000.book Page xiii Thursday, November 20, 2008 10:55 AM

CONTENTS

LIST OF JUMPSTARTS xxxvii
PREFACE xxxix

CHAPTER 1: WELCOME TO LINUX 1

Ubuntu Linux 2
The Linux 2.6 Kernel 3
The History of UNIX and GNU–Linux 3
The Heritage of Linux: UNIX 3
Fade to 1983 4
Next Scene, 1991 5
The Code Is Free 6
Have Fun! 6
What Is So Good About Linux? 7
Why Linux Is Popular with Hardware Companies and Developers 10
Linux Is Portable 10
The C Programming Language 11
Overview of Linux 12
Linux Has a Kernel Programming Interface 12
Linux Can Support Many Users 13
Linux Can Run Many Tasks 13
Linux Provides a Secure Hierarchical Filesystem 13
The Shell: Command Interpreter and Programming Language 14
A Large Collection of Useful Utilities 16
Interprocess Communication 16
System Administration 17

000.book Page xiv Thursday, November 20, 2008 10:55 AM

Additional Features of Linux 17
GUIs: Graphical User Interfaces 17
(Inter)Networking Utilities 18
Software Development 19
Conventions Used in This Book 19
Chapter Summary 21
Exercises 22

PART I INSTALLING UBUNTU LINUX 23

CHAPTER 2: INSTALLATION OVERVIEW 25

The Live/Install Desktop CD/DVD 26
More Information 26
Planning the Installation 27
Considerations 27
Requirements 27
Processor Architecture 29
Interfaces: Installer and Installed System 30
Ubuntu Releases 31
Ubuntu Editions 31
Installing a Fresh Copy or Upgrading an Existing Ubuntu System? 32
Setting Up the Hard Disk 33
RAID 39
LVM: Logical Volume Manager 40
The Installation Process 41
Downloading and Burning a CD/DVD 42
The Easy Way to Download a CD ISO Image File 42
Other Ways to Download a CD/DVD ISO Image File 42
Verifying an ISO Image File 45
Burning the CD/DVD 46
Gathering Information About the System 46
Chapter Summary 47
Exercises 48
Advanced Exercises 48

CHAPTER 3: STEP-BY-STEP INSTALLATION 49

Basic Installation from the Live/Install Desktop CD/DVD 50
Booting the System 50
Checking the CD/DVD for Defects 51
Live Session 51

000.book Page xv Thursday, November 20, 2008 10:55 AM

Graphical Partitioners 58
gparted: The GNOME Partition Editor 58
ubiquity: Setting Up Partitions 61
Upgrading to a New Release 64
Installing KDE 65
Setting Up a Dual-Boot System 66
Creating Free Space on a Windows System 66
Installing Ubuntu Linux as the Second Operating System 67
Advanced Installation 67
The Live/Install Desktop CD: The Initial Install Screen 67
The Alternate CD Initial Install Screen Menu 70
The Server CD Initial Install Screen Menu 71
The DVD 72
The Ubuntu Textual Installer 73
Chapter Summary 81
Exercises 81
Advanced Exercises 81

PART II GETTING STARTED WITH UBUNTU LINUX 83

CHAPTER 4: INTRODUCTION TO UBUNTU LINUX 85

Curbing Your Power: **root** Privileges/sudo 86
A Tour of the Ubuntu Linux Desktop 87
Logging In on the System 88
Introduction 88
Launching Programs from the Desktop 90
Switching Workspaces 91
Setting Personal Preferences 92
Mouse Preferences 93
Working with Windows 94
Using Nautilus to Work with Files 94
The Update Notifier 99
Changing Appearance (Themes) 100
Session Management 102
Getting Help 102
Feel Free to Experiment 103
Logging Out 103
Getting the Most out of the Desktop 104
GNOME Desktop Terminology 104
Opening Files 104
Panels 105
The Main Menu 108
Windows 109
The Object Context Menu 112

