Introduction

- **Welcome**
  - **Five Domains**
    - The Linux Community and a Career in Open Source
    - Finding Your Way on a Linux System
    - The Power of the Command Line
    - The Linux Operating System
    - Security and File Permissions

- **About the Exam**
  - **Closed book**
  - **Up to 60 minutes**
  - **40 multiple-choice items**
  - **Minimum score of 500 points to pass**
  - **No prerequisites**
  - **Lifetime certification**

Evolution of Linux

- **An Introduction to Linux**
  - **Linux**
    - A family of open source Unix-like operating system, typically packaged into a distribution
  - **Examples**
    - Ubuntu, Debian, Fedora
  - **Command Line Interface (CLI) or the terminal**
  - **Why study Linux?**
    - Over 96% of web servers are run on Linux
    - Low cost
    - Open source
    - Ease of scalability

- **Open Source Philosophy**
  - **Open Source**
    - Concept of making source codes available for public use or modification from its original design
  - **Examples**
    - Apache, WordPress
  - **Software License Types**
    - GNU General Public License
    - Apache License
    - MIT License
    - Unlicense

- **Linux Distributions**
  - **Distribution or Distro**
    - Linux kernel
    - Supporting software and libraries
    - Configuration files
  - **Kernel**
    - A low-level computer program which functions as the bridge between the user and the computer's resources

- **Different distributions have different scripts and utilities to launch programs**
- **Installation**
  - Image file on a CD
  - USB flash drive
  - Virtual server or cloud service

- **Distribution Life Cycle**
  - **Release Schedule**
    - Distribution life cycle that specifies when are new versions released to the public
  - **Pre-Release Versions**
    - Recommended to be used only for testing and debugging
    - Categories
      - Alpha – very new and contains a lot of bugs
      - Beta – where most testing are done
  - **Examples**
    - Disco Dingo (19.04), Cosmic Cuttlefish (18.10)
  - **Support Versions**
    - Short-term
    - Long-term
  - **Rolling Release Schedule** – ongoing updates

- **Embedded Systems**
  - **Embedded System**
    - A controller with a dedicated function within a larger mechanical or electrical system
  - **Example Applications**
    - Industrial automation
    - Navigation equipment
    - Medical devices
    - Wearable technology
    - Home appliances
  - **Examples**
    - Arduino
    - Raspberry Pi
    - Android
      - Highly-scalable
      - User-friendly
      - Open source
      - Free to use

- **Hardware Requirements**
  - **System requirements**
    - Prerequisites that are often used as a guide and not an absolute rule
  - **Hardware Compatibility List (HCL)**
    - Lists tested, compatible, and sometimes incompatible hardware devices for a particular distribution
  - **Minimum Requirements**
    - The lowest possible hardware specification that your computer should have to boot successfully and use with basic functionality
  - **Recommended Requirements**
    - Hardware that one should have in order to fully maximize a system's potential

- **Operating System Differences**
  - **Windows**
    - 90% of home users
    - Widely-available and widely-supported
    - Most prone to malware
    - Requires a license
    - GUI-based
  - **Mac OSX**
    - 7% of home users
    - Free but only works on Apple systems
    - GUI-based
  - **Linux**
    - Less than 2% of home users
    - More than 75% of enterprise server environments
    - Known as the OS for computer experts and hackers
    - Source code is available for modification
    - Open source
    - Can run from the command line only

Open Source Applications

- **What is Open Source?**
  - **Open-source Software**
    - Software released under a license in which the copyright holder grants users the rights to study, change, and distribute it to anyone and for any purpose
  - **Advantages**
    - Security
    - Affordability
    - Transparency
    - Interoperability
    - Scalability
    - Localization
  - **Open-source Initiative**
    - Public benefit corporation that promotes the use of open-source software
  - **Open Source Definition (OSD)**
    - A document which determines whether a software license can be labeled with the open-source certification mark

- **Cost of Open Source**
  - **Technical support, training, administration, and maintenance**
  - **Public Domain**
    - No ownership, copyright, trademark, or patent
  - **Hacking Culture**
  - **Free License**
    - Private funding
    - Crowdfunding
    - Donations
    - Commercialization

- **Package Installs and Repositories**
  - **Linux applications generally don't run on every distribution**

- **Linux users don't normally download and install applications from the applications' websites**
- **Archives contain a list of files**
- **Package Formats**
  - **.deb**
    - Gets its name from Debian; also used by Debian-based distros such as Ubuntu
  - **.rtm**
    - Originally stood for Red Hat Package Manager; used by Fedora and openSUSE
  - **.tar**
    - Considered a universal package format and is used by distros such as ArchLinux and Slackware
    - Can be .tar, .tgz, or .tar.gz
- **Personal Package Archives (PPAs)**
  - Contains software compiled by individual users and teams that have newer features that are not in the official distributions

The Linux Environment

- **Linux Desktop Environment**
  - **Kernel**
    - Translates software commands into hardware-specific requests
  - **Command Syntax**
    - Rules in which commands need to be run
  - **Desktop Environment**
    - Graphical user interface (GUI)
    - Linux desktop environments are modular
  - **Examples**
    - Ubuntu – Unity, Kubuntu, Xubuntu

