

Linux Overview

▼ Working with Shell I

▼ Intro

▼ GUI vs Shell

Ubuntu Desktop /
Graphical View



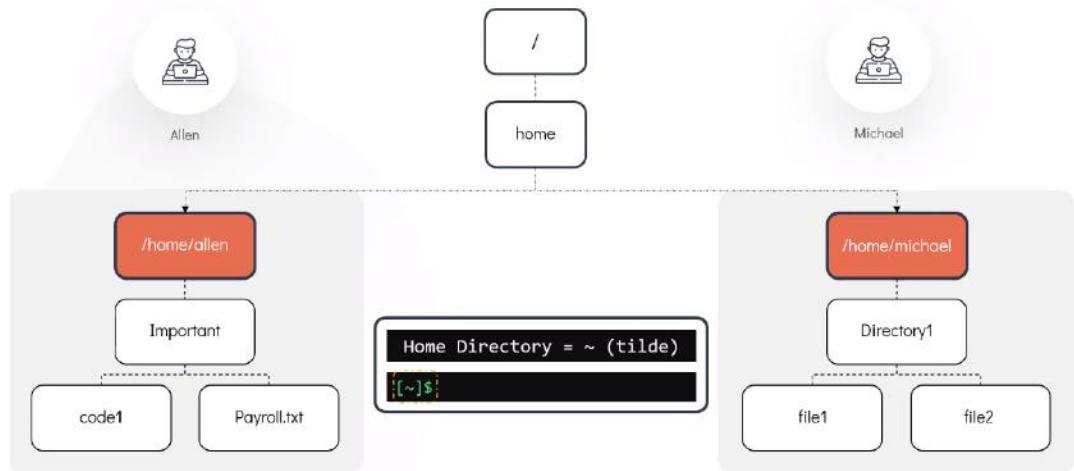
Linux Shell

```
$ echo Hello  
Hello  
$
```

▼ Home Directory

The home (/home) directory is unique to the user. Think of it as a dedicated locker assigned to you. Represented by tilde:

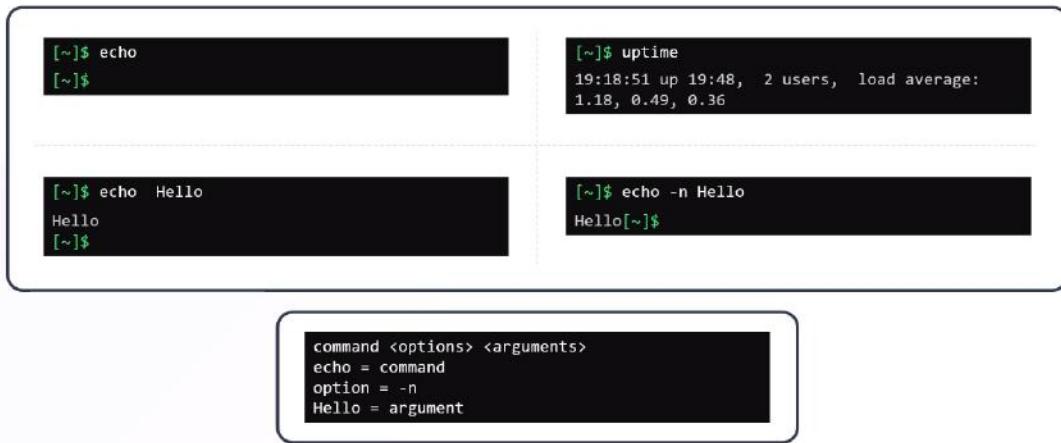
The Home Directory



▼ Command and Arguments

Arguments act as an input to the command, commands can work without arguments, commands can also have options (aka switch, flag). Can't remember all options, so refer to help/manuals

Command and Arguments



▼ Command Types

internal or external. internal are part of the shell itself, come bundled with it. External are binary programs or scripts, usually located in files within the system.

Use type command to determine internal or external:

Command Types

Internal or Built-in Commands
echo, cd, pwd, set e.t.c

```
[~]$ type echo  
echo is a shell built-in  
[~]$
```

External Commands
mv, date, uptime, cp, uptime e.t.c

```
[~]$ type mv  
mv is hashed (/bin/mv)  
[~]$
```

▼ Basic Linux Commands

▼ pwd, ls, mkdir

pwd (present working directory)

```
[~]$ pwd  
/home/michael
```

ls (List contents)

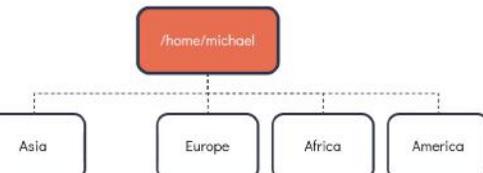
```
[~]$ ls
```

mkdir (make a new directory)

```
[~]$ mkdir Asia
```

mkdir (multiple directories)

