

Virginia Western Community College

ITN 170

Linux System Administration

Prerequisites

none

VCCS Course Description

Focuses instruction on the installation, configuration and administration of the Linux operating system and emphasizes the use of Linux as a network client and workstation.

Semester Credits: 3

Lecture Hours: 3

Required Materials

Textbook

- All reading material is located on labsimapp.testout.com

Other Required Materials:

- Computer and internet access sufficient to view and use labsimapp.testout.com class material.

VCCS COURSE OUTCOMES

- Explain Linux boot process concepts
- Understand the installation, configuration, and monitoring of kernel modules
- Configure and verify network connection parameters
- Manage storage
- Compare and contrast cloud and virtualization concepts and technologies
- Configure localization options
- Install, configure, update, and remove software
- Manage users and groups
- Create, modify, and redirect files
- Manage services
- Summarize and explain server roles
- Automate and schedule jobs
- Explain the use and operation of Linux devices
- Apply and/or acquire the appropriate user and group permissions
- Configure and implement appropriate access and authentication methods

- Summarize security best practices
- Backup, restore, and compress files
- Perform basic troubleshooting and diagnostics
- Write and execute basic BASH scripts

Note to Instructors

- All instructors are to use the CompTIA TestOut Linux Pro
- The Virginia Cyber Range can be used to provide a Linux desktop without setup and maintenance for students to practice on.
- Course prepares student for CompTIA Linux+ Certification

TOPICAL DESCRIPTIONS

1. Linux Pro Introduction

- **0.1 Course Introduction**
 - 0.1.1 Linux Pro Introduction (2:50)
 - 0.1.2 Basic Linux File Management
 - 0.1.3 Manage Linux Files
 - 0.1.4 Practice Questions
- **0.2 The TestOut Lab Simulator**
 - 0.2.1 Use the Lab Simulator (3:50)

2. 1.0 Linux Overview

- **1.1 Linux Introduction**
 - 1.1.1 Linux Operating System Introduction (4:29)
 - 1.1.2 Linux Implementations (10:48)
 - 1.1.3 Linux Introduction Facts
 - 1.1.4 Server Roles Facts
 - 1.1.5 Practice Questions

3. 2.0 Using Linux

- **2.1 The Linux Shell**
 - 2.1.1 Linux Shell Overview (4:18)
 - 2.1.2 Linux Shell Facts
 - 2.1.3 Shell Commands (6:32)
 - 2.1.4 Enter Shell Commands (4:11)
 - 2.1.5 Work with the Linux Shell (6:28)
 - 2.1.6 Linux Shell Command Facts
 - 2.1.7 Practice Questions
- **2.2 Linux Help**
 - 2.2.1 Linux Help Resources (7:04)
 - 2.2.2 Access Help Resources (7:31)
 - 2.2.3 Help Facts
 - 2.2.4 Get Help
 - 2.2.5 Practice Questions
- **2.3 Text Editors**

- 2.3.1 Text Editors (9:13)
- 2.3.2 Use vim (10:22)
- 2.3.3 Use nano (5:35)
- 2.3.4 Text Editor Facts
- 2.3.5 Create a New File
- 2.3.6 Modify an Existing File
- 2.3.7 Use the nano Editor
- 2.3.8 Practice Questions
- **2.4 Aliases**
 - 2.4.1 Aliases (4:21)
 - 2.4.2 Use Aliases (5:17)
 - 2.4.3 Alias Facts
 - 2.4.4 Practice Questions
- **2.5 Environment Variables**
 - 2.5.1 Environment Variables (6:29)
 - 2.5.2 Manage Environment Variables (6:23)
 - 2.5.3 Environment Variable Facts
 - 2.5.4 View Environment Variables
 - 2.5.5 Practice Questions
- **2.6 Shell Configuration Files**
 - 2.6.1 Shell Configuration Files (5:01)
 - 2.6.2 View Shell Configuration Files (7:01)
 - 2.6.3 Shell Configuration Facts
 - 2.6.4 Practice Questions
- **2.7 Redirection, Piping and Command Substitution**
 - 2.7.1 Redirection (8:14)
 - 2.7.2 Piping (3:59)
 - 2.7.3 Use Redirection (7:31)
 - 2.7.4 Use Piping (3:59)
 - 2.7.5 Redirection and Piping Facts
 - 2.7.6 Command Substitution (4:31)
 - 2.7.7 Command Substitution Facts
 - 2.7.8 Practice Questions
- **2.8 Directories**
 - 2.8.1 Directory Navigation (7:12)
 - 2.8.2 Navigate Directories (8:22)
 - 2.8.3 Directory Management (8:01)
 - 2.8.4 Manage Directories (4:45)
 - 2.8.5 Directory Management Facts
 - 2.8.6 Working with Directories
 - 2.8.7 Create Directories
 - 2.8.8 Delete Directories
 - 2.8.9 Practice Questions
- **2.9 Files**

