This book is used as the adopted text in many college classes. Because students who take these classes often seek LPI or CompTIA certification, instructors have asked for a mapping of certification objectives to the material covered in this book. This book fully covers LPI’s Linux Essentials certification learning goals and provides extensive coverage of CompTIA’s Linux+ exam objectives. This appendix maps these learning goals and exam objectives to pages in this book. The following icons are used throughout the book to mark the places where learning goals and exam objectives are discussed.

**LE** This icon indicates coverage of a topic in the LPI’s Linux Essentials certification learning goals.

**LPI** This icon indicates coverage of a topic in the CompTIA’s Linux+ exam objectives.

**LE+** This icon indicates coverage of a topic in the CompTIA’s Linux+ exam objectives and a topic in the LPI’s Linux Essentials certification learning goals.
MORE INFORMATION
LPI Linux Essentials: www.lpi.org/linux-certifications/introductory-programs/linux-essentials
LPI Certification Exams: www.lpi.org/linux-certifications/programs/lpic-1
CompTIA Exams: certification.comptia.org/getCertified/certifications/linux.aspx
CompTIA and LPI partnership: www.lpi.org/linux-certifications/partnership-programs/comptia

TOPIC 1: THE LINUX COMMUNITY AND A CAREER IN OPEN SOURCE
1.1 LINUX EVOLUTION AND POPULAR OPERATING SYSTEMS
DESCRIPTION: KNOWLEDGE OF LINUX DEVELOPMENT AND MAJOR DISTRIBUTIONS

Key Knowledge Areas
Open Source Philosophy
  ▶ Open-Source Software and Licensing page 6
Distributions
  ▶ Distribution page 6
Embedded Systems
  ▶ Embedded and mobile Linux page 6

Partial List of Used Files, Terms, and Utilities
Android
  ▶ Embedded and mobile Linux page 6
Debian
  ▶ Distribution page 6
CentOS
  ▶ CentOS page 33

1.2 MAJOR OPEN SOURCE APPLICATIONS
DESCRIPTION: AWARENESS OF MAJOR APPLICATIONS AND THEIR USES

Key Knowledge Areas
Desktop Applications
  ▶ Desktop applications page 1151
Server Applications
  ▶ DHCP: Configures Network Interfaces page 491
  ▶ Chapter 13: Printing with CUPS page 555
  ▶ Chapter 18: OpenSSH: Secure Network Communication page 685
  ▶ Chapter 19: FTP: Transferring Files Across a Network page 713
  ▶ Chapter 20: sendmail: Setting Up Mail Servers, Clients, and More page 739
  ▶ Chapter 21: NIS and LDAP page 769
  ▶ Chapter 22: NFS: Sharing Directory Hierarchies page 801
Mobile Applications
- Embedded and mobile Linux page 6

Development Languages
- Chapter 27: Programming the Bourne Again Shell (bash) page 981
- Chapter 28: The Python Programming Language page 1081
- Chapter 29: The MariaDB SQL Database Management System page 1113

Package Management Tools and repositories
- Chapter 12: Finding, Downloading, and Installing Software page 531
- Appendix D: Keeping the System Up-to-Date Using apt-get page 1183

Partial List of Used Files, Terms, and Utilities
- OpenOffice.org, LibreOffice, Thunderbird, Firefox, Blender, Gimp, Audacity, ImageMagick
- Desktop applications page 1151
- Apache, MySQL, PostgreSQL
- Chapter 26: Apache (httpd): Setting Up a Web Server page 931
- Chapter 29: The MariaDB SQL Database Management System page 1113
- Programming languages page 1152
- NFS, Samba, OpenLDAP, Postfix, DNS, DHCP
- Chapter 22: NFS: Sharing Directory Hierarchies page 801
- Chapter 23: Samba: Linux and Windows File and Printer Sharing page 827
- LDAP page 786
- Postfix page 742
- Chapter 24: DNS/BIND: Tracking Domain Names and Addresses page 851
- DHCP: Configures Network Interfaces page 491
- C, Perl, shell, Python, PHP
- Chapter 27: Programming the Bourne Again Shell (bash) page 981
- Chapter 28: The Python Programming Language page 1081
- Programming languages page 1152

1.3 Understanding Open Source Software and Licensing

Description: Open communities and licensing Open Source Software for business

Key Knowledge Areas
- Licensing
  - Open-Source Software and Licensing page 6
- Free Software Foundation (FSF), Open Source Initiative (OSI)
  - GNU Project page 3
  - Linux Is More than a Kernel page 6
  - FOSS/FLOSS page 7
  - GNOME and KDE page 17
Partial List of Used Files, Terms, and Utilities
GPL, BSD, Creative Commons
  ▪ GPL page 5
  ▪ Berkeley UNIX (BSD) page 3
  ▪ Creative Commons page 1245 (Glossary)
Free Software, Open Source Software, FOSS, FLOSS
  ▪ FOSS/FLOSS page 7
Open Source business models
  ▪ Making money page 7

1.4 ICT Skills and Working in Linux
Description: Basic Information and Communication Technology (ICT) skills and working in Linux

Key Knowledge Areas
Desktop Skills
  ▪ Chapter 4: Introduction to Fedora and Red Hat Enterprise Linux page 89
Getting to the Command Line
  ▪ Working from the Command Line page 119
  ▪ Chapter 7: The Linux Utilities page 215
Industry uses of Linux, Cloud Computing, and Virtualization
  ▪ Chapter 17: Setting Up Virtual Machines Locally and in the Cloud page 659

Partial List of Used Files, Terms, and Utilities
Using a browser, privacy concerns, configuration options, searching the Web, and saving content
  ▪ Opera: www.opera.com
Terminal and Console
  ▪ Using a Virtual Console page 121
Password issues
  ▪ Users: Changing Your Account Type and Password (GUI) page 112
  ▪ Password Security page 136
  ▪ passwd: Changing Your Password (CLI) page 137
  ▪ Passwords page 625
Privacy issues and tools
  ▪ Search the Web for browser privacy
    ▪ lifehacker.com/the-best-browser-extensions-that-protect-your-privacy-479408034
Use of common open-source applications in presentations and projects
  ▪ Desktop Applications page 1151
**TOPIC 2: FINDING YOUR WAY ON A LINUX SYSTEM**

**2.1 COMMAND LINE BASICS**

**DESCRIPTION: BASICS OF USING THE LINUX COMMAND LINE**

**Key Knowledge Areas**

- Basic shell
  - Working from the Command Line page 119
  - Chapter 5: The Shell page 141

- Formatting commands
  - The Command Line page 144

- Working with Options
  - Options page 145

- Variables
  - Parameters and Variables page 352
  - Variables page 1031

- Globbing
  - Filename Generation/Pathname Expansion page 165
  - Pathname Expansion page 412

