Linux Operating System Class26

Introduction to operating

what is an operating system?

every computer is made up of some hardware like cpu, memory and storage etc and all the program running on the computer need to use this hardware resources

so application use operating system as an intermidiary to talk to the hardware so the operating system interact with the hardware as well as the application

operating systems will also manage resources amongst applications

What are the task of an operating system?

- 1. Process management(Processor), a process is a small unit that execute on a computer for example opening a new browser tap is a process for a example if a computer has only 1 cpu it can handly only one process/task at a time but now we have multiple cpu or multi core computers now e.g Dual-Core = 2 CPU's Quad-Core = 4CPU's (4cpu or 4 processors) the more cpu your computer has the faster the application will work because they can execute this processes in parallel
- 2. Memory management (RAM=Rapid Access Memory) when ever you start and application that application need some data(memory) so that it can work
- 3. Storage (Hardrive of a computer): this is the secondary memory for persisting Data long-term

NB active working data is store in RAM and once you are done the data is save in storage ies the Hardrive for longterm data persistence

Operating system stores information in a structured way in folders or directory in linux-operating system the file system is structured in a tree form with the Root folder and sub-directories

- 4. Management of I/O Devices like Monitor, keyboard, mouse ,Printers , USB etc
- 5. Security and Networkong: in term of security operation system is responsible for managing users and their permissions because we can have multiple user in one computer and each user

will have a username and password to login and have thier own space to install application save file etc Users also have permissions.

Networking like assigning port and IP addresses etc are also task of an operating system.

Operating System Components:

- ***Kernel***: this is the heart of every Operating System use to manage the Hardware components(CPU, MEMORY,RAM) so the Kernel of the operating system interact with the Applications Layer and the Hardware layer

A kernel is a program which consist of device drivers

Linix Operating system is based on Linux Kernel while MacOS operating system is based on Darwin

There are three main operating system:

- 1. Linux
- 2. Windows
- 3. MacOS

Note that each operating system have many version because the evolve over time and get better.

Note that over half of all the server use world wide are using linux as an operating sytem

Knowing linux is a must for a DevOps engineer because many DevOps task involve working with servers, installing and configuring things on the them

Ubuntu is the most popular linux Distribution.

Introduction to virtualization and virtual machine

- what is virtualization and what is a virtual machine?
- Why is virtualization useful?
- Main concepts of how Virtualization works?

with virtualization you can install another operating system on top of another operating system for example you can install a linux Operating system on top of a windows operating system

Vitualization can be achieved using a Hypervisor.

Hypervisor is a technology that allows hosting multiple virtual computer on a physical computer on top of the operating system that you already install

Example of hypervisor is VitualBox from Oracle which is Open-source and works on all operating system.

So virtualBox will let you create a virtual machine on your windows computer by using the Host operating system hardware resource (vitual cpu, RAM, Storage) for the virtual machine.

- hypervisor could be of different types:
- ***Type 2*** Hypervisor also call HOSTED Hypervisors are use in personal computers Hardware ---> host OS ---> hypervisor ---> Guest OS
- ***Type 1*** Hypervisor are call Bare Metal hypervisors this because the hypervisor is install on the Hardware not on the host OS and the Guest machine install on the Hardware example of type one Hypervisors are:
- VMWARE
- ESXi
- Microsoft Hyper-v

Big company and big cloud platform use type 1 hypervisor to create and run their infratructure so when you create a virtual machine on AWS or Google cloud platform you are creating this virtual machine on a physical server

Advantages of type 1 hypervisor are as follows:

- 1. efficient usage of hardware resources
- 2. Abstraction of OS from the hardware

why are companies adopting Virtualization?

Before virtualization: when a company had a server where they have install maybe a database or Jenkins they will manage it themself by installing an Operating system directly on it and start installing their applications on the Operating system like installing and configuring Jenkins or installing database application etc.