000.book Page xvi Thursday, November 20, 2008 10:55 AM

Updating, Installing, and Removing Software Packages 116
Software Sources Window 116
Add/Remove Applications 118
synaptic: Finds, Installs, and Removes Software 118
Where to Find Documentation 121
Ubuntu Help Center 121
man: Displays the System Manual 122
apropos: Searches for a Keyword 124
info: Displays Information About Utilities 124
The **--help** Option 127
HOWTOs: Finding Out How Things Work 127
Getting Help with the System 128
More About Logging In 130
The Login Screen 130
What to Do If You Cannot Log In 131
Logging In Remotely: Terminal Emulators, ssh, and Dial-Up Connections 132
Logging In from a Terminal (Emulator) 132
Changing Your Password 133
Using Virtual Consoles 134
Working from the Command Line 135
Correcting Mistakes 135
Repeating/Editing Command Lines 137
Controlling Windows: Advanced Operations 138
Changing the Input Focus 138
Changing the Resolution of the Display 139
The Window Manager 139
Chapter Summary 140
Exercises 142
Advanced Exercises 142

CHAPTER 5: THE LINUX UTILITIES 145

Special Characters 146
Basic Utilities 147
ls: Lists the Names of Files 147
cat: Displays a Text File 148
rm: Deletes a File 148
less Is more: Display a Text File One Screen at a Time 148
hostname: Displays the System Name 149
Working with Files 149
cp: Copies a File 149
mv: Changes the Name of a File 150
lpr: Prints a File 151
grep: Searches for a String 152
head: Displays the Beginning of a File 152

000.book Page xvii Thursday, November 20, 2008 10:55 AM

tail: Displays the End of a File 153
sort: Displays a File in Order 154
uniq: Removes Duplicate Lines from a File 154
diff: Compares Two Files 154
file: Identifies the Contents of a File 156
| (Pipe): Communicates Between Processes 156
Four More Utilities 157
echo: Displays Text 157
date: Displays the Time and Date 158
script: Records a Shell Session 158
todos: Converts Linux and Macintosh Files to Windows Format 159
Compressing and Archiving Files 160
bzip2: Compresses a File 160
bunzip2 and bzcat: Decompress a File 161
gzip: Compresses a File 161
tar: Packs and Unpacks Archives 162
Locating Commands 164
which and whereis: Locate a Utility 164
slocate: Searches for a File 166
Obtaining User and System Information 166
who: Lists Users on the System 166
finger: Lists Users on the System 167
w: Lists Users on the System 169
Communicating with Other Users 170
write: Sends a Message 170
mesg: Denies or Accepts Messages 171
Email 171
Tutorial: Using vim to Create and Edit a File 172
Starting vim 172
Command and Input Modes 174
Entering Text 175
Getting Help 176
Ending the Editing Session 179
The **compatible** Parameter 179
Chapter Summary 179
Exercises 182
Advanced Exercises 183

CHAPTER 6: THE LINUX FILESYSTEM 185

The Hierarchical Filesystem 186
Directory Files and Ordinary Files 186
Filenames 187
The Working Directory 190
Your Home Directory 190

000.book Page xviii Thursday, November 20, 2008 10:55 AM

Pathnames 191
Absolute Pathnames 191
Relative Pathnames 192
Working with Directories 193
mkdir: Creates a Directory 194
cd: Changes to Another Working Directory 195
rmdir: Deletes a Directory 196
Using Pathnames 197
mv, cp: Move or Copy Files 198
mv: Moves a Directory 198
Important Standard Directories and Files 199
Access Permissions 201
ls –l: Displays Permissions 201
chmod: Changes Access Permissions 202
Setuid and Setgid Permissions 204
Directory Access Permissions 206
ACLs: Access Control Lists 207
Enabling ACLs 208
Working with Access Rules 208
Setting Default Rules for a Directory 211
Links 212
Hard Links 214
Symbolic Links 216
rm: Removes a Link 218
Chapter Summary 218
Exercises 220
Advanced Exercises 222