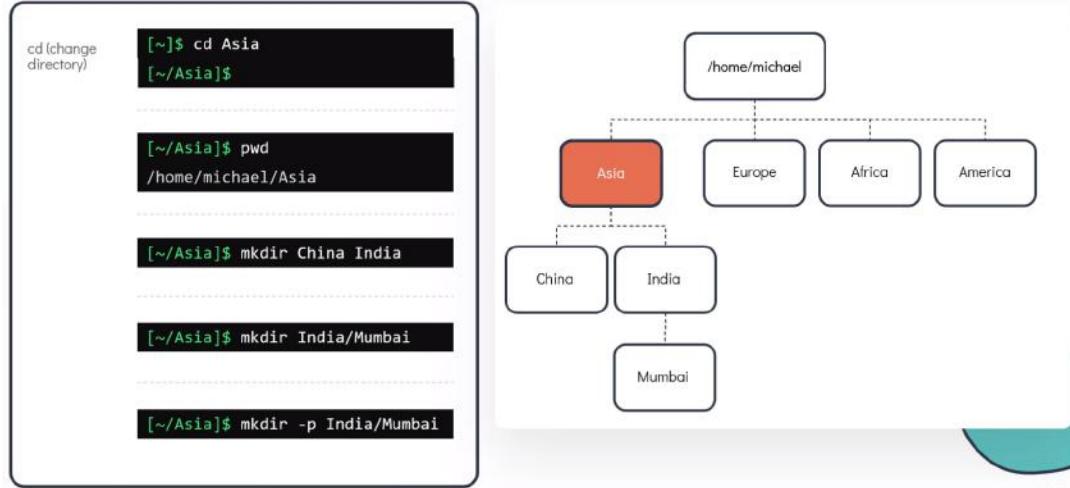
```
[~]$ mkdir Europe Africa America
```



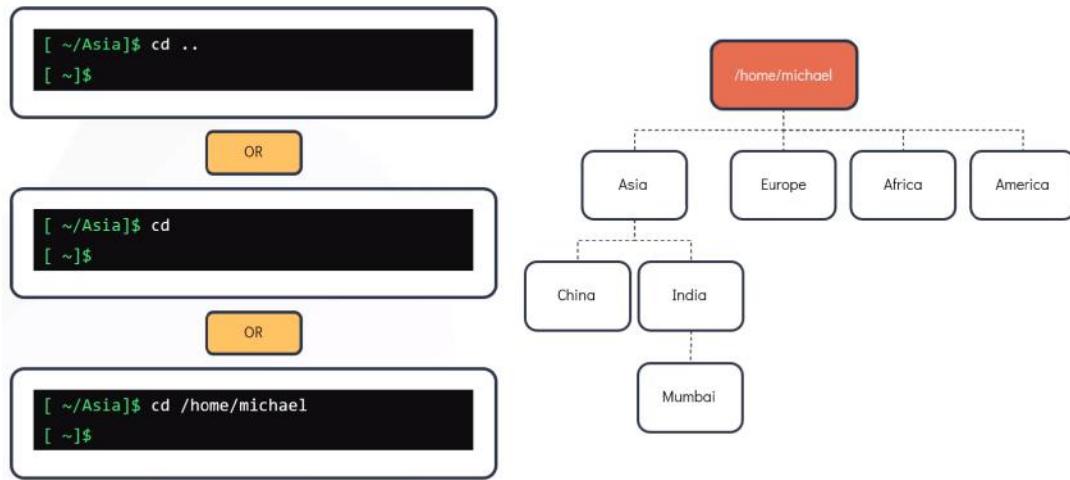
ls (List contents)

```
[~]$ ls  
Asia Europe Africa America
```

