大学计算机教育丛书（影印版）

Third Edition

JUST ENOUGH UNIX

Paul K. Andersen

UNIX

实用教程

第3版

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清华大学出版社
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Las Cruces, NM

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McGraw-Hill Companies, Inc.

(京)新登字 158 号

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北京市版权局著作权合同登记号: -2000-3921

出版者: 清华大学出版社(北京清华大学学研大厦,邮编 100084)
http:// www. tup. tsinghua. edu. cn
印刷者: 清华大学印刷厂
发行者: 新华书店总店北京发行所
开　本: 787×960 1/16　印张: 28.75
版　次: 2000 年 12 月第 1 版　2000 年 12 月第 1 次印刷
书　号: ISBN 7-302-04151-2/TP·2451
印　数: 0001～3000
定　价: 42.00 元

出版者的话

今天，我们的大学生、研究生和教学、科研工作者，面临的是一个国际化的信息时代。他们将需要随时查阅大量的外文资料；会有更多的机会参加国际性学术交流活动；接待外国学者；走上国际会议的讲坛。作为科技工作者，他们不仅应有与国外同行进行口头和书面交流的能力，更为重要的是，他们必须具备极强的查阅外文资料获取信息的能力。有鉴于此，在原国家教委所颁布的"大学英语教学大纲"中有一条规定：专业阅读应作为必修课程开设。同时，在大纲中还规定了这门课程的学时和教学要求。有些高校除开设"专业阅读"课之外，还在某些专业课拟进行英语授课。但教、学双方都苦于没有一定数量的合适的英文原版教材作为教学参考书。为满足这方面的需要，我们陆续精选了一批国外计算机科学方面最新版本的著名教材，进行影印出版。我社获得国外著名出版公司和原著作者的授权将国际先进水平的教材引入我国高等学校，为师生们提供了教学用书，相信会对高校教材改革产生积极的影响。

我们欢迎高校师生将使用影印版教材的效果、意见反馈给我们，更欢迎国内专家、教授积极向我社推荐国外优秀计算机教育教材，以利我们将《大学计算机教育丛书(影印版)》做得更好，更适合高校师生的需要。

清华大学出版社

《大学计算机教育丛书(影印版)》项目组

1999.6

PREFACE

What is UNIX?

Mention computers, and most people tend to think of computer hardware—the physical device, consisting of circuit boards, a central processing unit (CPU), memory chips, and so on. Equally important, however, is the software—the programs that tell the hardware what to do. Without software, a computer is just a box with wires attached to it.

An operating system is an important kind of software that manages the resources of the computer. You might think of the operating system as the master control program for the entire computer system, hardware and software.

In this book you will learn about the UNIX operating system. UNIX is fast becoming the standard computer operating system in industry, government, and education. It is especially popular in academia: according to AT&T, where UNIX was developed, every major university in the United States now has at least one computer system running under UNIX.

Which Version of UNIX?

Although UNIX originated at the AT&T Bell Laboratories, much of its subsequent development has occurred at the University of California, Berkeley. Computer manufacturers, too, have gotten into the act, producing their own variations on the UNIX theme. Examples include AIX, from IBM; A/UX, from Apple Computer; HP-UX, from Hewlett-Packard; Solaris, from Sun Microsystems; ULTRIX, from Digital Equipment Corporation; and XENIX, from Microsoft.

These versions of UNIX are quite similar. Most can trace their ancestry to either AT&T UNIX or Berkeley UNIX; some are amalgams of both. This book presents features that are found on almost all UNIX systems, with special emphasis on those that are common to AT&T System V and Berkeley System Distribution (BSD) 4.3 UNIX.

Who Should Read This Book?

This book is intended for anyone who wants to acquire a working knowledge of UNIX without having to become a UNIX expert. It is especially appropriate for students of science, engineering, or business who are taking their first computer programming course.

What Does This Book Cover?