- 2.9.1 Commands for Viewing Files (6:35)
- 2.9.2 File Management (5:47)
- 2.9.3 View File Contents (5:13)
- 2.9.4 Manage Files (8:34)
- 2.9.5 File Management Facts
- 2.9.6 View the Contents of Files
- 2.9.7 Delete Files
- 2.9.8 Move Files
- 2.9.9 Use stat
- 2.9.10 Delete Files and Directories
- 2.9.11 Practice Questions
- **2.10 Links**
 - 2.10.1 Links (3:55)
 - 2.10.2 Create Links (6:52)
 - 2.10.3 Link Facts
 - 2.10.4 Create a Hard Link
 - 2.10.5 Create a Symbolic Link
 - 2.10.6 Practice Questions
- **2.11 Filesystem Hierarchy Standard (FHS)**
 - 2.11.1 Filesystem Hierarchy Standard (FHS) (9:02)
 - 2.11.2 Filesystem Hierarchy Standard (FHS) Facts
 - 2.11.3 Practice Questions
- **2.12 Locating and Searching Files**
 - 2.12.1 File Location Utilities (7:18)
 - 2.12.2 Finding Linux Commands (4:28)
 - 2.12.3 Finding Files (6:16)
 - 2.12.4 File Search Facts
 - 2.12.5 Content Search Utilities (4:53)
 - 2.12.6 Find File Content (4:12)
 - 2.12.7 Content Search Facts
 - 2.12.8 Use grep
 - 2.12.9 Practice Questions
- **2.13 Text Stream Processing**
 - 2.13.1 Text Stream Processing Facts
 - 2.13.2 Process Text Streams (6:00)
 - 2.13.3 Practice Questions
- 4. 3.0 Installation and Localization**
 - **3.1 Linux System Design**
 - 3.1.1 System Design Part 1 (6:32)
 - 3.1.2 System Design Part 2 (10:17)
 - 3.1.3 System Design Facts
 - 3.1.4 Practice Questions
 - **3.2 Linux Installation**
 - 3.2.1 Linux Installation (5:27)

- 3.2.2 Installing Linux (8:07)
 - 3.2.3 Linux Installation Facts
 - 3.2.4 Practice Questions
 - **3.3 Localization**
 - 3.3.1 Locale Settings (5:38)
 - 3.3.2 Configuring Locale Settings (4:40)
 - 3.3.3 Localization Facts
 - 3.3.4 Practice Questions
- 5. 4.0 Boot and Shutdown**
- **4.1 Linux Boot Process**
 - 4.1.1 Linux Boot Process (3:45)
 - 4.1.2 Linux Boot Process Facts
 - 4.1.3 Linux Alternative Boot Options Facts
 - 4.1.4 Practice Questions
 - **4.2 Bootloaders**
 - 4.2.1 GRUB2 Bootloader (5:24)
 - 4.2.2 Use GRUB2 (4:32)
 - 4.2.3 GRUB2 Bootloader Facts
 - 4.2.4 Set the GRUB Timeout
 - 4.2.5 Configure Dual Boot
 - 4.2.6 Practice Questions
 - **4.3 systemd Boot Targets**
 - 4.3.1 systemd Boot Targets (3:51)
 - 4.3.2 Managing Boot Targets (4:48)
 - 4.3.3 Change the Current Target
 - 4.3.4 Set the Default Boot Target
 - 4.3.5 Boot Target Facts
 - 4.3.6 Unit Files Facts
 - 4.3.7 Practice Questions
 - **4.4 System Services**
 - 4.4.1 System Services (6:19)
 - 4.4.2 Manage System Services (6:02)
 - 4.4.3 System Service Facts
 - 4.4.4 Manage System Services
 - 4.4.5 Enable System Services at Boot
 - 4.4.6 Practice Questions
 - **4.5 System Shutdown**
 - 4.5.1 System Shutdown (4:51)
 - 4.5.2 Shut Down the System (3:16)
 - 4.5.3 Use wall to Message Users (2:40)
 - 4.5.4 Shutdown Facts
 - 4.5.5 Shut Down Immediately
 - 4.5.6 Shut Down with Notification
 - 4.5.7 Shut Down and Reboot