The consequence is that when an Operating system is install directly on a hardware without that Hypervisor in between, the Operating system is then ***Tightly coupled*** to the hardware this means if the hardware component of the computer fails like the hardisk or the motherboard fails and the component cannot be replace this mean the whole computer will be useless and the Operating system and the application you install and configure on it and all the data will be gone so relying on this one physical box means ***one point of failure*** and therefore high risk of losing all services running on that machine.

With Vitualization: your Operating system is a portable file that you can move around and this files are virtual machine images so this portable file or the image will have the OS and all the application on it (jenkins and database etc) document and everything will be inside the portable file and you can make copies and backup of the OS image call snapshot.

So if something happens you can take the snapshot of the OS image and run it on a defferent computer with Hypervisor on it.

This bring security, portability and Not dependent on any physical server.

So the virtualization concept is very powerful, this is the reason why you see it everywhere in IT.

This has completely change the ware we work so whether you are a cloud Engineer, System administrator, DevOps Engineer or software Developer you need to understand virtualization because you will be working with virtual machine.

Linux File System

WE have to look at how linux work and we will start by learning the linux filesystem/directory structure

The linux file system is a hierarchical tree structure

1. ***Root folder(directory) /***

Is the top level of the directory hierarchy and inside the root folder we have a couple of folders which each has its purpose and inside the folders we have other sub folders and file

2. ***/home directory***

Contain personal directories for user this is where all non-root linux user spaces are located so each linux user will have it own space in a home directory except for the root user who has its own folder separate.

The _/home directory_ is one of the most important folder you have to know in linux in addition to the program and files that only your user need to see there are also programs that need to be available system wide system wide means this program are install on a computer and available to all the users on that computer so they are not on the home directory of the user they are on the outter level outside the home directory an available for all users of your computer, and this could be application or linux command available for the whole system and for all the users. this are located in /bin

