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.

- **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 LPI’s Linux Essentials certification learning goals.
- **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.

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LPI and CompTIA Certification
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

Linux Essentials

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

1.2 Major Open Source Applications
Description: Awareness of major applications and their uses

Key Knowledge Areas
Desktop Applications
- Desktop Applications page 1173
Server Applications
- page 464
- Chapter 13: Printing with CUPS page 539
- Chapter 18: The OpenSSH Secure Communication Utilities page 713
- Chapter 20: FTP: Transferring Files Across a Network page 753
- Chapter 21: postfix: Setting Up Mail Servers, Clients, and More page 779
- Chapter 22: NIS and LDAP page 813
- Chapter 23: NFS: Sharing Directory Hierarchies page 843
- Chapter 24: Samba: Linux and Windows File and Printer Sharing page 869
Chapter 25: DNS/BIND: Tracking Domain Names and Addresses page 891
Chapter 27: Apache (apache2): Setting Up a Web Server page 951

Mobile Applications
Embedded and mobile Linux page 6

Development Languages
Chapter 28: Programming the Bourne Again Shell (bash) page 1003
Chapter 29: The Python Programming Language page 1103
Chapter 30: The MariaDB SQL Database Management System page 1135

Package Management Tools and repositories
Chapter 12: Finding, Downloading, and Installing Software page 509
Appendix C: Keeping the System Up to Date Using yum page 1177

Partial List of Used Files, Terms, and Utilities
OpenOffice.org, LibreOffice, Thunderbird, Firefox, Blender, Gimp, Audacity, ImageM agick
Desktop Applications page 1173
Apache, MySQL, PostgresQL
Chapter 27: Apache (apache2): Setting Up a Web Server page 951
Chapter 30: The MariaDB SQL Database Management System page 1135
Programming languages page 1174
NFS, Samba, OpenLDAP, postfix, DNS, DHCP
Chapter 21: postfix: Setting Up Mail Servers, Clients, and More page 779
Chapter 23: NFS: Sharing Directory Hierarchies page 843
Chapter 24: Samba: Linux and Windows File and Printer Sharing page 869
Chapter 25: DNS/BIN D : Tracking Domain Names and Addresses page 891
DHCP: Configures Network Interfaces page 464
Introduction to LDAP page 830
C, Perl, shell, Python, PHP
Chapter 28: Programming the Bourne Again Shell (bash) page 1003
Chapter 29: The Python Programming Language page 1103
Programming Languages page 1174

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
Berkeley UNIX (BSD) page 3
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 Ubuntu page 97

**Getting to the Command Line**
- Working from the Command Line page 125
- Chapter 7: The Linux Utilities page 223

**Industry uses of Linux, Cloud Computing, and Virtualization**
- Chapter 17: Setting Up Virtual Machines Locally and in the Cloud page 687

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

**Using a browser, privacy concerns, configuration options, searching the Web, and saving content**
- Firefox: support.mozilla.org/en-US/products/firefox
- Opera: www.opera.com

**Terminal and Console**
- Using a Virtual Console page 127

**Password issues**
- User Accounts: Changing Your Account Type and Password (GUI) page 118
- Password Security page 143
- passwd: Changing Your Password (CLI) page 144
- Passwords page 615

**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 1173
**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 125
  - Chapter 5: The Shell page 149
- **Formatting commands**
  - The Command Line page 152
- **Working with Options**
  - Options page 153
- **Variables**
  - Parameters and Variables page 358
  - Variables page 1053
- **Globbing**
  - Filename Generation/Pathname Expansion page 173
  - Pathname Expansion page 418
- **Quoting**
  - Special Characters page 150
  - Quoting the $ page 360
  - Quotation marks page 418

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

- **echo**
  - echo: Displays Arguments page 227
  - echo -e page 1031
- **history**
  - History page 382
- **PATH env variable**
  - Set PATH in .bash_profile page 337
  - PATH: Where the Shell Looks for Programs page 365
- **which**
  - which page 263

**Nice to Know**

- **Substitutions**
  - Command Substitution page 416
  - ||, & & , and ; control operators
    - Lists page 170
    - ; and NEWLINE Separate Commands page 347
    - & & and || Boolean Control Operators page 349
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 135
- `info`
  - `info`: Displays Information About Utilities page 137

**Partial List of Used Files, Terms, and Utilities**
- `man`
  - `man`: Displays the System Manual page 135
- `info`
  - `info`: Displays Information About Utilities page 137
- `man pages`
  - `man`: Displays the System Manual page 135
- `/usr/share/doc`
  - `/usr/share/doc` page 141
- `locate`
  - `locate`: Searches for a File page 264

**Nice to Know**
- `apropos`, `whatis`, `whereis`
  - `apropos`: Searches for a Keyword page 137
  - `whatis` page 137
  - `whereis` page 263

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 185
- Hidden files and directories
  - Hidden Filenames page 188
- Home
  - Your Home Directory page 151
- Absolute and relative paths
  - Absolute Pathnames page 189
  - Relative Pathnames page 190

**Partial List of Used Files, Terms, and Utilities**
- Common options for `ls`
  - `Options` page 229
Recursive listings
  - Recursive page 230

cd
  - cd: Changes to Another Working Directory page 193
.
  - The . and .. Directory Entries page 194
home and ~
  - Your Home Directory page 151
  - ~ (Tilde) in Pathnames page 190
  - Tilde (~) page 365
  - Tilde Expansion page 413

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 185
Case sensitivity
  - Case sensitivity page 187
Simple globbing and quoting
  - Filename Generation/Pathname Expansion page 173
  - Pathname Expansion page 418
  - Special Characters page 150
  - Quoting the $ page 394
  - Quotation marks page 452

