Linux Professional Institute Certification Level 1

Complete Study Guide & Reference Manual

Exam Objectives Coverage

System Architecture	User Interfaces
Linux Installation	Administrative Tasks
GNU and Unix Commands	Essential System Services
Devices, Filesystems	Networking Fundamentals
Shell Scripting	Security

Exam Codes: 101-500 & 102-500

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For educational purposes only

Contents

1 Introduction to LPIC-1 Certification

About LPIC-1 Certification

LPIC-1 is the first certification in the Linux Professional Institute's multi-level program. It validates the ability to perform maintenance tasks on the command line, install and configure a computer running Linux, and configure basic networking.

1.1 Exam Details

Parameter	Details
Exam Code	101-500 and 102-500
Number of Questions	60 per exam
Duration	90 minutes per exam
Passing Score	500/800 (62.5%)
Required Score	Must pass both exams
Validity	5 years

Table 1: LPIC-1 Exam Specifications

2 System Architecture

2.1 Determine and Configure Hardware Settings

Key Commands

```
# Hardware Information
lspci           # List PCI devices
lsusb           # List USB devices
lsblk           # List block devices
lscpu           # Show CPU information
free -h         # Memory usage
dmidecode       # DMI table decoder
```

Important Files

- `/proc/cpuinfo` - CPU information
- `/proc/meminfo` - Memory information
- `/proc/interrupts` - IRQ assignments
- `/proc/ioports` - I/O port assignments
- `/proc/dma` - DMA channel assignments

2.2 Boot the System

Bootloader	Configuration File	Command
GRUB Legacy	/boot/grub/menu.lst	grub-install
GRUB 2	/boot/grub/grub.cfg	update-grub
LILO	/etc/lilo.conf	lilo

Table 2: Linux Bootloaders

3 Linux Installation and Package Management

3.1 Design Hard Disk Layout

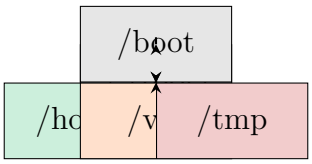


Figure 1: Typical Linux Filesystem Hierarchy

3.2 Install Boot Manager

Listing 1: GRUB 2 Installation

```
# Install GRUB to MBR
grub-install /dev/sda

# Update GRUB configuration
update-grub

# For UEFI systems
grub-install --target=x86_64-efi --efi-directory=/boot/efi
```

3.3 Manage Shared Libraries

- `ldd` - Print shared library dependencies
- `ldconfig` - Configure dynamic linker run-time bindings
- `/etc/ld.so.conf` - Configuration file for ldconfig
- `LD_LIBRARY_PATH` - Environment variable for libraries

3.4 Package Management

Debian/Ubuntu (APT)

```
apt update                  # Update package list
apt upgrade                 # Upgrade packages
apt install package         # Install package
apt remove package          # Remove package
apt search keyword          # Search for packages
apt-cache show package      # Show package info
dpkg -i package.deb         # Install .deb file
dpkg -l                     # List installed packages
```

RHEL/CentOS/Fedora (YUM/DNF)

```
yum install package         # Install package
yum remove package          # Remove package
yum update                  # Update packages
yum search keyword          # Search packages
yum info package            # Package information
```

```
rpm -i package.rpm          # Install .rpm file
rpm -qa                     # List installed packages
rpm -ql package             # List package files
```

4 GNU and Unix Commands

4.1 Work on the Command Line

Command	Description
`man command`	Display manual page
`info command`	Display info documentation
`whatis command`	One-line description
`which command`	Show full path of command
`whereis command`	Locate binary, source, and manual
`type command`	Display command type
`help`	Display shell built-in help

Table 3: Help and Documentation Commands

4.2 Process Text Streams Using Filters

Command	Description
`cat`	Concatenate and display files
`tac`	Concatenate and display in reverse
`head`	Output first part of files
`tail`	Output last part of files
`cut`	Remove sections from lines
`paste`	Merge lines of files
`sort`	Sort lines of text
`uniq`	Report or omit repeated lines
`wc`	Print line, word, and byte counts
`tr`	Translate or delete characters
`expand`	Convert tabs to spaces
`unexpand`	Convert spaces to tabs
`nl`	Number lines of input
`od`	Dump files in octal and other formats
`fmt`	Simple text formatter
`pr`	Convert text files for printing