- Quoting
  - Special Characters page 142
  - Quoting the $ page 354
  - Quotation marks page 412

**Partial List of Used Files, Terms, and Utilities**

- **echo**
  - echo: Displays Arguments page 219
  - echo –e page 1009

- **history**
  - History page 376

- **PATH** env variable
  - Set PATH in .bash_profile page 331
  - PATH: Where the Shell Looks for Programs page 359

- **which**
  - which page 255

**Nice to Know**

- **Substitutions**
  - Command Substitution page 410
  - ||, &, , and ; control operators
    - Lists page 162
    - ; and NEWLINE Separate Commands page 341
    - & & and || Boolean Control Operators page 343
2.2 Using the Command Line to Get Help

Description: Running Help commands and navigation of the various Help systems

Key Knowledge Areas

- **man**
  - man: Displays the System Manual page 128

- **info**
  - info: Displays Information About Utilities page 131

Partial List of Used Files, Terms, and Utilities

- **man**
  - man: Displays the System Manual page 128

- **info**
  - info: Displays Information About Utilities page 131

- **man pages**
  - man: Displays the System Manual page 128

- **/usr/share/doc**
  - /usr/share/doc page 134

- **locate**
  - locate: Searches for a File page 256

Nice to Know

- **apropos**, **whatis**, **whereis**
  - apropos: Searches for a Keyword page 130
  - whatis page 130
  - whereis page 255

2.3 Using Directories and Listing Files

Description: Navigation of home and system directories and listing files in various locations

Key Knowledge Areas

- **Files, directories**
  - Ordinary Files and Directory Files page 177

- **Hidden files and directories**
  - Hidden Filenames page 180

- **Home**
  - Your Home Directory page 143

- **Absolute and relative paths**
  - Absolute Pathnames page 181
  - Relative Pathnames page 182

Partial List of Used Files, Terms, and Utilities

Common options for **ls**

- Options page 221
Recursive listings
  ▶ Recursive page 222

`cd`
  ▶ `cd`: Changes to Another Working Directory page 185

. and ..
  ▶ The . and .. Directory Entries page 186

**home** and `~`
  ▶ Your Home Directory page 143
  ▶ `~` (Tilde) in Pathnames page 182
  ▶ Tilde (~) page 359
  ▶ Tilde Expansion page 407

### 2.4 Creating, Moving, and Deleting Files

**Description:** Create, move, and delete files and directories under the home directory

#### Key Knowledge Areas

**Files and directories**
  ▶ Ordinary Files and Directory Files page 177

**Case sensitivity**
  ▶ Case sensitivity page 179

**Simple globbing and quoting**
  ▶ Filename Generation/Pathname Expansion page 165
  ▶ Pathname Expansion page 412
  ▶ Special Characters page 166
  ▶ Quoting the `$` page 394
  ▶ Quotation marks page 452

#### Partial List of Used Files, Terms, and Utilities

**mv, cp, rm, touch**
  ▶ `mv`: Moves a Directory page 188
  ▶ `mv`: Renames or Moves a File page 237
  ▶ `mv, cp`: Move or Copy Files page 187
  ▶ `cp`: Copies Files page 224
  ▶ `rm`: Removes a Link page 208
  ▶ `rm`: Removes a File (Deletes a Link) page 222
  ▶ `touch`: Changes File Modification and Access Times page 243

**mkdir, rmdir**
  ▶ `mkdir`: Creates a Directory page 184
  ▶ `rmdir`: Deletes a Directory page 186
# Topic 3: The Power of the Command Line

## 3.1 Archiving Files on the Command Line

### Description: Archiving files in the user home directory

**Key Knowledge Areas**
- Files, directories
  - Ordinary Files and Directory Files page 177
- Archives, compression
  - Compressing and Archiving Files page 245

**Partial List of Used Files, Terms, and Utilities**

<table>
<thead>
<tr>
<th>Utility</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>tar</code></td>
<td>Stores or Extracts Files to/from an Archive File page 249</td>
</tr>
<tr>
<td><code>tar</code></td>
<td>Archives Files page 603</td>
</tr>
<tr>
<td><code>gzip</code>, <code>bzip2</code></td>
<td>Compress and Decompress Files page 245</td>
</tr>
<tr>
<td><code>zip</code>, <code>unzip</code></td>
<td></td>
</tr>
<tr>
<td><code>find</code></td>
<td>Finds Files Based on Criteria page 229</td>
</tr>
<tr>
<td><code>grep</code></td>
<td>Searches for a Pattern in Files page 232</td>
</tr>
<tr>
<td><code>less</code></td>
<td>less Is more: Display a Text File One Screen at a Time page 220</td>
</tr>
</tbody>
</table>

### Common `tar` options
- Options page 249
- Modifiers page 251

### Nice to Know
- Extracting individual files from archives
  - Extract page 250

## 3.2 Searching and Extracting Data from Files

### Description: Search and extract data from files in the home directory

**Key Knowledge Areas**
- Command line pipes
  - Pipelines page 158
- I/O redirection
  - Redirection page 153
- Partial POSIX Regular Expressions (``, `[`, `]`, `.*`, `?`)
  - Appendix A: Regular Expressions page 1139

**Partial List of Used Files, Terms, and Utilities**

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<td>less Is more: Display a Text File One Screen at a Time page 220</td>
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</tbody>
</table>
head, tail
   - head: Displays the Beginning of a File page 235
   - tail: Displays the Last Part of a File page 241
sort
   - sort: Sorts and/or Merges Files page 239
cut
   - cut: Selects Characters or Fields from Input Lines page 225
wc
   - wc: Displays the Number of Lines, Words, and Bytes in Files page 244

Nice to Know
Partial POSIX Basic Regular Expressions ([^ ]), (^, $)
   - Appendix A: Regular Expressions page 1139
Partial POSIX Extended Regular Expressions (+, ( ), |)
   - Appendix A: Regular Expressions page 1139
xargs
   - xargs: Converts Standard Input to Command Lines page 260

3.3 Turning Commands into a Script
Description: Turning repetitive commands into simple scripts

Key Knowledge Areas
Basic text editing
   - Tutorial: Using vim to Create and Edit a File page 262
   - Tutorial: Using nano to Create and Edit a File page 270
Basic shell scripting
   - Writing and Executing a Basic Shell Script page 127