- 4.5.8 Practice Questions

6. 5.0 Graphical User Interfaces and Desktops

- **5.1 Graphical User Interfaces**
 - 5.1.1 Graphical User Interfaces (7:16)
 - 5.1.2 Graphical User Interfaces Facts
 - 5.1.3 Practice Questions
- **5.2 Linux Desktops**
 - 5.2.1 Comparing Linux Desktops (3:32)
 - 5.2.2 Comparing Linux Desktops Facts
 - 5.2.3 Practice Questions
- **5.3 Remote Desktop**
 - 5.3.1 Remote Desktop (2:22)
 - 5.3.2 Remote Desktop Facts
 - 5.3.3 Practice Questions
- **5.4 Accessibility**
 - 5.4.1 Accessibility (6:55)
 - 5.4.2 Configuring Accessibility Settings (4:22)
 - 5.4.3 Accessibility Facts
 - 5.4.4 Practice Questions

7. 6.0 Software Installation

- **6.1 Red Hat Package Manager (RPM)**
 - 6.1.1 Red Hat Package Manager (RPM) (7:58)
 - 6.1.2 RPM Package Management (3:34)
 - 6.1.3 Manage RPM Packages (5:41)
 - 6.1.4 Install an RPM Package
 - 6.1.5 Remove an RPM Package
 - 6.1.6 Update an RPM Package
 - 6.1.7 RPM Facts
 - 6.1.8 Practice Questions
- **6.2 Online Package Installation**
 - 6.2.1 Yellowdog Updater, Modified (YUM) (6:40)
 - 6.2.2 Install Packages with YUM (2:36)
 - 6.2.3 Install Packages with Dandified YUM (DNF) (3:38)
 - 6.2.4 YUM and DNF Facts
 - 6.2.5 Use DNF to Install an RPM Package
 - 6.2.6 Use DNF to Remove an RPM Package
 - 6.2.7 Practice Questions
- **6.3 Debian Package Manager (dpkg)**
 - 6.3.1 Debian Package Manager (dpkg) (5:49)
 - 6.3.2 Advanced Packaging Tool (apt) (4:35)
 - 6.3.3 Managing Debian Packages (5:12)
 - 6.3.4 Debian Package Management Facts
 - 6.3.5 Use apt
 - 6.3.6 Practice Questions