Partial List of Used Files, Terms, and Utilities
mv, cp, rm, touch
  - mv, cp: Move or Copy Files page 195
  - mv: Moves a Directory page 196
  - mv: Renames or Moves a File page 245
  - cp: Copies Files page 232
  - rm: Removes a Link page 216
  - rm: Removes a File (Deletes a Link) page 231
  - touch: Changes File Modification and Access Times page 251

mkdir, rmdir
  - mkdir: Creates a Directory page 192
  - rmdir: Deletes a Directory page 194
**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 185
- Archives, compression
  - Compressing and Archiving Files page 253

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

- **tar**
  - `tar`: Stores or Extracts Files to/from an Archive File page 257
  - `tar`: Archives Files page 569
  - Common `tar` options
    - `Options` page 257
    - `Modifiers` page 259
- **gzip, bzip2**
  - `xz`, `bzip2`, and `gzip`: Compress and Decompress Files page 253
- **zip, unzip**
  - `zip` page 257
  - `unzip` page 257

**Nice to Know**

- Extracting individual files from archives
  - `Extract` page 258

**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 166
- I/O redirection
  - `Redirection` page 161
- Partial POSIX Regular Expressions (., [], *, ?)
  - `Appendix A: Regular Expressions` page 1161

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

- **find**
  - `find`: Finds Files Based on Criteria page 237
- **grep**
  - `grep`: Searches for a Pattern in Files page 240
- **less**
  - `less Is more`: Display a Text File One Screen at a Time page 228
- **head, tail**
  - `head`: Displays the Beginning of a File page 243
Tail: Displays the Last Part of a File page 249
Sort
  Sorts and/or Merges Files page 247
Cut
  Selects Characters or Fields from Input Lines page 233
Wc
  Displays the Number of Lines, Words, and Bytes in Files page 252
Nice to Know
Partial POSIX Basic Regular Expressions ([^ ]), (^, $)
  Appendix A: Regular Expressions page 1161
Partial POSIX Extended Regular Expressions (+, ( ), |)
  Appendix A: Regular Expressions page 1161
Xargs
  Converts Standard Input to Command Lines page 268

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 270
  Tutorial: Using nano to Create and Edit a File page 277
Basic shell scripting
  Writing and Executing a Basic Shell Script page 134
Partial List of Used Files, Terms, and Utilities
/bin/sh
  sh Shell page 334
Variables
  Parameters and Variables page 358
  Variables page 1053
Arguments
  Arguments page 153
For loops
  for...in page 1017
  for page 1019
Echo
  echo: Displays Arguments page 227
  echo -e page 1031
Exit status
  $?: Exit Status page 1051
Nice to Know
pico, nano, vi (only basics for creating scripts)
  Tutorial: Using vim to Create and Edit a File page 270
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- Tutorial: Using nano to Create and Edit a File page 277
- pico, see Desktop Applications page 1173

bash
- Chapter 5: The Shell page 149
- Chapter 9: The Bourne Again Shell (bash) page 333
- Chapter 28: Programming the Bourne Again Shell (bash) page 1003

if, while, case statements
- if...then page 1005
- if...then...else page 1009
- if...then...elif page 1011
- for...in page 1017
- for...in page 1017

read and test, and [ commands
- test builtin page 1005
- [] is a synonym for test page 1008
- test builtin page 1022
- read: Accepts User Input page 1063

**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

**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 1235 (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
- Processor Architecture page 32
- Setting Up the Hard Disk page 38
Peripheral, see device page 1244 (Glossary)
motherboard page 1260 (Glossary)
optical drive page 1263 (Glossary)
power supply page 1266 (Glossary)

Display types
Interfaces: Installer and Installed System page 33
Working from the Command Line page 125
ASCII terminal page 1233 (Glossary)
graphical display page 1249 (Glossary)

Drivers
Device files page 494
Block and Character Devices page 496
device driver page 1244 (Glossary)

4.3 WHERE DATA IS STORED
DESCRIPTION: WHERE VARIOUS TYPES OF INFORMATION ARE STORED ON A LINUX SYSTEM

Key Knowledge Areas
Kernel
Linux kernel page 2
Linux Is More Than a Kernel page 6
Linux Has a Kernel Programming Interface page 11
kernel page 1255 (Glossary)

Processes
Process page 158
Processes page 379
ps page 456
process page 1266 (Glossary)
syslog, klog, dmesg
rsyslogd: Logs System Messages page 585
klogd: deprecated; www.linuxjournal.com/article/4058
dmesg: Displays Kernel Messages page 454

/lib, /usr/lib, /etc, /var/log
/etc page 198
/lib page 198
/lib64 page 198
/usr/lib page 198
/usr/x86_64-linux-gnu page 199
/var/log page 199
/etc page 483
/var/log page 492
Log Files and Mail for root page 590
Partial List of Used Files, Terms, and Utilities
Programs, libraries, packages and package databases, system configuration

- /etc page 198
- /usr/bin page 198
- /lib page 198
- /lib64 page 198
- /usr/lib page 198
- /usr/sbin page 199
- /usr/x86_64-linux-gnu page 199
- /etc page 483
- library page 1256 (Glossary)
- Software package page 510
- PM S page 510
- Software package formats page 510
- Repositories page 511

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

- Process page 158
- Processes page 379
- dmesg: Displays Kernel Messages page 454
- ps page 456
- rsyslogd: Logs System Messages page 585
- process page 1266 (Glossary)

ps, top, free
- free: Displays Memory Usage Information page 261
- Process Identification page 380
- ps page 456
- top: Lists Processes Using the Most Resources page 577

