Linux + Certification

Introduction:

* LXO-103 == LPIC 101-400
* LXO-104 ==LPIC 102-400
* 500/800
* 60 questions
* 90 minutes and is valid for 5 years
* $200 to sit for exam.
* Watch video
* Take notes
* Re-watch video and pause at each step
* Read documentation for anything you don’t understand

**About Linux and Installation:**

What is linux?

* Unix-like computer OS for free and open source distribution.
* Originally made for x68 architecture
* Largest install base now with general purpose OS
* Some want to name it GNU/Linux or Linux
* Components
  + **Boot loader** – software that manages boot process
  + **Kernel** – core of OS. Manages CPU, memory
  + **Daemons** – processes that start during the boot that support the system
  + **The Shell** – access to the CLi and control the whole system.
  + **Graphical Server** – X server, sub system which displays graphics
  + **Desktop environment** – what the user interacts with.
  + Applications
* Free
* Stable
* Secure
* Open Source

Linux Distribution

* Collection of software
* **Package management system** – help install, upgrade, and remove software
* Keeps your server up to date
* Redhat
  + CentOS
  + Fedora
* Debian
  + Ubuntu
  + Mint
* SuSE
* Gentoo
* Arch
* Slackwareß

How can we run linux?

* Your own PC
* Someone else’s PC, Shared hosting, Cloud Provider (AWS, GCP, Azure)
* Virtualization

Installing Ubuntu & CentOS

* Not good to put a boot loader in the master boot record. Okay on VM.
* Enabling bridge network mode
  + CentOS
    - Set adapter to bridged
    - Cd /etc/sysconfig/network-scripts
    - Sudo vi ifcfg-enp0s3 (a=append)(:wq) (ESC)
    - Onboot = yes
    - Ip addr is to see IP address
  + Ubuntu
    - Just set adapter to bridged
* Sudo loadkeys us – shows keys local to the region.

**System Architecture:**

Boot the System

* **\*BIOS (Basic Input Output System**) – firmware that provides hardware initialization of the boot up of your system.
* **MIT (Motherboard Intelligent Tweaker)** – allows you to provide tweaks on the CPU and overclocking.
* **System Settings** – Time and Date
* **Boot Option priorities** – let us select which devices are booted from
  + **UEFI (Unified Extensive Firmware Intelligence)**– UEFI -> EFI Boot Loader -> Kernel -> Operating System
    - Has its own file system
    - Each should have its own boot loader
  + **Legacy booting** – BIOS -> MBR(Master Boot Record) -> BootLoader -> Kernel -> OS
* **MBR** – identifies where and why a OS is located to boot from.
* **Kernel** – lowest level of replicable software that interacts with the hardware.
* **Ps aux | head** – goes over the processes listed
* **Sysvinit** – first commercial version of linux available
* **Systemd** – low memory and perform’s better than sysvinit. Easier to read than sysvinit
* **Upstart** – Ubuntu developers made by it.
* **Dmesg/dmesg -T** – shows kernel messages when the system was booted

Determine and configure hardware settings

* **Udev** – device manager for the kernel of your system
  + Low level access to the linux device tree
  + Handles user space events
    - Loading firmware
  + Provided by a temporary filesystem (tmpfs)
  + Mounted to /dev on startup
* Dbus – inter-process communication mechanism that allows processes to talk to each other
  + Provides a high-level object oriented programming interface
* Sysfs – virtual filesystem that presents varios information about kernel subsystems
  + Mounted to /sys
  + Hardware devices
  + Drivers
* Procfs – similar to sysfs but presents information about processes and information about system information.
  + Mounted to /proc
  + Can be used to interface with the kernel and change parameters on the fly
  + **Cat cmdline**
  + **Lsmod | less –** page by page version of module
  + **Modprobe –** enable a mod
    - **Rmmod –** remove a mode
  + **Lspci** – shows devices connected to the computer