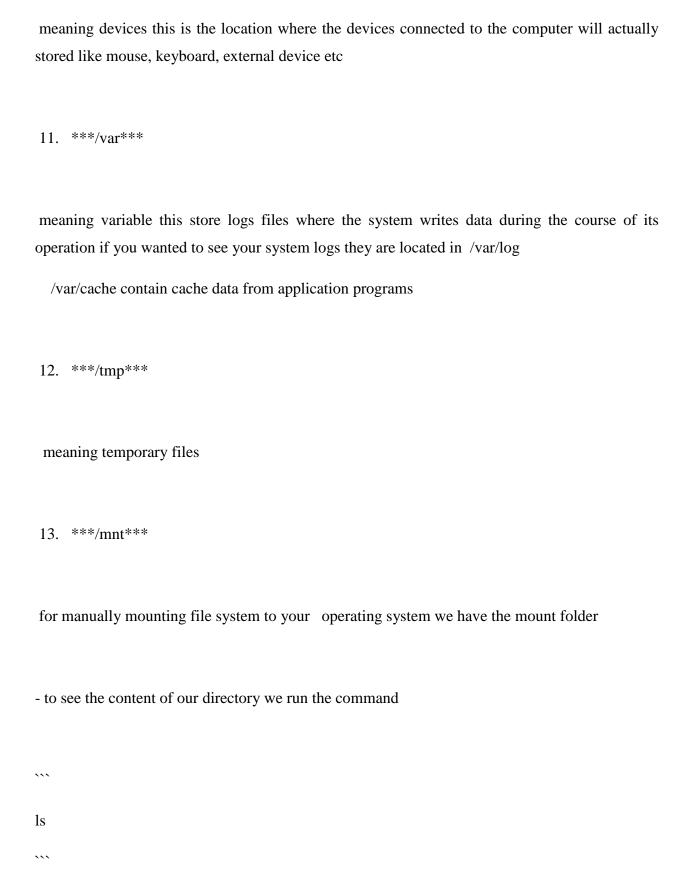
3. ***/bin directory:***

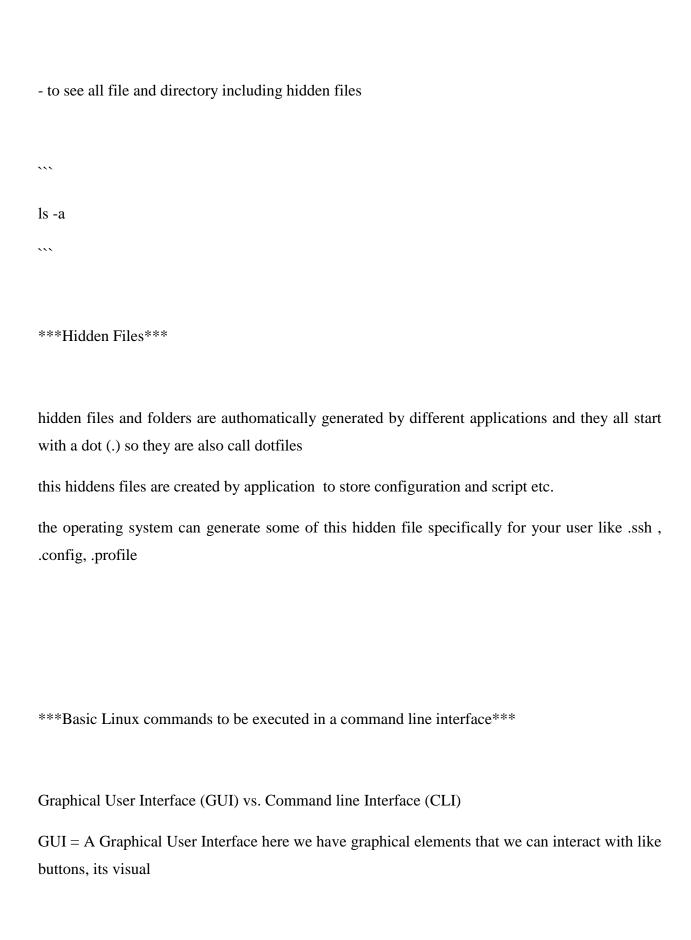
The bin (binaries) contain essential binary executable (programs) needed for booting and repairing the system.

Binary is a computer-readable format so all the commands are in a binary file

4. ***/sbin directory:*** Contain system binaries typically for root or administrative tasks. 5. ***/lib*** or libraries folders holds the libraries for those binaries for those commands 6. ***/usr*** meaning user, this contain user utilities and application 7. ***/opt*** meaning optional folder this is another location where third party application are install note that all this directories or folders are read only meaning you cannot change or modify them 8. ***/boot*** for booting the system which contain boot loader files, including the kernel 9. ***/etc*** stores system configuration and script for different applications

10. ***/dev***





CLI = Command Line Interface, where users type in commands and see the results printed on the screen/Terminal
terminal = this is the application for displaying and working with command line interface
The GUI and CLI are basically two different interfaces that we as operating system users interact with the operating system
note that on a personal computer we have both GUI and CLI whereas on servers we have only CLI and no GUI
As a DevOps Engineer you will be working with server so you need this skill
command line interface in
Basic Linux Command
- to create a file in linux for example if i want to create a file called _enginners-list_
touch engineer-list

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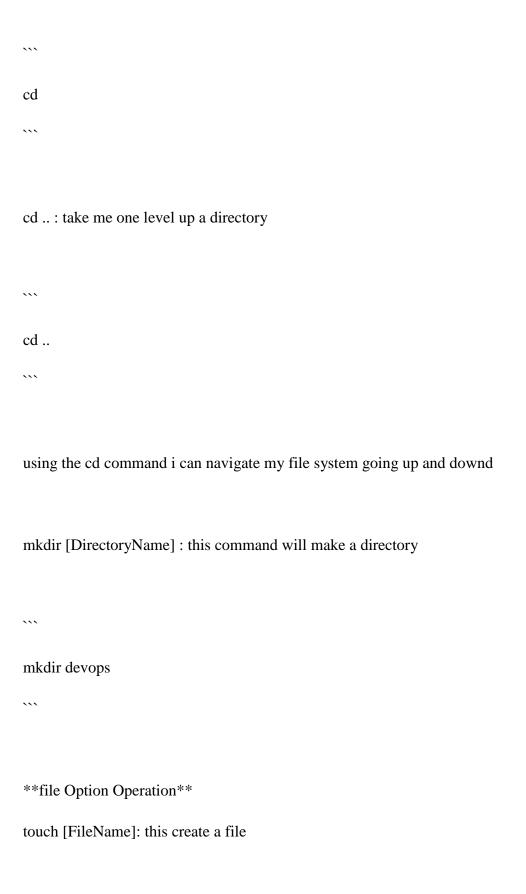
- This file call _engineer-list_ is empty if i want to add names of engineers in the file
- add the following content in the file
number name
1 peter
2 jame
3 paola
4 jane
5 carelle
vi engineer-list
- to read the content of the file run the command
cat engineer-list