CHAPTER 7: THE SHELL 223

The Command Line 224
Syntax 224
Processing the Command Line 226
Executing the Command Line 229
Editing the Command Line 229
Standard Input and Standard Output 229
The Screen as a File 230
The Keyboard and Screen as Standard Input and Standard Output 230
Redirection 231
Pipes 237
Running a Command in the Background 240
Filename Generation/Pathname Expansion 242
The ? Special Character 242
The * Special Character 243
The [ ] Special Characters 245

000.book Page xix Thursday, November 20, 2008 10:55 AM

Builtins 247
Chapter Summary 247
Utilities and Builtins Introduced in This Chapter 248
Exercises 248
Advanced Exercises 250

PART III DIGGING INTO UBUNTU LINUX 251

CHAPTER 8: LINUX GUIS: X AND GNOME 253

X Window System 254
Using X 256
Desktop Environments/Managers 261
The Nautilus File Browser Window 262
The View Pane 263
The Side Pane 263
Control Bars 264
Menubar 265
GNOME Utilities 269
Font Preferences 269
Pick a Font Window 269
Pick a Color Window 270
Run Application Window 270
Searching for Files 270
GNOME Terminal Emulator/Shell 272
Chapter Summary 272
Exercises 273
Advanced Exercises 274

CHAPTER 9: THE BOURNE AGAIN SHELL 275

Background 276
Shell Basics 277
Startup Files 277
Commands That Are Symbols 281
Redirecting Standard Error 281
Writing a Simple Shell Script 284
Separating and Grouping Commands 287
Job Control 291
Manipulating the Directory Stack 294
Parameters and Variables 296
User-Created Variables 298
Variable Attributes 301
Keyword Variables 302

000.book Page xx Thursday, November 20, 2008 10:55 AM

Special Characters 310
Processes 312
Process Structure 312
Process Identification 312
Executing a Command 314
History 314
Variables That Control History 314
Reexecuting and Editing Commands 316
The Readline Library 324
Aliases 330
Single Versus Double Quotation Marks in Aliases 331
Examples of Aliases 332
Functions 333
Controlling bash: Features and Options 336
Command-Line Options 336
Shell Features 336
Processing the Command Line 340
History Expansion 340
Alias Substitution 340
Parsing and Scanning the Command Line 340
Command-Line Expansion 341
Chapter Summary 349
Exercises 351
Advanced Exercises 353

CHAPTER 10: NETWORKING AND THE INTERNET 355

Types of Networks and How They Work 357
Broadcast Networks 358
Point-to-Point Networks 358
Switched Networks 358
LAN: Local Area Network 359
WAN: Wide Area Network 360
Internetworking Through Gateways and Routers 360
Network Protocols 363
Host Address 365
CIDR: Classless Inter-Domain Routing 370
Hostnames 370
Communicate Over a Network 372
finger: Displays Information About Remote Users 373
Sending Mail to a Remote User 374
Mailing List Servers 374

000.book Page xxi Thursday, November 20, 2008 10:55 AM

Network Utilities 374
Trusted Hosts 375
OpenSSH Tools 375
telnet: Logs In on a Remote System 375
ftp: Transfers Files Over a Network 377
ping: Tests a Network Connection 377
traceroute: Traces a Route Over the Internet 378
host and dig: Query Internet Nameservers 380
jwhois: Looks Up Information About an Internet Site 380
Distributed Computing 381
The Client/Server Model 382
DNS: Domain Name Service 383
Ports 385
NIS: Network Information Service 385
NFS: Network Filesystem 385
Network Services 386
Common Daemons 386
Proxy Servers 389
RPC Network Services 390
Usenet 391
WWW: World Wide Web 393
URL: Uniform Resource Locator 394
Browsers 394
Search Engines 395
Chapter Summary 395
Exercises 396
Advanced Exercises 397

PART IV SYSTEM ADMINISTRATION 399

CHAPTER 11: SYSTEM ADMINISTRATION: CORE CONCEPTS 401

Running Commands with **root** Privileges 403
sudo: Running a Command with **root** Privileges 406
sudoers: Configuring sudo 410
Unlocking the **root** Account (Assigning a Password to **root**) 415
su: Gives You Another User's Privileges 415
The Upstart Event-Based **init** Daemon 416
Software Packages 417
Definitions 417
Jobs 419
SysVinit (**rc**) Scripts: Start and Stop System Services 423

