

Streamlit Essentials

From basics to advanced data app development

Surabhi Pandey



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First Edition 2025

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ISBN: 978-93-65890-822

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Acknowledgement

I would like to express my sincere gratitude to everyone who contributed to completing this book.

First and foremost, I extend my heartfelt appreciation to my family for their unwavering support and encouragement; their love and encouragement have been a constant source of motivation.

I would also like to thank the BPB Publications team for their excellent work. I would also like to acknowledge the reviewers and technical experts who provided valuable feedback and contributed to the refinement of this manuscript. Their insights and suggestions have significantly enhanced the quality of the book.

Some people leave a lasting impression when they cross your path. I had the pleasure of working with Dennis Lau and Raymond Au Yong a few years back. Dennis introduced me to Streamlit (and many other tools), reigniting my spark for experimentation. Raymond was always encouraging and supportive of the ideas I brought to the table, offering valuable feedback that refined my ideas and improved my design thinking. Their belief and their expertise helped me build confidence and trust in my abilities. Their influence still resonates in my tech journey today, and I am grateful to have crossed paths with them.

Last but not least, we want to express our gratitude to the readers who have shown interest in our book. Your support and encouragement have been deeply appreciated.

Thank you to everyone who has played a part in making this book a reality.

Preface

“Streamlit Essentials: From basics to advanced data app development” provides a comprehensive introduction to Streamlit, a powerful framework that simplifies the process of building and deploying data apps.

The chapters in this book take readers from the fundamentals of Streamlit to advanced techniques. It begins with the basics, covering **Introduction to Streamlit and Getting Started with Streamlit**, ensuring that the readers understand the platform’s needs and core concepts.

As you progress, you will explore the intricacies of **Layouts and Widgets** and how to integrate data to create visually appealing **Data Visualizations**. With a focus on real-world applications, you will also learn about **Machine Learning Model Deployments**.

The later chapters focus on more advanced topics, such as **Advanced Streamlit Concepts** and **Deploying Streamlit Apps**, helping you leverage Streamlit’s features like secret management, callbacks, Database connectivity, App testing and streamlining your workflow to make your application production-ready. In addition, hands-on projects in the book will enable you to showcase your skills by building a professional portfolio.

Building and Enhancing your Portfolio will help to use the power of networking and community building to get the most out of Streamlit and create a portfolio that resonates with potential employers and collaborators. **Enhancing Streamlit development with AI Tools** introduces AI-assisted development tools that can help speed up the process of application building from ideation to deployment.

This book is designed for data professionals, from beginners looking to explore Streamlit for the first time to advanced users seeking to optimize their development process. With practical examples and hands-on projects, **“Streamlit Mastery”** is a valuable resource for anyone aiming to include Streamlit in their data tooling arsenal and build interactive, data-driven applications.

Chapter 1: Introduction to Streamlit: This chapter discusses the challenges of data presentation and how this gap can be bridged. The most commonly used tools and also the challenges faced by the data developers while communicating and understanding the non-technical stakeholders. We discuss various challenges and explore why Streamlit fits in as an ideal solution for faster prototyping and custom data application development.

Chapter 2: Getting Started with Streamlit: This chapter covers the installation, basic setup, and core concepts that make Streamlit so accessible. Here, readers will gain strong foundation of Streamlit's working and understand how to get Streamlit up and running quickly. We will also dive into building the first interactive Data application, which we will enhance throughout future chapters.

Chapter 3: Exploring Streamlit Widgets: This chapter covers Streamlit-provided widgets, which help in faster development of the applications. Knowing what Streamlit supports natively, can help readers visualize their ideas faster. From creating form-based applications to embedding media, Streamlit widgets help create a fully functional data app in no time.

Chapter 4: Styling and Layouts in Streamlit: This chapter covers layout options provided by Streamlit. Although not a full-fledged web application development framework, Streamlit provides great tools to enhance the design of your data application and apply design principles to build an aesthetic data application. We will discuss Streamlit state management, custom components library, and what it means to design an engaging and well-structured application.

Chapter 5: Data Visualization with Streamlit: This chapter focuses on integrating and creating compelling visualizations with Streamlit. Whether it's simple charts or complex real-time data-driven insights, transforming raw data into visually engaging content can be achieved using Streamlit. We will also explore Streamlit chat widgets and third-party visualization libraries and compare their functionalities and use cases.