Run levels, boot targets and how to shutdown and reboot system

* **Run level (inittab)** – number between 1-9 and determines which scripts are used based on the run level
  + 0 – halt or shut down
  + 1 – single user mode
  + 2 – multi-user mode without networking
  + 3 – normal boot
  + 4 – Unused/customizable
  + 5 – Run level 3 + GUI display manager
  + 6 – reboot
  + rcS.d – is run level used during every level
  + **init telinit** – used to change the run level
  + **man telinit** – manual command
  + **wall** – writes to the shell as to everyone that is logged in.
  + **systemctl** – is a way to control systemd devices or targets
    - can be used like init telinit
* **Scripts** – little programs held on the system that can be used.
* System run level
  + /etc/system/system
  + Package scripts
    - /user/lib/systemd/system
  + System packages take power over packaged scripts
  + **Targets** – are like run levels. Named instead of numbers

**Linux Installation and Package Management:**

Design a hard disk layout

* /usr – user binaries where packages are installed
* /home – user files
* /boot – where the boot loader is found
* /etc
* /var – variable files
* /tmp – unique storage area where everyone can write too
* Partitioning
  + Separation of files
  + Allows dual booting
  + Divide storage into multiple pieces
  + Data organizations
  + System protection
  + Helps ensure data doesn’t overflow into other directories.
  + Swap partition can be used to free up more memory
  + **LVM** – Logical Volume Manager – split physical partitions into pools

Install a boot manager

* Common boot loaders
  + LILO
  + GRUB Legacy
  + GRUB 2 **(grub-probe –version)(grub-install –version)**
    - **Less grub.cfg command**
    - **Sudo vi /etc/config/grub.d** 
      * need to run sudo **update-grub** to update the changes made.
      * Quiet mode will eliminate a lot of messages during bootup
    - Find where a script is located – **which update-grub**
    - Can have systemd boot from another target – like **vg-root ro systemd.unit=rescue.target**
    - **Sudo grub-install /dev/sda**

Manage Shared libraries

* Shared reuseable pieces of code
* **Static linking** – application included in a library
* **Dynamic linking** – two applications use one single library
* **/etc/ld.so.conf** is where the shared libraries would be
* **libc.conf** is in C programming language
* **man ldconfig** does the dynamic linking in a directory
* **environment variables –** customized pieces of text that are specific to your shell
  + **export LD\_LIBRARY\_PATH=/home/nick/lib/**
  + **echo $LD\_LIBRARY\_PATH**
  + **LDD –** prints shared object dependencies

Debian package management

* Dpkg
  + Debian Package Manager
  + Install software, ugrade, remove, low-level tool
  + **Dpkg –l | less**
  + **Wget to pull from a url**
  + **Dpkg –purge dlocate**
  + **Doesn’t find dependencies and doesn’t automatically install them**
* Apt
  + Advanced packaging Tool
  + High level tool
  + Install, upgrade, remove packages, upgrade entire system and handles package dependencies.
  + Uses online repositories
  + Installs dependencies.
  + **Apt-cache depends apache2 | less** – search for packages and looks at dependencies of a package.
  + **Apt-cache search nginx**
  + **Apt-get upgrade** – can’t upgrade all packages
  + **Apt-get dist-upgrade** – upgrades everything and deletes everything that it won’t use
  + **Sudo apt autoremove**

Using RPM and YUM package management

* **RPM (RedHat Package Manager) similar to dpkg**
  + Rpm command
  + Low level tool
  + Install software, remove, update.
    - Cpio files which are files that can be combined into on main location
    - Rpm2cpio wget-1.14-13.el7.x86\_64.rpm | cpio –idvm – good way to look in an rpm
  + Rpm –qf (query format) /etc/protocols
  + Sudo rpm –verify setup – queries everyfile to see if there in the directory
    - Don’t want a response on this which is good.
  + Sudo rpm –Va which is simliar
* **YUM (Yellowdog Updater, Modified) similar to apt-get**
  + Replaced YUP, Yellowdog Updater
  + Utilizes online repos
  + Manages dependencies
  + Conf file /etc/yum.conf
  + Sources url list /etc/yum.repos.d
  + Use head command to look at the top of the file
  + Sudo yum install –downloadonly –downloaddir=/tmp wget
    - Yumdownloader install doesn’t exist anymore

**GNU and UNIX commands:**

**Shell** – program in which you type in linux. command line interpreter. Bash shell, sh, sdsh, kssh

* **Sh** shell doesn’t show directory
* **Pwd** – shows working directory.
* **Echo $HISTFILE –** can show if it uses a different environment variable history
* . files are hidden
* **ls –a** shows all files even hidden ones. Can hide director too.
* **History** – shows number commands by order
* **Export HISTFILE=/home/guru/**.test – changes the history file to change where it writes too.
* **Set** – set values of shell options or positional parameters.
* **Man man** – view details about the man guide.
  + **Man –k (value)** – shows and searchs for commands related to it.
  + **Man 7 time** – shows different values for those commands.
  + **Manpath** – shows the directory of man.
* **Uname** - prints out system information

