

# Beginning the Linux Command Line



Sander van Vugt

## **Beginning the Linux Command Line**

**Copyright © 2009 by Sander van Vugt**

All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system, without the prior written permission of the copyright owner and the publisher.

ISBN-13 (pbk): 978-1-4302-1889-0

ISBN-13 (electronic): 978-1-4302-1890-6

Printed and bound in the United States of America 9 8 7 6 5 4 3 2 1

Trademarked names may appear in this book. Rather than use a trademark symbol with every occurrence of a trademarked name, we use the names only in an editorial fashion and to the benefit of the trademark owner, with no intention of infringement of the trademark.

Lead Editor: Michelle Lowman

Technical Reviewer: Mary Ann C. Tan

Editorial Board: Clay Andres, Steve Anglin, Mark Beckner, Ewan Buckingham, Tony Campbell,

Gary Cornell, Jonathan Gennick, Michelle Lowman, Matthew Moodie, Jeffrey Pepper,

Frank Pohlmann, Ben Renow-Clarke, Dominic Shakeshaft, Matt Wade, Tom Welsh

Project Manager: Beth Christmas

Copy Editor: Ami Knox

Associate Production Director: Kari Brooks-Copony

Production Editor: Elizabeth Berry

Compositor: Linda Weidemann, Wolf Creek Publishing Services

Proofreader: Nancy Sixsmith

Indexer: Brenda Miller, Odessa&Cie

Artist: April Milne

Cover Designer: Kurt Krames

Manufacturing Director: Tom Debolski

Distributed to the book trade worldwide by Springer-Verlag New York, Inc., 233 Spring Street, 6th Floor, New York, NY 10013. Phone 1-800-SPRINGER, fax 201-348-4505, e-mail [orders-ny@springer-sbm.com](mailto:orders-ny@springer-sbm.com), or visit <http://www.springeronline.com>.

For information on translations, please contact Apress directly at 2855 Telegraph Avenue, Suite 600, Berkeley, CA 94705. Phone 510-549-5930, fax 510-549-5939, e-mail [info@apress.com](mailto:info@apress.com), or visit <http://www.apress.com>.

Apress and friends of ED books may be purchased in bulk for academic, corporate, or promotional use. eBook versions and licenses are also available for most titles. For more information, reference our Special Bulk Sales—eBook Licensing web page at <http://www.apress.com/info/bulksales>.

The information in this book is distributed on an “as is” basis, without warranty. Although every precaution has been taken in the preparation of this work, neither the author(s) nor Apress shall have any liability to any person or entity with respect to any loss or damage caused or alleged to be caused directly or indirectly by the information contained in this work.

# Contents

About the Author.....	xiii
About the Technical Reviewer .....	xv
Introduction .....	xvii
<b>CHAPTER 1    Starting Linux Command-Line Administration.....</b>	<b>1</b>
Linux Distributions.....	1
Linux History .....	1
Open Source .....	2
The First Distributions .....	2
Linux Turning Mainstream .....	2
Logging In and Out .....	4
Different Login Interfaces.....	5
Working with a User Account.....	7
Command-Line Basics .....	8
The Command Interpreter .....	9
Commands, Options, and Arguments.....	9
Piping and Redirection .....	12
Piping.....	12
Redirection .....	14
Getting Help .....	16
Using man to Get Help.....	16
Using the --help Option.....	19
Getting Information on Installed Packages .....	20
Working with the Shell .....	20
Using the Shell to Best Effect.....	21
Managing Bash with Key Sequences .....	25
Summary.....	26

<b>CHAPTER 2</b>	<b>Performing Essential Command-Line Tasks</b>	27
	Changing Your Password	27
	Working with Virtual Consoles	28
	Becoming Another User	29
	Obtaining Information About Other Users	30
	Communicating with Other Users	31
	Real-Time Communication	31
	Sending Mail from the Command Line	33
	Finding Your Way in the File System	35
	Default Directories	35
	Working with the Linux File System	38
	Working with Directories	38
	Working with Files	39
	Cool Commands	43
	Displaying a Calendar with <code>cal</code>	44
	Clearing Your Screen with <code>clear</code>	44
	Displaying System Information with <code>uname</code> and <code>hostname</code>	44
	Counting Words, Lines, and Characters with <code>wc</code>	45
	Changing and Showing Date and Time with <code>date</code>	45
	Summary	45
<b>CHAPTER 3</b>	<b>Administering the Linux File System</b>	47
	Mounting Disks	47
	Using the <code>mount</code> Command	47
	Unmounting Devices	52
	Automating Mounts with <code>/etc/fstab</code>	53
	Checking File System Integrity	56
	Creating Backups	57
	Making File Backups with <code>tar</code>	57
	Making Device Backups Using <code>dd</code>	62
	Working with Links	63
	Why Use Links?	64
	Working with Symbolic Links	64
	Working with Hard Links	67
	Links Recap	67
	Summary	68