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- to create a folder or a directory for example if i want to create a directory with name _devops_
mkdir devops
- change directory into _devops_
la daviana
ls devops
cd devops

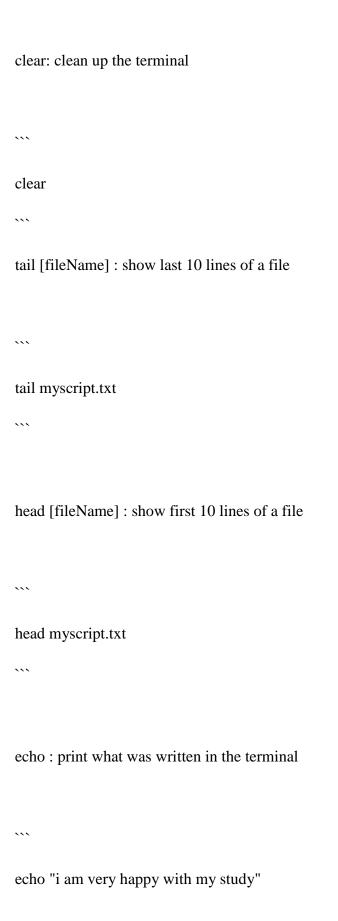
- create another file inside the _devops_ directory
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touch cloud-engineer-list.txt
pwd: print working directory is use to display folder that you are currently working in
pwd. print working directory is use to display folder that you are currently working in
PWD

ls: list folders and files
ls

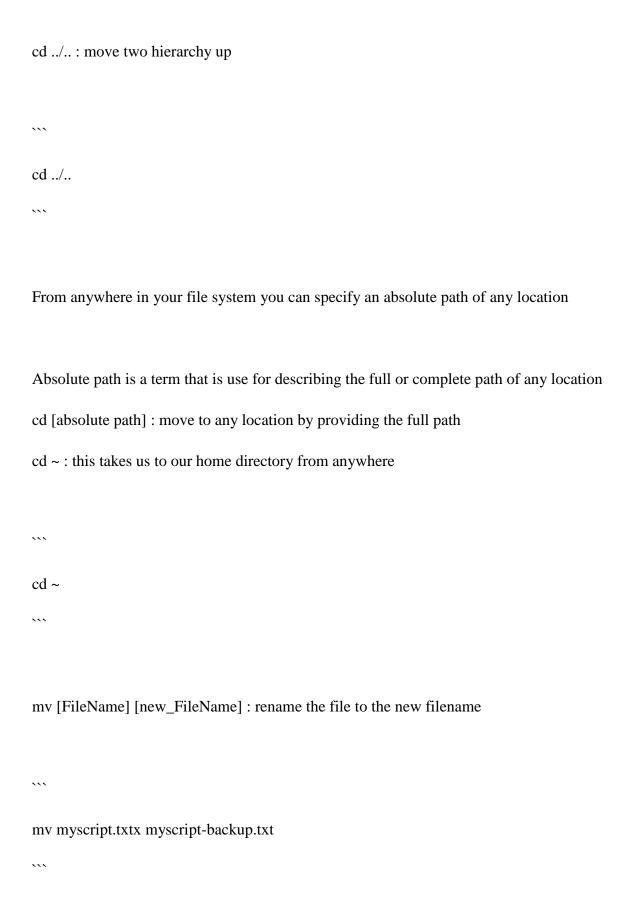
cd: change directory and the command is cd [DirectoryName]