- **Linux Shell and Commands**
  - **Linux Shell**
    - Program that takes commands from the keyboard and gives them to the kernel to execute
  - **Examples**
    - Bourne Again Shell (Bash)
      - Acts as the shell program within the command line interface
    - ksh (Korn shell)
    - tcsh (Tee See shell)
    - zsh (Zee shell)
  - **Terminal (terminal emulator)**
    - Provides access to a shell session
    - Examples
      - gnome-terminal
      - konsole
      - xterm
      - rxvt
      - kvt
      - nxterm
      - eterm
  - **Common commands**
    - **List (ls)**

        - Shows the files, folders, and directories within the system
    - **Change directory (cd)**
        - Switches between directories
    - **Move (mv)**
        - Moves a file from one folder directory to another

    - **Manual (man)**
        - Shows all information about a command being used
    - **Make directory (mkdir)**
        - Makes a new empty folder or directory inside the filesystem
    - **Remove directory (rmdir)**
        - Removes an empty, existing folder or directory
    - **Touch (touch)**
        - Makes a file using the command line
    - **Remove (rm)**
        - Removes files and directories
    - **Locate (locate)**
        - Finds a file within the system
    - **Clear (clear)**
        - Clears the screen or terminal environment

- **Managing Software Packages**
    - **Package**
        - A compressed file archive containing all of the files that come with a particular application
        - Package prerequisites = dependencies
    - **Common types of packages**
        - .deb
            - Debian, Debian-derived distros
            - Package managers: DPKG, APT-GET, and APT
        - .rpm
            - Red Hat, Fedora, openSUSE
            - Package managers: RPM, YUM, and DNF
        - .tgz
            - the “universal” Linux format

The Command Line

- **Basic Shell**
  - **Users are allowed to install various GUI terminal programs**
  - **Root User**
    - Administrator account in Linux

- **Command Line Syntax**
  - **Computer operation steps**
    - Computer waits for user input
    - User selects a command and enters it using a keyboard or a mouse
    - Computer executes the command
  - **In Linux, the shell displays a prompt**
  - **Command**
    - A sequence of characters in a line which ends by pressing the enter key and is subsequently evaluated by the shell
  - **Syntax - rules**
  - **The first word is usually the command name, while the other words are the parameters**
    - Types of parameters
      - Options (switches) – start with a dash and allow certain commands to be switched on or off
      - Argument – no leading dashes; often the names of files that the command should process
  - **General command structure**
    - Command (What to do?) > Options (How to do it?) > Arguments (What to do with it?)

- **Variables**
  - **Shell Script**
    - A file containing a series of commands
  - **Variables**
    - Areas of memory that can be used to store information and are referred to by a name

        - Act as a placeholder
    - **Naming rules**
        - Variable names must start with a letter
        - A name must not contain embedded spaces (Underscores are used instead)
        - Punctuation marks are not allowed

    - **Print Environment (printenv)**
        - Displays all the environmental variables (variables in ALL CAPS)

- **Quoting**
    - **Shell meta-characters**
        - Treated in a special way in the command line
    - **Examples of meta-characters**
        - Blank or space character (" ")
            - Tells a shell to use separate arguments between commands
            - Any number of blanks or spaces are treated as one
        - Dollar sign ($)
        - Star (*)
        - Semi-colon (;)
        - Greater-than symbol (>)
        - Question mark (?)
        - Ampersand (&)
        - Pipe (|)
    - **Quoting**
        - The act of protecting shell meta-characters from being treated specially by the shell
        - Prevents the shell from acting on and expanding the meta-characters
        - Done in double quotes (" "), single quotes (' '), or backslash (\ )
        - Backlashes can be used to quote or turn off a special character's ability

- **Man and Info Pages**
    - **Manual (Man) Pages**
        - A set of pages explaining every command available on the system
        - man <command>
        - man -k <search term>
        - /<search term>
    - **Commands**
        - Long hand
            - More human-readable

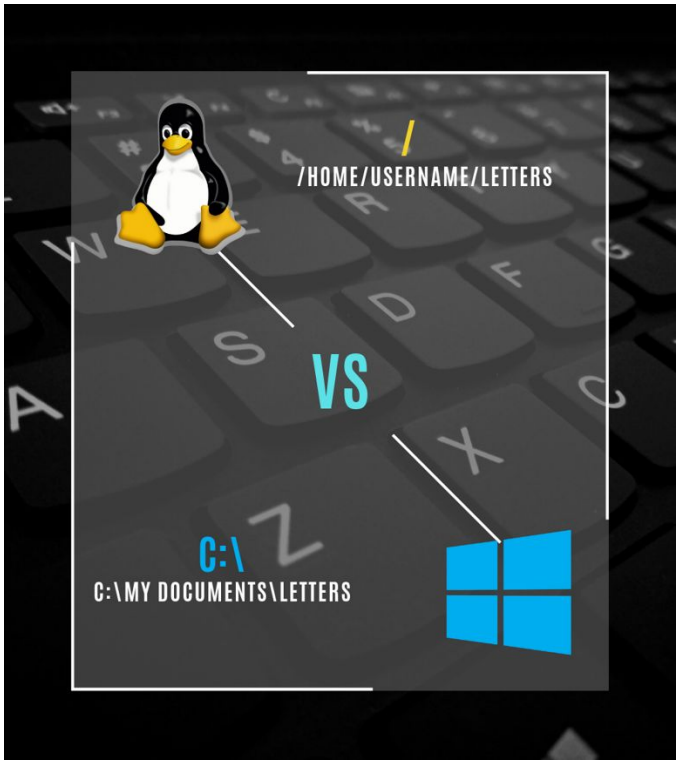
- Lets users remember what the command is doing
- Example: --all

