Seattle Community Network

Linux Introduction

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Contents

Introduction to Linux Class - Seattle Community Network

Welcome to the "Introduction to Linux" class offered by the Seattle Community Network! This class is designed to be your gateway into the world of Linux, an operating system that powers everything from tiny embedded devices to the majority of the world's servers. Whether you're a beginner curious about alternative operating systems or an enthusiast looking to sharpen your tech skills, this course promises to be a valuable resource.

Why Learn Linux?

Linux is more than just another operating system. It's a symbol of collaboration and freedom in software development. Here are a few reasons why learning Linux can be beneficial:

- **Versatility and Flexibility:** Linux can be installed on a wide range of hardware, from old computers to the most modern systems, including laptops, desktops, servers, mobile devices, and even IoT devices.
- **Career Opportunities:** Understanding Linux can open the door to numerous career paths in IT, including system administration, network security, and software development.
- **Open Source Nature:** Linux is free and open source, meaning that you can view, modify, and distribute your modified versions of the code. This transparency is a learning opportunity in itself.
- **Community Support:** Linux's widespread usage and community support make it an excellent choice for those who want to dive deep into learning an OS. With millions of users and developers all over the world, finding help and resources is easier than with proprietary systems.
- **Security and Stability:** Linux is known for its stability and security, making it the preferred choice for servers and critical systems.

Course Overview

This course is structured to help beginners navigate through the basics of Linux, from understanding its history and benefits to hands-on training with the operating system itself. No prior experience with Linux is required. Here's what we'll cover:

- Part 1: Logging into the shell
- Part 2: Navigating the File System
- Part 3: Text Editing
- Part 4: Secure remote access
- Part 5: Package Installation and Management
- Part 6: Network services
- Part 7: Looking at logs
- Part 8: Firewalls, firewall maintenance, and security

Learning Outcomes

By the end of this course, you will:

1. **Understand the fundamentals of Linux,** including its structure and operational concepts.
2. **Gain proficiency in using the Linux command line,** which is invaluable for troubleshooting and automation.
3. **Develop basic system administration skills** that can be built upon for more advanced IT roles.
4. **Be prepared to explore more specialized uses of Linux,** such as network security, software development, and cloud-based applications.

Course Materials and Resources

All participants will have access to:

- Comprehensive course notes and guides
- A list of recommended reading and resources
- Access to a virtual lab environment for hands-on practice
- Community forums for discussion and troubleshooting

Instructors and Community Support

Our course instructors come from a diverse background in IT and are experienced Linux users and enthusiasts. They are committed to providing a supportive learning environment and will be available to answer questions, guide experiments, and provide insights from their professional experiences.

Moreover, by joining this course, you will be part of the Seattle Community Network, a local community-driven initiative that promotes the use of free and open-source software. It's a great place to network, share ideas, and find collaborators on future projects.

Whether you're aiming to enhance your current career or embark on a new one, learning Linux can provide you with a solid foundation in a technology that continues to shape the digital world. We look forward to guiding you through this journey and watching you grow into competent Linux users who can leverage the power of an open-source environment to its fullest potential. Join us to begin your exploration of Linux with the Seattle Community Network!

Let's Get Started!

That covers all the preliminary information you need to know. You're now ready to get started with Chapter 1, where you'll learn how to interact with the Linux shell "bash" and learn why everything in Linux is a file.

Some typographical notations

Notation	Description
bold text	User input, commands, options, areguments, variables, and names of directories.
italic text	Names of variables which are to be assigned (e.g. *password*)
`constant width`	Linux command output, prompt signs and output from commands
< >	Input that won't apepar on the screen when pressed. For example, <ENTER>

Notation	Description
<Ctrl-?>	Hold the control key while pressing another key.
[ ]	Variabls are optional
|	Logical or, for example `[ arg1 | arg2 ]` would represent choose arg1 or arg2

How this book is organized

- Part 1: Logging into the shell
  - Commands: bash, login, ssh
  - Connecting to a remote shell.