<b>CHAPTER 4</b>	<b>Working with Text Files</b>	69
	Working with Vi	69
	Vi Modes	70
	Saving and Quitting	71
	Cutting, Copying, and Pasting	72
	Deleting Text	72
	Moving Through Text Files	72
	Changing All Occurrences of a String in a Text File	73
	Vi Summarized	73
	Displaying Contents of Text Files	74
	Showing File Contents with cat and tac	74
	Showing a File's Last Lines with tail	75
	Displaying the First Lines in a File with head	76
	Browsing File Contents with less and more	76
	Cool Text File Manipulation Tools	77
	Changing Contents in a Batch with tr	77
	Sorting Text Files with sort	78
	Finding Differences Between Text Files with diff	78
	Checking Whether a Line Exists Twice with uniq	79
	Getting Specific Information with cut	80
	Advanced Text File Filtering and Processing	81
	Working with Basic Regular Expressions	81
	Working with Programmable Filters	84
	Printing Files	87
	Managing CUPS Print Queues	87
	Finding Files	88
	Summary	90
<b>CHAPTER 5</b>	<b>Managing Partitions and Logical Volumes</b>	91
	Addressing Storage Devices	91
	File System Labels	91
	udev Device Names	92
	Creating Partitions	93
	Understanding Partitions	94
	Managing Partitions with fdisk	95
	Working with cfdisk	103
	Recovering Lost Partitions with gpart	104

Creating Logical Volumes . . . . .	106
Understanding Logical Volumes . . . . .	106
Setting Up a Disk with Logical Volume Manager . . . . .	107
Working with Snapshots . . . . .	112
Basic LVM Troubleshooting . . . . .	113
Working with File Systems . . . . .	116
Understanding File Systems . . . . .	117
Formatting File Systems . . . . .	122
Maintaining File Systems . . . . .	122
Resizing File Systems . . . . .	127
Working with Windows File Systems . . . . .	129
Cloning Devices . . . . .	129
Summary . . . . .	130

## **CHAPTER 6     Managing Users and Groups . . . . . 133**

Setting Up User Accounts . . . . .	133
Understanding Users and Their Properties . . . . .	133
Commands for User Management . . . . .	135
Working with Default Values for User Management . . . . .	137
Managing Passwords . . . . .	139
Performing Account Maintenance with passwd . . . . .	139
Managing Password Expiration . . . . .	140
Behind the Commands: Configuration Files . . . . .	140
Group Membership . . . . .	143
Creating Groups . . . . .	143
The Use of Group Passwords . . . . .	145
Managing the User's Shell Environment . . . . .	145
Creating Shell Login Scripts . . . . .	145
Showing Messages to Users Logging In . . . . .	146
Applying Quota to Allow a Maximum Amount of Files . . . . .	146
Installing the Quota Software . . . . .	147
Preparing the File System for Quota . . . . .	147
Initializing Quota . . . . .	148
Setting Quota for Users and Groups . . . . .	149

Techniques Behind Authentication .....	151
Understanding Pluggable Authentication Modules .....	151
Discovering PAM Modules .....	153
The role of <code>/etc/nsswitch.conf</code> .....	156
Configuring Administrator Tasks with <code>sudo</code> .....	158
Summary .....	160

## CHAPTER 7 Managing Permissions .....

Setting Ownership .....	163
Displaying Ownership .....	163
Changing User Ownership .....	164
Changing Group Ownership .....	164
Default Ownership .....	165
Basic Permissions: Read, Write, and Execute .....	166
Understanding Read, Write, and Execute Permissions .....	166
Applying Read, Write, and Execute Permissions .....	167
Advanced Permissions .....	168
Understanding Advanced Permissions .....	168
Applying Advanced Permissions .....	170
Working with Access Control Lists .....	171
Understanding ACLs .....	171
Preparing Your File System for ACLs .....	172
Changing and Viewing ACL Settings with <code>setfacl</code> and <code>getfacl</code> ....	172
Setting Default Permissions .....	175
Working with Attributes .....	176
Summary .....	178

## CHAPTER 8 Managing Software .....

Understanding Software Management .....	179
Managing RPM Packages .....	180
Working with RPM .....	180
Working with <code>yum</code> .....	181
Working with <code>zypper</code> .....	186
Managing DEB Packages .....	188
Managing <code>.deb</code> Software Repositories .....	188
Ubuntu Package Management Utilities .....	190
Summary .....	196