**Environment variables** – affect the way running processes behave on the terminal

* Temporary only during the time that your logged into the shell
* To keep them constant, have a script that executes every time your login.
  + Can be done by changing the .bashrc script

Process Text streams using filters

* Won’t save to files unless told too
* **Cat** file1.txt
  + **Cat /etc/passwd** shows all those that have passwords
* **Cut** – remove sections from each line of files
  + **Cut –c3** file1.txt
  + **Cut –c3-**5 which includes a range.
  + **Cut –d: -f1** - separate fields but the : -. F1 can choose which can be filtered out of the list
* **Expand** – convert tabs to 8 spaces
  + **^I** means tab
  + **Cat –vet file** – shows the spaces between the characters
  + **$** means end of line
* **unexpand** - convert 8 spaces back to tab
  + **unexpand –a**
* **wc** – tell new line count, word count, byte count for file
  + **wc** –l is just the line count.
  + **Fmt** – can split the lines into even lines
* **Head** – see the top of the page
  + 10 lines each
  + Head –n 2 /etc – changes lines in list
* **Tail** – see the bottom of a page
  + 10 lines each
* **Join** – join two files together that share a common field.
* **Less** – shows page by page version of file
* **Nl** – adds line numbers to a file for you.
* **Od** – dump files in octal formats
* **Paste** – does the same as the join command but combines everyfield.
* **Pr** – converts text files for printing.
* **Sed** – stream editor which can perform text
  + Sed – e – regular expressions
* **Sort** – sorts a file apabetically
* Split – splits files into multiple pieces with 1000 file limits.
* Tr – translate or delete characters.
* Unique – show syou matching json texts back to you.

Use Streams, pipes and redirects

* Streams
  + **STDIN - 0** (file describer) – inpute to programs via key strokes
    - 0 before > shows which stream should be done.
    - < can sort the content with sort.
    - << which manually allows us to input characters
      * sort << END
  + **STDOUT – 1** – print text characters to the terminal (Default)
    - > redirect to file name after it
    - >> is to append more about the file.
    - > overwrites a file
  + **STDERR – 2** - print text characters to the terminal
  + **&** copies to a file describer. Position matters
    - **ls > x 2>&1 > y**
  + **tr –s ‘ ‘ < ls.txt > output.txt**
* **Pipes** – allows us to stream an output from one command to an input of another command
  + **Cat input.txt | sort**
* **Xargs** takes input line by line and puts it input in the command thereafter
  + **Find / -name blah.txt | xargs rm**
* Redirect standard output but watch output at the same time.
  + **Ls | tee lsout.txt**

Create, monitor and kill processes

* **Ping** – tests how long a message takes to get to a computer and back again.
  + **Control z**
  + **Bg** can run a program in the background
    - **&** puts it also in the same background.
  + **Fg** can bring a command to the forfront.
* **#!/bin/bash** – tells the shell what the command is in.
  + **source script.sh** – runs a command without starting a new shell
  + **. script sh**
* **nohop –** shows the command but will run the command in the background.
* **Jobs –** shows jobs in the background.
* **Ps –** shows running processes running on the computer.
  + **Ps a –** shows everything to the shell and computer.
  + **Ps x –** shows commands by all users
  + **Ps aux –** shows in a user name formatted.
  + **Kill (process id) –** kills the process
    - Can send signals to the process.
    - SIGINT – CTRL + C – interrupt signal
    - SIGKILL – kill signal
      * **Killall ping** – can be dangerous – exact matching.
      * **Pkill** terminates by command name.
    - SIGSTOP – pause signal – CTRL + Z
    - SIGTERM – termination signal
      * **Kill –TERM 2384**
  + **Top –** shows continuing information being ran on your computer.
    - **Shift p –** sorting by CPU
    - **Uptime –** shows uptime of the computer.
    - **Free –** gives memory information about the computer.
  + **Screen –** run process and screens at the same time in the same window. Persists after.
    - **Control a d –** detach from the screen.
    - **Screen –r –** reattach screen.
    - **Control a c –** starts a new screen in the same shell and toggle back and forth.