- Part 2: Navigating the File System
  - Commands: pwd, cd, ls, mkdir, rmdir, find
  - Parts of a path (root, system directory)
  - Searching for files
  - File permissions
- Part 3: Text Editing
  - Commands: echo, cat, less, nano, grep, touch, joe, shell functions
  - Naming files and directories
  - Editing files
- Part 4: Secure remote access
  - Commands: ssh, ssh-keygen, ssh-copy-id, ssh-add, ssh-agent
  - Files: $HOME/.ssh/authorized_keys
  - Using Secure Shell (SSH)
  - Generating keys, copying keys, adding keys to ssh-agent
- Part 5: Package Installation and Management
  - Commands: apt, yum, /ports
  - Packages and package management
- Part 6: Network services
  - Commands: systemctl
  - Enabling, starting, and stopping network services
  - Verifying connectivity.

- Part 7: Looking at logs
  - Commands: journalctl, less
  - Viewing logs with journalctl
  - Viewing raw logs in /var/log/messages
- Part 8: Firewalls, firewall maintenance, and security
  - Commands: iptables, ufw
  - Listing, adding, and removing firewall rules
  - Viewing firewall logs

Logging In

- Part 1: Logging into the shell
  - Commands: bash, login, ssh
  - Connecting to a remote shell.

There are many ways of accessing Linux. To start for educational purposes, I encourage you to take the path of "Other" below and use this from within your browser.

Go to **https://HostTheBox.com/** or **https://linux.farm/**

Linux

- You're at the office and you've got a Linux workstation in front of you with a piece of paper with your username and password. You start up the computer, a bunch of text flows by and now you're looking at a prompt that says "`Username`." Now what?

In this case most likely you have a graphical interface in front of you and a box to enter text. Into the box labeled "`Username`" you'll enter the **username** provided and then hit <`ENTER`>. After that you'll be prompted for a *password* and again you'll enter the information provided and hit <`ENTER`>.

Once you hit <`ENTER`> the second time you should be logged in and presented with a user interface. I encourage you to click around and see what has been provided for you. In most of the graphical desktop environments there is an Applications menu that will either operate like the "Start" menu in Windows or pop up a "Search" box when you click on Applications. When you're ready to move on to the exercises into this box type "**Terminal**" and hit enter, a black box with a "`$`" prompt should appear.

macOS

- You use a macOS for graphics editing, now you want to expand your portfolio to include websites. You got your first client and they provide you a hostname, user, and

password and expect you to edit the website. How do you connect and login securely?

macOS is a cousin of Linux so you'll have many of the tools you need. Like the first login, you'll do the same. Then you'll go into Utilities and open Terminal. A black box with a "$" prompt should appear. Your client should have provided you `ssh` credentials which you'll enter as such:

From the shell prompt:

`$`: **ssh** *user@host*

`Password`: < ExampleSecret > <`ENTER`>

and another "`$`" prompt should appear.

Windows

- You use a Windows system at the office and were put in charge of auditing the security of your Linux server farm before an audit comes due and you've never touched a Linux server before and first need to know how to login.

The fastest way to get Linux on a Windows system, is to install the Windows Subsystem for Linux or WSL. In order to do this in Windows 10 or later, open a Command Shell via "Run as Administrator" or PowerShell Window and run the command "wsl –install" and Ubuntu Linux will be installed into a virtual machine which you can run as the application "Ubuntu" after which you'll be at a graphical interface and can follow the instructions above.

Other

- Finally, you're only passingly interested in Linux and don't want to spend much time learning it right now but would like to experience it. How can you do that?

Go to **https://HostTheBox.com/** or **https://linux.farm/**

Click on the starter Linux distribution and a black box will open and a "`$`" prompt should appear.

Navigating the file system

- Part 2: Navigating the File System
  - Commands: pwd, cd, ls, mkdir, rmdir, find
  - Parts of a path (root, system directory)
  - Searching for files
  - File permissions

Exercise Set for `pwd` (Print Working Directory)

Exercise 1: Check Your Current Directory

1. Open your terminal.
2. Type `pwd` and press Enter.
3. Note down the output. This shows your current directory path.

Exercise 2: Changing Directories and Verifying

1. Change to your home directory by typing `cd ~` and pressing Enter.
2. Use `pwd` to confirm that you are now in your home directory.
3. Record the output and compare it to the expected home directory path.

