript. This chapter serves as a refresher for JavaScript concepts and syntax, ensuring you have a strong foundation to build upon. You will review fundamental JavaScript topics such as variables, data types, operators, functions, objects, and arrays. Additionally, you will explore modern JavaScript features introduced in ECMAScript 6 (ES6) and beyond, including arrow functions, template literals, destructuring, and modules.

Chapter 3: Understanding the Basics of React - This chapter will lay the foundation for your React journey by covering the fundamental concepts of React.js. You will learn how to create React components and explore the power of JSX and React elements. Additionally,

you will delve into handling events and user interactions within React components. By the end of this chapter, you will have a solid understanding of the core building blocks of React and be ready to start building dynamic user interfaces.

Chapter 4: React Hooks - This chapter will introduce you to React Hooks, a powerful feature introduced in React. You will explore the benefits of using hooks and how they simplify component logic and state management. The useState and useEffect hooks will be covered extensively, along with other commonly used hooks such as useContext, useMemo, and useCallback. You will also learn how to migrate existing class components to functional components with hooks.

Chapter 5: Managing Component State and Lifecycle - This chapter will delve into the concept of component state and lifecycle in React. You will learn how to manage and update component state, as well as handle changes and perform actions accordingly. Additionally, you will explore conditional rendering and dynamic component creation. Understanding the lifecycle methods of React components will also be covered, allowing you to optimize your components' behaviour and performance.

Chapter 6: Integrating with REST APIs - In this chapter, you will learn how to integrate React applications with REST APIs. You will explore the usage of libraries like axios, which provides a simple and efficient way to make HTTP requests. Additionally, you will discover how to create a generic service class that can handle authentication tokens, headers, and other common configurations. You will also delve into defining request and response models to ensure type safety and consistency in your API interactions. Finally, you will learn how to render the API responses in your React components, allowing you to display the fetched data effectively.

Chapter 7: Testing React Applications - This chapter will cover various testing techniques and best practices for React applications. You will learn how to write unit tests and integration tests for React components using popular testing libraries such as Jest and React Testing Library. Additionally, you will explore techniques for testing asynchronous code, mocking dependencies, and implementing test coverage reports.

Chapter 8: Routing in React with React Router - This chapter will focus on navigation and routing in React applications using React Router. You will learn how to set up React Router in a React project and define routes for different pages. Handling route parameters, query strings, and implementing nested and protected routes will also be covered. By the end of this chapter, you will be able to create dynamic and navigable user interfaces in your React applications.

Chapter 9: State Management in React - This chapter provides a comprehensive guide to state management in React applications using Redux. Readers will learn the core concepts of Redux and its significance in efficiently managing state. It covers setting up Redux in a React project, defining actions, reducers, and the Redux store. Additionally, readers will explore techniques for handling asynchronous actions, simplifying state updates, and debugging with Redux DevTools.

Chapter 10: Optimizing and Scaling React Apps - This combined chapter focuses on optimizing the performance of React applications and implementing best practices for building scalable and maintainable projects. Readers will learn various techniques to improve rendering performance, minimize unnecessary re-renders, and optimize component updates using memoization. They will also explore performance monitoring and profiling tools to identify bottlenecks and make informed optimizations. In addition to performance optimization, the chapter covers best practices for building scalable React applications. Readers will learn about project structure, component organization, and writing clean, maintainable code. It also includes strategies for testing and debugging React applications effectively. Furthermore, readers will discover code quality tools and techniques for code review and collaboration in team environments.

Chapter 11: Building Server-side Rendered Applications with Next.js - This chapter will provide a comprehensive guide to building server-side rendered applications with Next.js and React. You will learn how to set up a Next.js project, leverage its features such as automatic code splitting, server-side rendering, and static site generation. Additionally, you will explore advanced topics including data fetching techniques, building API routes and serverless functions, internationalization and localization, and optimizing performance with static site generation and incremental static regeneration. The chapter also covers implementing **progressive web app** (**PWA**) features in React and building micro-frontends using singleSpa.js.