Modify process execution priorities

* **Nice value** – determines how much CPU time a process will get.
  + -20 – Highest priority
  + 19 – lowest priority
  + 0 – default nice value
  + **nice** – execute a value with a different nice value than default
  + (-) is with a –
  + **renice** – change a nice value again.

Regular expressions

* Sequence of symbols and characters
* Express a string or pattern
* Searched within text
* Regex
* Symbols
  + | - or
    - Eg gray|grey
  + () – grouping
    - Eg gr(a|e)y
  + $ - end of a line
  + ^ start of a line
  + . – one character
  + ? – 0 or 1 occurrence of the preceding element
    - Colou?r matches color or colour
  + \* - 0 or more occurrences of the preceding element
    - Eg. Ab\*c matches ac, abc, abbc, etc
  + + - 1 or more occurrences of the preceding element
    - Eg. Ab+c matches abc, abbc, abbc, but not ac
  + {n} – the preceding item is matched exactly n times
  + {min,} – the preceding item is matched min or more times
  + {min,max} – the preceding item is matched at least min times but not more than max times
* **Grep** – globally search for a regular expression and print
  + Uses symbols and regular expressions to search plain text
  + Can search for opposites too
  + **Grep**
  + **Egrep (grep –E)** extended search characters
  + **Fgrep** – searches the entire string without quantifiers
  + **Sed** – can use quantifiers with search and replace

Perform basic file editing operations using vi (VIM improved)

* Editing mode
  + Can edit/delete text
  + I – insert mode
  + Esc gets you out of editing
  + A – types in front of cursor
  + o – lets you start typing after the cursor
  + O – lets you start typing before the cursor
  + Shift + ZZ lets you save and quit.
  + :q! changes aren’t saved and exit
  + :w – saves the file without quitting the file.
* Command mode
  + Move around the file and manipulate the text
  + Can type things new in the file.
  + Can delete text
  + Can use letter keys to move around like with hjkl
  + Can search the text
  + n – repeats the last command
  + ?init searches back in the file for the text
  + dd – delete line you are completely on
    - 3dd – deletes three lines
  + P – paste the entire line after the line your own
  + Shift + P inserts it above the line
  + Yy – copies the line.
  + X deletes characters
  + :3 – jump around on lines

**Devices, FileSystems, and Filesystem hierarchy:**

Create partitions and filesystems

* **df** – shows disk partition and disk usage.
  + **Df** –h – readable disk sizes.
* **Lsblk** – shows us what is going on with partition based on the dev mapper with LVM
* **Fdisk** (m shows all of what can be done with fdisk). Gives us a way to create partitions on a hard disk.
* **Parted** – another way to create partitions.
  + Mkpart creates a new partition
* **MBR (old standard)**
  + Allows 4 primary partitions
  + Max disk is 2 TB. Have to put anything above 4 partitions in an extended mode.
* **GPT**  - let’s us use much bigger disk sizes.
  + Associated with UEFI
  + Basically, unlimited partitions
* Filesystems
  + **Ext2** – default and replaced ext
    - Ext only allowed certain amount of characters. Partition size was to small
  + **Ext3** – allows journaling
    - Journaling assists in recovery lost data.
  + **Ext4** – allows huge files and filesystems. (16 TB starting)
  + **Reiserfs** – resizable, journaling filesystem
  + B**trfs** – b-tree filesystem, supports snapshots, checksums, and pooling
    - Online defragmentation and autodefrag mount
    - Online resizing
    - Online filesystem checks.
  + **Mkfs** – makes a filesystem
    - If you don’t specify filesystem, ext2 will be default.
  + **Mount** – shows all the filesystems that are mounted.
  + **Mkswap** – wipes the drive and creates a swap space
  + **Swapon** – provides a swap disk drive.
    - Free shows disk space.