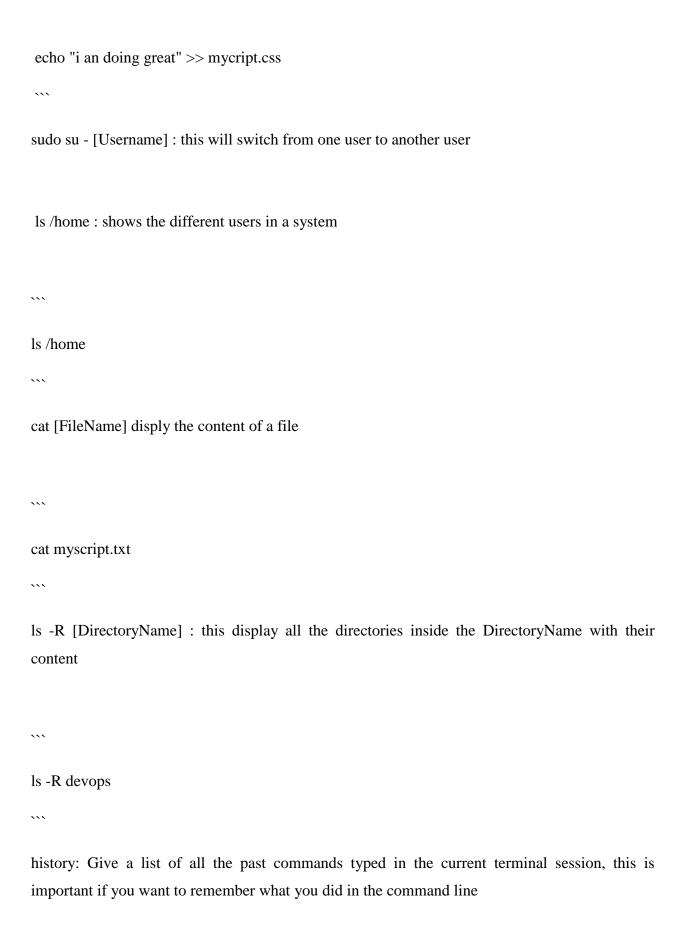
```
...
touch engineer-backup
rm [FileName]: this will Delete the file
...
rm engineer-backup
rm -r [DirectoryName]: this will Delete the directory recursively
(any sub directory that is inside the main directory)
...
rm -r devops
rmdir [DirectoryName]: Delete and empty directory
...
rmdir class26
...
```