This book covers the basics of the UNIX operating system. It has eight main parts:

I INTRODUCTION TO UNIX

II UNIX FILE SYSTEM

III UNIX SHELL

IV TEXT EDITORS

V UNIX NETWORKING

VI STARTUP FILES

VII SHELL SCRIPTS

VIII PROGRAMMING UNDER UNIX

INTRODUCTION. In Part I, you will find an overview of the UNIX operating system, and you will learn what you will need to start using it. Three different approaches are presented: traditional (command-line) UNIX; the X Window System with Motif; and the Common Desktop Environment (CDE).

UNIX FILE SYSTEM. UNIX organizes information in collections called files. You will learn how to create, name, rename, copy, and delete files in Part II. You will also learn how UNIX keeps track of your files.

UNIX SHELL. The part of UNIX that interprets user commands and passes them on to the computer is called a shell. Many different shells have been written for UNIX; the three most prevalent are the Bourne Shell (standard on AT&T System V UNIX), the C Shell (standard on Berkeley UNIX), and the Korn Shell. These shells are considered in Part III.

TEXT EDITORS. You can create or modify UNIX files using a utility program called an editor. The most popular UNIX editors are `vi` ("vee-eye"), `emacs`, `pico`, and CDE Text Editor, which are discussed in Part IV.

UNIX NETWORKING. The recent growth of the Internet and World Wide Web around the world has been phenomenal. UNIX systems are a considerable part of this development. Internet and Web tools are presented in Part V.

STARTUP FILES. One of the great advantages of the UNIX operating system is its flexibility. A startup file contains commands for the shell to execute when it begins running. Startup files are examined in Part VI.

SHELL SCRIPTS. The UNIX shell is also a sophisticated programming language. A file containing a program for the UNIX shell is called a shell script. Shell scripts are described in Part VII.

PROGRAMMING UNDER UNIX. Most UNIX systems include the programming languages C and Fortran. Many also include Pascal and other languages such as C++, BASIC, Lisp, and COBOL. UNIX also offers a selection of software tools that are used in programming. UNIX programming is discussed in Part VIII, with emphasis on C, Fortran, and Pascal.

What's New in the Third Edition

Seven new chapters have been added; several chapters have been revised extensively. Most of the new material has to do with the Common Desktop Environment (CDE). The new chapters are

- Getting Started with CDE (Chapter 5)
- Using File Manager (Chapter 9)
- Editing with `emacs` (Chapter 14)
- Editing with `pico` (Chapter 15)
- Editing with Text Editor (Chapter 16)
- Processing Mail with `pine` (Chapter 19)
- Processing Mail with Mailer (Chapter 20)

A chapter on `gopher` has been deleted. It appears that `gopher`, if not yet extinct, is seriously endangered by Web browsers such as Netscape Navigator.

How to Use This Book

Anyone who is just starting with UNIX should read straight through Parts I, II, III, and IV. The remaining parts may be read in any order. If your interest is in the Internet and the World Wide Web, read Part V. If you would like to learn about shell scripts and startup files, read Parts VI and VII. If you are interested primarily in using UNIX to program in C, FORTRAN, or Pascal, read Part VIII.

Each part of this book begins with a chapter that explains the material without requiring the use of the computer. Other chapters are called "tutorials." These are intended to be read at the computer terminal. You should plan to spend about an hour at the terminal to cover each tutorial.

At the end of each section, you will find some short exercises. To derive the maximum benefit from this text, be sure to work through all of the exercises.