- **6.4 Shared Libraries**
 - 6.4.1 Shared Libraries (3:38)
 - 6.4.2 Managing Shared Libraries (3:01)
 - 6.4.3 Shared Libraries Facts
 - 6.4.4 Practice Questions
- 8. 7.0 Users and Groups**
 - **7.1 User and Group Overview**
 - 7.1.1 Linux User Overview (11:19)
 - 7.1.2 Linux Group Overview (5:06)
 - 7.1.3 User and Group File Review (6:31)
 - 7.1.4 User and Group Facts
 - 7.1.5 View User Account Information
 - 7.1.6 View Group Membership Information
 - 7.1.7 Practice Questions
 - **7.2 User Management**
 - 7.2.1 User and Password Management (9:09)
 - 7.2.2 Managing Users (6:04)
 - 7.2.3 Managing User Passwords (4:56)
 - 7.2.4 User Management Facts
 - 7.2.5 Create a User Account
 - 7.2.6 Rename a User Account
 - 7.2.7 Delete a User
 - 7.2.8 Change Your Password
 - 7.2.9 Change a User's Password
 - 7.2.10 Lock and Unlock User Accounts
 - 7.2.11 Practice Questions
 - **7.3 Group Management**
 - 7.3.1 Group Management (5:28)
 - 7.3.2 Managing Groups (3:44)
 - 7.3.3 Group Management Facts
 - 7.3.4 Rename and Create Groups
 - 7.3.5 Add Users to a Group
 - 7.3.6 Add a User to Additional Groups
 - 7.3.7 Delete a Group and Users
 - 7.3.8 Remove a User from a Group
 - 7.3.9 Remove a User from All Groups
 - 7.3.10 Practice Questions
 - **7.4 Troubleshoot User Issues**
 - 7.4.1 Common User Account Problems (7:55)
 - 7.4.2 Common Permission Problems (2:08)
 - 7.4.3 User and Permission Issue Facts
 - 7.4.4 Practice Questions
- 9. 8.0 Disk and File System Management**
 - **8.1 Storage Concepts**

- 8.1.1 Storage Types (9:46)
- 8.1.2 FUSE (3:26)
- 8.1.3 RAID on Linux (2:33)
- 8.1.4 Storage Facts
- 8.1.5 Use lsblk
- 8.1.6 Practice Questions
- **8.2 MBR Disk Partitions**
 - 8.2.1 MBR Disk Partitions (7:03)
 - 8.2.2 Managing MBR Partitions (7:56)
 - 8.2.3 MBR Partition Management Facts
 - 8.2.4 Device Naming Facts
 - 8.2.5 View the MBR Partition Table
 - 8.2.6 Practice Questions
- **8.3 GUID Partitions**
 - 8.3.1 GUID Partitions (6:23)
 - 8.3.2 Managing GUID Partitions with gdisk (4:21)
 - 8.3.3 Managing GUID Partitions with parted (2:18)
 - 8.3.4 GUID Partition Management Facts
 - 8.3.5 Practice Questions
- **8.4 Logical Volume Manager**
 - 8.4.1 Logical Volume Manager (LVM) (9:10)
 - 8.4.2 Using LVM (6:38)
 - 8.4.3 LVM Facts
 - 8.4.4 Create a Logical Volume
 - 8.4.5 Practice Questions
- **8.5 File Systems**
 - 8.5.1 Linux File System Types (6:03)
 - 8.5.2 File System Creation (6:03)
 - 8.5.3 Swap Area Management (4:20)
 - 8.5.4 Mounting Standard Partitions (5:32)
 - 8.5.5 Mounting LVM Partitions (3:01)
 - 8.5.6 Adding Entries to /etc/fstab (2:42)
 - 8.5.7 File System Management Facts
 - 8.5.8 Format a Hard Disk with ext3
 - 8.5.9 Format a Hard Disk with ext4
 - 8.5.10 Create a Swap Area
 - 8.5.11 Practice Questions
- **8.6 Mounting File Systems**
 - 8.6.1 File System Mounting Facts
 - 8.6.2 Mounting a File System (5:41)
 - 8.6.3 Mount a Volume
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 - 8.6.5 Practice Questions
- **8.7 File System Maintenance**