Chapter 6: Streamlit and Machine Learning: This chapter dives into integrating machine learning models with Streamlit, showcasing how to build and deploy interactive apps powered by machine learning. Readers will learn how to load pre-trained models, visualize predictions, and make the models accessible to a wider audience.

Chapter 7: Advanced Streamlit Concepts: In this chapter, we explore more advanced features, including caching, secret management, app testing, and optimizing performance. We will also discuss the recommended design patterns and pitfalls, ensuring that the data application.

Chapter 8: Deployment of Streamlit Apps: In this chapter, we will explore the steps required to deploy Streamlit applications using various options like Streamlit Sharing or cloud providers. We will deploy our Product Recommender application using Streamlit Sharing and Google Cloud Platform and compare various considerations to note when deciding on the deployment platform.

Chapter 9-11: Hands-On Projects: Easy-Advanced: In these chapters, we dive into real-world projects from easy to advanced. These projects can help you streamline your learning and explore tooling options available with Streamlit.

Chapter 12: Build and Enhance Your Portfolio: This chapter gives a walkthrough on Streamlit's active and vibrant global community boards and how to leverage them to enhance your portfolio. From contributing to open-source projects to marketing your apps, you will learn practical tips for getting your work noticed in the broader data and tech community.

Chapter 13: Enhancing Streamlit Development with AI Tools: The final chapter introduces how AI tools can complement Streamlit development. Readers will gain insights into how AI can speed up coding, assist in generating ideas, and even optimize the development process. We will also touch upon the ethical considerations when using AI tools in your projects.

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CHAPTER 1

Introduction to Streamlit

Introduction

In the modern digital realm, where data has earned its reputation as the new oil, our interaction with this invaluable resource has been rapidly transforming. The journey from traditional spreadsheets to intricate BI tools and now to intuitive data apps showcases the ever-evolving canvas of data interactivity. This is where Streamlit shines brightly. It is an open-source Python library that is reshaping how we build and visualize data applications.

Streamlit empowers data professionals to transform their intricate analyses and models into dynamic web apps by serving as a bridge between data science and app development. Designed with Python enthusiasts in mind, it eliminates the need for exhaustive knowledge of front-end development, making data app creation accessible and straightforward.

Structure

The chapter discusses the following topics:

- Challenges of data presentation
- Need for Streamlit

Objectives

In this chapter, we will understand the role of Streamlit in a data project, highlighting how it empowers data professionals to create impactful, accessible, and interactive data applications that resonate with a broad audience, including those with minimal technical expertise.

Challenges of data presentation

As businesses and organizations become increasingly data-driven, the gap between complex data analysis and actionable insights for decision-makers and stakeholders becomes more evident.

Data scientists often find themselves at a crossroads when it is time to present their findings, discoveries, or models. It is prudent that the stakeholders are kept in the loop at every project stage to avoid any miscommunication and differences at later stages. Given ahead is an overview of the high-level stages of data projects.

Let us walk through each stage of the project to understand the challenges better:

- **Problem definition, data collection, and preparation:** The project begins with understanding the business problem, defining the scope, and setting clear objectives. This is an important stage of the project; defining correct boundaries and the definition of done is of utmost importance for a successful project execution. This also acts as a guardrail in the later stages of a project when new requirements are brought in. Challenges include dealing with large volumes of data, ensuring data quality, and addressing missing or inconsistent data. Challenges at this stage include aligning the project with business goals and ensuring stakeholder agreement on the project's direction. Data collection involves gathering relevant data from various sources and preprocessing it for analysis. It is important to communicate the findings and data quality issues to the stakeholders, too. It might not seem important to convey at the start, but it helps to set the right expectations from the data.
- **Exploratory Data Analysis (EDA):** Here, data scientists explore the data to understand patterns, anomalies, and relationships. Challenges include making sense of complex data patterns and summarizing key findings in a way that is understandable to non-technical stakeholders.
- **Model building and insight generation:** This stage involves selecting, building, and validating machine learning models, as well as model results, to generate actionable insights. Challenges include translating technical findings into business insights and validating these insights with stakeholders.
- **Deployment and maintenance:** The final model is deployed into a production environment. Challenges include integrating the model with existing systems and ensuring its performance over time.

Each of the stages has its varied technical hurdles. However, one common thing across all the steps is the challenge to constantly communicate and keep the stakeholders in the loop. When communicating with stakeholders who might come from different areas of expertise like sales, advertising, and marketing, it is crucial to ensure that the presentation tools are selected carefully to communicate the key points effectively and precisely.