- Short hand
  - Quicker to type out
  - Allows for multiple options to be chained together and is quicker to type out
  - Example: -a

- **Info Pages**
  - More detailed than man pages; divided into different nodes or pages and works like a web browser
  - Info <command>
  - p for previous
  - n for next
  - q for exit

Directories and Files

- **Introduction to the Linux Filesystem**
  - **Multiuser system**
    - Any number of users can simultaneously work on one single machine
  - **Types of users**
    - Normal user
    - Superuser/administrator (root)
      - A superuser can access all parts of the system to execute admin tasks
  - **Home directory**
    - This is where all private data is stored
  - **System directory**
    - Holds central configuration and executable files that can only be modified by the superuser
  - **Root of the filesystem**
    - Topmost directory represented by a single slash (/)
    - Example:



- **Linux Filesystem Key Features**
  - **In Linux, data from unmounted partition or device is inaccessible**
  - **Linux distinguishes between uppercase and lowercase letters in the filesystem**
    - Example: test.txt ≠ TeST.txt ≠ Test.txt
  - **Files in Linux may have a file extension, but do not need to have one**
  - **Files can be hidden by adding a dot (.) at the beginning of the filename**
  - **Only the owner of a file or directory (plus the root user) can grant access**
  - **Access permissions**
    - Read
    - Write
    - Execute
  - **Access permissions to files and folders can be changed through the shell or the file manager**
  - **Filesystem Hierarchy Standard (FHS)**
    - Distinguishes between shareable and unshareable files, and between static and variable files
    - Shareable files – user data files, program binary files
    - Unshareable files – configuration files

- Static files – program executables
- Variable files – any files stored in the home directory like documents, photos

- **Navigating Files and Directories**
  - **List command (ls)**
    - ls -a – displays all the files in the directory
    - ls -l – displays an output which includes permission strings, ownership, file sizes, file creation dates
  - **Change directory (cd)**
    - Linux uses a forward slash as a directory separator
    - A backslash serves as a "quote" or "escape" character
  - **Present Working Directory (pwd)**
    - Tells what directory you are in
  - **File references**
    - Absolute
      - Relative to the root directory
      - Begins with a forward slash
      - Example: /home/user1/file.txt
    - Home directory
      - A tilde (~) replaces the path's home directory
      - Example: ~/file.txt
    - Relative
      - Relative to the current directory
      - Subdirectories
        - . refers to "this" directory
        - .. refers to the parent directory
      - Subdirectory replaces the parent directory
      - Example: ../dir2/afile.txt

- **File Creation and Management**
  - **Touch (touch)**
    - Creates files on the command line
    - Example: touch newfile.txt
    - Empty files can act as "scratch files"
  - **Copy (cp)**
    - Copies files
  - **Move (mv)**
    - Moves and renames files

- The mv command's effects are much like cp, except the new file will replace the original file
- Copies and deletes the original file

- **Creating Links**
  - **Hard Link**
    - A duplicate directory entry where both entries point to the same file
    - ln origname linkname
  - **Symbolic Link**
    - A file that refers to another file by name
    - ln –s origname linkname

- **Wildcards and Case Sensitivity**
  - **Wildcard**
    - A symbol or set of symbols that stands in for other characters
  - **Types of wildcards**
    - Question mark (?)
      - Stands for a single character
      - Example: b??l can match bowl, ball, bull, etc.
    - Asterisk (*)
      - Matches any character or set of characters, including no characters
      - Example: b*l can match bowl, ball, bull, bl, bbll, brawl, etc.
    - Bracketed value ([ ])
      - Matches any character inside the bracket
      - Example: b[ao][lw]l can match bowl, ball, etc., but not bull
  - **Careless usage of wildcards can lead to undesired consequences**
  - **Case sensitivity is a function of the Linux filesystem and not the Linux operating system itself**

- **Manipulating Directories**
  - **Make Directory (mkdir)**
    - Creates a new directory
    - Example: mkdir newfolder
  - **Remove Directory (rmdir)**
    - Deletes an empty directory
    - Example: rmdir newfolder
    - To delete a set of nested empty directories, -p can be used
      - Example: rmdir -p newfolder

        - To delete directories that contain files within a directory tree, use: rm -r newfolder
    - **Remember that directory names are case sensitive**
    - **Directories are just special files as far as the Linux filesystem is concerned**
    - **Touch (touch)**
        - When used with a directory, it will only update the date/time stamp
    - **Copy (cp)**
        - Can be used to copy a directory if used with the -r or –a switches
    - **Move (mv)**
        - Can be used for directories or files
    - **Link (ln)**
        - ln –s can create symbolic links to a directory
        - directories don't have support for hard link, only symbolic links