000.book Page xxii Thursday, November 20, 2008 10:55 AM

System Operation 426
Runlevels 426
Booting the System 427
Recovery (Single-User) Mode 428
Going to Multiuser Mode 431
Logging In 432
Logging Out 433
Bringing the System Down 434
Crash 435
Avoiding a Trojan Horse 436
Getting Help 438
Textual System Administration Utilities 438
kill: Sends a Signal to a Process 438
Other Textual Utilities 441
Setting Up a Server 443
Standard Rules in Configuration Files 444
rpcinfo: Displays Information About **portmap** 446
The **inetd** and **xinetd** Superservers 447
Securing a Server 448
DHCP: Configures Network Interfaces 454
nsswitch.conf: Which Service to Look at First 458
How **nsswitch.conf** Works 458
PAM 461
More Information 462
Configuration Files, Module Types, and Control Flags 462
Example 464
Modifying the PAM Configuration 465
Chapter Summary 466
Exercises 467
Advanced Exercises 467

CHAPTER 12: FILES, DIRECTORIES, AND FILESYSTEMS 469

Important Files and Directories 470
File Types 482
Ordinary Files, Directories, Links, and Inodes 482
Device Special Files 483
Filesystems 487
mount: Mounts a Filesystem 488
umount: Unmounts a Filesystem 491
fstab: Keeps Track of Filesystems 492
fsck: Checks Filesystem Integrity 494
tune2fs: Changes Filesystem Parameters 495
RAID Filesystem 497

000.book Page xxiii Thursday, November 20, 2008 10:55 AM

Chapter Summary 497
Exercises 497
Advanced Exercises 498

CHAPTER 13: DOWNLOADING AND INSTALLING SOFTWARE 499

JumpStart: Installing and Removing Packages Using aptitude 501
Finding the Package That Holds a File You Need 503
APT: Keeps the System Up-to-Date 504
    Repositories 504
    sources.list: Specifies Repositories for APT to Search 505
    The APT Local Package Indexes and the APT Cache 506
    The **apt** cron Script and APT Configuration Files 506
    aptitude: Works with Packages and the Local Package Index 508
    apt-cache: Displays Package Information 512
    apt-get source: Downloads Source Files 514
dpkg: The Debian Package Management System 514
    deb Files 515
    dpkg: The Foundation of the Debian Package Management System 516
BitTorrent 521
Installing Non-**dpkg** Software 523
    The **/opt** and **/usr/local** Directories 523
    GNU Configure and Build System 524
wget: Downloads Files Noninteractively 525
Chapter Summary 526
Exercises 527
Advanced Exercises 527

CHAPTER 14: PRINTING WITH CUPS 529

Introduction 530
    Prerequisites 530
    More Information 531
    Notes 531
JumpStart I: Configuring a Local Printer 531
system-config-printer: Configuring a Printer 532
    Configuration Tabs/Selections 533
    Setting Up a Remote Printer 534
JumpStart II: Setting Up a Local or Remote Printer Using the CUPS Web Interface 538
Traditional UNIX Printing 542
Configuring Printers 543
    The CUPS Web Interface 543
    CUPS on the Command Line 545
    Sharing CUPS Printers 548

000.book Page xxiv Thursday, November 20, 2008 10:55 AM

Printing from Windows 550
Printing Using CUPS 550
Printing Using Samba 550
Printing to Windows 552
Chapter Summary 552
Exercises 552
Advanced Exercises 553

