LPIC-1: Linux Professional Institute Certification

Comprehensive Study Notes

Version 1.0

Ehsan Esmaeili

November 18, 2024

Disclaimer

These notes are prepared for LPIC-1 certification exam preparation. They cover essential Linux concepts, commands, and system administration topics.

Contents

Linux Filesystem Hierarchy Standard (FHS)

Key Points

Understanding the Linux directory structure is fundamental for system administration.

Directory Structure

- / - Root directory
- **/boot** - Kernel, initrd, bootloader and its configuration
- **/root** - Root user's home directory
- **/home** - Users' home directories
- **/bin** (binary) - User commands (general commands)
- **/sbin** (system binary) - System commands (administration commands)
- **/lib** (library) - Shared libraries & kernel modules
- **/opt** (optional) - Third-party applications
- **/tmp** (temporary) - Temporary files
- **/etc** (etcetera) - Host configuration files
- **/dev** (device) - Device files
- **/mnt** (mount) - Mount point for peripheral devices
- **/media** - Mount point for removable media
- **/var** (variable) - Variable data (logs, spool, cache, etc.)
- **/usr** (user) - Non-essential executable programs
- **/proc** (process) - Virtual filesystem providing process and kernel information
- **/sys** (system) - Virtual filesystem providing system information

System Identifiers

- **File**: Every file has a unique identifier called `inode#`
- **User**: Every user has a unique identifier called `UID`
- **Group**: Every group has a unique identifier called `GID`
- **Process**: Every process has a unique identifier called `PID`

Basic Linux Commands

File Listing - `ls`

The `ls` command lists files and directories.

Listing 1: ls command examples

```
ls          # Basic listing
ls -a       # Show all files including hidden
ls -l       # Long listing with details
ls -i       # Show inode numbers
ls -la      # Combine options
```

File Types in Detailed Listing

- `-` - Regular file
- `d` - Directory
- `l` - Symbolic link
- `s` - Socket
- `p` - Pipe
- `c` - Character device
- `b` - Block device

Wildcards and Pattern Matching

```
ls *.txt            # All .txt files
ls file?.txt        # file1.txt, file2.txt, etc.
ls [abc]*           # Files starting with a, b, or c
ls [!abc]*          # Files not starting with a, b, or c
ls {file1,file2}    # Specific files
ls file[1-5].txt    # Files file1.txt through file5.txt
```

Navigation Commands

- `pwd` - Print working directory
- `whoami` - Display current username
- `cd` - Change directory
  - `cd -` - Switch between two last directories
  - `cd /path` - Absolute path
  - `cd ./dir` - Relative path
  - `cd ../dir` - Parent directory

File Operations

- `rm` - Remove files
  - `rm -r` - Remove directories recursively
  - `rm -f` - Force removal without confirmation
- `cp` - Copy files
  - `cp -r` - Copy directories recursively
- `mv` - Move/rename files
- `mkdir` - Create directories
  - `mkdir -p` - Create parent directories if needed
- `rmdir` - Remove empty directories
- `touch` - Create empty files or update timestamps

File Examination

- `file` - Determine file type
- `cat` - Concatenate and display files
  - `cat -n` - Number all output lines
- `more` - View file contents page by page
- `less` - Improved version of `more`
- `nl` - Number lines of files

System Information

- `hostname` - Show or set system hostname
- `uname -a` - Show all system information
- `df` - Display disk space usage
  - `df -h` - Human readable format
  - `df -hT` - Show with filesystem type
  - `df -i` - Show inode information
- `du` - Estimate file space usage
  - `du -sh` - Summary in human readable format
  - `du -csh` - Total summary
- `lsblk` - List block devices
- `free -h` - Display memory usage

Text Processing

- `grep` - Search text using patterns
  - `grep -i` - Case insensitive
  - `grep -v` - Invert match
  - `grep -n` - Show line numbers
- `cut` - Remove sections from lines
- `sort` - Sort lines of text
- `uniq` - Report or omit repeated lines
- `wc` - Word count
  - `wc -l` - Count lines
  - `wc -w` - Count words
  - `wc -c` - Count bytes

Permission Management

- `chmod` - Change file permissions
  - `chmod u+w file` - Add write permission for user
  - `chmod 755 file` - Numeric permission setting
- `chown` - Change file owner
  - `chown -r` - Recursive ownership change
  - `chown user:group file` - Change both owner and group
- `chgrp` - Change file group
- `umask` - Set default file permissions
- `stat` - Display file status

Process Management

- `ps` - Report process status
  - `ps aux` - Detailed process information
  - `ps -ef` - Full format listing
  - `ps -el` - Long format
- `top` - Dynamic real-time view of processes
- `kill` - Send signals to processes
  - `kill -9 PID` - Force kill process

  - `kill -15 PID` - Terminate gracefully
- `nice` - Run with modified scheduling priority
- `renice` - Alter priority of running process

Package Management

RPM-based Systems (RedHat/CentOS/Fedora)

- `rpm -i package.rpm` - Install package
- `rpm -e package` - Remove package
- `rpm -q package` - Query package
- `rpm -qa` - List all installed packages

APT-based Systems (Debian/Ubuntu)

- `apt install package` - Install package
- `apt remove package` - Remove package
- `apt update` - Update package list
- `apt upgrade` - Upgrade packages

System Configuration Files

Important Configuration Files

These files are crucial for system administration and troubleshooting.