Exercise Set for `cd` (Change Directory)

Exercise 1: Navigating to a Subdirectory

1. From your home directory, list all directories using `ls`.
2. Pick a subdirectory and navigate into it using `cd [subdirectory name]`.
3. Use `pwd` to ensure you have moved into the correct directory.

Exercise 2: Returning to the Previous Directory

1. From the current directory, use `cd ..` to go back to the parent directory.
2. Verify your current directory using `pwd`.
3. Navigate back to the initial directory using `cd -` and verify again with `pwd`.

Exercise Set for `ls` (List Directory Contents)

Exercise 1: Listing All Files and Directories

1. In any directory, type `ls -a` to list all contents, including hidden files.
2. Observe the output and identify any hidden files (usually prefixed with a dot).

Exercise 2: Detailed List of Files

1. Use `ls -l` to list all files and directories with detailed information such as permissions, number of links, owner, group, size, and timestamp.
2. Note the file permissions of each file listed.

Exercise Set for `mkdir` (Make Directory)

Exercise 1: Creating a Single Directory

1. Choose a location where you want to create a new directory.
2. Use `mkdir newfolder` to create a directory named `newfolder`.
3. Verify the creation by using `ls` and observing if `newfolder` appears in the output.

Exercise 2: Creating Multiple Directories

1. In your current directory, use `mkdir dir1 dir2 dir3` to create three directories simultaneously.
2. Verify their creation by listing the directory contents with `ls`.

Exercise Set for `rmdir` (Remove Directory)

Exercise 1: Removing an Empty Directory

1. Create a temporary directory using `mkdir tempdir`.
2. Remove this directory by typing `rmdir tempdir`.
3. Confirm removal by listing the directory contents to ensure `tempdir` no longer exists.

Exercise 2: Attempting to Remove a Non-Empty Directory

1. Create a directory and add a file inside it using `mkdir testdir` and `touch testdir/testfile`.
2. Try removing the directory using `rmdir testdir` and observe the error message.
3. Remove the file with `rm testdir/testfile` and then remove the directory using `rmdir testdir`. Confirm the directory is removed.

Exercise Set for `find`

Exercise 1: Finding Files by Name

1. In your home directory, use `find . -name "sample.txt"` to search for a file named `sample.txt`.
2. Observe and note down which directories contain the file named `sample.txt`.

Exercise 2: Finding Directories

1. Use `find / -type d -name "config"` to find all directories named `config` starting from the root directory.
2. Note the paths of all directories named `config`.

Text Editing

- Part 3: Text Editing
  - Commands: echo, cat, less, nano, grep, touch, joe, shell functions
  - Naming files and directories
  - Editing files

Exercise Set for `echo` (Display a Line of Text)

Exercise 1: Display Simple Text

1. Open your terminal.
2. Type `echo "Hello, Linux World!"` and press Enter.
3. Observe the text displayed on your terminal.

Exercise 2: Redirecting Echo to a File

1. In the terminal, type `echo "This is a test file content."> testfile.txt`.
2. Use `cat testfile.txt` to view the contents of the file and verify that the text has been written.

Exercise Set for `cat` (Concatenate and Display Files)

Exercise 1: Viewing Contents of a File

1. Create a file using `echo "First line of text"> myfile.txt`.
2. Add a second line using `echo "Second line of text">> myfile.txt`.
3. Use `cat myfile.txt` to display the contents of the file.

Exercise 2: Concatenating Multiple Files

1. Create another file using `echo "Another file content."> anotherfile.txt`.
2. Concatenate both files and view the output using `cat myfile.txt anotherfile.txt`.

Exercise Set for `less` (View Content of a File Page by Page)

Exercise 1: View a Large File

1. Create a large file by typing `for i in {1..500}; do echo "Line $i">> largefile.txt; done`.
2. Open the file using `less largefile.txt`.
3. Navigate through the file using the arrow keys and observe how `less` handles large file navigation.

Exercise 2: Search Within a File in `less`

1. While still in `less`, type `/Line 150` and press Enter to search for "Line 150".
2. Observe how `less` navigates directly to the line containing the search term.