Chapter 12: React Native for Mobile Development - In this bonus chapter, you will be introduced to React Native, a popular framework for building mobile applications using React. You will learn the basics of React Native, including setting up a development environment, building user interfaces with React Native components, handling user input and navigation, and accessing device features and APIs. By the end of this chapter, you will have a solid foundation to start developing mobile applications with React Native.

Chapter 13: Integrating React with GraphQL - In this chapter, you will explore the integration of React with GraphQL, a modern query language for APIs. You will learn the basics of GraphQL, including setting up a GraphQL server, querying and mutating data, and integrating React with GraphQL.

Chapter 14: Exploring React's Future Trends - In this chapter, you will explore the future trends and advancements in the React ecosystem. You will discover the latest features and updates in React, such as Concurrent Mode and Suspense, React Server Components, and React's integrations with Web Assembly. By gaining insights into these evolving technologies, you will be prepared to embrace React's continued evolution and stay ahead in the ever-changing landscape of web development.

Chapter 15: Final Thoughts - In this concluding chapter, you will recap the key concepts and topics covered throughout the book. You will reflect on your journey of mastering React 18 development using TypeScript and how it can benefit your career as a web developer. Additionally, you will be provided with guidance on the next steps to continue your learning and exploration of React, TypeScript, and related technologies.

Code Bundle and Coloured Images

Please follow the link to download the
Code Bundle and the ***Coloured Images*** of the book:

https://rebrand.ly/f162gli

The code bundle for the book is also hosted on GitHub at
https://github.com/bpbpublications/React-Development-using-TypeScript.
In case there's an update to the code, it will be updated on the existing GitHub repository.

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Chapter 1

Getting Started with React 18 and TypeScript

Introduction

This chapter offers a comprehensive overview of React.js, discussing its advantages and the integration of TypeScript in React development. We will guide you through setting up the development environment, creating your first React component with TypeScript, and understanding the concepts of **JavaScript XML** (**JSX**) and type safety. Additionally, we will explore the new features introduced in React 18. React.js, developed by *Facebook*, is a widely used JavaScript library for building user interfaces. Its popularity stems from its simplicity and effectiveness, making it a preferred choice among web developers.

This book adopts a practical approach, providing hands-on examples, code snippets, and real-world projects to reinforce your understanding and application of *React* and *TypeScript* concepts. With a focus on practicality, we will cover a wide range of topics essential for building professional React applications. We will explore advanced techniques such as leveraging hooks for efficient and reusable code, implementing state management solutions to handle complex data flows, and optimizing performance for better user experiences. We will also learn how to write comprehensive tests for your React components, ensuring the stability and reliability of your codebase.

Additionally, we will dive into topics like styling React components with TypeScript, allowing for more maintainable and scalable CSS. We will explore routing and navigation techniques using React Router, enabling seamless transitions between different parts of your application.

Moreover, we will gain insights into best practices for code organization and architecture, ensuring your React applications are scalable, maintainable. We will also touch upon topics such as internationalization and accessibility, empowering you to create inclusive and user-friendly applications.

Each chapter in this book is designed to build upon the previous ones, providing a cohesive and progressive learning experience. By the end of your journey, you will have the skills and knowledge necessary to confidently develop production-ready React applications.

Structure

The chapter covers the following topics:

- Overview of React.js and its benefits
- Setting up the development environment
- Introduction to TypeScript in React
- Creating your first React component with TypeScript
- Understanding JSX and type safety
- React.js vs. Vanilla JavaScript
- What is new in React 18

Objectives

By the end of this chapter, you will learn the fundamentals of React.js and gain a clear understanding of its benefits in web development. You will discover how to integrate TypeScript into your React projects, ensuring type safety and improving code quality. Additionally, you will be equipped with the knowledge to set up a development environment for React.js, create your first React components using TypeScript, and understand the concepts of JSX and type safety. By exploring the new features and improvements in React 18, you will stay up to date with the latest advancements in the framework. This chapter serves as a solid foundation for your journey into React.js development, empowering you to build efficient and scalable user interfaces.