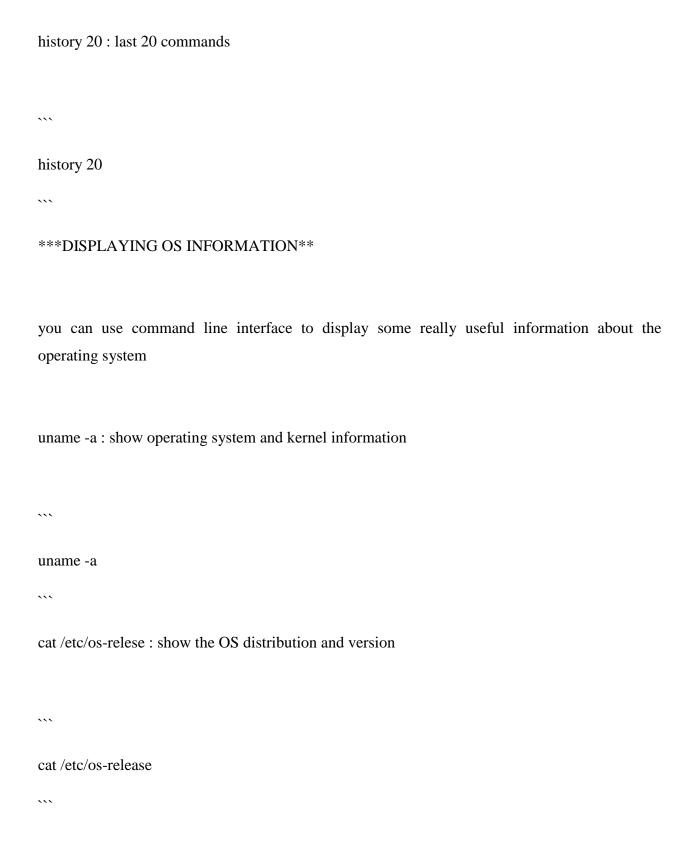


navigating to the root folder
cd /: navigate to the root folder and when you type [pwd] enter you see that you are in the root
folder when you type [ls] it shows you the different folder in the root folder
~~~
cd /
pwd
ls
NB everything in linux is represented as a file (text document, picture, directories, devices like
printers, keyboard, USB, CD) this permit them to be copied move from one place to another etc
Navigating into the filesystem
ravigating into the mesystem
cd /usr/local/bin : this move you to the bin directory
cd /usr/local/bin