Searching and Extracting Data from Files and Archiving

- **Command Line Pipes**
    - **Command line pipe or pipeline (|)**
        - A standard output from one program or command that is used as input for the second program or command
        - Example: cat sample | less, cat sample | pg, cat sample | more
        - Pipes allow for the quick execution of commands performing complex tasks
    - **Grep**
        - Searches for keywords in the output
        - Example: grep <optional set of options> <regular expression> <optional filename specification>

- **Input/Output Redirection**

- **Redirect to an output file if you need to save it for future reference**
- **Redirect from an input file if you have a program that needs it**
- **A program's output can be used as an input via the process of piping**
- **Xargs**
  - Enables a user to generate command line options from files or other programs' output
- **Common redirector operations**
  - Greater than symbol (>)
    - Creates a new file containing standard output
  - 2 Greater than symbols (>>)
    - Appends the existing output to an existing file
  - The number 2 + Greater than symbol (2>)
    - Creates a new file containing any standard errors
  - The number 2 + 2 Greater then symbol (2>>)
    - Appends standard error to an existing file
  - Ampersand + Greater then symbol (&>)
    - Creates a new file that contains the standard output and the standard error
  - Less than symbol (<)
    - Sends the content of a specified file as input back into the standard input
  - 2 Less than symbols (<<)
    - Accepts text on the following lines as standard input
  - Less than + Greater than symbols (<>)
    - Specified file can be used for standard input and standard output
- **Standard Output**
  - Normal program messages
- **Standard Error**
  - Any error messages

- **Basic Regular Expressions**
  - **Regular Expressions**
    - A way to describe patterns that a user might want to look for in data files
    - Regular expressions are similar to wildcards
  - **Forms of Regular Expressions**
    - Basic
    - Extended
  - **Types of Regular Expressions**
    - Alphanumeric/Alphabetic string
    - Non-alphanumeric string

- **Special Characters**
  - Bracket Expression ([ ])
    - Example: b[aeiou]g can match bag, beg, big, bog, bug
  - Range Expression (-)
    - Example: a[2-4]z can match a2z, a3z, a4z
  - Single Characters (.)
    - Example: a.z can match all words that starts with a and ends in z that has one letter in between
  - Caret (^)
    - Shows the start of a line
  - Dollar sign ($)
    - Shows the end of a line
  - Repetition
    - Example: .*
  - Backslash (\ )
    - Used to escape a special character
    - Example: filename\.txt

- **Archiving Files**
  - **File-Archiving Tool**
    - Collects a group of files into a single “package” file to easily move around on a single system
  - **Common archiving commands**
    - Tar (Tape archiver)
      - Used to archive various data files into a single file (archive file) while the original files remain on the disk
      - Tarball
        - Compressed archive file
    - ZIP
      - GZIP (.gz; .tgz for tarballs)
        - gunzip
      - BZIP2 (.bz2; .tbz, .tbz2, .tb2 for tarballs)
        - bunzip2
      - XZ (.xz; .txz for tarballs)
        - unxz

Scripting Basics

- **Text Files and Text Editors**
  - **Text Files**
    - Configuration files and shell scripts
  - **Text Editor**
    - Lets you edit documents that are stored in plain-text format
  - **File Types**
    - Human language files
    - Programming language files
    - Formatted text files
    - Program and system configuration files
    - Program log files
  - **Popular Text Editors**
    - vi

        - very small and installed by default
        - a little more difficult to use
    - emacs
        - big editor with a lot more features
        - less likely to be installed by default on lightweight distributions
        - also has a GUI version
    - pico
        - modeled after emacs
        - more lightweight and better suited for lightweight distributions
        - often installed by default
    - nano
        - clone of pico but has extra features
        - much more lightweight than emacs
        - commonly found in small and lightweight distributions

- **Beginning a Shell Script**
    - **Script**
        - A program written in an interpreted language, typically associated with a shell or a compiled program
    - **GUI-based Editors**
        - KWrite
        - Gedit
    - **Text-based Editors**
        - vi
        - emacs
        - pico
        - nano

- **Commands**
    - **Most commands entered into a shell prompt are external commands**
    - **The ampersand (&) lets users run many programs simultaneously**
    - **Commonly-used Commands**
        - **ls, mv, cp, rm**
        - **Grep**
            - Locates files containing specific strings and display them into a file or screen
        - **Find**
            - Locates files by filenames, ownerships, and other permissions at the filesystem level
        - **Cut**

        - Extracts text from a field within a file
    - **Echo**
        - Displays something as a message to the user in the command line terminal

- **Arguments**
    - **Values of variables can be:**
        - Passed as parameters to a script
        - Generated internally to a script
        - Extracted from a script's environment
    - **Arguments**
        - Variables that are passed to the script. These are also called parameters
        - Represented in the script as a dollar sign ($) followed by a number from 0 onwards
        - Examples: $0, $1, $2