Exercise Set for `nano` (Basic Text Editor)

Exercise 1: Create and Edit a File with Nano

1. Open terminal and type `nano mytextfile.txt`.
2. In nano, type a few lines of text.
3. Use `CTRL`+`O` and `ENTER` to save the file, then `CTRL`+`X` to exit nano.

Exercise 2: Modify an Existing File

1. Reopen `mytextfile.txt` in nano.
2. Add additional text and use `CTRL`+`X`, then `Y` and `ENTER` to save changes and exit.

Exercise Set for `grep` (Search Text Using Patterns)

Exercise 1: Basic Text Search

1. Use `grep "line"largefile.txt` to find all occurrences of "line" in the previously created large file.
2. Observe and record which lines contain the word.

Exercise 2: Case Insensitive Search

1. Use `grep -i "LINE"largefile.txt` to perform a case-insensitive search.
2. Compare the output with the previous case-sensitive search.

Exercise Set for `touch` (Change File Timestamps/Create Files)

Exercise 1: Creating a New File

1. In the terminal, type `touch newfile.txt`.
2. Use `ls -l newfile.txt` to verify the creation date and time of the file.

Exercise 2: Updating the Timestamp of an Existing File

1. Wait a minute, then use `touch newfile.txt` again.
2. Check the timestamp again using `ls -l newfile.txt` to see the update.

Exercise Set for `joe` (Joe's Own Editor)

Exercise 1: Editing in Joe

1. Open terminal and type `joe anothernewfile.txt`.
2. Type some text, then save with `CTRL`+`K X` and confirm saving when prompted.

Exercise 2: Searching in Joe

1. Reopen `anothernewfile.txt` in joe.
2. Press `CTRL`+`K W` and type a search term that is in the text, then `ENTER` to find it.

Exercise Set for Shell Functions

Exercise 1: Create a Simple Function

1. Open your terminal.
2. Type the following to create a function named `greet`:

```
greet() {
    echo "Welcome, $1!"
}
```

3. Activate the function by typing `greet "User"` and observe the output.

Exercise 2: A More Complex Function

1. Define a function `list_files` that takes a directory name and lists its contents:

```
list_files() {
    echo "Listing files in $1:"
    ls -l $1
}
```

2. Call the function with a directory path, e.g., `list_files /home/user`.

Secure remote access

- Part 4: Secure remote access
  - Commands: ssh, ssh-keygen, ssh-copy-id, ssh-add, ssh-agent
  - Files: $HOME/.ssh/authorized_keys
  - Using Secure Shell (SSH)
  - Generating keys, copying keys, adding keys to ssh-agent

Exercise Set for `ssh` (Secure Shell)

Exercise 1: Connect to a Remote Server

1. If you have access to a remote server (make sure you have permission to access it), open your terminal.
2. Connect using `ssh username@hostname` (replace `username` with your actual username on the server and `hostname` with the server's IP address or domain name).
3. If connected successfully, execute a simple command like `ls` or `pwd` to ensure the connection is working.

Exercise 2: Running a Command on a Remote Server 1. Without logging into the server's interactive shell, run a command remotely: `ssh username@hostname pwd`. 2. This command should output the current working directory on the remote server.

Exercise Set for `ssh-keygen` (SSH Key Generator)

Exercise 1: Generate a New SSH Key Pair

1. In your terminal, type `ssh-keygen -t rsa -b 4096` to generate a new RSA key pair with 4096 bits.
2. Follow the prompts to choose the file in which to save the key and enter a passphrase for added security.

Exercise 2: View and Confirm the SSH Key Pair

1. Navigate to the directory where the keys are stored (usually `~/.ssh/`).
2. Use `cat ~/.ssh/id_rsa.pub` to view the public key.

Exercise Set for `ssh-copy-id` (Copy SSH Key to Remote Server)

Exercise 1: Copy Your SSH Public Key to a Server

1. Assuming you have a remote server where you have password-based SSH access, type `ssh-copy-id username@hostname`.
2. Enter your password when prompted to copy your public key to the server's authorized keys.

Exercise 2: SSH into the Server Without a Password

1. After copying the key, try to SSH into the server again using `ssh username@hostname`.
2. If the key was successfully copied, you should not be prompted for a password.