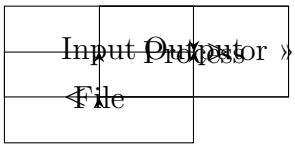
4.3 Perform Basic File Management

Listing 2: File Operations

```
# Copy files and directories
cp file1 file2
cp -r dir1 dir2

# Move/rename files
mv oldname newname
mv file /path/to/destination/

# Remove files and directories
rm file
```

```
rm -r directory
rm -f file  # force removal

# Create and remove directories
mkdir newdir
mkdir -p path/to/newdir
rmdir emptydir

# Create links
ln -s target linkname  # symbolic link
ln target linkname     # hard link
```

4.4 Use Streams, Pipes, and Redirects



Listing 3: I/O Redirection Examples

```
# Standard output redirection
command > file        # Overwrite file
command >> file       # Append to file

# Standard error redirection
command 2> error.log  # Redirect errors
command 2>&1          # Merge stderr with stdout

# Input redirection
command < input.txt

# Pipes
command1 | command2 | command3

# Here document
cat << EOF
This is a
multiline
text
EOF
```

4.5 Create, Monitor, and Kill Processes

Signal	Number	Description
SIGHUP	1	Hangup (reload configuration)
SIGINT	2	Interrupt (Ctrl+C)
SIGKILL	9	Kill (cannot be caught/ignored)
SIGTERM	15	Terminate (graceful shutdown)
SIGSTOP	19	Stop (pause process)
SIGCONT	18	Continue (resume process)

Table 5: Common Linux Signals

Process Management Commands

```
# Process viewing
ps aux          # Show all processes
ps -ef          # Full format listing
top             # Interactive process viewer
htop            # Enhanced top (if installed)
pstree          # Show process tree

# Process control
kill PID        # Send TERM signal
kill -9 PID     # Force kill
killall name    # Kill all processes with name
pkill pattern   # Kill by pattern

# Job control
jobs            # List jobs
fg %n           # Bring job n to foreground
bg %n           # Send job n to background
Ctrl+Z          # Suspend foreground job
Ctrl+C          # Interrupt process
```

4.6 Modify Process Execution Priorities

- `nice` - Run a program with modified scheduling priority
- `renice` - Alter priority of running process
- Priority range: -20 (highest) to 19 (lowest)
- Only root can set negative nice values

Listing 4: Process Priority Examples

```
# Start process with low priority
nice -n 10 command

# Start process with high priority (root only)
nice -n -10 command

# Change priority of running process
renice -5 PID
```

5 Devices, Linux Filesystems, Filesystem Hierarchy Standard

5.1 Create Partitions and Filesystems

Listing 5: Partition Management

```
# List disks and partitions
fdisk -l
lsblk
parted -l

# Create partition with fdisk
fdisk /dev/sda
# Commands in fdisk:
# n - new partition
# p - print partition table
# d - delete partition
# w - write changes and exit
# q - quit without saving

# Create partition with parted
parted /dev/sda
mkpart primary ext4 1MiB 1GiB

# Create filesystem
mkfs.ext4 /dev/sda1
mkfs.xfs /dev/sda2
mkfs.vfat /dev/sda3

# Check filesystem
fsck /dev/sda1
e2fsck /dev/sda1
```

5.2 Maintain the Integrity of Filesystems

- `du` - Estimate file space usage
- `df` - Report filesystem disk space usage
- `dumpe2fs` - Dump ext2/ext3/ext4 filesystem information
- `tune2fs` - Adjust tunable filesystem parameters
- `debugfs` - ext2/ext3/ext4 filesystem debugger
- `xfs_info` - XFS filesystem information

5.3 Control Mounting and Unmounting of Filesystems

Listing 6: Mount Operations

```
# Mount filesystem
mount /dev/sda1 /mnt
mount -t ext4 /dev/sda1 /mnt
mount -o ro /dev/sda1 /mnt  # Read-only
```

```

# Unmount filesystem
umount /mnt
umount /dev/sda1

# List mounted filesystems
mount
cat /proc/mounts
findmnt

# Mount at boot (add to /etc/fstab)
/dev/sda1   /mnt/data   ext4   defaults   0   2

# Mount all from fstab
mount -a
```

5.4 Manage Disk Quotas

1. Install quota tools: `apt-get install quota`
2. Enable quotas in /etc/fstab: `usrquota,grpquota`
3. Remount filesystem: `mount -o remount /`
4. Create quota files: `quotacheck -cugm /`
5. Turn on quotas: `quotaon /`
6. Set quotas: `edquota username`

5.5 Manage File Permissions and Ownership

Permission	Description
777	rwxrwxrwx (all permissions for all)
755	rwxr-xr-x (owner: all, group/others: read+execute)
644	rw-r–r– (owner: read+write, others: read)
600	rw——- (owner: read+write, others: none)
400	r——— (owner: read only)
775	rwxrwxr-x (owner/group: all, others: read+execute)