Visualization serves as a powerful tool in bridging the gap between technical and non-technical stakeholders in such projects. It translates complex data sets into intuitive, easy-to-understand graphical formats, enabling stakeholders who may not have the technical expertise to grasp intricate patterns and insights at a glance. This visual approach not only facilitates clearer communication but also aids in collaborative decision-making. By presenting data in a visually engaging and accessible manner, stakeholders can more effectively comprehend the implications of the data, leading to informed discussions and more efficient decision-making processes. Visualization is a universal language, democratizing access to insights and fostering a shared understanding among diverse teams. Also, it is important to remember that the end goal is always to assist in providing insights to the business.

There are many dashboarding options available in the market today. Most tools cater to specific use cases; some are good at churning out heavy-weight BI insights or building a fancy dashboard, but the fanciest tool might not be the answer here. A simple tool is required that can build faster without over-engineering.

There are some traditional methods like using Jupyter Notebook for building faster, but these might present challenges such as:

- **The complexity of sharing:** Raw data, detailed algorithms, or even Jupyter notebooks with non-technical stakeholders can lead to confusion. It demands an intricate dance of explanations, which might fail to drive the point home.
- **Static visuals:** While visuals like charts and graphs are a step forward, they are static. They showcase a snapshot in time rather than a dynamic flow of data, which might not encapsulate the entire story or the potential variations.
- **Lack of interactivity:** Presenting a model without interactivity means stakeholders cannot experiment with inputs to understand potential outcomes. It becomes a one-way street of information flow, lacking the essential feedback loop.

Need for Streamlit

Turning a data analysis or a machine learning model into an interactive web application required a blend of front-end development skills and a stack of web frameworks. This often meant that data scientists needed to collaborate with web developers or invest time learning these frameworks, which is time-consuming and sometimes cumbersome.

Streamlit fills this void by offering a platform where the usual Python code can magically turn into an interactive web application. Think about when you wanted to share your

analysis or a prototype model with a non-technical stakeholder. Instead of navigating through Jupyter Notebooks or sharing static visuals, Streamlit provides a medium to make these insights dynamic, interactive, and web-ready.

The current industry is full of tools for data visualization and app creation. From Dash by Plotly to Shiny for R, the options are varied. However, Streamlit has carved its niche, especially when fast prototyping is the goal, for the following reasons:

- **Ease of use:** Unlike some platforms that require a deep dive into the nuances of web frameworks, Streamlit offers a simpler Python-centric approach. If you are comfortable with Python, you are already halfway there.
Streamlit's promise is to deliver a functional web application with minimal Python code. Gone are the days when JavaScript, HTML, or CSS were barriers.
- **Interactivity at its core:** While tools like Dash offer interactivity, Streamlit's widget ecosystem is designed to be integrated seamlessly, making the building process intuitive and less cumbersome.
- **Widgets** like sliders, buttons, and text inputs are not just add-ons; they are core to Streamlit. They transform static data insights into dynamic narratives.
- **Speed of delivery:** Rapid prototyping is one of Streamlit's forte. The immediate feedback and live-coding feature ensure a quick transition from code to a visual prototype, a feature not all tools can boast of.

The essence of *what you see is what you get* is embodied in Streamlit's live-coding capability, making prototyping swift and iterative.

When comparing Streamlit with other dashboarding tools in the market, an interesting key feature is the ability to save visualizations as code, which brings several significant advantages over traditional dashboarding tools. When you implement your visualizations as code, there are a few advantages that technical engineers might appreciate:

- **Version control and change management:** By saving visualizations as code, Streamlit allows integration with version control systems like Git. This means any changes made to the dashboard are trackable and reversible, similar to how software development teams manage code changes. This capability is a game-changer for data teams, as it ensures that updates or modifications to the dashboard are documented, can be reviewed, and rolled back if necessary.
- **One point of change:** Streamlit's code-centric approach allows changes to a visualization or dashboard that do not require navigating through complex GUI settings. Instead, updates are made directly in the code. This ensures that there is a single point of change, which is particularly beneficial in maintaining consistency and reducing errors or conflicts that might arise from multiple adjustment points.
- **Collaborative development:** Streamlit's compatibility with standard development tools and workflows makes it an ideal platform for collaborative projects. Multiple team members can work on different aspects of the dashboard simultaneously,