Exercise Set for `ssh-add` (Add SSH Key to the Agent)

Exercise 1: Add SSH Key to the SSH Agent

1. First, ensure the ssh-agent is running: `eval "$(ssh-agent -s)"`.
2. Add your SSH private key to the agent using `ssh-add ~/.ssh/id_rsa`.
3. Enter your passphrase if prompted.

Exercise 2: List the Keys Added to the Agent

1. Check which keys are loaded into the ssh-agent by typing `ssh-add -l`.
2. The output will list all keys currently managed by the agent.

Exercise Set for `ssh-agent` (SSH Authentication Agent)

Exercise 1: Start the SSH Agent

1. Open your terminal and start the ssh-agent with `eval "$(ssh-agent -s)"`.
2. Note the agent PID that is output to the terminal.

Exercise 2: Use the SSH Agent with SSH-Add

1. After starting the ssh-agent, add a key as done in the previous exercise.
2. SSH into a server to verify that the agent is using the key for authentication without needing to re-enter the passphrase.

Package Installation and Management

- Part 5: Package Installation and Management
  - Commands: apt, yum, /ports
  - Packages and package management

Here are practical exercises for each of the package management commands and systems used in various Linux distributions, specifically `apt` for Debian-based systems, `yum` for Red Hat-based systems, and the FreeBSD Ports collection (`/ports`). These exercises will provide hands-on experience with installing, updating, and managing software packages.

Exercise Set for `apt` (Advanced Packaging Tool)

Exercise 1: Update Package List

1. Open your terminal.
2. Type `sudo apt update` to refresh your system's package list. This ensures you have the latest versions of packages available for installation.
3. Observe the output as `apt` retrieves new package data from configured repositories.

Exercise 2: Install a Package

1. Choose a software package to install. For example, let's install `htop`, a system-monitoring utility.
2. Use `sudo apt install htop`.
3. After installation, type `htop` to run the program and ensure it was installed correctly.

Exercise Set for `yum` (Yellowdog Updater, Modified)

Exercise 1: Search for a Package

1. Open your terminal on a Red Hat-based system.
2. Type `yum search nano` to search for the nano text editor package.

3. Review the output to see if the package is available for installation.

Exercise 2: Install and Update Software

1. Install nano using `sudo yum install nano`.
2. After installation, check for updates specifically for the nano package by typing `sudo yum update nano`.

Exercise Set for FreeBSD Ports (/ports)

The FreeBSD Ports collection is a system of directories that simplifies the process of installing and managing software on the FreeBSD operating system.

Exercise 1: Navigating the Ports Tree

1. Assuming you are on a FreeBSD system, navigate to the Ports collection using `cd /usr/ports`.
2. Use `ls` to list the categories of software available. Choose a category like `editors`.
3. Inside the editors directory, list the software packages available, e.g., `ls editors`.

Exercise 2: Installing Software from Ports

1. Navigate to a specific port you wish to install, e.g., `cd /usr/ports/editors/nano`.
2. Compile and install the software using `make install clean`. This command will fetch the source code, compile it, and install the resulting binaries and other files.
3. After installation, you can use the `nano` command to ensure it is working.

Network Services

- Part 6: Network services
  - Commands: systemctl
  - Enabling, starting, and stopping network services
  - Verifying connectivity.

`systemctl` is a utility in Linux systems that is part of the systemd system and service manager. It is used to examine and control the systemd system and service manager. Here are five practical exercises designed to help you learn to manage services and system resources using `systemctl`.

Exercise 1: Checking the Status of a Service

Objective: Learn how to check the status of a service using `systemctl`.

Steps:

1. Open your terminal.
2. Type `sudo systemctl status sshd` to check the status of the SSH server service on your machine.
3. Observe the output, which includes whether the service is active, its start time, and its recent logs.

Exercise 2: Starting and Stopping Services

Objective: Learn how to start and stop services.

Steps:

1. To stop a service (for example, the Apache server), type `sudo systemctl stop apache2`.
2. Check if the service has stopped by using `sudo systemctl status apache2`.
3. Start the service again with `sudo systemctl start apache2`.
4. Verify that the service is running again by checking its status.

Exercise 3: Enabling and Disabling Services

Objective: Learn how to enable and disable services to start automatically at boot.