CHAPTER 15: BUILDING A LINUX KERNEL 555

Prerequisites 556
Downloading the Kernel Source Code 557
aptitude: Downloading and Installing the Kernel Source Code 557
git: Obtaining the Latest Kernel Source Code 558
Read the Documentation 559
Configuring and Compiling the Linux Kernel 559
.config: Configures the Kernel 559
Customizing a Kernel 561
Cleaning the Source Tree 562
Compiling a Kernel Image File and Loadable Modules 563
Using Loadable Kernel Modules 564
Installing the Kernel, Modules, and Associated Files 566
Rebooting 567
grub: The Linux Boot Loader 567
menu.lst: Configures grub 568
update-grub: Updates the **menu.lst** file 571
grub-install: Installs the MBR and grub Files 573
dmesg: Displays Kernel Messages 575
Chapter Summary 576
Exercises 576
Advanced Exercises 576

CHAPTER 16: ADMINISTRATION TASKS 577

Configuring User and Group Accounts 578
users-admin: Manages User Accounts 578
useradd: Adds a User Account 580
userdel: Removes a User Account 581
usermod: Modifies a User Account 581
groupadd: Adds a Group 581
groupdel: Removes a Group 581
Backing Up Files 582
Choosing a Backup Medium 583
Backup Utilities 583

000.book Page xxv Thursday, November 20, 2008 10:55 AM

Performing a Simple Backup 585
dump, restore: Back Up and Restore Filesystems 586
Scheduling Tasks 588
cron and anacron: Schedule Routine Tasks 588
at: Runs Occasional Tasks 591
System Reports 591
vmstat: Reports Virtual Memory Statistics 591
top: Lists Processes Using the Most Resources 592
parted: Reports on and Partitions a Hard Disk 593
Keeping Users Informed 597
Creating Problems 598
Solving Problems 599
Helping When a User Cannot Log In 599
Speeding Up the System 600
lsof: Finds Open Files 601
Keeping a Machine Log 601
Keeping the System Secure 602
Log Files and Mail for **root** 603
Monitoring Disk Usage 603
logrotate: Manages Log Files 604
Removing Unused Space from Directories 606
Disk Quota System 607
syslogd: Logs System Messages 608
Chapter Summary 610
Exercises 610
Advanced Exercises 611

CHAPTER 17: CONFIGURING A LAN 613

Setting Up the Hardware 614
Connecting the Computers 614
Routers 615
NIC: Network Interface Card 615
Tools 615
Configuring the Systems 617
nm-connection-editor: Configures Network Connections 618
nm-applet: Configures Network Connections Automatically 618
iwconfig: Configures a Wireless NIC 620
Setting Up Servers 622
More Information 623
Chapter Summary 623
Exercises 624
Advanced Exercises 624

000.book Page xxvi Thursday, November 20, 2008 10:55 AM

PART V USING CLIENTS AND SETTING UP SERVERS 625

CHAPTER 18: OPENSSH: SECURE NETWORK COMMUNICATION 627

Introduction to OpenSSH 628
- How OpenSSH Works 628
- Files 629
- More Information 630

Running the ssh, scp, and sftp OpenSSH Clients 631
- Prerequisites 631
- JumpStart: Using ssh and scp to Connect to an OpenSSH Server 631
- Configuring OpenSSH Clients 632
- ssh: Connects to or Executes Commands on a Remote System 634
- scp: Copies Files to and from a Remote System 636
- sftp: A Secure FTP Client 638
- **~/.ssh/config** and **/etc/ssh/ssh_config** Configuration Files 638

Setting Up an OpenSSH Server (**sshd**) 640
- Prerequisites 640
- Note 640
- JumpStart: Starting an OpenSSH Server 641
- Authorized Keys: Automatic Login 641
- Command-Line Options 642
- **/etc/ssh/sshd_config** Configuration File 643

Troubleshooting 644

Tunneling/Port Forwarding 645

Chapter Summary 648

Exercises 648

Advanced Exercises 649

CHAPTER 19: FTP: TRANSFERRING FILES ACROSS A NETWORK 651

Introduction to FTP 652
- Security 652
- FTP Connections 652
- FTP Clients 653
- More Information 653

Running the ftp and sftp FTP Clients 654
- Prerequisites 654
- JumpStart I: Downloading Files Using ftp 654
- Anonymous FTP 658
- Automatic Login 658
- Binary Versus ASCII Transfer Mode 658
- ftp Specifics 659