Partial List of Used Files, Terms, and Utilities
/bin/sh
   - sh Shell page 328
Variables
   - Parameters and Variables page 352
   - Variables page 1031
Arguments
   - Arguments page 145
for loops
   - for...in page 995
   - for page 997
echo
   - echo: Displays Arguments page 219
     - echo -e page 1009
Exit status
   - $? : Exit Status page 1029
Nice to Know
pico, nano, vi (only basics for creating scripts)
  ‣ pico, see Desktop applications page 1151
  ‣ Tutorial: Using vim to Create and Edit a File page 262
  ‣ Tutorial: Using nano to Create and Edit a File page 270
bash
  ‣ Chapter 5: The Shell page 141
  ‣ Chapter 9: The Bourne Again Shell (bash) page 327
  ‣ Chapter 27: Programming the Bourne Again Shell (bash) page 981
if, while, case statements
  ‣ if...then page 983
  ‣ if...then...else page 987
  ‣ if...then...elif page 989
  ‣ for...in page 995
read and test, and [] commands
  ‣ read: Accepts User Input page 1041
  ‣ test builtin page 983
  ‣ [] is a synonym for test page 986
  ‣ test builtin page 1000

Topic 4: The Linux Operating System
4.1 Choosing an Operating System
Description: Knowledge of major operating systems and Linux distributions
Key Knowledge Areas
Windows, Mac, Linux differences
  ‣ Choosing an Operating System page 19
Distribution life cycle management
  ‣ Fedora, RHEL, and CentOS page 33
Partial List of Used Files, Terms, and Utilities
GUI versus command line, desktop configuration
  ‣ Choosing an Operating System page 19
Maintenance cycles, Beta and Stable
  ‣ beta release page 1239 (Glossary)
  ‣ stable release page 1274 (Glossary)
4.2 Understanding Computer Hardware
Description: Familiarity with the components that go into building desktop and server computers
Key Knowledge Areas
Hardware
  ‣ Requirements page 30
Partial List of Used Files, Terms, and Utilities
Hard drives and partitions, motherboards, processors, power supplies, optical drives, peripherals
- Setting Up the Hard Disk page 36
- motherboard page 1261 (Glossary)
- Processor Architecture page 31
- power supply page 1267 (Glossary)
- optical drive page 1264 (Glossary)
- Peripheral, see device page 1246 (Glossary)

Display types
- Interfaces: Installer and Installed System page 32
- Working from the Command Line page 119
- ASCII terminal page 1237 (Glossary)
- graphical display page 1251 (Glossary)

Drivers
- Device files page 515
- Block and Character Devices page 518
- device driver page 1246 (Glossary)

4.3 Where Data Is Stored
Description: Where various types of information are stored on a Linux system

Key Knowledge Areas
Kernel
- Chapter 14: Building a Linux Kernel page 579
- kernel page 1257 (Glossary)

Processes
- Process page 150
- Processes page 373
- ps page 466
- process page 1267 (Glossary)

syslog, klog, dmesg
- rsyslogd: Logs System Messages page 620
- klogd: deprecated; www.linuxjournal.com/article/4058
- dmesg: Displays Kernel Messages page 595

/lib, /usr/lib, /etc, /var/log
- /lib page 190
- /lib64 page 190
- /usr/lib page 190
- /usr/lib64 page 191
- /etc page 190
- /etc page 506
- /var/log page 191
- /var/log page 514
- Log Files and Mail for root page 626
Partial List of Used Files, Terms, and Utilities
Programs, libraries, packages and package databases, system configuration

- /lib page 190
- /lib64 page 190
- /usr/lib page 190
- /usr/lib64 page 191
- /usr/bin page 190
- /usr/sbin page 190
- /etc page 190
- /etc page 506
- library page 1258 (Glossary)
- Software package page 532
- PM S page 532
- Software package formats page 532
- Repositories page 533

Processes and process tables, memory addresses, system messaging, and logging

- Process page 150
- Processes page 373
- ps page 466
- dmesg: Displays Kernel Messages page 595
- rsyslogd: Logs System Messages page 620
- D-BUS page 898
- process page 1267 (Glossary)

ps, top, free

- Process Identification page 374
- ps page 466
- top: Lists Processes Using the Most Resources page 612
- free: Displays Memory Usage Information page 253

4.4 Your Computer on the Network
Description: Querying vital networking settings and determining the basic requirements for a computer on a Local Area Network (LAN)

Key Knowledge Areas
Internet, network, routers
- Internet page 280
- Introduction to Networking page 280
- Internetworking Through Gateways and Routers page 287

Domain Name Service
- Chapter 24: DNS/BIND: Tracking Domain Names and Addresses page 851

Network configuration
- Chapter 16: Configuring and Monitoring a LAN page 631

Partial List of Used Files, Terms, and Utilities
route

deprecated (route man page): see ip man page, route object instead
resolv.conf
- `/etc/resolv.conf` page 510

IPv4, IPv6
- IPv4 page 292
- IPv6 page 293

`ifconfig`
- deprecated: (`ifconfig` man page): see `ip` man page, `addr` and `link` objects instead

`netstat`
- `netstat`: see the `netstat` man page and wikipedia.org/wiki/netstat

`ping`
- `ping`: Tests a Network Connection page 305

**Nice to Know**

`ssh`
- `ssh`: Logs in or Executes Commands on a Remote System page 693

`dig`
- `host` and `dig`: Query Internet Nameservers page 307
- `dig` page 861
- `dig` page 862

**TOPIC 5: SECURITY AND FILE PERMISSIONS**

**5.1 BASIC SECURITY AND IDENTIFYING USER TYPES**

**DESCRIPTION: VARIOUS TYPES OF USERS ON A LINUX SYSTEM**

**Key Knowledge Areas**

**Root and Standard Users**
- Running Commands with `root` Privileges page 422
- The Special Powers of a Privileged User page 422
- Gaining `root` Privileges page 423
- Real UID Versus Effective UID page 425

**System users**
- `/etc/passwd` page 508

**Partial List of Used Files, Terms, and Utilities**

`/etc/passwd`, `/etc/group`
- `/etc/passwd` page 508
- `/etc/group` page 506

`id, who, w`
- `id` page 426
- `who`: Lists Users on the System page 254
- `who`, `whoami` page 426
- `w`: Lists Users on the System page 254

`sudo`
- Using `sudo` to Gain `root` Privileges page 428
Nice to Know

su
  ▶ Using su to Gain root Privileges page 425

5.2 Creating Users and Groups

Description: Creating users and groups on a Linux system

Key Knowledge Areas

User and group commands
  ▶ useradd: Adds a User Account page 600
  ▶ groupadd: Adds a Group page 601
  ▶ usermod: Modifies a User Account page 601
  ▶ userdel: Removes a User Account page 600
  ▶ groupdel and groupmod: Remove and Modify a Group page 601

User IDs
  ▶ Real UID Versus Effective UID page 425
  ▶ /etc/passwd page 508
  ▶ user ID page 1279 (Glossary)