Steps:

1. Disable a service (for example, the Bluetooth service) so it does not start at boot using `sudo systemctl disable bluetooth`.
2. Check if the service is disabled from starting at boot using `sudo systemctl is-enabled bluetooth`.
3. Enable the service again with `sudo systemctl enable bluetooth`.
4. Verify that the service is enabled to start at boot by checking its status with `sudo systemctl is-enabled bluetooth`.

Exercise 4: Listing Active Services

Objective: Learn how to list all currently active services.

Steps:

1. Type `sudo systemctl list-units --type=service --state=running` to display a list of all active services.
2. Observe the output and try to identify some of the key services running on your system (e.g., network manager, web server).

Exercise 5: Masking and Unmasking Services

Objective: Learn how to prevent a service from being started manually or automatically.

Steps:

1. Mask a service (e.g., the `cups` service for printing) by typing `sudo systemctl mask cups`.
2. Try to start the service using `sudo systemctl start cups`. Note that the service should not start because it is masked.
3. Check the status using `sudo systemctl status cups` to confirm it has not started and is indeed masked.
4. Unmask the service with `sudo systemctl unmask cups` to allow it to be started again.
5. Start the service to ensure it can now run after unmasking.

Logs

- Part 7: Looking at logs
  - Commands: journalctl, less
  - Viewing logs with journalctl
  - Viewing raw logs in /var/log/messages

Here are three exercises for each command (`journalctl`, viewing logs in the filesystem, and `dmesg`) to help you practice handling and analyzing system logs in Linux environments.

Exercises for `journalctl` (Systemd Journal)

Exercise 1: Viewing Logs for a Specific Service Objective: Learn to view logs for a specific systemd service using `journalctl`. **Steps:**

1. Open your terminal.
2. Type `journalctl -u sshd` to view all journal entries for the SSH daemon.
3. Scroll through the entries to understand how the service has been performing or troubleshoot issues.

Exercise 2: Viewing Logs Since the Last Boot Objective: Use `journalctl` to view all system logs since the last system boot. **Steps:**

1. Type `journalctl -b` in your terminal.
2. Explore the log entries to see what activities and services were initiated at boot.

Exercise 3: Filtering Logs by Priority Objective: Learn how to filter log entries by their priority level. **Steps:**

1. Enter `journalctl -p err` to view all entries with the error priority.
2. Review the output to identify any critical errors that need attention.

Exercises for Viewing Logs in the Filesystem

Exercise 1: Viewing Apache Access Logs Objective: Learn to view and interpret Apache web server access logs. **Steps:**

1. Navigate to the Apache log directory by typing `cd /var/log/apache2` or `/var/log/httpd` depending on your distribution.
2. Use `less access.log` to view access logs. Navigate through the file to see the requests handled by the server.

Exercise 2: Monitoring Real-Time Log Updates Objective: Use `tail` to monitor real-time updates to a log file. **Steps:**

1. Open a terminal and type `sudo tail -f /var/log/syslog` to follow the syslog file as it's updated.
2. Watch the live updates to the syslog, especially useful during troubleshooting or system changes.

Exercise 3: Searching Logs with Grep Objective: Use `grep` to search through large log files for specific entries. **Steps:**

1. In your log directory, use a command like `grep "error" /var/log/syslog` to find all occurrences of the word "error" in the syslog file.
2. Analyze the output to understand the context and frequency of errors logged.

Exercises for `dmesg` (Display Message or Driver Message)

Exercise 1: Viewing Hardware and Boot Messages Objective: Use `dmesg` to view kernel-related messages and hardware initialization during boot. **Steps:**

1. Open a terminal and type `dmesg` to display the kernel ring buffer messages.
2. Browse through the messages to find details about hardware detection and initialization.

Exercise 2: Filtering `dmesg` Output by Priority Objective: Filter the output of `dmesg` by a specific log level. **Steps:**

1. Type `dmesg --level=err` to see all error messages from the kernel.
2. Review these messages to identify any potential issues with hardware or drivers.

Exercise 3: Saving `dmesg` Output to a File Objective: Save the output of `dmesg` to a file for later analysis. **Steps:**

1. Use the command `dmesg > dmesg_output.txt` to redirect the output to a file.
2. Open `dmesg_output.txt` with a text editor or `less` to review or share the file as needed.