000.book Page xxvii Thursday, November 20, 2008 10:55 AM

Setting Up an FTP Server (**vsftpd**) 663
Prerequisites 663
Notes 663
JumpStart II: Starting a **vsftpd** FTP Server 664
Testing the Setup 664
Configuring a **vsftpd** Server 665
Chapter Summary 675
Exercises 676
Advanced Exercises 676

CHAPTER 20: **exim4**: SETTING UP MAIL SERVERS, CLIENTS, AND MORE 677

Introduction to **exim4** 678
Alternatives to **exim4** 679
More Information 679
Setting up a Mail Server (**exim4**) 679
Prerequisites 679
Notes 680
JumpStart I: Configuring **exim4** to Use a Smarthost 680
JumpStart II: Configuring **exim4** to Send and Receive Mail 682
Working with **exim4** Messages 684
Mail Logs 684
Working with Messages 685
Aliases and Forwarding 686
Related Programs 687
Configuring an **exim4** Mail Server 688
Using a Text Editor to Configure **exim4** 688
The **update-exim4.conf.conf** Configuration File 688
dpkg-reconfigure: Configures **exim4** 690
SpamAssassin 691
How SpamAssassin Works 691
Prerequisites 692
Testing SpamAssassin 692
Configuring SpamAssassin 694
Additional Email Tools 695
Webmail 695
Mailing Lists 697
Setting Up an IMAP or POP3 Mail Server 699
Authenticated Relaying 700
Chapter Summary 702
Exercises 702
Advanced Exercises 703

000.book Page xxviii Thursday, November 20, 2008 10:55 AM

CHAPTER 21: NIS AND LDAP 705

Introduction to NIS 706
- How NIS Works 706
- More Information 708

Running an NIS Client 708
- Prerequisites 709
- Notes 709
- Configuring an NIS Client 710
- Testing the Setup 711
- yppasswd: Changes NIS Passwords 712

Setting Up an NIS Server 714
- Prerequisites 714
- Notes 715
- Configuring the Server 715
- Testing the Server 720
- **yppasswdd**: The NIS Password Update Daemon 721

LDAP 722
- More Information 724

Setting Up an LDAP Server 724
- Prerequisites 724
- Notes 724
- Step-by-Step Setup 725

Other Tools for Working with LDAP 731
- Evolution Mail 731
- Konqueror 733
- gq: An LDAP Client 733

Chapter Summary 734

Exercises 735

Advanced Exercises 735

CHAPTER 22: NFS: SHARING FILESYSTEMS 737

Introduction to NFS 738
- More Information 740

Running an NFS Client 740
- Prerequisites 740
- JumpStart I: Mounting a Remote Directory Hierarchy 741
- mount: Mounts a Directory Hierarchy 742
- Improving Performance 744
- **/etc/fstab**: Mounts Directory Hierarchies Automatically 745

Setting Up an NFS Server 746
- Prerequisites 746
- Notes 746
- JumpStart II: Configuring an NFS Server Using shares-admin 747
- Manually Exporting a Directory Hierarchy 749
- Where the System Keeps NFS Mount Information 753

000.book Page xxix Thursday, November 20, 2008 10:55 AM

exportfs: Maintains the List of Exported Directory Hierarchies 755
Testing the Server Setup 756
automount: Mounts Directory Hierarchies on Demand 756
Chapter Summary 759
Exercises 759
Advanced Exercises 760

CHAPTER 23: SAMBA: LINUX AND WINDOWS FILE AND PRINTER SHARING 761
Introduction to Samba 762
More Information 763
Notes 763
Samba Users, User Maps, and Passwords 763
Setting up a Samba Server 764
Prerequisites 764
JumpStart: Configuring a Samba Server Using shares-admin 765
swat: Configures a Samba Server 766
smb.conf: Manually Configuring a Samba Server 769
Working with Linux Shares from Windows 776
Browsing Shares 776
Mapping a Share 777
Working with Windows Shares from Linux 777
smbtree: Displays Windows Shares 777
smbclient: Connects to Windows Shares 778
Browsing Windows Networks 778
Mounting Windows Shares 779
Troubleshooting 779
Chapter Summary 782
Exercises 782
Advanced Exercises 782