Partial List of Used Files, Terms, and Utilities

/etc/passwd, /etc/shadow, /etc/group
  ▶ /etc/passwd page 508
  ▶ /etc/shadow page 511
  ▶ /etc/group page 506

id, last
  ▶ id page 426
  ▶ last: see the last man page

useradd, groupadd
  ▶ useradd: Adds a User Account page 600
  ▶ groupadd: Adds a Group page 601

passwd
  ▶ Users: Changing Your Account Type and Password (GUI) page 112
  ▶ passwd: Changing Your Password (CLI) page 137

Nice to Know

usermod, userdel
  ▶ usermod: Modifies a User Account page 601
  ▶ userdel: Removes a User Account page 600

groupmod, groupdel
  ▶ groupdel and groupmod: Remove and Modify a Group page 601

5.3 Managing File Permissions and Ownership

Description: Understanding and manipulating file permissions and ownership settings

Key Knowledge Areas

File/directory permissions and owners
  ▶ Access Permissions page 191
Partial List of Used Files, Terms, and Utilities

**ls -l**
- ls -l: Displays Permissions page 191

**chmod, chown**
- chmod: Changes File Access Permissions page 193
- chmod: Makes a File Executable page 337
- chown: Changes File Ownership page 195

**Nice to Know**

**chgrp**
- chgrp: Changes File Group Association page 195

5.4 Special Directories and Files

**Description:** Special directories and files on a Linux system including special permissions

**Key Knowledge Areas**

System files, libraries
- Important Standard Directories and Files page 189
- library page 1258 (Glossary)

Symbolic links
- Symbolic Links page 206
- Symbolic links page 515
- symbolic link page 1276 (Glossary)

**Partial List of Used Files, Terms, and Utilities**

**/etc, /var**
- /etc page 190
- /etc page 506
- /var page 41
- /var page 191

**/tmp, /var/tmp and Sticky Bit**
- /tmp page 190
- /var page 191
- Sticky bit page 196
- sticky bit page 1275 (Glossary)

**ls -d**
- Directory page 221

**ln -s**
- Size page 222

**Nice to Know**

**Hard links**
- Hard Links page 204

**Setuid/Setgid**
- Setuid and Setgid Permissions page 196
- Setuid file page 424
Appendix E  LPI and CompTIA Certification

- Setuid files page 626
- setuid page 1272 (Glossary)
- setgid page 1272 (Glossary)

Certification Exam 1
Objectives: LX0-101

101 System Architecture

101.1 Determine and Configure Hardware Settings

Enable and disable integrated peripherals
Configure systems with or without external peripherals such as keyboards
Differentiate between the various types of mass storage devices
  - /dev page 503
Set the correct hardware ID for different devices, especially the boot device
Know the differences between coldplug and hotplug devices
  - Hotplug page 516

Determine hardware resources for devices

Tools and utilities to list various hardware information (e.g., lsusb, lspci, etc.)
  - dmesg: Displays Kernel Messages page 595
  - lspci: Lists PCI Information page 635
  - lsblk: Lists Block Device Information page 635
  - lshw: Lists Hardware Information page 636
  - lsusb: Lists USB Devices page 636

Tools and utilities to manipulate USB devices
  - Writing to a USB Flash Drive page 50

Conceptual understanding of sysfs, udev, hald, dbus
  - udev page 516
  - D-BUS page 898

Partial List of Used Files, Terms, and Utilities

/sys
  - /sys page 190
  - /sys page 514
  - /sys page 516

/proc
  - /proc page 190
  - /proc page 512
  - proc page 520

/dev
  - Device file page 152
  - /dev page 190
101.2 Boot the System

Provide common commands to the boot loader and options to the kernel at boot time
- Modifying Boot Parameters (Options) page 70
- GRUB: The Linux Boot Loader page 590

Demonstrate knowledge of the boot sequence from BIOS to boot completion
- BIOS setup page 31
- CMOS page 31
- Booting the System page 450
- GRUB: The Linux Boot Loader page 590
- BIOS page 590
- BIOS page 1239 (Glossary)

Check boot events in the log file
- dmesg: Displays Kernel Messages page 595

Partial List of Used Files, Terms, and Utilities

/dev page 503
Device files page 515

modprobe
- modprobe page 589

lsmod
- lsmod page 589

lspci
- lspci: Lists PCI Information page 635

lsusb
- lsusb: Lists USB Devices page 636

BIOS
- BIOS setup page 31
- BIOS page 590
- BIOS page 1239 (Glossary)

boot loader
- GRUB: The Linux Boot Loader page 590

kernel
- Chapter 14: Building a Linux Kernel page 579
- kernel page 1257 (Glossary)

init
- init daemon page 374
Appendix E  LPI and CompTIA Certification

The **systemd init** Daemon page 438
- SysVinit (rc) Scripts: Start and Stop System Services page 448
- **systemd init** daemon page 450

101.3 Change Runlevels and Shutdown or Reboot System

Set the default runlevel
- Setting the Persistent Runlevel page 444
- `/etc/inittab` page 508

Change between runlevels including single-user mode
- Changing the Current Runlevel page 445
- `telinit` page 449
- Booting the System to Single-User/Rescue Mode page 450
- Going to Graphical Multiuser Mode page 452

Shutdown and reboot from the command line
- Bringing the System Down page 454

Alert users before switching runlevels or other major system events

Properly terminate processes
- `kill`: Aborting a Background Job page 164
- `kill`: Sends a Signal to a Process page 465
- `killall`: Kills a Command page 467
- `pkill`: Kills a Command page 468
- `kill`: Aborts a Process page 1050

Partial List of Used Files, Terms, and Utilities

`/etc/inittab`
- `/etc/inittab` page 508

`shutdown`
- Bringing the System Down page 454

`init`
- `init` daemon page 374
- The **systemd init** Daemon page 438
- SysVinit (rc) Scripts: Start and Stop System Services page 448
- **systemd init** daemon page 450

`/etc/init.d`
- SysVinit (rc) Scripts: Start and Stop System Services page 448

`telinit`
- `telinit` page 449

102 Linux Installation and Package Management

102.1 Design Hard Disk Layout

Allocate filesystems and swap space to separate partitions or disks
- Setting Up the Hard Disk page 36
Tailor the design to the intended use of the system
- Planning the Installation page 29

Ensure the /boot partition conforms to the hardware architecture requirements for booting
- Where to put the /boot partition page 41
- LBA addressing mode and the /boot partition page 590