Overview of React.js and its benefits

React.js, often referred to as React, is an open-source JavaScript library, developed by *Facebook* that allows developers to create reusable UI components. It follows a component-based architecture, where each component encapsulates a specific piece of the user interface. React efficiently renders and updates components, resulting in a fast and responsive user interface.

React.js offers several advantages that make it a popular choice for web development projects. Let us understand its main features and benefits:

- **Component-based architecture**: React promotes a modular approach of building user interfaces. Developers can break down complex user interfaces by creating reusable components that encapsulate specific functionality and styling. For example, you can split user interface in components like header, footer, menu, page body etc. This modularity simplifies code maintenance and promotes reusability resulting in more efficient and scalable applications.
- **Virtual DOM and efficient rendering**: React utilizes a virtual **Document Object Model** (**DOM**) to efficiently update and render components. The virtual DOM is a lightweight representation of the actual DOM, allowing React to minimize expensive direct DOM manipulations. By comparing the previous and current states of the virtual DOM, React updates only the necessary components, resulting in improved performance.
- **Unidirectional data flow in React**: React follows a unidirectional data flow, where data changes propagate in a single direction. This approach makes it easier to understand and track data changes, reducing the likelihood of bugs and making the application more predictable. One-way data binding also facilitates easier debugging and testing.
- **React-native for mobile app development**: React-native, a framework built on top of React.js, allows developers to build native mobile applications using JavaScript. By leveraging React's component-based approach, developers can create cross-platform mobile apps with a single codebase. This enables faster development and maintenance compared to traditional native app development.

TypeScript is a popular choice for React developers seeking to enhance their coding experience and application reliability. It extends JavaScript by adding static types, offering tools to define interfaces and types for props, state, and events within React components.

Let us understand the advantages of using *TypeScript* with *React* below:

- **Static typing**: TypeScript helps catch errors before runtime, making code more reliable.
- **Enhanced developer experience**: Features like auto-completion and type-checking make coding easier and faster.
- **Code maintainability**: TypeScript's type annotations make code self-explanatory, simplifying maintenance.
- **Better collaboration**: Clear interfaces and type definitions improve teamwork and reduce misunderstandings.
- **Improved refactoring**: TypeScript helps identify issues when changing code, making refactoring safer and more efficient.

Overall, TypeScript with React results in cleaner, more manageable code, smoother development, and higher-quality applications. We will understand TypeScript in details in upcoming sections of this chapter.

Setting up the development environment

To begin with development using React.js, it is necessary to have a well-configured development environment.

Follow the given steps to set up your development environment:

1. **Installing Node.js and NPM/Yarn**:

   Node.js is a JavaScript runtime that allows you to run JavaScript code outside the browser. **Node Package Manager** (**NPM**) and **Yarn** are the popular package managers that help you manage dependencies in your projects. Install Node.js and choose either NPM or Yarn as your package manager. You can download executable for your operating system by visiting **https://nodejs.org/en/download**.

2. **Choosing a code editor**:

   Selecting a code editor is crucial for efficient development. Popular code editors for React.js development include **Visual Studio Code** (**VS Code**), **Sublime Text**, **Atom**, and **WebStorm**. Choose the code editor that best suits your preferences and install it. We will be using VS Code throughout this book. There are popular VS Code extensions like **ESLint**, **prettier** etc. you can install to make your development easy.

3. **Initializing a React project with create React app**:

   `create react app` is a popular tool for setting up a React project. It provides a preconfigured development environment with all the necessary tools and configurations. To create and initialize your first React project with TypeScript as template, execute the following command:

   ```
   npx create-react-app weather-suggestion --template typescript
   ```

   Now, navigate to project using `cd <FolderName>` and run `npm start` command. Take a look at *Figure 1.1*:

