

*Paul S. Wang*

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# *Mastering Linux*



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## *Preface*

Linux is one of the great success stories of open-source, community-developed software. It is increasingly used as Web and application servers, software development platforms, personal workstations, and research machines. In computer science and engineering departments, you'll find Linux systems in classrooms, programming labs, and computer centers, not just because Linux is free, but also because it offers a rich computing environment for teaching and learning.

From its beginning in 1991, and with help from the GNU Project, Linux has evolved quickly and has brought new powers and conveniences to users. Competency on Linux will be important for any serious computer professional.

This book provides a comprehensive and up-to-date guide to Linux concepts, usage, and programming. The text helps you master Linux with a well-selected set of topics. Hands-on practice is encouraged; it is the only way to gain familiarity with an operating system. A primer gets you started quickly. The chapters lead you from user interfaces, commands and filters, Shell scripting, the file system, networking, to kernel system calls. There are many examples and complete programs ready to download and run. A summary and exercises of varying degrees of difficulty can be found at the end of each chapter. A companion website provides appendices, information updates, an example code package, and other resources for instructors as well as students. See page 405 for details.

### **User Friendly and Comprehensive**

There is both breadth and depth in this book's presentation. Chapter 1 contains a Linux primer to get the new user started as quickly as possible without awkwardness or confusion. Being able to play and experiment with the system adds to the user's interest and motivation to learn more. Once introduced and comfortable, the user is guided through a well-selected set of topics covering the type of detailed material appropriate for a one-semester course at the advanced undergraduate or beginning graduate level.

The first part of the textbook covers interactive use of Linux via the *Graphical User Interface* (GUI) and the *Command-Line Interface* (CLI), including comprehensive treatment of the Gnome desktop and the Bash Shell. Using different commands and filters, building pipelines, and matching patterns with regular expressions are major focuses.

Next comes Bash scripting, file system structure, organization, and usage, which bring us to about the middle of the book.

Chapters 7 and 8 present networking, the Internet and the Web, and data encryption, as well as Web hosting. The Linux Apache MySQL PHP (LAMP) Web hosting combination is presented in depth. Such practical knowledge can be valuable for many Linux programmers.

In Chapters 9–11, attention is then turned to C-level programming. Because the Linux kernel and most of its applications are implemented in it, C is considered the native language of Linux. In-depth knowledge of Linux requires understanding the *Standard C Libraries* and the *system calls* which form the interface to the Linux kernel. Topics covered include the C compiler, preprocessor, debugger, I/O, file manipulation, process control, inter-process communication, and networking. Many complete example programs, written in the standard ISO C99, are provided.

Chapter 12 deals with GUI programming in Ruby/GTK2, where we present topics such as widgets, layout, event-driven programming, and object orientation. Examples show how to build GUI applications for Linux.

Appendices and the bibliography for the book are kept on the book's website (<http://ml.sofpower.com>).

## Flexible Usage

This book is for people who wish to learn Linux and to become good at using it and writing programs in it. The book does not assume prior knowledge of Linux or UNIX, but has the depth to satisfy even those with Linux experience.

Compared to other Linux books, this text is not a thick volume. However, it presents many topics comprehensively and in depth. Many examples are given to illustrate concepts and usage. It is well-suited for a one-semester course. An instructor can cover all the chapters in sequence or choose among them depending on the class being taught.

For an *Introduction to Linux* course, the chapters on C-level programming and perhaps on Web hosting can be skipped.

For a system programming-oriented course, the Linux primer, interactive use of Bash, and the GNU desktop material can be omitted or assigned for reading at the beginning of the class. This will provide more time for the hard-core topics on programming.

For an *introduction to operating system principles* course, this book is a good supplement. Discussion of Linux subjects—the Shell, file system structure, concurrent process management, I/O structure, signals/interrupts, and inter-process communication—provides concrete examples and adds to the students' understanding of the abstract operating system principles being studied.

For a server-side Web programming course, the coverage of Bash, file system, Internet and the Web, and Web hosting can make this book a great supplemental text.

For courses on network programming, graphics, C programming, distributed computing, etc., the book can be a valuable supplement as well.

For those who use Linux in school or at work, this book enables you to apply the system's capabilities more effectively, resulting in much increased productivity. Ready-to-use examples provide many immediate practical applications.

Going beyond, you can learn how to write programs at the Shell and the C levels. This ability enables you to build new capabilities and custom tools for applications or R&D.

## Appendices Online

The table of contents lists all the appendices, but to reduce the volume of the book, we are keeping the appendices online at the book's website. The appendices in PDF are easier to use and search. The appendix "Secure Communication with SSH and SFTP" is actually a Web page so we can supply download and usage hyperlinks. This arrangement also allows us to add and improve the appendices in the future.

## Example Code Package

Throughout the book, concepts and usages are thoroughly explained with examples. Instead of using contrived examples, however, every effort has been made to give examples with practical value and to present them as complete programs ready to run on your Linux system.

These programs are collected in an *example code package* ready to download from the companion website (<http://ml.sofpower.com>). See page 405 for instructions on downloading and unpacking the example code package. The description for each example program is cross-referenced to its file location with a notation such as (**Ex:** `ex05/argCheck.sh`).

## Easy Reference

You'll find a smooth readable style uncharacteristic of a book of this type. Nevertheless, it is understood that such books are used as much for reference as for concentrated study, especially once the reader gets going on the system. Therefore, information is organized and presented in a way that also facilitates quick and easy reference. There are ample resource listings and appendices (at the website) and a thorough and comprehensive index. The in-text examples are also cross-referenced with files in the example code package. This book will be a valuable aid for anyone who uses tools, accesses the Internet, or writes programs, under Linux, even occasionally.

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