CHAPTER 24: DNS/BIND: TRACKING DOMAIN NAMES AND ADDRESSES 783
Introduction to DNS 784
Nodes, Domains, and Subdomains 784
Zones 786
Queries 787
Servers 788
Resource Records 789
DNS Queries and Responses 792
Reverse Name Resolution 793
How DNS Works 795
More Information 795
Notes 795

000.book Page xxx Thursday, November 20, 2008 10:55 AM

Setting Up a DNS Server 796
Prerequisites 796
JumpStart: Setting Up a DNS Cache 796
Configuring a DNS Server 798
Setting Up Different Types of DNS Servers 811
A Full-Functioned Nameserver 811
A Slave Server 815
A Split Horizon Server 816
Chapter Summary 821
Exercises 821
Advanced Exercises 822

CHAPTER 25: firestarter, ufw, AND iptables: SETTING UP A FIREWALL 823
Introduction to firestarter 824
Notes 824
More Information 826
firestarter: Setting Up and Maintaining a Firewall 826
Prerequisites 826
JumpStart: Configuring a Firewall Using the firestarter Firewall Wizard 827
Maintaining a Firewall using firestarter 828
ufw: The Uncomplicated Firewall 834
Introduction to iptables 836
More Information 839
Prerequisites 839
Notes 839
Anatomy of an iptables Command 840
Building a Set of Rules Using iptables 841
Commands 841
Packet Match Criteria 843
Display Criteria 843
Match Extensions 843
Targets 846
Copying Rules to and from the Kernel 847
Sharing an Internet Connection Using NAT 848
Connecting Several Clients to a Single Internet Connection 850
Connecting Several Servers to a Single Internet Connection 852
Chapter Summary 852
Exercises 853
Advanced Exercises 853

CHAPTER 26: APACHE: SETTING UP A WEB SERVER 855
Introduction 856
More Information 857
Notes 857

000.book Page xxxi Thursday, November 20, 2008 10:55 AM

Running a Web Server (Apache) 858
Prerequisites 858
JumpStart: Getting Apache Up and Running 859
Configuring Apache 861
Configuration Directives 865
Directives I: Directives You May Want to Modify as You Get Started 866
Contexts and Containers 871
Directives II: Advanced Directives 875
Configuration Files 888
The Ubuntu **apache2.conf** File 888
The Ubuntu **default** Configuration File 890
Advanced Configuration 891
Redirects 891
Content Negotiation 891
Server-Generated Directory Listings (Indexing) 893
Virtual Hosts 893
Troubleshooting 896
Modules 897
mod_cgi and CGI Scripts 898
mod_ssl 899
Authentication Modules and **.htaccess** 901
Scripting Modules 902
Multiprocessing Modules (MPMs) 903
webalizer: Analyzes Web Traffic 904
MRTG: Monitors Traffic Loads 904
Error Codes 904
Chapter Summary 905
Exercises 906
Advanced Exercises 906

PART VI PROGRAMMING TOOLS 907

CHAPTER 27: PROGRAMMING THE BOURNE AGAIN SHELL 909

Control Structures 910
if...then 910
if...then...else 914
if...then...elif 917
for...in 923
for 924
while 926
until 930
break and **continue** 932
case 933
select 939
Here Document 941

000.book Page xxxii Thursday, November 20, 2008 10:55 AM

File Descriptors 943
Parameters and Variables 946
Array Variables 946
Locality of Variables 948
Special Parameters 950
Positional Parameters 952
Expanding Null and Unset Variables 957
Builtin Commands 958
type: Displays Information About a Command 959
read: Accepts User Input 959
exec: Executes a Command or Redirects File Descriptors 962
trap: Catches a Signal 965
kill: Aborts a Process 968
getopts: Parses Options 968
A Partial List of Builtins 971
Expressions 972
Arithmetic Evaluation 972
Logical Evaluation (Conditional Expressions) 973
String Pattern Matching 974
Operators 975
Shell Programs 980
A Recursive Shell Script 981
The **quiz** Shell Script 984
Chapter Summary 990
Exercises 992
Advanced Exercises 994