Table 6: Common Permission Numeric Codes

Listing 7: Permission Commands

```
# Change permissions
chmod 755 file
chmod u+x file            # Add execute for user
chmod g-w file            # Remove write for group
chmod o=r file            # Set others to read only
chmod a+x file            # Add execute for all

# Change ownership
chown user file
chown user:group file
chown -R user directory   # Recursive
```

```
12
13 # Change group
14 chgrp group file
15 chgrp -R group directory  # Recursive
16
17 # Special permissions
18 chmod +s file             # Set SUID/SGID
19 chmod +t directory        # Sticky bit
```

5.6 Create and Change Hard and Symbolic Links

Feature	Hard Link	Symbolic Link
Created with	`ln target link`	`ln -s target link`
Inode	Same as original	Different from original
Cross-filesystem	No	Yes
Directory linking	No	Yes
After original deleted	Still works	Broken link
File size	Same as original	Path length

Table 7: Hard Links vs Symbolic Links

6 Shell Scripting and Data Management

6.1 Customize and Use the Shell Environment

Listing 8: Shell Configuration

```
# Environment variables
echo $PATH              # Command search path
echo $HOME              # Home directory
echo $USER              # Current user
echo $SHELL             # Current shell
echo $PS1               # Prompt string
echo $PWD               # Present working directory

# Set environment variables
export VAR=value        # For current shell and children
VAR=value               # For current shell only

# Shell configuration files
~/.bashrc               # Non-login interactive shells
~/.bash_profile         # Login shells
~/.profile              # Alternative profile
/etc/bashrc             # System-wide bashrc
/etc/profile            # System-wide profile

# Aliases
alias ll='ls -la'
alias rm='rm -i'
unalias ll              # Remove alias
```

6.2 Customize or Write Simple Scripts

Listing 9: Basic Shell Script Template

```
#!/bin/bash
# Script: backup.sh
# Description: Backup script example
# Author: Your Name
# Date: $(date)

# Configuration
BACKUP_DIR="/backup"
SOURCE_DIR="/home/user/documents"
DATE=$(date +%Y%m%d_%H%M%S)
LOG_FILE="/var/log/backup.log"

# Functions
log_message() {
    echo "[$(date)] $1" >> "$LOG_FILE"
    echo "$1"
}

# Check if running as root
if [[ $EUID -ne 0 ]]; then
    echo "This script must be run as root" >&2
    exit 1
fi

```

```
# Check if source directory exists
if [ ! -d "$SOURCE_DIR" ]; then
    log_message "ERROR: Source directory $SOURCE_DIR not found"
    exit 1
fi

# Create backup directory if it doesn't exist
mkdir -p "$BACKUP_DIR"

# Perform backup
log_message "Starting backup of $SOURCE_DIR"
tar -czf "$BACKUP_DIR/backup_$DATE.tar.gz" "$SOURCE_DIR"

# Check if backup was successful
if [ $? -eq 0 ]; then
    log_message "Backup completed successfully: backup_$DATE.tar.gz"
    # Remove backups older than 30 days
    find "$BACKUP_DIR" -name "*.tar.gz" -mtime +30 -delete
else
    log_message "ERROR: Backup failed"
    exit 1
fi

log_message "Backup process completed"
```

7 User and Group Administration

7.1 Manage User and Group Accounts

Listing 10: User Management Commands

```
# Add user
useradd username
useradd -m username       # Create home directory
useradd -g groupname username  # Primary group
useradd -G group1,group2 username  # Supplementary groups
useradd -s /bin/bash username  # Specify shell

# Modify user
usermod -aG groupname username  # Add to group
usermod -s /bin/sh username     # Change shell
usermod -L username             # Lock account
usermod -U username             # Unlock account

# Delete user
userdel username
userdel -r username     # Remove home directory and mail

# Manage groups
groupadd groupname
groupdel groupname
gpasswd -a username groupname  # Add user to group
gpasswd -d username groupname  # Remove user from group

# Password management
passwd username
passwd -l username      # Lock password
passwd -u username      # Unlock password
chage username          # Change password aging
```

7.2 Configure User Environment

- `/etc/passwd` - User account information
- `/etc/shadow` - Secure user password information
- `/etc/group` - Group information
- `/etc/gshadow` - Secure group password information
- `/etc/skel/` - Skeleton directory for new users
- `/etc/login.defs` - Configuration for useradd