- **Variables**
    - **Common Commands**
        - Hostname
            - Shows the current hostname where the command is being run on
        - Date
            - Gives the current date and time
        - Uptime
            - Total time the computer has been up and running
        - df
            - Shows the free disk space

- **Conditional Expressions**
    - **Conditional Expressions**
        - Enable a script to perform one of several actions relying on a particular condition or value of a variable
        - Example: if [-f file], if [-s file]
    - **Conditionals may be combined together with the logical and (&&) or logical or (||) operators**
    - **You can nest several if / then /else clauses**

- **Loops and Functions**
    - **Loops**
        - Tell the script to perform the same task repeatedly

- **Seq**
  - Generates a list of numbers starting from its first argument and continuing to its last one
  - Example: seq 1 10, seq 1 2 10
- **While**
  - Executes for as long as its condition is true
- **Until**
  - Similar to the while loop but continues to execute as long as its condition is false or until the condition becomes true
- **Function**
  - A specific subtask to be called by name from other parts of the script
  - The keyword function may optionally precede the function name

- **Exit Value**
  - **A script's return value is the same as the last command the script called**
  - **Exit**
    - Causes immediate termination of the script

Processes and Process Data

- **Package Management Principles**
  - **Process**
    - Any running program
  - **Package management varies between distros**
  - **Package Management Principles**
    - Each package is a single file
    - Packages rely on other programs to do the work of installing the software
    - Packages contain dependency information
    - Packages contain version information
    - Packages contain architecture information
    - Binary packages are built from source packages

- **Package software maintains a database of information about all installed packages, which includes:**
  - Names and version numbers
  - Locations of all installed files

- **Package Management Systems**
  - **Examples:**
    - RPM
    - Debian
  - **Always use native packages on your system**
  - **Software Repositories**
    - Area where tools can be automatically downloaded as packages and then get installed
  - **Software Installation Process**
    - A command is issued to install a program
    - The software locates dependencies of the specified program
    - The user issues a final approval for software installation
    - The software downloads all of the necessary packages
    - The software installs all the packages

- **Process Hierarchy**
  - **Init Process**
    - Responsible for starting up all basic programs that Linux needs to run
    - **Children**
      - Program launched by init
    - **Parent**
      - Process that launched a program
  - **Process ID (PID)**
  - **Parent Process ID (PPID)**

- **Identifying Running Processes**
  - **Utilities to identify processes**
    - ps
      - Provides information at only a single moment in time
    - top
      - An interactive version of ps
    - free
      - Tells how much memory is being uses
  - **Load Average**
    - Measure of the demand of CPU time by different applications

- Useful in detecting “runaway processes”

- **Measuring Memory Use**
  - **Pressing the M key within top sorts processes by memory use**
  - **A program with a memory leak consumes <u>increasing</u> amounts of memory**
  - **Mem**
    - This line reveals total RAM statistics
  - **Swap**
    - This line reveals how much swap space Linux is using (disk space that’s set aside as an adjunct to memory)

- **Log Files**
  - **Daemons**
    - Programs that run in the background
  - **Log Files**
    - Serve as a record or notes
    - Mostly stored in /var/log
  - **Common Log Files**
    - boot.log
      - Summary of services that started up late in the boot process through the csv startup scripts
    - cups/
      - Related to Linux printing system
    - gdm/
      - Related to the gnome display manager or gdm environment
      - Handles graphical-based user logins
    - messages or syslog
      - General purpose log file containing messages from many different daemons that don’t have dedicated log files
    - Secure
      - Security-related messages
    - Xorg.0.log
      - Info about the most recent startup of an X windows system
  - **Log files are frequently rotated**
  - **Log files are mostly plaintext files**
  - **Syslog/Syslogd**
    - General standard for logging system and program messages
  - **Klog/Klogd**

        - Handles logging messages from the kernel separately from ordinary programs
    - **System Messaging**
        - A technique wherein a log daemon accepts messages from other processes

- **Kernel Ring Buffer**
    - **Returned by entering $ dmesg, $ dmesg | less**
    - **Kernel ring buffer messages are invaluable in diagnosing hardware and driver problems**
    - **To manually create a kernel ring buffer log file, edit /etc/rc.d/rc.local by adding this at the end: dmesg > /var/log/dmesg**

Networking Basics

- **Network Features**
    - **Common Networking Terms and Definitions**
        - Domain Name System (DNS)
            - Global network of servers that translates between hostnames and IP addresses
            - "Internet phonebook"
        - Dynamic Host Configuration Protocol (DHCP)
            - A way for computers on a network to be able to obtain configuration information from another computer on the network