- 8.7.1 File System Maintenance (9:17)
- 8.7.2 Maintaining File Systems (4:13)
- 8.7.3 File System Maintenance Facts
- 8.7.4 Use iostat
- 8.7.5 I/O Scheduling
- 8.7.6 Practice Questions
- **8.8 Disk Quotas**
 - 8.8.1 Disk Quotas (5:17)
 - 8.8.2 Manage Quotas (8:52)
 - 8.8.3 Quota Facts
 - 8.8.4 Determine Disk Free Space
 - 8.8.5 Determine the Directory Size
 - 8.8.6 Find the User Quota
 - 8.8.7 Generate a Quota Report
 - 8.8.8 Turn Quotas On
 - 8.8.9 Turn Quotas Off
 - 8.8.10 Edit Quotas 1
 - 8.8.11 Edit Quotas 2
 - 8.8.12 Practice Questions
- **8.9 Ownership**
 - 8.9.1 Ownership (4:56)
 - 8.9.2 Managing Ownership (5:38)
 - 8.9.3 File Ownership Facts
 - 8.9.4 View Ownership Information
 - 8.9.5 Change File Ownership
 - 8.9.6 Change Group Ownership for a File
 - 8.9.7 Change Directory Ownership
 - 8.9.8 Practice Questions
- **8.10 Permissions**
 - 8.10.1 Permission Facts
 - 8.10.2 Managing File Permissions (6:58)
 - 8.10.3 Managing Directory Permissions (6:01)
 - 8.10.4 Set Directory Permissions
 - 8.10.5 Add File Permissions
 - 8.10.6 Set File Permissions
 - 8.10.7 Enable Directory Browsing
 - 8.10.8 Practice Questions
- **8.11 The umask Command**
 - 8.11.1 The umask Command (5:54)
 - 8.11.2 Use umask (7:34)
 - 8.11.3 The umask Command Facts
 - 8.11.4 Change the umask
 - 8.11.5 Practice Questions
- **8.12 Special Permissions**

- 8.12.1 Special Permissions (4:52)
- 8.12.2 Assigning Special File Permissions (8:58)
- 8.12.3 Special Permission Facts
- 8.12.4 Set the SUID Bit
- 8.12.5 Remove SUID and SGID Permissions
- 8.12.6 Practice Questions
- **8.13 Access Control Lists**
 - 8.13.1 Introduction to ACLs (3:04)
 - 8.13.2 Using ACLs (7:07)
 - 8.13.3 ACL Facts
 - 8.13.4 Use ACL Utilities
 - 8.13.5 Practice Questions
- **8.14 Archive and Backup**
 - 8.14.1 File Archives (6:43)
 - 8.14.2 Using tar (5:45)
 - 8.14.3 Create a Compressed tar File
 - 8.14.4 Extract from tar Files
 - 8.14.5 Archive Facts
 - 8.14.6 The cpio command (5:15)
 - 8.14.7 The dd command (3:26)
 - 8.14.8 Using cpio (4:50)
 - 8.14.9 cpio and dd Facts
 - 8.14.10 Backup Strategy Facts
 - 8.14.11 Practice Questions
- **8.15 Troubleshooting Storage**
 - 8.15.1 Common Storage Issues (13:21)
 - 8.15.2 Troubleshoot Storage Problems (3:33)
 - 8.15.3 Troubleshooting Storage Facts
 - 8.15.4 Practice Questions

10.9.0 Hardware Installation

- **9.1 Device Drivers**
 - 9.1.1 Device Drivers (4:31)
 - 9.1.2 Device Types Facts
 - 9.1.3 System Hardware Information (5:27)
 - 9.1.4 Viewing Hardware Information (2:34)
 - 9.1.5 Device Driver Facts
 - 9.1.6 View /proc Information
 - 9.1.7 Practice Questions
- **9.2 Kernel Module Management**
 - 9.2.1 Kernel Module Management (6:30)
 - 9.2.2 Managing Kernel Modules (2:57)
 - 9.2.3 Kernel Module Management Facts
 - 9.2.4 Insert a Module into the Kernel
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- 9.2.6 Practice Questions
- **9.3 Hotplug and Coldplug Devices**
 - 9.3.1 Hotplug and Coldplug Devices (7:48)
 - 9.3.2 Hotplug and Coldplug Device Facts
 - 9.3.3 Practice Questions