Partial List of Used Files, Terms, and Utilities
/ (root) filesystem
- / (root) page 40
- / (root) page 181
- / page 189
- root filesystem page 1271 (Glossary)
/var filesystem
- /var page 41
- /var page 191
/home filesystem
- /home page 41
- /home page 190
swap space
- (swap) page 40
- swap page 513
- swap space page 1276 (Glossary)
mount points
- Mount Points page 38
- Mount point page 521
partitions
- Partitions page 36
- Partition table page 36
- Primary, Extended, and Logical Partitions page 37
- Default Partitioning page 39
- Example minimum partition sizes page 42
- Manual/Custom Partitioning page 74
- partition page 1265 (Glossary)

102.2 Install a Boot Manager
Providing alternative boot locations and backup boot options
Install and configure a boot loader such as GRUB
- GRUB: The Linux Boot Loader page 590
Interact with the boot loader
- Booting the System to Single-User/Rescue Mode page 450

Partial List of Used Files, Terms, and Utilities
/boot/grub/menu.lst
- Configuring GRUB page 591
grub-install
  • grub2-install: Installs the MBR and GRUB Files page 594

M BR
  • Reinstalling the MBR page 456
  • M BR page 590
  • grub2-install: Installs the MBR and GRUB Files page 594

superblock
  • superblock page 1276 (Glossary)

/etc/lilo.conf
lilo

102.3 MANAGE SHARED LIBRARIES

Identify shared libraries
  • ldd page 487

Identify the typical locations of system libraries

Load shared libraries

Partial List of Used Files, Terms, and Utilities

ldd
  • ldd & libwrap page 486
  • ldd page 487

ldconfig

/etc/ld.so.conf
LD_LIBRARY_PATH

102.4 USE DEBIAN PACKAGE MANAGEMENT

Install, upgrade, and uninstall Debian binary packages
  • Using apt-get to Install, Remove, and Update Packages page 1184

Find packages containing specific files or libraries which may or may not be installed

Obtain package information like version, content, dependencies, package integrity, and installation status (whether or not the package is installed)

Partial List of Used Files, Terms, and Utilities

/etc/apt/sources.list
  • sources.list: Specifies Repositories for apt-get to Search page 1187

dpkg
  • apt-get and dpkg page 1184

dpkg-reconfigure

apt-get
  • Using apt-get to Install, Remove, and Update Packages page 1184
  • Using apt-get to Upgrade the System page 1185
  • Other apt-get Commands page 1186
apt-cache
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102.5 USE RPM AND YUM PACKAGE MANAGEMENT
See Chapter 12: Finding, Downloading, and Installing Software page 531
Install, re-install, upgrade, and remove packages using RPM and YUM
- JumpStart: Installing and Removing Software Packages Using yum page 534
- Updating Packages page 538
- RPM: The RPM Package Manager page 546
- Installing, Upgrading, and Removing Packages page 548
Obtain information on RPM packages such as version, status, dependencies, integrity, and signatures
- Querying Packages and Files page 547
Determine what files a package provides, as well as find which package a specific file comes from
- Finding the Package That Holds an Application or File You Need page 536
- Querying Packages and Files page 547

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- RPM: The RPM Package Manager page 546
- Querying Packages and Files page 547
rpm2cpio
/etc/yum.conf
- yum.conf: Configures yum page 541
/etc/yum.repos.d/
- yum Repositories page 542
yum
- yum page 533
- JumpStart: Installing and Removing Software Packages Using yum page 534
- Finding the Package That Holds an Application or File You Need page 536
- yum: Keeps the System Up-to-Date page 538
yumdownloader
- Downloading RPM Package Files with yumdownloader page 540
- yumdownloader page 582

103 GNU AND UNIX COMMANDS
103.1 WORK ON THE COMMAND LINE
See Chapter 5: The Shell page 141
See Chapter 9: The Bourne Again Shell (bash) page 327
See Chapter 7: The Linux Utilities page 215
See Chapter 27: Programming the Bourne Again Shell (bash) page 981
Use single shell commands and one line command sequences to perform basic tasks on the command line
  ▸ Chapter 5: The Shell page 141
  ▸ Chapter 7: The Linux Utilities page 215
  ▸ Chapter 9: The Bourne Again Shell (bash) page 327
Use and modify the shell environment including defining, referencing, and exporting environment variables
  ▸ Parameters and Variables page 352
  ▸ Variables page 1031
Use and edit command history
  ▸ History page 376
Invoke commands inside and outside the defined path
  ▸ Absolute versus relative pathnames page 149
  ▸ PATH: Where the Shell Looks for Programs page 359
Partial List of Used Files, Terms, and Utilities
  . (dot)
  ▸ . (Dot) or source: Runs a Startup File in the Current Shell page 332
  ▸ exec versus . (dot) page 1045
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  ▸ Chapter 5: The Shell page 141
  ▸ Chapter 9: The Bourne Again Shell (bash) page 327
  ▸ Chapter 27: Programming the Bourne Again Shell (bash) page 981
echo
  ▸ echo: Displays Arguments page 219
  ▸ echo -e page 1009
env
  ▸ env: Runs a Program in a Modified Environment page 1035
exec
  ▸ Opening a File Descriptor page 1017
  ▸ Duplicating a File Descriptor page 1017
  ▸ exec: Executes a Command or Redirects File Descriptors page 1045
export
  ▸ declare: Lists and Assigns Attributes to Variables page 357
  ▸ readonly and export page 357
  ▸ export: Puts Variables in the Environment page 1032
pwd
  ▸ pwd page 143
set
  ▸ set -o: Turns Shell Features On and Off page 400
  ▸ set: Initializes Positional Parameters page 1024
unset
  ▸ unset: Removes a Variable page 356
man
  ▪ man: Displays the System Manual page 128

uname
  ▪ uname: Displays System Information page 470

history
  ▪ History page 376

103.2 Process Text Streams Using Filters
Send text files and output streams through text utility filters to modify the output using standard UNIX commands found in the GNU textutils package
  ▪ Redirection page 153
  ▪ Pipelines page 158
  ▪ Filters page 161

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  ▪ cat: Joins and Displays Files page 216
  ▪ cat page 152
  ▪ Redirection page 153

cut
  ▪ cut: Selects Characters or Fields from Input Lines page 225

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fmt
head
  ▪ head: Displays the Beginning of a File page 235

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nl
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  ▪ sort: Sorts and/or Merges Files page 239
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tail
  ▪ tail: Displays the Last Part of a File page 241

tr
  ▪ tr page 159
  ▪ tr page 260
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unexpand
uniq
wc