        - Ethernet
            - Wired network hardware used by most computers today
        - Hostname
            - The name of a computer that is easier to read and remember
        - Internet
            - Globe-spanning network of interconnected computers that we use TCP-IP to communicate over
        - Internet Protocol (IP) Address
            - A number assigned to computer for network addressing purposes
            - “Phone number” for a computer
            - IPv4, IPv6
        - Network Mask (Netmask)
            - Distinguishes between the network and the machine portions of an IP address
        - Router
            - A device that connects two or more networks together
            - Serves as a gateway between these two networks
        - Transmission Control Protocol-Internet Protocol (TCP-IP)
            - A set of standards that underly most modern network connections at the software level
            - Backbone of the Internet
        - Wi-Fi
            - Common name for wireless networking IEEE 802.11 standard
    - **Four Things Needed for a Valid Internet Connection**
        - IP Address
        - Netmask
        - Router’s IP Address
        - DNS Server’s IP Address
- **Configuring a Connection**
    - **Automatic configuration is handled via DHCP**
    - **Fixed DHCP**
        - Each computer receives the exact same IP address every time it boots up
    - **Dynamic DHCP**
        - A computer receives possibly different IP addresses from the DHCP server every time it connects
    - **Establishing a Wi-Fi connection is easiest using the GUI method**
    - **Wireless Configuration Tools**
        - iwlist
            - Can identify nearby wireless networks
        - iwconfig

        - Can connect to and disconnect from specific wireless networks
    - **Wired Configuration Tools**
        - ifconfig
            - Brings up or shut down a specific network connection and associate a netmask to a particular piece of network hardware such as a network adapter
        - route
            - Adjusts the computer's routing table
        - /etc/resolv.conf
            - Configuration file that contains the IP addresses of up to 3 DNS servers
        - DHCP client
            - Can configure a network connection automatically
            - Example: dhclient, dhcpcd
        - Distribution-Specific Network Scripts

- **Network Testing**
    - **Common Network Connectivity Tests**
        - Routing table
        - PING
            - If you can ping your local systems but not your remote systems, you must be having a router problem
            - If you can ping the IP address but not the name of the device, you must be having a DNS problem
            - If you cannot ping at all, you must be having a fundamental configuration problem
        - Traceroute
            - Tests the connectivity for breaks
        - Domain Name Servers (DNS)
            - Host, dig, nslookup
        - Netstat
            - "Swiss army knife" of networking tools

- **Network Protection**
    - **Basic Tips**
        - Shut down unused servers
        - Enable a firewall
        - Use good passwords
        - Be suspicious
        - Keep your software up-to-date

User Accounts and Groups

- **Understanding User Accounts**
  - **User accounts**
    - Enable multiple users to share a single, physical computer
    - Allow for tracking of who's using system resources
    - Most account features are defined in /etc/passwd
  - **Username**
    - Most relevant feature which consists mainly of lowercase letters and some numbers
  - **Password**

        - Usually contains an “x” which means it is stored in a different file known as the shadow file
    - **User ID (UID)**
        - Used to track the accounts
    - **Group ID (GID)**
    - **Groups**
        - Collections of accounts that can be given special permissions within the Linux system
    - **Command field**
        - Holds the user’s full name
    - **Home directory**
        - States where the home directory is
    - **Default shell**
        - Associated with every single account

- **Account Security**
    - **Passwords today are stored in /etc/shadow**
    - **Salted hash**
        - Uses a one-way mathematical process with additional random input to produce a non-readable password
    - **Username**
    - **Password**
        - Stored as a salted hash
    - **Last password change**
    - **Days until a change is allowed**
    - **Days before a change is required**
    - **Days of warning before password expiration**
    - **Days between expiration and deactivation**
    - **Expiration date**
    - **Special flag**

- **Understanding Groups**
    - **Groups**
        - Collections of accounts that are defined in the /etc/group file
    - **Group name**
    - **Password**
    - **GID**
    - **User list**
    - **Group membership**
        - By specifying the group’s GID in users’ individual /etc/passwd entries

- By specifying usernames in the user list in the /etc/group file

- **Using Account Tools**
  - **whoami**
    - Tells the user with multiple accounts which one they're logged in as
  - **id**
    - Gives more information about the user
  - **who**
    - Gives information about who's currently using the computer
      - Username
      - Terminal identifier
      - Login date and time
      - Remote host
  - **w**
    - Similar to who but produces more verbose output
      - Idle time
      - JCPU – total amount of CPU time for a given session
      - PCPU – total amount of CPU time for the processes running inside a given session
      - WHAT – tells what the session is running and doing

- **Working as Root**
  - **Root**
    - Also called superuser or administrator
    - Has access to system files
  - **Root user privilege**
    - Log in as root user
    - Use the switch user (su) command
    - Use the sudo command
      - Similar to the su command but only works for one command at a time
  - **Precautions**
    - Confirm the need for root access
    - Verify the command
    - Do not run a suspicious program as root
    - Favor the use of sudo over su
    - Do not leave a root shell open
    - Do not share root password with others

Managing File Ownership and Permission

- **Setting Ownership**
  - **Ownership**
    - Every file has an associated owner or account with it
    - Also applies to running programs and processes
  - **Permission**
    - Defines what a file's owner, the member of the file's group, and other users can do with the file

- **Sets of permissions**
  - User
  - Group
  - Other
- **Ownership association**
  - User ID number
  - Group ID number
- **Change ownership (chown)**
  - Changes a file's ownership inside the terminal
  - Can only be done by a root user
- **Change group (chgrp)**
  - Changes a file's group
  - Can also be done by an ordinary user if you're the file owner and you belong to both groups