8 Security

8.1 Perform Security Administration Tasks

- `su` - Switch user
- `sudo` - Execute commands as another user
- `visudo` - Edit sudoers file safely
- `chroot` - Run command with special root directory
- `setuid/setgid` - Special file permissions
- `umask` - Default file permissions

8.2 Set Up Host Security

Listing 11: Security Commands

```
# SSH configuration
/etc/ssh/sshd_config    # SSH server configuration
ssh-keygen              # Generate SSH keys
ssh-copy-id             # Copy SSH key to remote host

# Firewall management (iptables)
iptables -L             # List rules
iptables -A INPUT -p tcp --dport 22 -j ACCEPT
iptables -A INPUT -j DROP

# Firewall management (firewalld)
firewall-cmd --list-all
firewall-cmd --add-port=80/tcp --permanent
firewall-cmd --reload

# SELinux management
getenforce              # Check SELinux status
sestatus                # Detailed SELinux status
setenforce 0            # Disable SELinux (temporary)
setenforce 1            # Enable SELinux (temporary)
```

9 Networking

9.1 Fundamentals of Internet Protocols

- TCP/IP Protocol Suite
- IPv4 and IPv6 Addressing
- Subnetting and CIDR Notation
- Common Ports and Services
  - 22 - SSH
  - 80 - HTTP
  - 443 - HTTPS
  - 53 - DNS
  - 25 - SMTP
  - 110 - POP3
  - 143 - IMAP

9.2 Basic Network Configuration

Listing 12: Network Commands

```
# Network interface configuration
ifconfig eth0 192.168.1.100 netmask 255.255.255.0
ip addr add 192.168.1.100/24 dev eth0

# Network interface control
ifconfig eth0 down
ifconfig eth0 up
ip link set eth0 down
ip link set eth0 up

# Routing configuration
route add default gw 192.168.1.1
ip route add default via 192.168.1.1
route -n
ip route show

# DNS configuration
/etc/resolv.conf        # DNS resolver configuration
/etc/hosts              # Local hostname resolution
```

9.3 Troubleshooting Network Issues

```
ping google.com          # Test connectivity
traceroute google.com    # Trace route
netstat -tulpn           # Show open ports
ss -tulpn                # Alternative to netstat
nslookup google.com      # DNS lookup
dig google.com           # DNS query
host google.com          # Hostname lookup
```

10 Essential System Services

10.1 System Logging

- `rsyslog` - System logging daemon
- `/etc/rsyslog.conf` - Configuration file
- `/var/log/` - Log directory
  - `messages` - General system messages
  - `auth.log` - Authentication logs
  - `syslog` - System logs
  - `kern.log` - Kernel logs
  - `dpkg.log` - Package manager logs
- `logrotate` - Rotate, compress, and mail logs

10.2 Time Synchronization

- `ntpd` - Network Time Protocol daemon
- `chronyd` - Chrony NTP daemon
- `date` - Display or set system date and time
- `timedatectl` - Control system time and date
- `hwclock` - Hardware clock access

10.3 Mail Transfer Agent (MTA) Basics

- `postfix` - Mail transfer agent
- `sendmail` - Alternative MTA
- `mail` - Send and receive mail
- `mailq` - Print mail queue

11 Appendix: Exam Tips and Resources

Exam Preparation Tips

- **Practice on real Linux systems** - Use VirtualBox or VMware
- **Learn command line options** - Focus on commonly used switches
- **Understand configuration files** - Know location and syntax
- **Time management** - Each question has about 1.5 minutes
- **Read questions carefully** - Pay attention to details
- **Use elimination method** - Remove obviously wrong answers

11.1 Recommended Resources

- **Official LPIC-1 Objectives**: https://www.lpi.org/our-certifications/exam-101-objectives
- **LPIC-1 Study Guide** by Christine Bresnahan and Richard Blum
- **Linux Command Line and Shell Scripting Bible** by Richard Blum
- **Online Practice Exams**: Boson, ExamCompass, ExamTopics
- **Linux Documentation Project**: https://tldp.org/

11.2 Command Quick Reference

Category	Key Commands
File Management	ls, cp, mv, rm, find, chmod, chown
Process Management	ps, top, kill, nice, jobs
Text Processing	grep, sed, awk, cut, sort, uniq
Networking	ping, ifconfig, netstat, ssh, scp
Package Management	apt, yum, dpkg, rpm
System Info	uname, df, du, free, lspci, lsusb
User Management	useradd, usermod, passwd, groupadd
Disk Management	fdisk, mkfs, mount, fsck

Table 8: LPIC-1 Essential Commands

Good Luck with Your LPIC-1 Certification!

Remember: Practice is key to success in Linux administration.