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 286
- Introduction to Networking page 286
- Internetworking Through Gateways and Routers page 293

Domain Name Service
- Chapter 25: DNS/BIND: Tracking Domain Names and Addresses page 891

Network configuration
- Chapter 16: Configuring and Monitoring a LAN page 661

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 488
IPv4, IPv6
  › IPv4 page 298
  › IPv6 page 299
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 311

Nice to Know
ssh
  › ssh: Logs in or Executes Commands on a Remote System page 720
dig
  › host and dig: Query Internet Nameservers page 313
  › dig page 901
  › dig page 902

**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 596
  › The Special Powers of a User Working with root Privileges page 596
  › Gaining root Privileges page 597
  › Real UID Versus Effective UID page 599
System users
  › /etc/passwd page 486

**Partial List of Used Files, Terms, and Utilities**
/etc/passwd, /etc/group
  › /etc/group page 484
  › /etc/passwd page 486

id, who, w
  › w: Lists Users on the System page 262
  › who: Lists Users on the System page 262
  › who, whoami page 600
  › id page 601

sudo
  › Using sudo to Gain root Privileges page 602
Nice to Know

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 566
- `userdel`: Removes a User Account page 566
- `groupadd`: Adds a Group page 567
- `groupdel` and `groupmod`: Remove and Modify a Group page 567
- `usermod`: Modifies a User Account page 567

User IDs
- `/etc/passwd` page 486
- Real UID Versus Effective UID page 599
- User ID page 1279 (Glossary)

Partial List of Used Files, Terms, and Utilities

/etc/passwd, /etc/shadow, /etc/group
- `/etc/group` page 484
- `/etc/passwd` page 486
- `/etc/shadow` page 489

id, last
- `id` page 601
- `last`: see the last man page

useradd, groupadd
- `useradd`: Adds a User Account page 566
- `groupadd`: Adds a Group page 567

passwd
- User Accounts: Changing Your Account Type and Password (GUI) page 118
- `passwd`: Changing Your Password (CLI) page 144

Nice to Know

usermod, userdel
- `userdel`: Removes a User Account page 566
- `usermod`: Modifies a User Account page 567

groupmod, groupdel
- `groupdel` and `groupmod`: Remove and Modify a Group page 567

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 199
Partial List of Used Files, Terms, and Utilities

Is -I
  - Is -I: Displays Permissions page 199

chmod, chown
  - chmod: Changes File Access Permissions page 201
  - chown: Changes File Ownership page 203
  - chmod: Makes a File Executable page 343

Nice to Know

chgrp
  - chgrp: Changes File Group Association page 203

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 197
  - library page 1256 (Glossary)

Symbolic links
  - Symbolic Links page 214
  - Symbolic links page 494
  - symbolic link page 1276 (Glossary)

Partial List of Used Files, Terms, and Utilities
/etc, /var
  - /etc page 198
  - /etc page 483
  - /var page 43
  - /var page 199

/tmp, /var/tmp and Sticky Bit
  - /tmp page 198
  - /var page 199
  - Sticky bit page 204
  - sticky bit page 1275 (Glossary)

Is -d
  - Directory page 229

ln -s
  - Size page 230

Nice to Know

Hard links
  - Hard Links page 212

Setuid/Setgid
  - Setuid and Setgid Permissions page 204
  - Setuid file page 598
  - Setuid files page 614
  - setuid page 1271 (Glossary)
  - setgid page 1271 (Glossary)
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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 481
Set the correct hardware ID for different devices, especially the boot device
Know the differences between coldplug and hotplug devices
   ▸ Hotplug page 495
Determine hardware resources for devices
Tools and utilities to list various hardware information (e.g., lsusb, lspci, etc.)
   ▸ dmesg: Displays Kernel Messages page 454
   ▸ lspci: Lists PCI Information page 664
   ▸ lsblk: Lists Block Device Information page 665
   ▸ lshw: Lists Hardware Information page 665
   ▸ lsusb: Lists USB Devices page 666
Tools and utilities to manipulate USB devices
   ▸ Writing to a USB Flash Drive page 52
Conceptual understanding of sysfs, udev, hald, dbus
   ▸ udev page 494

Partial List of Used Files, Terms, and Utilities
/sys
   ▸ /sys page 198
   ▸ /sys page 492
   ▸ /sys page 495
/proc
   ▸ /proc page 198
   ▸ /proc page 490
   ▸ proc page 498
/dev
   ▸ Device file page 160
   ▸ /dev page 197
   ▸ /dev page 481
   ▸ Device files page 494
modprobe
   ▸ modprobe page 444
lsmod
  ◦ lsmod page 444

lspci
  ◦ lspci: Lists PCI Information page 664

lsusb
  ◦ lsusb: Lists USB Devices page 666

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 75
  ◦ GRUB: The Linux Boot Loader page 444

Demonstrate knowledge of the boot sequence from BIOS to boot completion
  ◦ BIOS setup page 32
  ◦ CMOS page 32
  ◦ Booting the System page 438
  ◦ GRUB: The Linux Boot Loader page 444
  ◦ BIOS page 445
  ◦ BIOS page 1235 (Glossary)