- **Understanding Permissions**
  - **Permissions**
    - Shows the file permissions
  - **Number of links**
    - Shows the number of unique file names that may be used to access a file
  - **Username**
    - Identifies the file's owner
  - **Group name**
    - Identifies the group that owns a file
  - **File size**
  - **Time stamp**
    - Tells when a file was last modified
  - **Filename**
  - **Permission string**
    - File Type Code
      - This type character represents the file's type and is often omitted from descriptions when the file type is not relevant
        - Normal data file (-)
        - Directory disk (d)
        - Symbolic link (|)
        - Named pipe (p)
        - Socket (s)
        - Block device (b)
        - Character device (c)
    - Owner Permissions

        - Determine what the file's owner can do with the file
    - Group Permissions
        - Determine what members of the file's group who are not its owner can do with the file
    - World or Other Permissions
        - Determine what users who are not the file's owner or members of its group can do with the file

- **Permission Strings and Setting Umask**
    - **Access types**
        - Read
        - Write
        - Execute
            - The file can be run as a program
        - Example: -rwxr-xr-x

Permission String	3-digit Code	Permissions
rwxrwxrwx	777	Read, write, and execute permissions for all users
rwxr—x———	750	Read and execute permission for the owner and group. The file's owner also has write permission. Other users have no access to the file

rw—r—r—	644	Read and write permissions for the owner. Read-only permission for all others
r———————	400	Read permission for the owner. No permission for anybody else

- **Special Cases**
  - Directory execute bit
    - Grants permission to search the directory
  - Directory write permission
    - Allows a user to create, delete, rename files within a directory, even if the user does not own the file
  - Symbolic link
    - Permissions on symbolic links are always 777
  - Root user
    - Many of the permission rules don't apply to root
- **User Mask (Umask)**
  - Determines the default permissions for new files

- **Using Sticky Bits**
  - **Sticky Bit**
    - A special filesystem flag that alters behaviors and limits a user to only delete own files or files stored in own directory
  - **Octal Code**
    - 1 – on, 0 – off
  - **Symbolic Code**
    - +t – on, -t – off

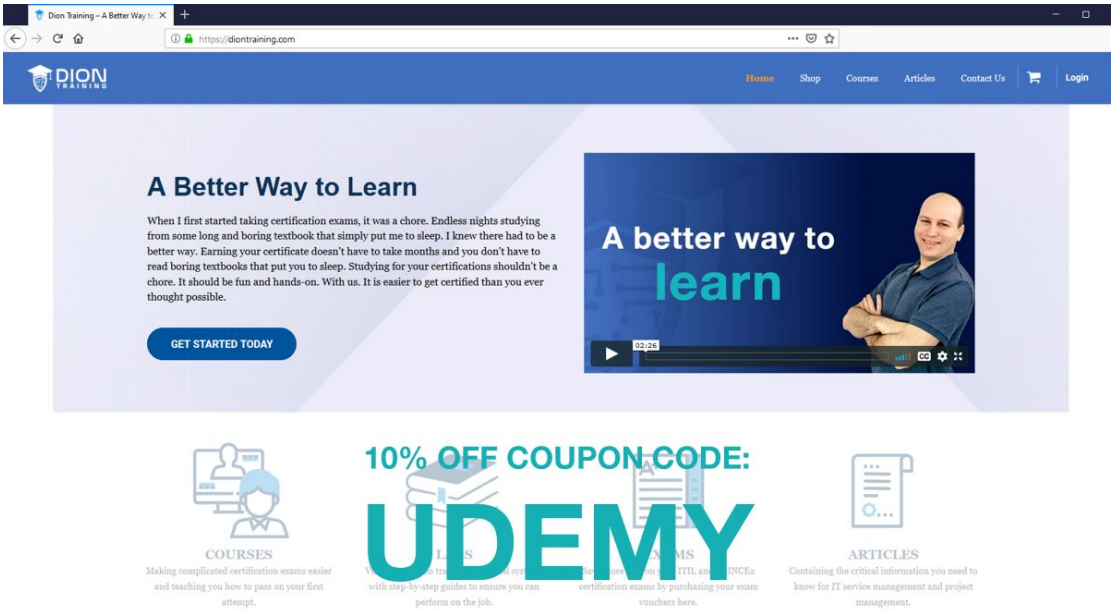
- **Special Execute Permissions**
  - **Set User ID (SUID)**
    - Tells Linux to run the program with the permissions of whoever owns the file rather than the user who runs the program
  - **Set Group ID (SGID)**
    - Sets the group of the running program to the group of the file
  - **Octal Codes**
    - 4 to set the SUID bit
    - 2 to set the SGID bit
    - 6 to set both bits
  - **Symbolic Codes**

        - u+s to set the SUID bit
        - g+s to set the SGID bit
        - ug to set both bits

- **Hiding Files and Directories**
    - **Hidden bit**
        - Hides a file in the file manager
        - Linux uses a file naming convention to hide files by way of a dot (.) at the beginning of the file name
        - Example: .myfile.txt
    - **Hidden directories**
        - Current directory (.)
        - Parent directory (..)
    - **Renaming a file will also make the file inaccessible to programs that uses it**
    - **The –d option will get information from the subdirectories rather than the content**