- wc: Displays the Number of Lines, Words, and Bytes in Files page 244

103.3 Perform Basic File Management
Copy, move, and remove files and directories individually
- rmdir: Deletes a Directory page 186
- mv, cp: Move or Copy Files page 187
- mv: Moves a Directory page 188
- rm: Removes a Link page 208
- rm: Removes a File (Deletes a Link) page 222
- cp: Copies Files page 224
- mv: Renames or Moves a File page 237
Copy multiple files and directories recursively
- cp: Copies Files page 224
Remove files and directories recursively
- rm: Removes a File (Deletes a Link) page 222
Use simple and advanced wildcard specifications in commands
- Filename Generation/Pathname Expansion page 165
- Pathname Expansion page 412
Using find to locate and act on files based on type, size, or time
- find: Finds Files Based on Criteria page 229
Usage of tar, cpio, and dd
- tar: Stores or Extracts Files to/from an Archive File page 249
- tar: Archives Files page 603
- cpio: Archives Files page 605

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- cp
  - mv, cp: Move or Copy Files page 187
  - cp: Copies Files page 224
- find
  - find: Finds Files Based on Criteria page 229
- mkdir
  - mkdir: Creates a Directory page 184
- mv
  - mv: Moves a Directory page 188
  - mv: Renames or Moves a File page 237
  - mv, cp: Move or Copy Files page 187
- ls
  - ls -l: Displays Permissions page 191
  - ls: Displays Information About Files page 221
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- rm: Removes a Link page 208
- rm: Removes a File (Deletes a Link) page 222

rm
- rm: Removes a Link page 208
- rm: Removes a File (Deletes a Link) page 222

rmdir
- rmdir: Deletes a Directory page 186

touch
- touch: Changes File Modification and Access Times page 243

tar
- tar: Stores or Extracts Files to/from an Archive File page 249
- tar: Archives Files page 603

cpio
- cpio: Archives Files page 605

dd

dd: Displays the Classification of a File page 229

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- xz, bzip2, and gzip: Compress and Decompress Files page 245

gzip
- xz, bzip2, and gzip: Compress and Decompress Files page 245

unzip
- unzip bzip2 gunzip page 248

bzip2
- xz, bzip2, and gzip: Compress and Decompress Files page 245

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- Filename Generation/Pathname Expansion page 165
- Pathname Expansion page 412

103.4 Use Streams, Pipes, and Redirects
Redirecting standard input, standard output, and standard error
- Redirecting Standard Output page 154
- Redirecting Standard Input page 155
- Redirecting Standard Error page 333
- redirection page 1269 (Glossary)
- standard input page 1274 (Glossary)
- standard output page 1275 (Glossary)
- standard error page 1274 (Glossary)

Pipe the output of one command to the input of another command
- Pipelines page 158
- Filters page 161
- filter page 1250 (Glossary)
- pipeline page 1266 (Glossary)

Use the output of one command as arguments to another command
- xargs: Converts Standard Input to Command Lines page 260

Send output to both stdout and a file
- tee page 162
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tee
  tee page 162

xargs
  xargs: Converts Standard Input to Command Lines page 260

103.5 CREATE, MONITOR, AND KILL PROCESSES

Run jobs in the foreground and background
  Running a Command in the Background page 163
  Moving a Job from the Foreground to the Background page 164
  Background process page 375
  background process page 1238 (Glossary)
  foreground process page 1250 (Glossary)

Signal a program to continue running after logout
  Monitor active processes
    Process Identification page 374
    ps page 374
    ps page 466

Select and sort processes for display
  Process Identification page 374
  ps page 466
  top: Lists Processes Using the Most Resources page 612

Send signals to processes
  Aborting Execution page 123
  kill: Aborting a Background Job page 164
  kill: Sends a Signal to a Process page 465
  killall: Kills a Command page 467
  pkill: Kills a Command page 468
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  Background process page 375
  background process page 1238 (Glossary)
  foreground process page 1250 (Glossary)

bg
  Moving a Job from the Foreground to the Background page 164
  bg: Sends a Job to the Background page 348
  background process page 1238 (Glossary)

fg
  Foreground page 163
  Moving a Job from the Foreground to the Background page 164
  fg: Brings a Job to the Foreground page 347
  foreground process page 1250 (Glossary)
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Jobs
- Determining the number of a job using `jobs` page 164
- `jobs`: Lists Jobs page 346

Kill
- `kill`: aborting a background job page 164
- `kill`: sends a signal to a process page 465

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Ps
- `ps`: Process identification page 374
- `ps` page 466

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- `top`: Lists Processes Using the Most Resources page 612

Free
- `free`: Displays Memory Usage Information page 253

Uptime
- `uptime`: Displays System Load and Duration Information page 253

Killall
- `killall`: Kills a Command page 467

103.6 Modify Process Execution Priorities
Know the default priority of a job that is created
- `Process Identification` page 374
- `ps` page 466
- `top`: Lists Processes Using the Most Resources page 612
Run a program with higher or lower priority than the default
Change the priority of a running process

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Ps
- `Process Identification` page 374
- `ps` page 466

Renice

Top
- `top`: Lists Processes Using the Most Resources page 612

103.7 Search Text Files Using Regular Expressions
See Appendix A: Regular Expressions page 1139
Create simple regular expressions containing several notational elements
- Appendix A: Regular Expressions page 1139
- Regular Expressions page 1101 (Python)
Use regular expression tools to perform searches through a filesystem or file content
- See preceding entry.
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  grep: Searches for a Pattern in Files page 232
egrep
  Extended regular expression page 233
fgrep

103.8 Perform Basic File Editing Operations Using vi
A Practical Guide to Fedora and Red Hat Enterprise Linux, Seventh Edition covers the vim editor. All commands discussed here are compatible between vi and vim.

Tutorial: Using vim to Create and Edit a File page 262

Navigate a document using vi
  Moving the Cursor page 268

Use basic vi modes
  Command and Input Modes page 264

Insert, edit, delete, copy, and find text
  Entering Text page 265
  Deleting Text page 268
  Correcting Text page 268

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  Tutorial: Using vim to Create and Edit a File page 262
  /, ?
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    Moving the Cursor page 268
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    Entering Text page 265
    Entering Additional Text page 268
  c, d, p, y, dd, yy
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  ZZ, :w!, :q!, :e!
    Ending the Editing Session page 269

104 Devices, Linux Filesystems, Filesystem Hierarchy Standard
104.1 Create Partitions and Filesystems
Use various mkfs commands to set up partitions and create various filesystems such as:

ext2
  ext2 page 519
  ext2 to ext3 page 527
**ext3**
- ext3 page 519
- ext3 to ext2 page 527

**xfs**
- The XFS Filesystem page 527

**reiserfs v3**
- reiserfs page 520

**vfat**
- vfat page 520

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- fdisk
  - fdisk: see the fdisk man page
  - See also parted: Reports on and Partitions a Hard Disk page 614
- mkfs
  - mkfs: Creates a Filesystem page 467
- mkswap
  - swap page 513

**104.2 Maintain the Integrity of Filesystems**

Verify the integrity of filesystems
- fsck: Checks Filesystem Integrity page 525

Monitor free space and inodes
- df: shows where directory hierarchies are mounted page 804