11. 10.0 Processes and System Services

- **10.1 Processes**
 - 10.1.1 Linux Processes (6:17)
 - 10.1.2 Process Heredity (5:49)
 - 10.1.3 Process Facts
 - 10.1.4 Process Display (10:13)
 - 10.1.5 Viewing Process Information with ps (5:44)
 - 10.1.6 Viewing Process Information with top (2:51)
 - 10.1.7 Viewing Process Information with pgrep (1:17)
 - 10.1.8 Process Display Facts
 - 10.1.9 View Process Information
 - 10.1.10 Use pidof
 - 10.1.11 Practice Questions
- **10.2 Process Management**
 - 10.2.1 Process Management (5:26)
 - 10.2.2 Switching Foreground and Background Processes (2:22)
 - 10.2.3 Process Prioritization (6:23)
 - 10.2.4 Prioritizing Processes (3:29)
 - 10.2.5 Process Management Facts
 - 10.2.6 Process Termination Part 1 (5:12)
 - 10.2.7 Process Termination Part 2 (5:50)
 - 10.2.8 Terminating Processes (5:22)
 - 10.2.9 Process Termination Facts
 - 10.2.10 Stop a Zombie Process
 - 10.2.11 Bring an Application to the Foreground
 - 10.2.12 Practice Questions
- **10.3 Task Management**
 - 10.3.1 at Task Scheduling (7:12)
 - 10.3.2 Scheduling Tasks with at (2:27)
 - 10.3.3 at Command Facts
 - 10.3.4 cron Task Scheduling Part 1 (5:54)
 - 10.3.5 cron Task Scheduling Part 2 (3:53)
 - 10.3.6 Scheduling Tasks with cron (7:26)
 - 10.3.7 cron Facts
 - 10.3.8 Using anacron (4:06)
 - 10.3.9 anacron Facts
 - 10.3.10 Configure Crontab
 - 10.3.11 Practice Questions
- **10.4 System Time Configuration**

- 10.4.1 Time Zone Settings (7:15)
- 10.4.2 Configuring Time Zone Settings (2:59)
- 10.4.3 Time Zone Facts
- 10.4.4 Time Maintenance (5:44)
- 10.4.5 Managing System Time (6:14)
- 10.4.6 Time Maintenance Facts
- 10.4.7 Network Time Protocol (NTP) Part 1 (7:11)
- 10.4.8 Network Time Protocol (NTP) Part 2 (6:20)
- 10.4.9 Synchronize Time with NTP (7:30)
- 10.4.10 NTP Facts
- 10.4.11 Practice Questions

12. 11.0 System Monitoring

- **11.1 System Logging**
 - 11.1.1 Linux Log Files (6:41)
 - 11.1.2 Log File Facts
 - 11.1.3 journald Logging (4:29)
 - 11.1.4 Configure journald (5:11)
 - 11.1.5 journald Logging Facts
 - 11.1.6 Viewing Log Files (5:26)
 - 11.1.7 Log File Display Facts
 - 11.1.8 logrotate (6:26)
 - 11.1.9 logrotate Facts
 - 11.1.10 View Log Files
 - 11.1.11 Practice Questions
- **11.2 Resource Monitoring**
 - 11.2.1 CPU Resource Monitoring (8:52)
 - 11.2.2 Resource Monitoring Tools (2:46)
 - 11.2.3 Resource Monitoring Facts
 - 11.2.4 Use Uptime
 - 11.2.5 Use top
 - 11.2.6 Practice Questions

13. 12.0 Networking

- **12.1 IPv4 Overview**
 - 12.1.1 IP Protocols (7:58)
 - 12.1.2 IP Protocol Facts
 - 12.1.3 IPv4 Addressing (5:07)
 - 12.1.4 Subnet Masks (6:28)
 - 12.1.5 Variable Length Subnet Masking (VLSM) (12:03)
 - 12.1.6 IPv4 Addressing Facts
 - 12.1.7 Common Ports (8:08)
 - 12.1.8 IP Port Facts
 - 12.1.9 Practice Questions
- **12.2 Network Interface Configuration**
 - 12.2.1 Network Interface Naming (6:42)