- **/etc/passwd** - User account information
- **/etc/group** - Group information
- **/etc/shadow** - Secure user password information
- **/etc/fstab** - Filesystem table
- **/etc/hostname** - System hostname
- **/etc/hosts** - Static hostname lookup table
- **/etc/resolv.conf** - DNS resolver configuration
- **/etc/sudoers** - Sudo configuration
- **/etc/ssh/sshd_config** - SSH server configuration
- **/etc/crontab** - System cron jobs

User Environment Files

- **~/.bash_profile** - Login initialization
- **~/.bashrc** - Non-login shell initialization
- **~/.profile** - Default profile
- **~/.bash_logout** - Logout actions

System Information Files

- **/proc/cpuinfo** - CPU information
- **/proc/meminfo** - Memory information
- **/proc/version** - Linux version
- **/proc/swaps** - Swap information
- **/proc/loadavg** - System load average

Network Configuration

Network Commands

- `ifconfig` - Configure network interfaces
- `ip addr show` - Show IP addresses
- `route -n` - Display routing table
- `ping` - Test network connectivity
- `netstat` - Network statistics
- `ss` - Socket statistics
- `hostname` - Show or set hostname

SSH Configuration

- **Connect to remote server**: `ssh user@hostname`
- **Copy files securely**: `scp file user@hostname:path`
- **SSH configuration file**: `/etc/ssh/sshd_config`

Network Configuration Files

- **Debian/Ubuntu**: `/etc/network/interfaces`
- **RedHat/CentOS**: `/etc/sysconfig/network-scripts/ifcfg-*`
- **DNS Configuration**: `/etc/resolv.conf`
- **Hosts file**: `/etc/hosts`

Disk Management

Partition Management

- `fdisk` - Partition table manipulator
- `parted` - Partition manipulation program
- `gdisk` - GPT fdisk

Filesystem Operations

- `mkfs` - Build a filesystem
  - `mkfs.ext4` - Create ext4 filesystem
  - `mkfs.xfs` - Create XFS filesystem
- `mount` - Mount filesystem
- `umount` - Unmount filesystem
- `fsck` - Check and repair filesystem

Swap Management

- `mkswap` - Set up a Linux swap area
- `swapon` - Enable swapping
- `swapoff` - Disable swapping

System Services and Runlevels

Systemd Service Management

- `systemctl start service` - Start a service
- `systemctl stop service` - Stop a service
- `systemctl restart service` - Restart a service
- `systemctl enable service` - Enable service at boot
- `systemctl disable service` - Disable service at boot
- `systemctl status service` - Check service status

Runlevels

- **0** - Halt
- **1** - Single user mode
- **2** - Multi-user without NFS
- **3** - Full multi-user mode
- **4** - Unused
- **5** - Graphical mode
- **6** - Reboot

Service Control Commands

- `service` - Run a System V init script
- `chkconfig` - Update runlevel information
- `update-rc.d` - Install/remove System-V style init links

Shell Scripting Basics

Shell Special Characters

- `|` - Pipe (redirect output)
- `;` - Command separator
- `&&` - Logical AND (run next command if previous succeeds)
- `||` - Logical OR (run next command if previous fails)
- `>` - Output redirection
- `>>` - Append output
- `<` - Input redirection
- `2>` - Error redirection

Variable Usage

Listing 2: Shell variables

```
echo $USER        # Current username
echo $HOME        # Home directory
echo $PATH        # Command search path
echo $SHELL       # Current shell
echo $PWD         # Current directory
echo $UID         # User ID
echo $?           # Exit status of last command
```

Bash Script Example

Listing 3: Simple backup script

```
#!/bin/bash
# Simple backup script

BACKUP_DIR="/backup"
SOURCE_DIR="/home/user/documents"
DATE=$(date +%Y%m%d)

if [ ! -d "$BACKUP_DIR" ]; then
    mkdir -p "$BACKUP_DIR"
fi

tar -czf "$BACKUP_DIR/backup_$DATE.tar.gz" "$SOURCE_DIR"

if [ $? -eq 0 ]; then
    echo "Backup␣completed␣successfully!"
else
```

```
    echo "Backup␣failed!"
fi
```

Appendix: Quick Reference

Essential Commands Cheat Sheet

Most frequently used Linux commands for LPIC-1

File Operations

Command	Description
`ls -la`	List all files with details
`cp -r src dst`	Copy recursively
`mv old new`	Move/rename
`rm -rf dir`	Remove force recursively
`find / -name file`	Find files
`grep pattern file`	Search text

System Monitoring

Command	Description
`top`	Process monitor
`df -h`	Disk usage
`free -m`	Memory usage
`ps aux`	Process list
`netstat -tulpn`	Network connections

User Management

Command	Description
`useradd username`	Add user
`passwd username`	Change password
`usermod -aG group user`	Add user to group
`userdel -r username`	Delete user with home
`chmod 755 file`	Change permissions

End of LPIC-1 Study Notes

Good luck with your certification exam!