Repair simple filesystem problems
- fsck: Checks Filesystem Integrity page 525

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- du
  - du: Displays Disk Usage Information page 523
- df
  - df: shows where directory hierarchies are mounted page 804
- fsck
  - fsck: Checks Filesystem Integrity page 525
- e2fsck
- mke2fs
- debugfs
- dumpe2fs
- tune2fs
  - tune2fs: Changes Filesystem Parameters page 526
- xfs tools (such as xfs_metadump and xfs_info)
104.3 CONTROL MOUNTING AND UNMOUNTING OF FILESYSTEMS
Manually mount and unmount filesystems
- `mount`: Mounts a Filesystem page 520
- `umount`: Unmounts a Filesystem page 523
- `mount`: Mounts a Directory Hierarchy page 807
- `umount`: Unmounts Shares page 834
Configure filesystem mounting on bootup
- `/etc/fstab`: Keeps Track of Filesystems page 524
- `/etc/fstab`: Mounts Directory Hierarchies Automatically page 811
Configure user mountable removable filesystems
- `mount`: Mounts a Directory Hierarchy page 807
- `mount`: Mounts Shares page 834

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- `/etc/fstab`
  - `/etc/fstab`: Keeps Track of Filesystems page 524
  - `/etc/fstab`: Mounts Directory Hierarchies Automatically page 811
- `/media`
  - `mount`: Mounts a Filesystem page 520
  - `mount`: Mounts a Directory Hierarchy page 807
  - `umount`: Unmounts Shares page 834

104.4 MANAGE DISK QUOTAS
Set up a disk quota for a filesystem
- Disk Quota System page 629
Edit, check, and generate user quota reports
- `quota` and `repquota` page 629

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- `quota`
  - `quota` and `repquota` page 629
- `edquota`
  - `edquota` and `quotaon` page 629
- `repquota`
  - `quota` and `repquota` page 629
- `quotaon`
  - `edquota` and `quotaon` page 629

104.5 MANAGE FILE PERMISSIONS AND OWNERSHIP
Manage access permissions on regular and special files as well as directories
- `chmod`: Changes File Access Permissions page 193
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chmod: Makes a File Executable page 337

Use access modes such as suid, sgid, and the sticky bit to maintain security
  • Setuid and Setgid Permissions page 196
  • Setuid file page 424
  • Setuid files page 626
  • setuid page 1272 (Glossary)
  • setgid page 1272 (Glossary)

Know how to change the file creation mask
  • umask: Specifies the File Permission Mask page 469

Use the group field to grant file access to group members
  • ls -l: Displays Permissions page 191
  • chmod: Changes File Access Permissions page 193
  • /etc/group page 506

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chmod
  • chmod: Changes File Access Permissions page 193
  • chmod: Makes a File Executable page 337

umask
  • umask: Specifies the File Permission Mask page 469

chown
  • chown: Changes File Ownership page 195

chgrp
  • chgrp: Changes File Group Association page 195

104.6 CREATE AND CHANGE HARD AND SYMBOLIC LINKS

Create links
  • ln: Creates a Hard Link page 204
  • ln: Creates Symbolic Links page 207

Identify hard and/or soft links
  • ls and link counts page 206
  • ls and inodes page 206
  • hard link page 1252 (Glossary)
  • link page 1258 (Glossary)
  • symbolic link page 1276 (Glossary)

Copying versus linking files
  • cp Versus ln page 205

Use links to support system administration tasks
  • ln: Creates a Hard Link page 204
  • ln: Creates Symbolic Links page 207

Partial List of Used Files, Terms, and Utilities
ln
  • ln: Creates a Hard Link page 204
  • ln: Creates Symbolic Links page 207
104.7 **Find System Files and Place Files in the Correct Location**

Understand the correct locations of files under the FHS

- Important Standard Directories and Files page 189
- Important Files and Directories page 502

Find files and commands on a Linux system

- `whereis` page 255
- `locate`: Searches for a File page 256

Know the location and purpose of important files and directories as defined in the FHS

- Important Standard Directories and Files page 189
- Important Files and Directories page 502

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- `find`
  - `find`: Finds Files Based on Criteria page 229
- `locate`
  - `locate`: Searches for a File page 256
- `updatedb`
  - `updatedb` page 256
- `whereis`
  - `whereis` page 255
- `which`
  - `which` page 255
- `type`
  - `type`: Displays Information About a Command page 1041

`/etc/updatedb.conf`

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**Certification Exam 2**

**Objectives: LX0-102**

105 **Shells, Scripting, and Data Management**

105.1 **Customize and Use the Shell Environment**

See Chapter 9: The Bourne Again Shell (*bash*) page 327

Set environment variables (e.g., `PATH`) at login or when spawning a new shell

- Startup Files page 329
- Set `PATH` in `.bash_profile` page 331
- Keyword variables page 353
- Keyword Variables page 358

Write bash functions for frequently used sequences of commands

- Functions page 396
- Variables in Functions page 1039
Maintain skeleton directories for new user accounts
- `useradd`: Adds a User Account page 600

Set command search path with the proper directory
- `PATH`: Where the Shell Looks for Programs page 359

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/`etc/profile`
- `/etc/profile` page 330
- `/etc/profile` and `/etc/profile.d` page 509

`env`
- `env`: Runs a Program in a Modified Environment page 1035

`export`
- `declare`: Lists and Assigns Attributes to Variables page 357
- `export`: Puts Variables in the Environment page 1032

`set`
- `set ±o`: Turns Shell Features On and Off page 400
- `set`: Initializes Positional Parameters page 1024

`unset`
- `unset`: Removes a Variable page 356

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- `~/.bash_profile`, `~/.bash_login`, and `.profile` page 330
- `~/.bash_profile` page 502

`~/.bash_login`
- `~/.bash_profile`, `~/.bash_login`, and `.profile` page 330

`~/.profile`
- `~/.bash_profile`, `~/.bash_login`, and `.profile` page 330

`~/.bashrc`
- `~/.bashrc` page 331
- `~/.bashrc` page 502

`~/.bash_logout`
- `~/.bash_logout` page 330

functions
- Functions page 396
- Variables in Functions page 1039

alias
- Aliases page 392
- Alias Substitution page 404

lists
- Lists page 162

105.2 Customize or Write Simple Scripts
See Chapter 9: The Bourne Again Shell (`bash`) page 327
See Chapter 27: Programming the Bourne Again Shell (`bash`) page 981
Use standard sh syntax (loops, tests)
   Control Structures page 982
Use command substitution
   Command Substitution page 410
Test return values for success or failure or other information provided by a command
   test builtin page 983
   [] is a synonym for test page 986
   test builtin page 1000
Perform conditional mailing to the superuser
Correctly select the script interpreter through the shebang (#!) line
   #! Specifies a Shell page 338
Manage the location, ownership, execution, and suid-rights of scripts
   Listing setuid files page 458