```
cp -r [DirectoryName] [New_DirectoryName] : this will copy
DirectoryName to New_DirectoryName
...
cp -r devops devops-backup
cp [FileName] [New_FileName] : this will copy the FileName to New_FileName
***
cp file.txt myfile.txt
redirect (>): add a content to a new file or replace existing
content in a file
echo "it is a good" > mycript.css
apend (>>): add content into a file
```





lscpu : display information about cpu
df -h : display information about storage/hard disk

df -h
lsmem: display information about the memory

lsmem
、、、
free -m : display information about memory

free -m

swap: Swap space in Linux is a dedicated area on the disk that acts as an overflow space for the system's physical memory (RAM). When the physical memory is fully utilized, the system moves inactive pages from the RAM to the swap space, thereby freeing up RAM for active processes. This mechanism helps in managing memory efficiently, especially when the system is under heavy load.

NETWORK COMMAND

- nslookup: Queries DNS to obtain domain name or IP address mapping

• • • •

nslookup facebook.com

• • • •

- dig : Queries DNS servers for information

...

dig facebook.com

...

- ps aux: command in Linux is used to display information about all running processes on the system.

ps aux
- ps aux grep
- ifconfig: Used to configure and display network interface parameters.
···
curl ifconfig.io
···
- ping: Checks the network connectivity between the host and the specified network node.
ping facebook.com
- netstart -tulp: Displays network connections, routing tables, interface statistics
netstart -tuln

- curl: Transfers data from or to a server using various protocols.
curl link to download
- wget: Retrieves files from the web.
wget linked to download
DISPLAYING OPERATING INFORMATION
you can use command line interface to display some really useful information about the operating system

unam	ie -a : show operating system and kernel information

unam	ne -a

cat /e	tc/os-relese :show the OS distribution and version

cat /e	tc/os-release

lscpu	: display information about cpu

lscpu	
\\\	
df h	: display information about storage/hard disk
uı -II	. dispiay imormation about storage/hard disk

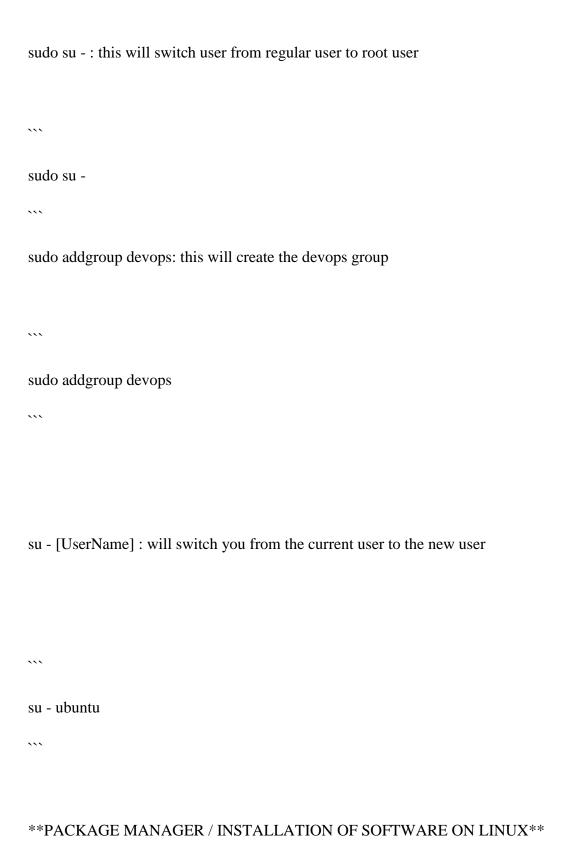
df -h	

lsmem : display information about the memory
lsmem

free -m : display information about memory
Tree in a display information about memory

free -m
check disk pace and swap space

free -h
EXECUTING COMMAND AS SUPERUSER
This command can only be executed by a superuser, a regular non root user cannot execute such command
sudo adduser [UserName] = this add a linux new user to the group
···
sudo adduser
···
ls /home : to verify if the new user was added
ls /home
sudo : this allows regular users to run programs with the security privileges of the superuser or root



A package manager is a tool or system that automates the process of installing, updating, configuring, and removing software packages on a system. It simplifies the management of software by handling dependencies, ensuring proper installation, and providing an easy way to uninstall or upgrade software components.

we are looking on how to install software application on linux

In linux we install most software application using a package manager tool even though we have exception but 90% of the packages will be install using package manager tools

What is a package manager?

what is a software package?: this is a compressed archive which contain all the files that are required by a specific software to run

software application usually have dependencies, they depend on other software to run.

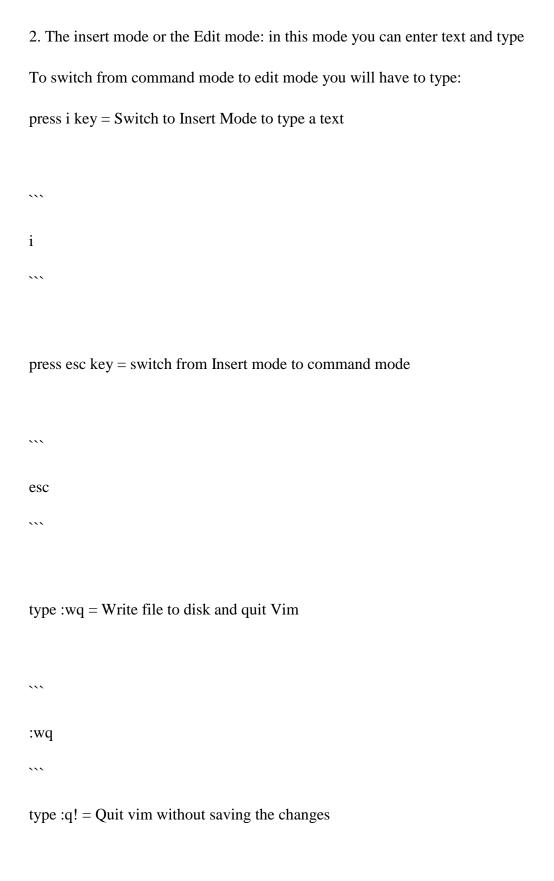
The package manager will do the following:

- 1. downloads, installs or updates existing software from a repository
- 2. ensures the integrity and authenticity of the package
- 3. easy upgrading of the software

in every linux distribution a package manager is already included in every linux distribution ubuntu linux distribution has a package manager call APT and for Redhat the package manager is YUM