Firewalls and Security

- Part 8: Firewalls, firewall maintenance, and security
  - Commands: iptables, ufw, selinux, apparmor, aide
  - Listing, adding, and removing firewall rules
  - Viewing firewall logs

These exercises will help you understand and practice basic commands and configurations for Linux security tools, including iptables, ufw, SELinux, AppArmor, and AIDE.

Exercises for `iptables` (Network Packet Filter)

Exercise 1: Listing Current iptables Rules Objective: Learn to display all current iptables rules. **Steps:**

1. Open a terminal and type `sudo iptables -L`.
2. Observe the output, noting how rules are organized into chains (INPUT, FORWARD, OUTPUT).

Exercise 2: Blocking an IP Address Objective: Use iptables to block all traffic from a specific IP address. **Steps:**

1. To block incoming traffic from IP address 192.168.1.100, type `sudo iptables -A INPUT -s 192.168.1.100 -j DROP`.
2. Verify that the rule has been added by checking the rules list again with `sudo iptables -L`.

Exercise 3: Allowing Port Access Objective: Configure iptables to allow access to a specific port (e.g., port 80 for web traffic). **Steps:**

1. Allow traffic on port 80 by typing `sudo iptables -A INPUT -p tcp --dport 80 -j ACCEPT`.
2. Verify the rule by listing the iptables rules.

Exercises for `ufw` (Uncomplicated Firewall)

Exercise 1: Enabling and Checking Status Objective: Enable ufw and check its status. **Steps:**

1. Enable ufw by typing `sudo ufw enable`.
2. Check the status with `sudo ufw status verbose` to see which rules are active.

Exercise 2: Adding Firewall Rules Objective: Add rules to allow traffic on common ports. **Steps:**

1. Allow SSH traffic by typing `sudo ufw allow 22/tcp`.
2. Allow HTTP web traffic by typing `sudo ufw allow 80/tcp`.
3. List all active rules with `sudo ufw status`.

Exercise 3: Denying Traffic to a Port Objective: Learn to deny traffic to a specific port. **Steps:**

1. Deny access to port 21 (FTP) by typing `sudo ufw deny 21/tcp`.
2. Verify the rule by checking the firewall status.

Exercises for `SELinux` (Security-Enhanced Linux)

Exercise 1: Checking SELinux Status Objective: Determine the current mode of SELinux. **Steps:**

1. Check the SELinux status by typing `sestatus`.
2. Note whether SELinux is enabled and whether it is in enforcing, permissive, or disabled mode.

Exercise 2: Changing SELinux Mode Objective: Temporarily change the SELinux mode. **Steps:**

1. Set SELinux to permissive mode by typing `sudo setenforce 0`.
2. Verify the change with `sestatus`.

Exercise 3: Restoring File Contexts Objective: Use `restorecon` to restore the correct SELinux context on a file. **Steps:**

1. Create a new file with `touch /var/www/html/index.html`.
2. Restore default SELinux context by typing `restorecon /var/www/html/index.html`.
3. Check the context with `ls -Z /var/www/html/index.html`.

Exercises for `AppArmor` (Application Security)

Exercise 1: Listing AppArmor Profiles Objective: View all AppArmor profiles and their status. **Steps:**

1. List all profiles by typing `sudo aa-status`.
2. Note which applications are protected and their enforcement modes (enforcing or complain).

Exercise 2: Changing Profile Mode Objective: Change an AppArmor profile mode from enforcing to complain. **Steps:**

1. Switch the profile mode for a specific application, e.g., `sudo aa-complain /usr/sbin/nginx`.
2. Verify the change by listing the profiles again.

Exercise 3: Reload an AppArmor Profile Objective: Learn how to reload a profile after making changes. **Steps:**

1. Modify an AppArmor profile using your favorite editor.
2. Reload the profile with `sudo apparmor_parser -r /etc/apparmor.d/profile.name`.

Exercises for `AIDE` (Advanced Intrusion Detection Environment)

Exercise 1: Initializing AIDE Database Objective: Create the initial AIDE database. **Steps:**

1. Initialize the AIDE database with `sudo aide --init`.
2. Confirm that a new database file has been created in the `/var/lib/aide` directory.