Check boot events in the log file
  ◦ dmesg: Displays Kernel Messages page 454

Partial List of Used Files, Terms, and Utilities
/var/log/messages
  ◦ /var/log/messages page 492
  ◦ /var/log/syslog page 587
  ◦ Log Files and Mail for root page 590
  ◦ Truncating log files page 591

dmesg
  ◦ dmesg: Displays Kernel Messages page 454

BIOS
  ◦ BIOS setup page 32
  ◦ BIOS page 445
  ◦ BIOS page 1235 (Glossary)

boot loader
  ◦ GRUB: The Linux Boot Loader page 444

kernel
  ◦ Linux kernel page 2
  ◦ Linux Is More Than a Kernel page 6
  ◦ Linux Has a Kernel Programming Interface page 11
  ◦ kernel page 1255 (Glossary)

init
  ◦ init daemon page 380
  ◦ The Upstart Event-Based init Daemon page 427
  ◦ SysVinit (rc) Scripts: Start and Stop System Services page 435
  ◦ Upstart init daemon page 439
101.3 **Change Runlevels and Shutdown or Reboot System**

Set the default runlevel
- `rc-sysinit` task and `inittab` page 435
- `/etc/inittab` page 486

Change between runlevels including single-user mode
- `telinit` page 438
- Going to Graphical Multiuser Mode page 439
- Booting the System to Recovery (Single-User) Mode page 451

Shutdown and reboot from the command line
- Bringing the System Down page 441

Alert users before switching runlevels or other major system events

Properly terminate processes
- `kill`: Aborting a Background Job page 172
- `kill`: Sends a Signal to a Process page 455
- `killall`: Kills a Command page 457
- `pkill`: Kills a Command page 458
- `kill`: Aborts a Process page 1072

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

/`etc/inittab`
- `rc-sysinit` task and `inittab` page 435
- `/etc/inittab` page 486

shutdown
- Bringing the System Down page 441

init
- `init` daemon page 380
- The Upstart Event-Based `init` Daemon page 427
- SysVinit (rc) Scripts: Start and Stop System Services page 435
- Upstart `init` daemon page 439

/`etc/init.d`
- SysVinit (rc) Scripts: Start and Stop System Services page 435

telinit
- `telinit` page 438

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 38

Tailor the design to the intended use of the system
- Planning the Installation page 30

Ensure the `/boot` partition conforms to the hardware architecture requirements for booting
- Where to put the `/boot` partition page 43
- LBA mode and the `/boot` partition page 445
Partial List of Used Files, Terms, and Utilities

/ (root) filesystem
  / (root) page 42
  / (root) page 189
  / page 197
  root filesystem page 1270 (Glossary)
/var filesystem
  /var page 43
  /var page 199
/home filesystem
  /home page 44
  /home page 198
swap space
  (swap) page 42
  swap page 491
  swap space page 1276 (Glossary)
mount points
  Mount Points page 40
  Mount point page 499
partitions
  Partitions page 38
  Partition table page 38
  Primary, Extended, and Logical Partitions page 39
  Guided Partitioning page 41
  Guided partitioning page 65
  The ubiquity Advanced Partitioning Screen page 67
  Manual Partitioning Using the Textual Partition Editor page 82
  gnome-disks: The GNOME Disk Utility page 88
  Example minimum partition sizes page 44
  partition page 1264 (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 444
Interact with the boot loader
  Booting the System to Recovery (Single-User) Mode page 451

Partial List of Used Files, Terms, and Utilities

/boot/grub/menu.lst
  Configuring GRUB page 445
grub-install
  grub-install: Installs the MBR and GRUB Files page 450
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M BR
- Reinstalling the M BR page 450
- M BR page 445
- grub-install: Installs the M BR and GRUB Files page 450

superblock
- superblock page 1275 (Glossary)

/etc/lilo.conf
- lilo deprecated

102.3 Manage Shared Libraries

Identify shared libraries
- ldd page 618

Identify the typical locations of system libraries

Load shared libraries

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- ldd & libwrap page 616
- ldd page 618

ldconfig

/etc/ld.so.conf

LD_LIBRARY_PATH

102.4 Use Debian Package Management

Install, upgrade, and uninstall Debian binary packages
- JumpStart: Installing and Removing Software Packages Using apt-get page 512

Find packages containing specific files or libraries which may or may not be installed
- Finding the Package That Holds an Application or File You Need page 514

Obtain package information like version, content, dependencies, package integrity, and installation status (whether or not the package is installed)
- apt-cache: Displays Package Information page 522
- dpkg --list: Displays Information About a Package page 526

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/etc/apt/sources.list
- sources.list: Specifies Repositories for APT to Search page 516

dpkg
- dpkg: The Debian Package Management System page 524

dpkg-reconfigure
- dpkg-reconfigure: Reconfigures postfix page 796

apt-get
- JumpStart: Installing and Removing Software Packages Using apt-get page 512
- apt-get: Works with Packages and the Local Package Index page 519
- apt-get source: Downloads Source Files page 523
apt-cache
  ▶ apt-cache: Displays Package Information page 522

aptitude

102.5 USE RPM AND YUM PACKAGE MANAGEMENT
See Chapter 12: Finding, Downloading, and Installing Software page 509
Install, re-install, upgrade, and remove packages using RPM and YUM
  ▶ Installing and Removing Software Packages Using yum page 1178
  ▶ Working with yum page 1179
Obtain information on RPM packages such as version, status, dependencies, integrity, and signatures
  ▶ Working with yum page 1179
Determine what files a package provides, as well as find which package a specific file comes from
  ▶ Finding the Package That Holds a File You Need page 1179

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rpm
  ▶ RPM page 1178
rpm2cpio
/etc/yum.conf
  ▶ yum.conf: Configures yum page 1182
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yum
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  ▶ Updating Packages page 1180
  ▶ yum Commands page 1181
  ▶ yum.conf: Configures yum page 1182
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yumdownloader