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   for...in page 995
   for page 997
while
   while page 999
test
   test builtin page 983
   [] is a synonym for test page 986
   test builtin page 1000
if
   if...then page 983
   if...then...else page 987
   if...then...elif page 989
read
   read: Accepts User Input page 1041
seq
   seq page 407

105.3 SQL DATA MANAGEMENT
See Chapter 29: The MariaDB SQL Database Management System page 1113
Use of basic SQL commands
   Notes page 1114
Perform basic data manipulation
   Examples page 1123

Partial List of Used Files, Terms, and Utilities
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   INSERT INTO page 1125
update
  ▶ UPDATE page 1128
select
  ▶ Retrieving Data page 1126
  ▶ Joins page 1130
delete
  ▶ DELETE FROM page 1128
from
  ▶ DELETE FROM page 1128
where
  ▶ WHERE page 1127
group by
order by
  ▶ ORDER BY page 1126
join
  ▶ Joins page 1130

106 User Interfaces and Desktops

106.1 Install and Configure X11
See X Window System page 459
Verify that the video card and monitor are supported by an X server
  ▶ Displays page 109
Awareness of the X font server
Basic understanding and knowledge of the X Window configuration file

Partial List of Used Files, Terms, and Utilities
/etc/X11/xorg.conf
xhost
  ▶ xhost Grants Access to a Display page 461
DISPLAY
  ▶ The DISPLAY Variable page 462
xwininfo
xdpyinfo
X
  ▶ X Window System page 459
106.2 Set Up a Display Manager
Turn the display manager on or off
Change the display manager greeting
Change default color depth for the display manager
Configure display managers for use by X-stations

Partial List of Used Files, Terms, and Utilities
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  /etc/inittab page 508
xdm configuration files
kdm configuration files
gdm configuration files
  Graphical login page 453
  The \texttt{Xorg --nolisten tcp} Option page 460

106.3 Accessibility
Keyboard Accessibility Settings (\textsc{AccessX}?)
Visual Settings and Themes
Assistive Technology (\textsc{ATs})

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Sticky/Repeat Keys
Slow/Bounce/Toggle Keys
Mouse Keys
High Contrast/Large Print Desktop Themes
Screen Reader
Braille Display
Screen Magnifier
On-Screen Keyboard
Gestures (used at login, for example gdm)
Orca
GOK
emacspeak

107 Administrative Tasks

107.1 Manage User and Group Accounts and Related System Files
Add, modify, and remove users and groups
  
  system-config-users: Manages User Accounts page 598
  
  Managing User Accounts from the Command Line page 600

Manage user/group info in password/group databases
  
  Modifying a User page 600
  
  Working with Groups page 600
usermod: Modifies a User Account page 601
groupdel and groupmod: Remove and Modify a Group page 601
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Create and manage special purpose and limited accounts

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/etc/shadow
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/etc/group
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/etc/skel
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  groupadd: Adds a Group page 601
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groupmod
  groupdel and groupmod: Remove and Modify a Group page 601
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useradd
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  userdel: Removes a User Account page 600
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  usermod: Modifies a User Account page 601

107.2 AUTOMATE SYSTEM ADMINISTRATION TASKS BY SCHEDULING JOBS
Manage cron and at jobs
  cron and anacron: Schedule Routine Tasks page 607
  at: Runs Occasional Tasks page 611
Configure user access to cron and at services
  /etc/at.allow, /etc/at.deny, /etc/cron.allow, and /etc/cron.deny page 506

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  Crontab Files page 607
/etc/at.deny
  /etc/at.allow, /etc/at.deny, /etc/cron.allow, and /etc/cron.deny page 506
107.3 **Localization and Internationalization**

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- Locale page 368
- locale page 1258 (Glossary)

Time zone settings
- tzconfig page 372
- tzselect page 372
- /etc/timezone page 372

Partial List of Used Files, Terms, and Utilities

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- /etc/timezone page 372

/etc/localtime
- /etc/localtime page 373

/usr/share/zoneinfo
- /usr/share/zoneinfo page 372

Environment variables:
- LC_: Locale Variables page 368
- Environment Variables page 1032

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- locale: Displays Locale Information page 369

Environment variables:
- LC_: Locale Variables page 368
- Environment Variables page 1032

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  ▪ date: Displays the System Time and Date page 218
iconv
  ▪ UTF-8
    ▪ LC_: Locale Variables page 368
    ▪ ISO-8859
    ▪ ASCII
    ▪ ASCII page 1237 (Glossary)
    ▪ Unicode
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108 Essential System Services

108.1 Maintain System Time
Set the system date and time
  ▪ timedatectl: Reports on and Sets the System Clock page 613
Set the hardware clock to the correct time in UTC
Configure the correct time zone
  ▪ Time page 371
Basic NTP configuration
Knowledge of using the pool.ntp.org service

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  ▪ /usr/share/zoneinfo page 372
/etc/timezone
  ▪ /etc/timezone page 372
/etc/localtime
  ▪ /etc/localtime page 373
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date
  ▪ date: Displays the System Time and Date page 218
  ▪ timedatectl: Reports on and Sets the System Clock page 613
hwclock
ntpd
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108.2 System Logging
Syslog configuration files
  ▪ rsyslog.conf page 620
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  • rsyslogd: Logs System Messages page 620
standard facilities, priorities, and actions
  • Selectors page 620
  • Facilities page 620
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109 Networking Fundamentals
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Demonstrate an understanding of network masks
  ▶ Subnet mask page 298
  ▶ network mask page 1263 (Glossary)

Knowledge of the differences between private and public “dotted quad” IP Addresses
  ▶ Private address space page 637
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Knowledge about common TCP and UDP ports (20, 21, 22, 23, 25, 53, 80, 110, 119, 139, 143, 161, 443, 465, 993, 995)
- Each chapter covering a server discusses which ports that server uses.
- Ports page 312
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Knowledge about the differences and major features of UDP, TCP, and ICMP
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- Configuring the Systems page 636
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Basic TCP/IP host configuration

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- `ifconfig`
- `ifup`
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- `route`
- `ping`
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**109.3 Basic Network Troubleshooting**
Manually and automatically configure network interfaces and routing tables to include adding, starting, stopping, restarting, deleting, or reconfiguring network interfaces.
Change, view, or configure the routing table and correct an improperly set default route manually.
Debug problems associated with the network configuration.

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- `ifconfig`
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Demonstrate the use of DNS on the local system
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  ▶ Users: Changing Your Account Type and Password (GUI) page 112
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