Conclusion

- **Conclusion**
  - **Five Domains**
    - The Linux Community and a Career in Open Source
    - Finding Your Way on a Linux System
    - The Power of the Command Line
    - The Linux Operating System
    - Security and File Permissions
  - **Take the two practice exams that are included in this course**
  - **You can take the exam at any Pearson Vue authorized testing center**
    - **Vouchers are available on the Pearson Vue website (www.pearsonvue.com), OR**
    - **You can purchase them from the Dion Training website (www.diontraining.com) for a 10% discount**



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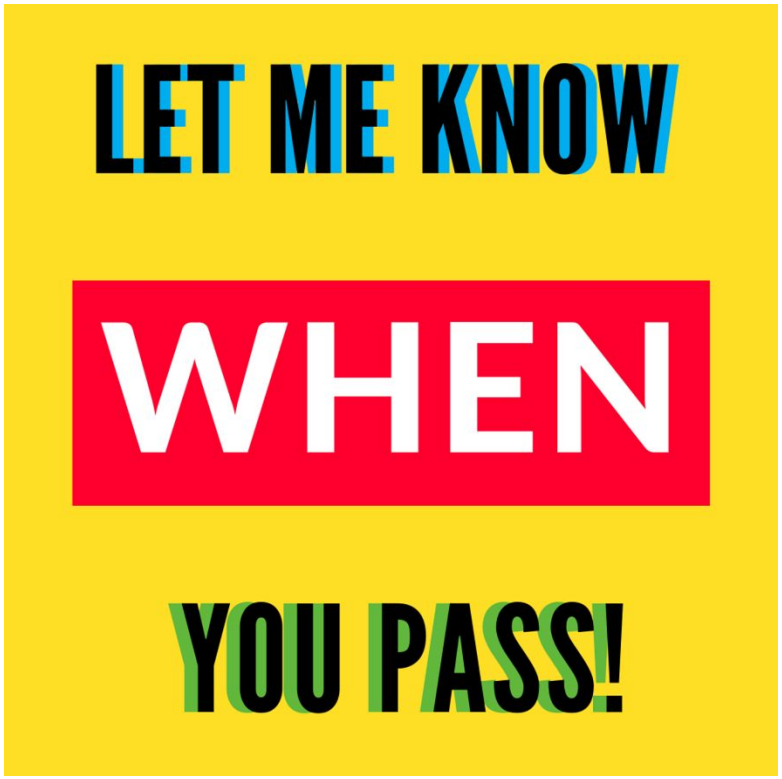
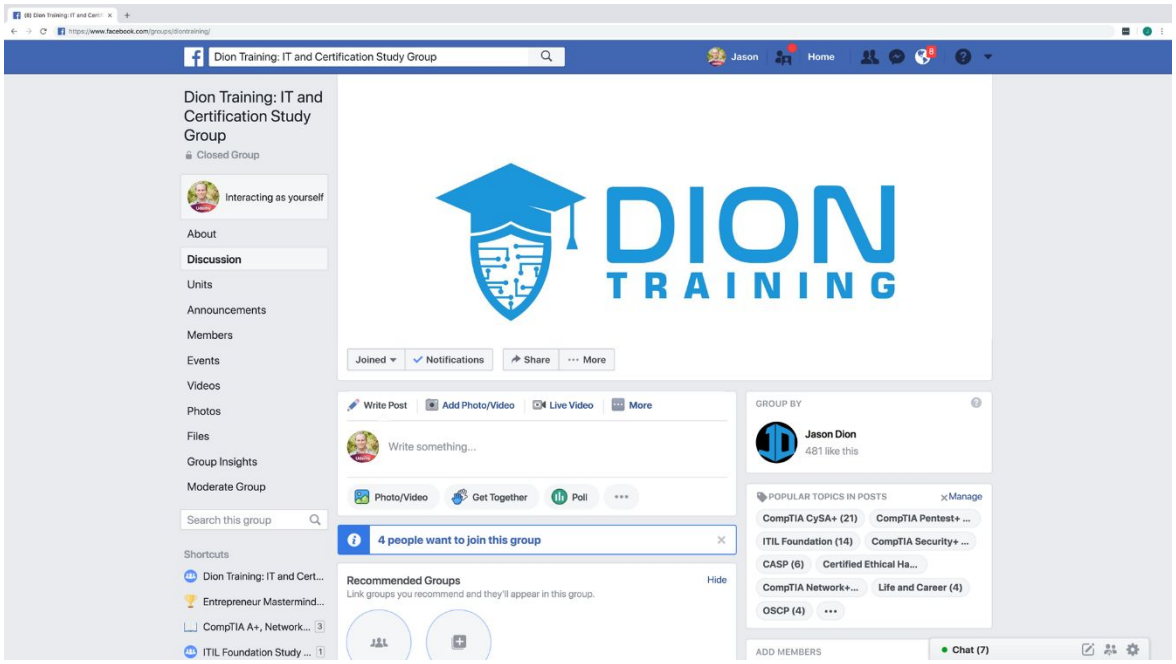
- **Keep studying, take the two practice exams that are included in this course, and...**

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