103 GNU AND UNIX COMMANDS
103.1 WORK ON THE COMMAND LINE
See Chapter 5: The Shell page 149
See Chapter 9: The Bourne Again Shell (bash) page 333
See Chapter 7: The Linux Utilities page 223
See Chapter 28: Programming the Bourne Again Shell (bash) page 1003
Use single shell commands and one line command sequences to perform basic tasks on the command line
  ▶ Chapter 5: The Shell page 149
  ▶ Chapter 7: The Linux Utilities page 223
  ▶ Chapter 9: The Bourne Again Shell (bash) page 333
Use and modify the shell environment including defining, referencing, and exporting environment variables
- Parameters and Variables page 358
- Variables page 1053

Use and edit command history
- History page 382

Invoke commands inside and outside the defined path
- Absolute versus relative pathnames page 157
- PATH: Where the Shell Looks for Programs page 365

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- . (dot)
  - . (Dot) or source: Runs a Startup File in the Current Shell page 338
  - exec versus . (dot) page 1067
- bash
  - Chapter 5: The Shell page 149
  - Chapter 9: The Bourne Again Shell (bash) page 333
  - Chapter 28: Programming the Bourne Again Shell (bash) page 1003
- echo
  - echo: Displays Arguments page 227
  - echo -e page 1031
- env
  - env: Runs a Program in a Modified Environment page 1057
- exec
  - Opening a File Descriptor page 1039
  - Duplicating a File Descriptor page 1039
  - exec:Executes a Command or Redirects File Descriptors page 1067
- export
  - declare: Lists and Assigns Attributes to Variables page 363
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  - pwd page 151
- set
  - set: Turns Shell Features On and Off page 406
  - set: Initializes Positional Parameters page 1046
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  - unset: Removes a Variable page 362
- man
  - man: Displays the System Manual page 135
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  - uname: Displays System Information page 460
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 161
- Pipelines page 166
- Filters page 169

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  - cat page 160
  - Redirection page 161
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  - cut: Selects Characters or Fields from Input Lines page 233
- expand
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  - head: Displays the Beginning of a File page 243
- od
- join
- nl
- paste
- pr
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- sort
  - sort: Sorts and/or Merges Files page 247
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- tail
  - tail: Displays the Last Part of a File page 249
- tr
  - tr page 167
  - tr page 268
- unexpand
- uniq
- wc
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Copy, move, and remove files and directories individually
- rmdir: Deletes a Directory page 194
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- **mv**, **cp**: Move or Copy Files page 195
- **mv**: Moves a Directory page 196
- **rm**: Removes a Link page 216
- **rm**: Removes a File (Deletes a Link) page 231
- **cp**: Copies Files page 232
- **mv**: Renames or Moves a File page 245

Copy multiple files and directories recursively
- **cp**: Copies Files page 232

Remove files and directories recursively
- **rm**: Removes a File (Deletes a Link) page 231

Use simple and advanced wildcard specifications in commands
- Filename Generation/Pathname Expansion page 173
- Pathname Expansion page 418

Using **find** to locate and act on files based on type, size, or time
- **find**: Finds Files Based on Criteria page 237

Usage of **tar**, **cpio**, and **dd**
- **tar**: Stores or Extracts Files to/from an Archive File page 257
- **tar**: Archives Files page 569
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- **cp**
  - **mv**, **cp**: Move or Copy Files page 195
  - **cp**: Copies Files page 232

- **find**
  - **find**: Finds Files Based on Criteria page 237

- **mkdir**
  - **mkdir**: Creates a Directory page 192

- **mv**
  - **mv**, **cp**: Move or Copy Files page 195
  - **mv**: Moves a Directory page 196
  - **mv**: Renames or Moves a File page 245

- **ls**
  - **ls -l**: Displays Permissions page 199
  - **ls**: Displays Information About Files page 229

- **rm**
  - **rm**: Removes a Link page 216
  - **rm**: Removes a File (Deletes a Link) page 231

- **rmdir**
  - **rmdir**: Deletes a Directory page 194

- **touch**
  - **touch**: Changes File Modification and Access Times page 251
103.4 Use Streams, Pipes, and Redirects

Redirecting standard input, standard output, and standard error
- Redirecting Standard Output page 162
- Redirecting Standard Input page 163
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- redirection page 1268 (Glossary)
- standard error page 1274 (Glossary)
- standard input page 1274 (Glossary)
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Pipe the output of one command to the input of another command
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- Filters page 169
- filter page 1248 (Glossary)
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- xargs: Converts Standard Input to Command Lines page 268

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tee
- tee page 170

xargs
- xargs: Converts Standard Input to Command Lines page 268
103.5 Create, Monitor, and Kill Processes

Run jobs in the foreground and background
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- Moving a Job from the Foreground to the Background page 172
- Background process page 381
- background process page 1235 (Glossary)
- foreground process page 1248 (Glossary)

Signal a program to continue running after logout
- Process Identification page 380
- ps page 380
- ps page 456

Monitor active processes
- Process Identification page 380
- ps page 456
- top: Lists Processes Using the Most Resources page 577

Select and sort processes for display
- Process Identification page 380
- ps page 456
- top: Lists Processes Using the Most Resources page 577

Send signals to processes
- Aborting Execution page 130
- kill: Aborting a Background Job page 172
- kill: Sends a Signal to a Process page 455
- killall: Kills a Command page 457
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Partial List of Used Files, Terms, and Utilities