- 12.2.2 Address Configuration Part 1 (4:13)
- 12.2.3 Address Configuration Part 2 (6:20)
- 12.2.4 View and Manage IPv4 Addresses (7:38)
- 12.2.5 Addressing Method Facts
- 12.2.6 Network Configuration Facts
- 12.2.7 Network Interface Bonding Facts
- 12.2.8 Use ping and traceroute
- 12.2.9 Start a NIC
- 12.2.10 Stop a NIC
- 12.2.11 Configure IP Addresses
- 12.2.12 Practice Questions
- **12.3 NetworkManager**
 - 12.3.1 Introduction to NetworkManager (1:45)
 - 12.3.2 Using NetworkManager (4:26)
 - 12.3.3 NetworkManager Facts
 - 12.3.4 Practice Questions
- **12.4 IPv6 Overview**
 - 12.4.1 IPv6 Addressing (10:05)
 - 12.4.2 IPv6 Facts
 - 12.4.3 Configure IPv6 Addresses (3:18)
 - 12.4.4 IPv6 Configuration Facts
 - 12.4.5 Practice Questions
- **12.5 Routing Configuration**
 - 12.5.1 Routing Configuration Part 1 (8:51)
 - 12.5.2 Routing Configuration Part 2 (5:08)
 - 12.5.3 Configure the Default Route (4:36)
 - 12.5.4 Routing Facts
 - 12.5.5 Practice Questions
- **12.6 Hostname and DNS Configuration**
 - 12.6.1 Hostname and DNS Configuration (8:51)
 - 12.6.2 Configure DNS Settings (5:27)
 - 12.6.3 Testing Name Resolution (4:35)
 - 12.6.4 Name Resolution Facts
 - 12.6.5 Use nslookup
 - 12.6.6 Practice Questions
- **12.7 Linux Firewalls**
 - 12.7.1 Linux Firewalls (7:35)
 - 12.7.2 Configure firewalld (4:56)
 - 12.7.3 IP Forwarding (3:37)
 - 12.7.4 Linux Firewall Facts
 - 12.7.5 Change Default Ports
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 - 12.7.7 Practice Questions
- **12.8 Network Troubleshooting**

- 12.8.1 Troubleshooting Methodology (4:43)
- 12.8.2 Troubleshooting Methodology Facts
- 12.8.3 Using Network Troubleshooting Tools (7:08)
- 12.8.4 Troubleshooting Tool Facts
- 12.8.5 Find Path Information
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- 12.8.7 Practice Questions

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- **13.1 Cloud and Virtualization Overview**
 - 13.1.1 Cloud and Virtualization Overview: Part 1 (7:51)
 - 13.1.2 Cloud and Virtualization Overview: Part 2 (8:07)
 - 13.1.3 Install Hypervisor (3:49)
 - 13.1.4 Linux Cloud and Virtualization Facts
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- **13.2 Virtual Machines**
 - 13.2.1 Virtual Machine Concepts: Part 1 (4:59)
 - 13.2.2 Virtual Machine Concepts: Part 2 (7:15)
 - 13.2.3 Creating a Virtual Machine (4:03)
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- **13.3 Sandboxed Applications**
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- **13.4 Containers**
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 - 13.4.2 Using Containers (6:23)
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 - 13.4.4 Container Facts
 - 13.4.5 Practice Questions
- **13.5 Virtual Networking**
 - 13.5.1 Virtual Networking Concepts (5:47)
 - 13.5.2 Configuring Networking on a Virtual Machine (2:16)
 - 13.5.3 Virtual Networking Facts
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- **14.1 Bash Shell Scripting**
 - 14.1.1 Bash Scripting Overview (6:28)
 - 14.1.2 Bash Script Execution (5:01)
 - 14.1.3 Executing and Sourcing a Script (4:59)
 - 14.1.4 Scripting Facts
 - 14.1.5 Practice Questions

- **14.2 Shell Environments, Bash Variables and Parameters**
 - 14.2.1 Bash Shell Environments and Shell Variables (7:38)
 - 14.2.2 Bash Shell Parameters and User Variables (8:56)
 - 14.2.3 Bash Shell Expansion (3:23)
 - 14.2.4 Bash Shell Variables and Parameters (7:26)
 - 14.2.5 User Variables and Shell Arithmetic (6:55)
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