CHAPTER 28: PERL 997
Introduction to Perl 998
More Information 998
Terminology 1000
Running a Perl Program 1001
Syntax 1003
Perl Help 1004
Variables 1004
Scalar Variables 1006
Array Variables 1007
Hash Variables 1010
Control Structures 1011
if/unless 1012
if...else 1014
if...elsif...else 1014
foreach/for 1015
while/until 1018
last and **next** 1019
Working with Files 1020

000.book Page xxxiii Thursday, November 20, 2008 10:55 AM

Sort 1023
Subroutines 1025
Regular Expressions 1027
    Syntax and the =~ Operator 1027
CPAN Modules 1033
Examples 1035
Chapter Summary 1038
Exercises 1039
Advanced Exercises 1039

PART VII APPENDIXES 1041

APPENDIX A: REGULAR EXPRESSIONS 1043

Characters 1044
Delimiters 1044
Simple Strings 1044
Special Characters 1044
    Periods 1045
    Brackets 1045
    Asterisks 1046
    Carets and Dollar Signs 1046
    Quoting Special Characters 1047
Rules 1047
    Longest Match Possible 1047
    Empty Regular Expressions 1048
Bracketing Expressions 1048
The Replacement String 1048
    Ampersand 1049
    Quoted Digit 1049
Extended Regular Expressions 1049
Appendix Summary 1051

APPENDIX B: HELP 1053

Solving a Problem 1054
Finding Linux-Related Information 1055
    Documentation 1055
    Useful Linux Sites 1056
    Linux Newsgroups 1057
    Mailing Lists 1057
    Words 1058
    Software 1058
    Office Suites and Word Processors 1060
Specifying a Terminal 1060

000.book Page xxxiv Thursday, November 20, 2008 10:55 AM

APPENDIX C: SECURITY 1063

Encryption 1064
- Public Key Encryption 1065
- Symmetric Key Encryption 1066
- Encryption Implementation 1067
- GnuPG/PGP 1067

File Security 1069

Email Security 1069
- MTAs (Mail Transfer Agents) 1069
- MUAs (Mail User Agents) 1070

Network Security 1070
- Network Security Solutions 1071
- Network Security Guidelines 1071

Host Security 1073
- Login Security 1074
- Remote Access Security 1075
- Viruses and Worms 1076
- Physical Security 1076

Security Resources 1078

Appendix Summary 1081

APPENDIX D: THE FREE SOFTWARE DEFINITION 1083

APPENDIX E: THE LINUX 2.6 KERNEL 1087

Native Posix Thread Library (NPTL) 1088
IPSecurity (IPSec) 1088
Asynchronous I/O (AIO) 1088
O(1) Scheduler 1089
OProfile 1089
kksymoops 1089
Reverse Map Virtual Memory (rmap VM) 1089
HugeTLBFS: Translation Look-Aside Buffer Filesystem 1090
remap_file_pages 1090
2.6 Network Stack Features (IGMPv3, IPv6, and Others) 1090
Internet Protocol Virtual Server (IPVS) 1091
Access Control Lists (ACLs) 1091
4GB-4GB Memory Split: Physical Address Extension (PAE) 1091
Scheduler Support for HyperThreaded CPUs 1091
Block I/O (BIO) Block Layer 1091
Support for Filesystems Larger Than 2 Terabytes 1092
New I/O Elevators 1092
Interactive Scheduler Response Tuning 1092

000.book Page xxxv Thursday, November 20, 2008 10:55 AM

GLOSSARY 1093
JUMPSTART INDEX 1143
FILE TREE INDEX 1145
UTILITY INDEX 1149
MAIN INDEX 1155

000.book Page xxxvi Thursday, November 20, 2008 10:55 AM