<b>CHAPTER 9</b>	<b>Process and System Management</b>	197
	Understanding Linux Processes	197
	Monitoring Processes	199
	Monitoring Processes with top	199
	Finding Processes with ps	204
	Finding PIDs with pgrep	207
	Showing Parent-Child Relations with pstree	207
	Displaying Memory Usage with free	210
	Managing Processes	210
	Killing Processes with kill, pkill, and killall	210
	Adjusting Process Priority with nice	212
	Process Management from top	213
	Scheduling Processes	213
	Summary	215
<b>CHAPTER 10</b>	<b>System Logging</b>	217
	Understanding Logging	217
	Monitoring Log Files	219
	Configuring the syslog Service	220
	Passing Startup Parameters to syslog and syslog-ng	224
	Configuring syslog-ng	226
	Sending Logs Yourself with logger	232
	Rotating Old Log Files	232
	Summary	235
<b>CHAPTER 11</b>	<b>Configuring the Network</b>	237
	A Quick Introduction to Computer Networking	237
	Setting the IP Address	238
	Using ifconfig	238
	Using the ip Tool	242
	Storing Address Configuration	245
	Storing IP Address Configuration on Ubuntu	245
	Storing IP Address Configuration on Fedora	246
	Storing IP Address Configuration on SUSE	248
	Configuring Routing	249
	Managing the Default Route with route	249
	Managing the Default Route with the ip Tool	250
	Storing Routing Information	250



Resolving DNS Names to IP Addresses .....	251
The Role of the <code>/etc/nsswitch.conf</code> File .....	251
Using the <code>/etc/hosts</code> File .....	252
Tuning the Network Card with <code>ethtool</code> .....	253
Analyzing Network Connections .....	255
Testing Connectivity .....	255
Testing Routing .....	257
Testing Availability of Services .....	258
Connecting Remotely with Secure Shell .....	262
Working with Public/Private Key Pairs .....	263
Working with Secure Shell .....	264
Configuring SSH .....	266
Using SSH Key-Based Authentication .....	268
Caching Keys with <code>ssh-agent</code> .....	271
Tunneling Traffic with SSH .....	272
Summary .....	274

## CHAPTER 12    **Configuring a File Server** .....

Creating a Samba File Server .....	277
Background of the Samba Project .....	277
Configuring a Samba File Server .....	277
Accessing a Samba File Server .....	286
Basic Samba Troubleshooting .....	289
Configuring an NFS Server .....	291
NFS Backgrounds .....	291
Understanding NFS Processes .....	291
Configuring an NFS Server .....	293
Configuring an NFS Client .....	295
Summary .....	297

## CHAPTER 13    **Working with the Kernel** .....

Understanding the Kernel .....	299
Managing Kernel Modules .....	300
Listing Modules with <code>lsmod</code> .....	300
Loading and Unloading Modules with <code>modprobe</code> .....	301
Displaying Module Properties with <code>modinfo</code> .....	301
Changing Module Options .....	302
Managing Module Dependencies .....	303
Legacy Commands for Module Management .....	303

Tuning Kernel Parameters . . . . .	303
Writing Changes to /proc . . . . .	304
Some Useful /proc Parameters . . . . .	306
Compiling Your Own Kernel and Kernel Modules. . . . .	307
Understanding Make . . . . .	307
Modifying and Compiling the Kernel. . . . .	308
Compiling Modules . . . . .	311
Managing the GRUB Boot Loader . . . . .	312
The GRUB Configuration File . . . . .	313
Working with the GRUB Boot Menu . . . . .	315
Summary. . . . .	317
 <b>CHAPTER 14 Introduction to Bash Shell Scripting</b> . . . . .	 319
Basic Shell Script Components . . . . .	319
Elements of a Good Shell Script . . . . .	319
Executing the Script. . . . .	321
Working with Variables and Input. . . . .	322
Understanding Variables. . . . .	323
Variables, Subshells, and Sourcing. . . . .	324
Working with Script Arguments. . . . .	326
Asking for Input . . . . .	329
Using Command Substitution. . . . .	331
Substitution Operators. . . . .	331
Changing Variable Content with Pattern Matching. . . . .	334
Performing Calculations . . . . .	336
Using Control Structures. . . . .	339
Using if ... then ... else . . . . .	340
Case . . . . .	344
Using while . . . . .	345
Using until . . . . .	346
Using for . . . . .	347
Summary. . . . .	350
 <b>APPENDIX Installing Linux</b> . . . . .	 353
 <b>INDEX</b> . . . . .	 361