Maintain the integrity of filesystems

* **Inode** – data structure which describes a file or directory
  + Stores attributes
    - Last time of change/access/modification
    - Owner/permissions data
  + Stores disk location
  + You **can** run out of inodes before running out of disk space
  + Directory of a list of names assigned to inodes
    - Contains entry for itself, its parent, and its children
  + **Ls – I** – shows us the inode for a particular file or directory
  + **Find . –inum 585 | xargs rm**
  + **Df –I –** shows inodes on root filesystem
  + **Du –h –** shows all files in your current directory and the amount of disk it is using.
    - **-s** gives summary
    - **du –**h –max-depth=1 / - shows disk usage in root file system. Won’t show files
  + **fsck** – check and repair errors that may be found with the file system. Don’t run integrity check on a disk when it is mounted.
    - Reboot to rescue mode when working on the root drive.
    - **Fsck tab tab** shows all file system for it and the versions.
    - **Fsck** is a wrapper.
  + Super block – segment of file system that stores metadata about itself
    - **Dumpe2fs –h**
    - **Tune2fs –L –** adjust tunable filesystem variables. Lets us set the filesystem name.
    - **Max-mount-counts** – number of times filesystem is mounted

Control mounting and unmounting of filesystems

* **Mount** – can see mounted file systems
  + Cat /pro/self/mounts
  + **/etc/fstab**
    - dump means to create a backup of the system.
    - Pass is used for filesystem checks. 1 is for root disk. 2 is for other checks
    - **Mount –a** mounts everything in fstab without noauto default.
  + **Fuser** – shows us which process is taking the directory
    - **Ps aufx**

Manage disk quotas

* Etc/fstab edited
  + Defaults,usrquota – enable user quote on hard disk
* Apt-get install quota with inline command tools
  + **Quotacheck** – initialize the disk to start quotas.
  + **Edquota** – edit a quota for a user.
  + Quotaon /mnt/photos enables quotas
  + **Quota** – v shows the quota for the partition/hard disk
  + **Dd if=/dev/zero** of=test.file bs=1 count=5120 – dev zero outputs null characters in a file
  + 7 day grace period to go over the quota.
  + **Repquota** – gives a report on the filesystem

Manage file permissions and ownership

* **Ls –la, ls –lad** (shows permissions of the folder not all content)
  + Rwx rw- r—
    - Rwx is the user
    - Rw is the group
    - R—is for others
    - R – read
    - W – write
    - X - execute
  + D – references a directory
  + L – means link
  + – means file type
* **cmod**
  + u+rwx, g+wx, o+r
  + r = 4, w=2, x=1, -=0
    - add the numbers together and then apply 764
    - 0764 the 0 is implied as that is the sticky bit
  + rwx = 421, rw- = 420, r-x = 401, -r- = 040, -wx = 021, -w- = 020, --x = 001, --- = 000
* **setuid/setgid**
  + used to tell the system to run as the program owner with the owner permission even with you not being the owner.
  + **+s**
* **stick bit**
  + used on folders. Prevents folder deletion even if a user has persmission
  + **+t**
  + S not set, s is set
* **Chown** – used to change the owner of a file
  + **Chown username:group filename**
  + **Chown –R username \***
* **Chgrp** – used to change the group of a file
* **Umask (0002 by default)** shows the default of permissions are not set on a files. List what you want to suppress from default files and default folders.

Create and change hard and symbolic links

* File is only removed when all links to an inode are removed
* **Hard link –** link to another file indoe and can occur on the same filesystem.
  + **Ln –** link command.Ln –s is for a symbolic link.
    - **Ls –**li shows the inode tied to the file.
* **Soft link –** link to another file but can occur across file systems.
  + Similar to a shortcut in windows.

Find system files and place files in the correct location

* **Type** – tells if the command is built in or a shell command
* **Whereis** – locates binary, source, and manual page if possible for a command.
* **Locate** - builds a database on your filesystem and then being able to find things on the filesystem.
  + **Updatedb** – updates current database on device.

**Shells, scripting, and data management:**

Customize and use the shell environment

* **Configuration Files**
  + Allows us to change how our shells work
  + Define path, environment variables
  + Set up aliases
  + System wide - /etc/bash.bashrc and /etc/profile
  + Local - ~/.bash\_profile, ~/.bashrc and ~/.profile
    - If [ -f ~/.bashrc]; then source ~/.bashrc fi
  + Action specific - ~/.bash\_login and ~/.bash\_logout
* Shell commands
  + **Set –o noclobber** – changes how the > works
  + **Set –o xtrace** – show you full command when you run it and all the commands
  + **Aliases** – allow you to customize your commands. Edit bashrc to include new ones.