APT: Advanced Package Tool this have command to install, uninstall and upgrade packages apt search <package_name> : this will search for a given package sudo apt search openidk: to search all the java version packages that are available sudo apt search openidk apt install <package_name> : install a given package apt install <package_name1> <package_name2> : install multiple packages with one command apt remove <package_name> : remove installed packages ## **VI and VIM Text Editor** ## Vi and Vim are text editor that we use in command line interface 1. why do we need a command line Text Editor like vim or vi? 2. how do we write or edit a file in the command line, linux command line has a built-In text editor call **vi** or it more modern version call **vim** with this text editor you can write in its like a normal text editor.

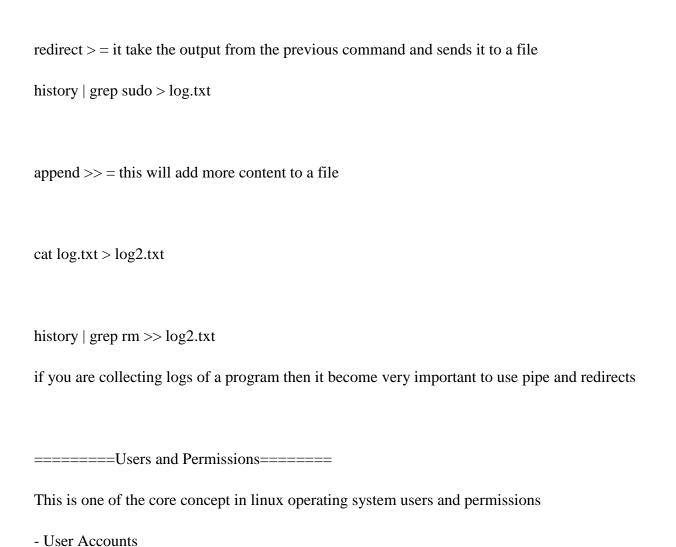
you need to know the specific text editor command to know how to work with the text editor
USE CASES TO USE TEXT EDITOR IN CLI
You may want to edit a file to change a configuration like kubernetes configuration files faster to create and edit a file at the same time using VI and VIM
the vi editor is pre-install with the linux operating system
to create text and move in to a text editor
vi [FileName] : create a file an open it in a text editor
vi file.txt
vim or vi editor has two mode:
1. The Default mode OR the Command mode (it is call a command mode because what you type is interpreted as a command): in this mode you cannot edit the text, but you can navigate, search, Delete, Undo etc



:q!

switch to command mode then type dd = Delete the entire line
···
dd
====pipe and grep====================================
grep = is a linus command use to filter and sort out a particular word
history grep sudo = this will filter the print out all word with sudo
history grep "sudo chmod" = this will filter and print out the word sudo chmod
we can use the grep command to find phrases in specific file content
====REDIRECTS IN LINUX====================================

We can redirects the result of a command execution into a file and save it for later use



- Groups \$ Ownership and File Permissions
- Linux Commands for managing Users and their permissions
- -we have to understand how permission works and how to give users and groups defferent permission to work with files and do things in the system

There are three categories of users we may have in a linux system:

1. Root User(superuser) (Superuser Account) - this user has unristricted access/permissions to the whole system for administrative task in the system you need to login as a root user to execute commands 2. Regular or standard User(User Account) that we create to login to the system: each regular or standard user will have it own dedicated space eg john /home/john 3. Service User (service Account) to run different service eg apache, mysql and each such service will get its own user which will start it own service e.g mysql user will start mysql application so such service will not be started by a root user or a regular user but rather they will have a dedicated mysql user or apache user that will start the application, because this make sure that each application is isolated from each other in terms of permission and insure better security. and this is a best practice in server management to run the services with their own dedicated user. Running a service with root user is very bad because this will create a lot of security issues.

This command can only be executed by a superuser a regular non root user cannot execute such command

=====EXECUTING COMMAND AS SUPERUSER================

sudo adduser [UserName] = this add a linux new user to the group ls /home : to verify if the new user was added sudo: this allows regular users to run programs with the security privileges of the superuser or root sudo addgroup devops: this will create the devops group su - [UserName] : will switch you from the current user to the new user sudo adduser [UserName] = to create a new user cat /etc/passwd = to see the user created, note that when we create a user using useradd by default it create a group for the user with the same name as the user adduser addgroup deluser delgroup sudo passwd [username] = will change the password of a user su - [username] = login as username where su is short for substitute or switch user su - = Login as root without specifying any user be default it root