Acknowledgments

Many persons helped in the preparation of this and previous editions. The following reviewers read the manuscript at various stages in its development and provided helpful comments and suggestions:

John Thomas Berry
Foothill College

Eric P. Bloom
Boston University

Goranka Bjedov
AT&T

John Carroll
San Diego State University

Tat W. Chan
Fayetteville State University

Richard J. Easton
Indiana State University

John K. Estell
University of Toledo

Charles Frank
Northern Kentucky University

Donald L. Greenwell
Eastern Kentucky University

Scott Gever
Foothill College

Joe Hagarty
Raritan Valley Community College

Vasant G. Honavar
Iowa State University

Jack S. Kaye
University of Wisconsin—Milwaukee

Bill Manaris
University of Southwest Lousiana

J. Fernando Naveda
Rochester Institute of Technology

Evelyn Obaid
San José State University

Harapan Sinaga
Oklahoma State University

John Slimick
University of Pittsburgh—Bradford

Alexander Stoffel
Mayville State University

J. William A. Ward
University of South Alabama

This book could not have been produced without the invaluable assistance of Dr. M. G. Scarbrough, colleague and friend.

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PART I:
INTRODUCTION TO UNIX

1 INTRODUCTION TO UNIX

Read a computer magazine, and you are sure to find an advertisement like this:

> *Blow the doors off the competition with the latest MegaMicro Daytona 500 workstations! Our 64-bit, 333-MHz AlphaBeta CPU delivers astounding 500-MIPS power that leaves the others in the dust. With 128 MB of RAM and an enormous 20-GB disk, the MegaMicro Daytona 500 is easy on your budget too ....*

And so on. Or perhaps something like this:

> *MICROFRIENDLY takes you to the next level of user-friendly computing with the latest release of the HARMONIX® operating system. Featuring the X Window System with Motif and the Common Desktop Environment, MICROFRIENDLY HARMONIX® is a fully POSIX-compliant version of System V UNIX® with Berkeley utilities. MICROFRIENDLY HARMONIX® makes client-server computing easy, harmonious, and FRIENDLY.*

In this chapter, you will learn what these ads mean. You will also get an overview of UNIX—what it is, how it works, and what it can do for you.

1.1 Computer Hardware

Computers come in a bewildering range of shapes, sizes, and types. Despite their differences, almost all have the following four essential components (see Figure 1–1):

- ***Central processing unit (CPU).*** The CPU performs calculations and manipulates data.
- ***Main memory (primary memory, internal memory, RAM).*** This is the place where the CPU looks for instructions and data to process. Main memory—also