Exercise 2: Checking the System Integrity Objective: Use AIDE to check for changes in the system. **Steps:**

1. After initialization, make a change to a file tracked by AIDE, like modifying `/etc/passwd` .
2. Run `sudo aide --check` to see if

AIDE detects the modification.

Exercise 3: Updating the AIDE Database Objective: Update the AIDE database after making authorized changes. **Steps:**

1. After making legitimate changes and verifying them, update the database with `sudo aide --update`.
2. Rename the new database to become the primary database using `sudo mv /var/lib/aide/aide.db.new.gz /var/lib/aide/aide.db.gz`.

Exercises for `mv` (Move and Rename Files)

Exercise 1: Renaming Files with Patterns Objective: Use the `mv` command in a scripted loop to rename multiple files following a pattern. **Steps:** 1. Create several files for testing: `touch testfile1.txt testfile2.txt testfile3.txt`. 2. Write a simple loop to rename these files from `.txt` to `.md`: `bash for file in *.txt; do mv "$file""${file%.txt}.md" done` 3. Use `ls` to verify that all files now have the `.md` extension.

Exercise 2: Organizing Files by Type Objective: Move files of different types into designated directories. **Steps:** 1. Create a few test files: `touch file1.docx file2.pdf file3.docx file4.pdf`. 2. Create directories for each file type: `mkdir DOCX PDF`. 3. Write a script to move files into their respective directories based on the extension: `bash mv *.docx DOCX/ mv *.pdf PDF/` 4. Verify by listing the contents of `DOCX` and `PDF` directories.

Exercises for `sed` (Stream Editor)

Exercise 1: Replacing Text in a File Objective: Use `sed` to find and replace text in a file. **Steps:** 1. Create a file named `sample.txt` and add some content: `echo "This is a test file. Testing, one, two, three."> sample.txt`. 2. Use `sed` to replace "test" with "demo": `sed 's/test/demo/g'sample.txt`. 3. Display the output using `cat sample.txt` to verify the replacement.

Exercise 2: Delete Lines Containing a Specific Pattern Objective: Use `sed` to delete lines that contain a certain word. **Steps:** 1. Add more lines to `sample.txt`: `echo "Remove this line test.">> sample.txt`. 2. Use `sed` to delete lines containing the word "Remove": `sed '/Remove/d'sample.txt`. 3. Display the updated content to verify that the line has been removed.

Exercises for `awk` (Pattern Scanning and Processing Language)

Exercise 1: Print Specific Fields from a Text File Objective: Use `awk` to print specific fields from a delimited file. **Steps:** 1. Create a CSV file: `echo -e "Name,Age,Job\nAlice,30,Doctor\nBob,25,Engineer"> people.csv`. 2. Use `awk` to print only the names and jobs:

`awk -F',''{print $1, $3}'people.csv`. 3. Check the output to ensure it lists only the names and their jobs.

Exercise 2: Summing a Column of Numbers Objective: Use `awk` to sum the values of a specific column. **Steps:** 1. Add a column for salary to `people.csv`: `echo -e "Name,Age,Job,Salary\nAlice,30,Doctor,50000\nBob,25,Engineer,48000"> people.csv`. 2. Use `awk` to sum the salary column: `awk -F',''BEGIN {sum=0} {sum += $4} END {print "Total Salary:", sum}'people.csv`. 3. Verify the output shows the correct total salary.

Exercises for `grep` with Regex

Exercise 1: Finding Lines That Start With a Capital Letter Objective: Use `grep` with a regex pattern to find lines starting with a capital letter. **Steps:** 1. Use `grep` on `people.csv` to find lines starting with a capital letter: `grep '^[A-Z]'people.csv`. 2. Check the output to ensure it includes all lines except the header.

Exercise 2: Finding Entries With a Specific Age Objective: Use `grep` with regex to find all entries where the age is 25. **Steps:** 1. Use `grep` to find entries with the age 25 in `people.csv`: `grep ',25,'people.csv`. 2. Verify the output to ensure only entries with the age 25 are displayed.

These exercises are crafted to give you hands-on experience with powerful Linux text processing tools, helping you manipulate files and data effectively.