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- Background process page 381
- background process page 1235 (Glossary)
- foreground process page 1248 (Glossary)

bg
- Moving a Job from the Foreground to the Background page 172
- bg: Sends a Job to the Background page 354
- background process page 1235 (Glossary)

fg
- Foreground page 171
- Moving a Job from the Foreground to the Background page 172
- fg: Brings a Job to the Foreground page 353
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jobs
- Determining the number of a job using jobs page 172
- jobs: Lists Jobs page 352

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- kill: Aborting a Background Job page 172
- kill: Sends a Signal to a Process page 455
nohup
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  ▶ Process Identification page 380
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top
  ▶ top: Lists Processes Using the Most Resources page 577
free
  ▶ free: Displays Memory Usage Information page 261
uptime
  ▶ uptime: Displays System Load and Duration Information page 261
killall
  ▶ killall: Kills a Command page 457

103.6 Modify Process Execution Priorities
Know the default priority of a job that is created
  ▶ Process Identification page 380
  ▶ ps page 456
  ▶ top: Lists Processes Using the Most Resources page 577
Run a program with higher or lower priority than the default
Change the priority of a running process

Partial List of Used Files, Terms, and Utilities
nice
  ▶ Process Identification page 380
  ▶ ps page 456
renice
top
  ▶ top: Lists Processes Using the Most Resources page 577

103.7 Search Text Files Using Regular Expressions
See Appendix A: Regular Expressions page 1161
Create simple regular expressions containing several notational elements
  ▶ Appendix A: Regular Expressions page 1161
  ▶ Regular Expressions page 1123 (Python)
Use regular expression tools to perform searches through a filesystem or file content
  ▶ See preceding entry.

Partial List of Used Files, Terms, and Utilities
grep
  ▶ grep: Searches for a Pattern in Files page 240
egrep
  ▶ Extended regular expression page 241
fgrep
sed
  ▶ regex(7)
### 103.8 Perform Basic File Editing Operations Using vi

A Practical Guide to Ubuntu Linux, Fourth 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 270**

Navigate a document using vi
- Moving the Cursor page 274

Use basic vi modes
- Command and Input Modes page 272

Insert, edit, delete, copy, and find text
- Entering Text page 273
- Deleting Text page 275
- Correcting Text page 276

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vi
- Tutorial: Using vim to Create and Edit a File page 270

/, ?
- Moving the Cursor page 274

h, j, k, l
- Entering Text page 273
- Entering Additional Text page 276

c, d, p, y, dd, yy
- Deleting Text page 275

ZZ, :w!, :q!, :e!
- Ending the Editing Session page 276

### 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 497
- ext2 to ext3 page 505

**ext3**
- ext3 page 497
- ext3 to ext2 page 505

**xfs**
- The XFS Filesystem page 506

**reiserfs v3**
- reiserfs page 498

**vfat**
- vfat page 498
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fdisk
  - fdisk: see the fdisk man page
  - See also parted: Reports on and Partitions a Hard Disk page 579
mkfs
  - mkfs: Creates a Filesystem page 457
mkswap
  - swap page 491

104.2 MAINTAIN THE INTEGRITY OF FILESYSTEMS

Verify the integrity of filesystems
  - fsck: Checks Filesystem Integrity page 503
Monitor free space and inodes
  - df: shows where directory hierarchies are mounted page 846
Repair simple filesystem problems
  - fsck: Checks Filesystem Integrity page 503

Partial List of Used Files, Terms, and Utilities

du
  - du: Displays Disk Usage Information page 501
df
  - df: shows where directory hierarchies are mounted page 846
fsck
  - fsck: Checks Filesystem Integrity page 503
e2fsck
mke2fs
dump
debug

dumpe2fs
tune2fs
  - tune2fs: Changes Filesystem Parameters page 504
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 499
  - umount: Unmounts a Filesystem page 501
  - mount: Mounts a Directory Hierarchy page 849
  - M ounting Shares page 876

Configure filesystem mounting on bootup
  - fstab: Keeps Track of Filesystems page 502
  - fstab file page 849
  - /etc/fstab: Mounts Directory Hierarchies Automatically page 853
Configure user mountable removable filesystems

- Mount Options page 500

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/etc/fstab
- `fstab`: Keeps Track of Filesystems page 502
- `fstab`: file page 849
- `/etc/fstab`: Mounts Directory Hierarchies Automatically page 853

/media
- mount: Mounts a Filesystem page 499
- mount: Mounts a Directory Hierarchy page 849
- Mounting Shares page 876

/unmount
- umount: Unmounts a Filesystem page 501

104.4 Manage Disk Quotas

Set up a disk quota for a filesystem

- Disk Quota System page 592

Edit, check and generate user quota reports

- `quota` and `repquota` page 593

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`quota`
- quota and repquota page 593

`edquota`
- edquota and quotaon page 593

`repquota`
- quota and repquota page 593

`quotaon`
- edquota and quotaon page 593

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 201
- `chmod`: Makes a File Executable page 343

Use access modes such as suid, sgid, and the sticky bit to maintain security

- Setuid and Setgid Permissions page 204
- Setuid file page 598
- Setuid files page 614
- `setgid` page 1271 (Glossary)
- `setuid` page 1271 (Glossary)

Know how to change the file creation mask

- `umask`: Specifies the File Permission Mask page 459
Use the group field to grant file access to group members

- **ls -l**: Displays Permissions page 199  
- **chmod**: Changes File Access Permissions page 201  
- **/etc/group** page 484

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

**chmod**

- **chmod**: Changes File Access Permissions page 201  
- **chmod**: Makes a File Executable page 343