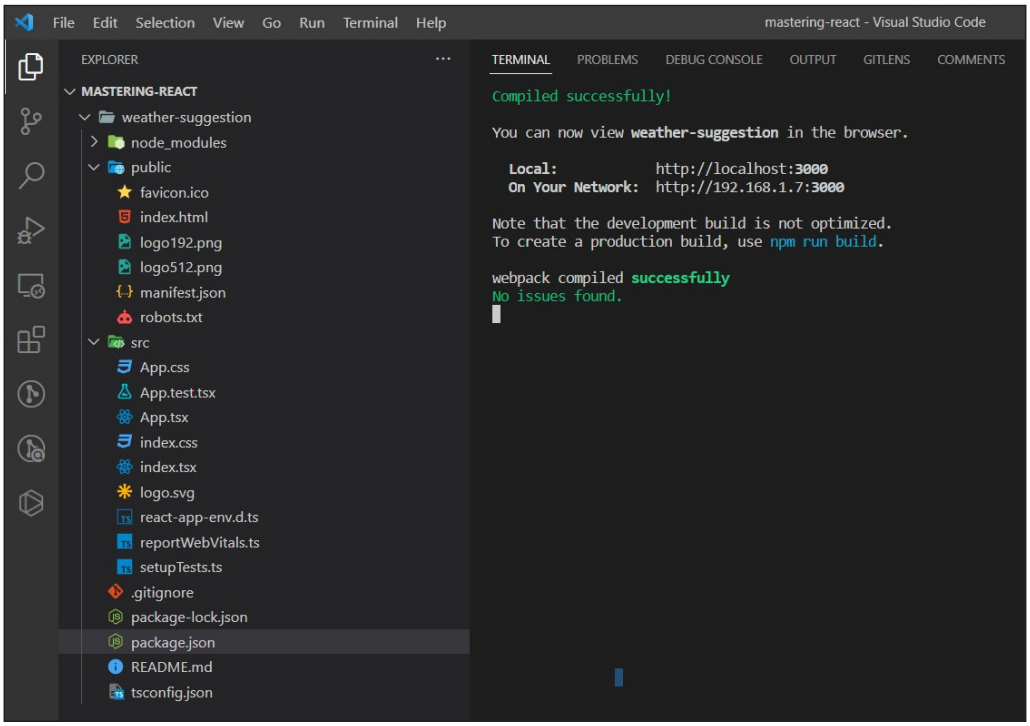

***Figure 1.1**: React project folders and files*

Now, you should be able to see your application running in browser by navigating to **http://localhost:3000/**, as shown in *Figure 1.2*:

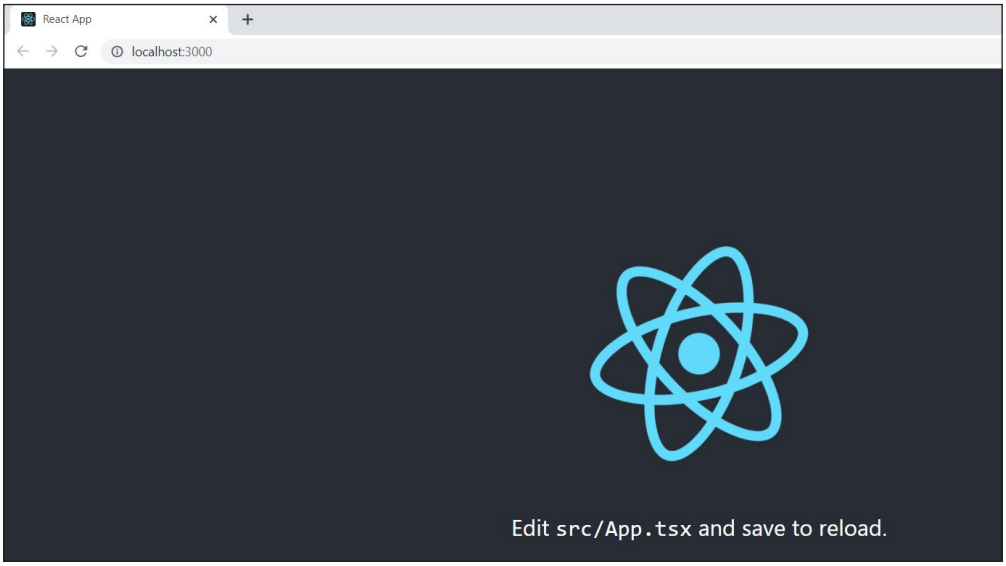

***Figure 1.2**: Running created react project in browser*