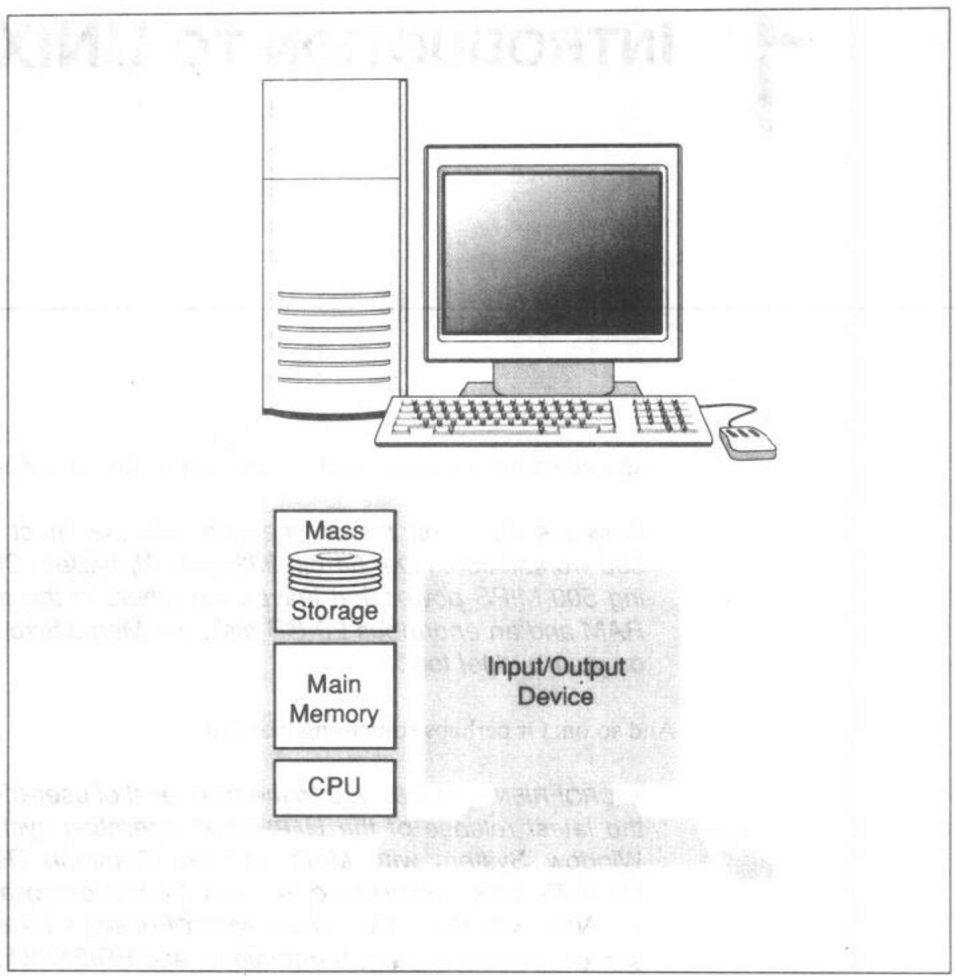

Figure 1–1
A typical computer system. The four parts of a single-user computer are shown

called *random-access memory* or *RAM*—is fast but limited in how much it can hold.

- ***Mass storage (external memory, secondary memory).*** Information that is not immediately needed by the computer is placed in mass storage or secondary memory, which is usually slower than main memory but can hold much more. The most common mass storage devices are magnetic disks.
- ***Input/output (I/O) device.*** I/O devices are used to move information to and from the computer. The most common I/O devices include the keyboard, mouse, video display, and printer.

Other devices—such as terminals, printers, scanners, and so on—are sometimes attached to the computer. These are generally called *peripherals*.

Bits, Bytes, Hertz, MIPS, and Flops

Computer memory is usually measured in bits and bytes. *Bit* is short for *binary digit*; a bit can store either a 0 or a 1. A *byte* is a grouping of eight bits; a byte can store a single character. The following prefixes are used to express larger quantities:

Sometimes these prefixes are meant as approximations—see Exercise 6.

kilo- (K) "thousand" (10^3)

mega- (M) "million" (10^6)

giga- (G) "billion" (10^9)

Thus, 1 megabyte (Mbyte or MB) is approximately 1 million bytes of memory. A million bytes can hold a million characters, or about 500 typewritten pages of text.

A CPU may be rated by the number of bits it can process at a time. For example, a 32-bit CPU manipulates 32 bits at a time. Another way to say this is that the CPU has a 32-bit *word size*.

The rate at which words are processed by a CPU is determined by the *clock speed*. The *clock speed* is expressed in megahertz (MHz); 1 megahertz = 1 million pulses per second. Other things being equal, CPUs with larger word sizes and higher clock speeds are faster.

A computer's speed is sometimes expressed in terms of the number of arithmetic operations it can perform in a second. This is measured in *flops*, which is short for *floating-point operations per second*. Alternatively, a computer's speed may be expressed by the number of instructions it can execute in a second. This is measured in *MIPS*, which is short for *millions of instructions per second*.

1.2 One User or Many?

Workstations are more powerful than the typical personal computer.

The computer represented in Figure 1–1 is a *single-user* computer, either a *personal computer* or *workstation*. It has one keyboard and one video display, and is intended to serve just one person at a time. This is a common arrangement with smaller computers.

Large computer systems, on the other hand, often have more power than one person can profitably use. These computers are commonly set up as *multiuser systems*, as depicted in Figure 1–2. Note that the multiuser computer has the same four basic parts as the single-user computer: CPU, main memory, mass storage, and input/output devices. (The I/O devices shown in Figure 1–2 are terminals, which consist of a keyboard and a video monitor.)