**umask**

- **umask**: Specifies the File Permission Mask page 459

**chown**

- **chown**: Changes File Ownership page 203

**chgrp**

- **chgrp**: Changes File Group Association page 203

### 104.6 CREATE AND CHANGE HARD AND SYMBOLIC LINKS

#### Create links

- **ln**: Creates a Hard Link page 212  
- **ln**: Creates Symbolic Links page 215

#### Identify hard and/or softlinks

- **ls** and link counts page 214  
- **ls** and inodes page 214  
- **hard link** page 1250 (Glossary)  
- **link** page 1256 (Glossary)  
- **symbolic link** page 1276 (Glossary)

#### Copying versus linking files

- **cp Versus ln** page 213

#### Use links to support system administration tasks

- **ln**: Creates a Hard Link page 212  
- **ln**: Creates Symbolic Links page 215

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

**ln**

- **ln**: Creates a Hard Link page 212  
- **ln**: Creates Symbolic Links page 215

### 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 197  
- **Important Files and Directories** page 480

#### Find files and commands on a Linux system

- **whereis** page 263  
- **locate**: Searches for a File page 264
Know the location and purpose of important files and directories as defined in the FHS

- Important Standard Directories and Files page 197
- Important Files and Directories page 480

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- `find`: Finds Files Based on Criteria page 237
- `locate`: Searches for a File page 264
- `updatedb` page 264
- `whereis` page 263
- `which` page 263
- `type`: Displays Information About a Command page 1063

```
/etc/updatedb.conf
```

---

**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 333

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

- Startup Files page 335
- Set `PATH` in `.bash_profile` page 337
- Keyword variables page 359
- Keyword Variables page 364

Write `bash` functions for frequently used sequences of commands

- Functions page 402
- Variables in Functions page 1061

Maintain skeleton directories for new user accounts

- `useradd`: Adds a User Account page 566

Set command search path with the proper directory

- `PATH`: Where the Shell Looks for Programs page 365

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/etc/profile
```

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- `/etc/profile` and `/etc/profile.d` page 487
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  env: Runs a Program in a Modified Environment page 1057

export
  declare: Lists and Assigns Attributes to Variables page 363
  export: Puts Variables in the Environment page 1054

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  set ±o: Turns Shell Features On and Off page 406
  set: Initializes Positional Parameters page 1046

unset
  unset: Removes a Variable page 362

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  .bash_profile, .bash_login, and .profile page 336
  ~/.bash_profile page 480

~/.bash_login
  .bash_profile, .bash_login, and .profile page 336

~/.profile
  .bash_profile, .bash_login, and .profile page 336

~/.bashrc
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~/.bash_logout
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Functions
  Functions page 402
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  Aliases page 398
  Alias Substitution page 410

Lists
  Lists page 170

105.2 Customize or Write Simple Scripts
See Chapter 9: The Bourne Again Shell (bash) page 333
See Chapter 28: Programming the Bourne Again Shell (bash) page 1003

Use standard sh syntax (loops, tests)
  Control Structures page 1004

Use command substitution
  Command Substitution page 416

Test return values for success or failure or other information provided by a command
  test builtin page 1005
  [] is a synonym for test page 1008
  test builtin page 1022
Perform conditional mailing to the superuser
Correctly select the script interpreter through the shebang (#!) line
  > #! Specifies a Shell page 344
Manage the location, ownership, execution, and suid-rights of scripts
  > Listing setuid files page 614

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  > for...in page 1017
  > for page 1019
while
  > while page 1021
test
  > test builtin page 1005
  > [] is a synonym for test page 1008
  > test builtin page 1022
if
  > if...then page 1005
  > if...then...else page 1009
  > if...then...elif page 1011
read
  > read: Accepts User Input page 1063
seq
  > seq page 413

105.3 SQL Data Management
See Chapter 30: The MariaDB SQL Database Management System page 1135
Use of basic SQL commands
  > Notes page 1136
Perform basic data manipulation
  > Examples page 1145

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  > INSERT INTO page 1147
update
  > UPDATE page 1150
select
  > Retrieving Data page 1148
  > Joins page 1152
delete
  > DELETE FROM page 1150
from
  > DELETE FROM page 1150
where
  ▪ WHERE page 1149

group by
  ▪ ORDER BY page 1148

join
  ▪ Joins page 1152

106 User Interfaces and Desktops

106.1 Install and Configure X11
See X Window System page 471

Verify that the video card and monitor are supported by an X server
  ▪ Displays page 116

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 473

DISPLAY
  ▪ The DISPLAY Variable page 474

xwininfo

xdpyinfo

X
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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

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/etc/inittab
  ▪ /etc/inittab page 486

xdm configuration files

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gdm configuration files
  ▪ Graphical login page 440
  ▪ The Xorg -nolisten tcp Option page 472
106.3 Accessibility
Keyboard Accessibility Settings (accessX?)
Visual Settings and Themes
Assistive Technology (ATs)

Partial List of Used Files, Terms, and Utilities
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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
- unity-control-center: Manages User Accounts page 564
- Managing User Accounts from the Command Line page 566

Manage user/group info in password/group databases
- Modifying a User page 566
- usermod: Modifies a User Account page 567
- groupadd: Adds a Group page 567
- groupdel and groupmod: Remove and Modify a Group page 567
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Create and manage special purpose and limited accounts

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groupadd
  - groupadd: Adds a Group page 567

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  - groupdel and groupmod: Remove and Modify a Group page 567

groupmod
  - groupdel and groupmod: Remove and Modify a Group page 567

passwd
  - User Accounts: Changing Your Account Type and Password (GUI) page 118
  - passwd: Changing Your Password (CLI) page 144

useradd
  - useradd: Adds a User Account page 566

userdel
  - userdel: Removes a User Account page 566

usermod
  - usermod: Modifies a User Account page 567

107.2 Automate System Administration Tasks by Scheduling Jobs
Manage cron and at jobs
  - cron and anacron: Schedule Routine Tasks page 573
  - at: Runs Occasional Tasks page 576

Configure user access to cron and at services
  - / etc/at. allow, / etc/at. deny, / etc/cron. allow, and / etc/cron. deny page 484

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/etc/at.deny
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/etc/at.allow
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/etc/crontab
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/etc/cron.allow
  - /etc/at.allow, /etc/at.deny, /etc/cron.allow, and /etc/cron.deny page 484

/etc/cron.deny
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/var/spool/cron/*
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crontab
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  - cron and anacron: Schedule Routine Tasks page 573
107.3 Localization and Internationalization

Locale settings
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Partial List of Used Files, Terms, and Utilities
- `/etc/timezone`
  - `/etc/timezone` page 378
- `/etc/localtime`
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- `/usr/share/zoneinfo`
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Environment variables:
- `LC_`: Locale Variables page 374
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Partial List of Used Files, Terms, and Utilities
- `/usr/bin/locale`
  - `locale`: Displays Locale Information page 375
- tzselect
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- tzconfig
  - tzconfig page 378
- date
  - date: Displays the System Time and Date page 226
- iconv
- UTF-8
  - `LC_`: Locale Variables page 374
  - UTF-8 page 1280 (Glossary)
- ISO-8859
  - `LC_`: Locale Variables page 374
- ASCII
  - ASCII page 1233 (Glossary)
108 ESSSENTIAL SYSTEM SERVICES

108.1 MAINTAIN SYSTEM TIME

Set the system date and time
- `timedatectl`: Reports on and Sets the System Clock page 579

Set the hardware clock to the correct time in UTC
Configure the correct time zone
- `Time` page 377

Basic NTP configuration
Knowledge of using the pool.ntp.org service

Partial List of Used Files, Terms, and Utilities

- `/usr/share/zoneinfo`
  - `/usr/share/zoneinfo` page 378

- `/etc/timezone`
  - `/etc/timezone` page 378

- `/etc/localtime`
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- `/etc/ntp.conf`

- `date`
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- `hwclock`

- `ntpd`

- `ntpdate`

- `pool.ntp.org`

108.2 SYSTEM LOGGING

Syslog configuration files
- `rsyslog.conf` page 585

- `syslog`:
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standard facilities, priorities, and actions
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108.3 Mail Transfer Agent (MTA) Basics
See Chapter 21: postfix: Setting Up Mail Servers, Clients, and More page 779

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  ▶ /etc/aliases page 794

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  ▶ ~/.forward page 796

Knowledge of commonly available MTA programs (postfix, sendmail, Qmail, exim) (no configuration)
  ▶ Alternatives to postfix page 783

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- The System Configures a Local Printer Automatically page 542
- JumpStart I: Configuring a Printer Using system-config-printer page 542
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- Working with the CUPS Web Interface page 548
- Configuring Printers page 549
Manage user print queues
- Managing Print Queues page 555
Troubleshoot general printing problems
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- JumpStart I: Configuring a Printer Using system-config-printer page 542
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lpd legacy interface (lpr, lprm, lpq)
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109 NETWORKING FUNDAMENTALS
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109.1 FUNDAMENTALS OF INTERNET PROTOCOLS
See Network Protocols page 296
Demonstrate an understanding of network masks
- Subnet mask page 304
- network mask page 1262 (Glossary)
Knowledge of the differences between private and public “dotted quad” IP addresses
- Private address space page 667
- private address space page 1266 (Glossary)
Setting a default route
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.
Knowledge about the differences and major features of UDP, TCP, and ICMP

- UDP page 296
- UDP: User Datagram Protocol page 298
- TCP page 296
- TCP: Transmission Control Protocol page 297
- ping: Tests a Network Connection page 311
- UDP page 1279 (Glossary)
- TCP page 1276 (Glossary)
- ICMP page 1252 (Glossary)

Knowledge of the major differences between IPv4 and IPv6

- IPv4 page 298
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- Network Services page 319
- /etc/services page 489

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- Chapter 20: FTP: Transferring Files Across a Network page 753

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- host and dig: Query Internet Nameservers page 313

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- host and dig: Query Internet Nameservers page 313
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Manually and automatically configure network interfaces

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- NetworkManager: Configures Network Connections page 667
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/etc/nsswitch.conf
  - nsswitch.conf: Which Service to Look at First page 468

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  - ping: Tests a Network Connection page 311

**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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  - hostnamectl page 227
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  - dig page 901
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▶ traceroute: Traces a Route over the Internet page 312

109.4 Configure Client Side DNS
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Demonstrate the use of DNS on the local system
▶ JumpStart: Setting Up a DNS Cache page 906
Modify the order in which name resolution is done
▶ Resolver page 894
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/etc/resolv.conf
▶ /etc/resolv.conf page 488
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110.1 Perform Security Administration Tasks
Audit a system to find files with the suid/sgid bit set
▶ Listing setuid files page 614
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Set or change user passwords and password aging information
▶ User Accounts: Changing Your Account Type and Password (GUI) page 118
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Awareness of shadow passwords and how they work

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Understand the role of TCP wrappers

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- Going to Recovery (Single-User) Mode page 442

**/etc/passwd**

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/etc/hosts.deny
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