▼ cd, mkdir x/x, mkdir -p x/x



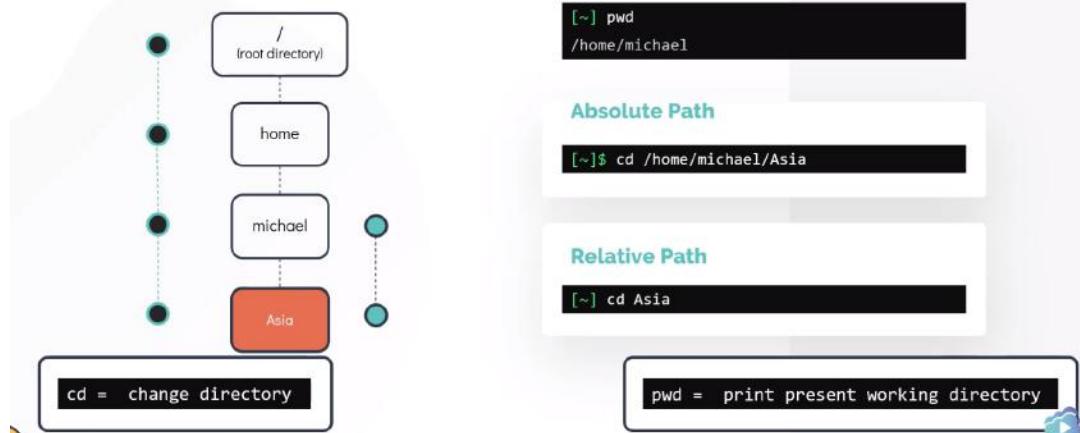
▼ cd .. , cd /x/x , cd by itself takes you to home directory



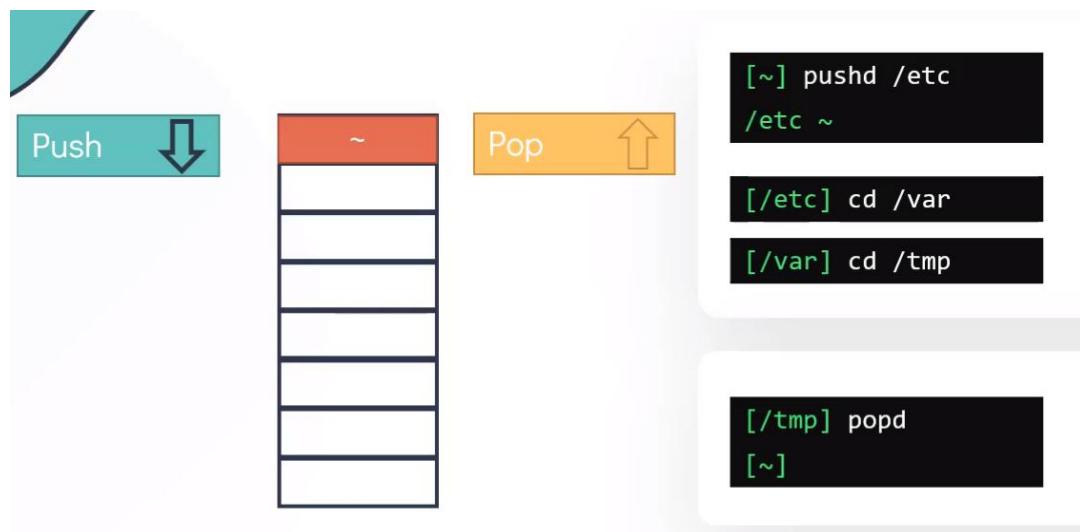
▼ Absolute and relative path

absolute - path starting from root directory

Absolute and Relative Path



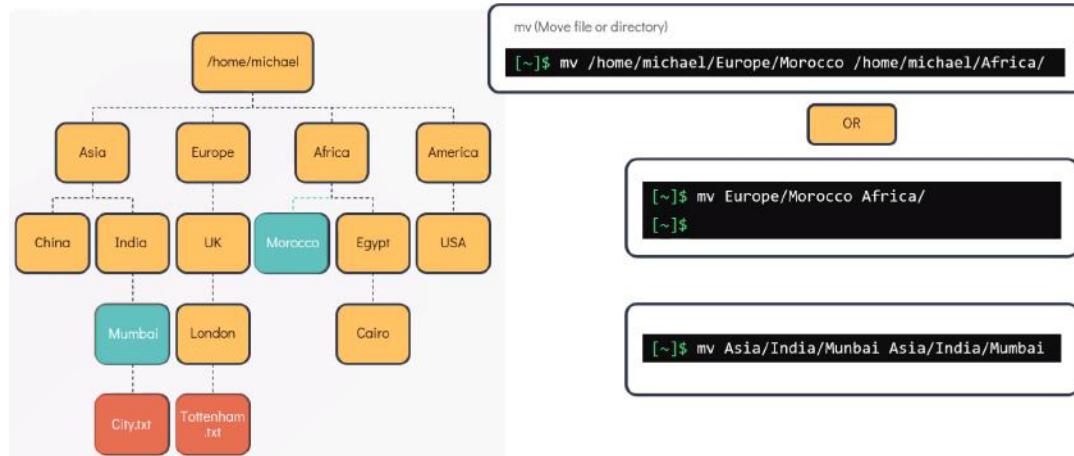
▼ pushd/popd



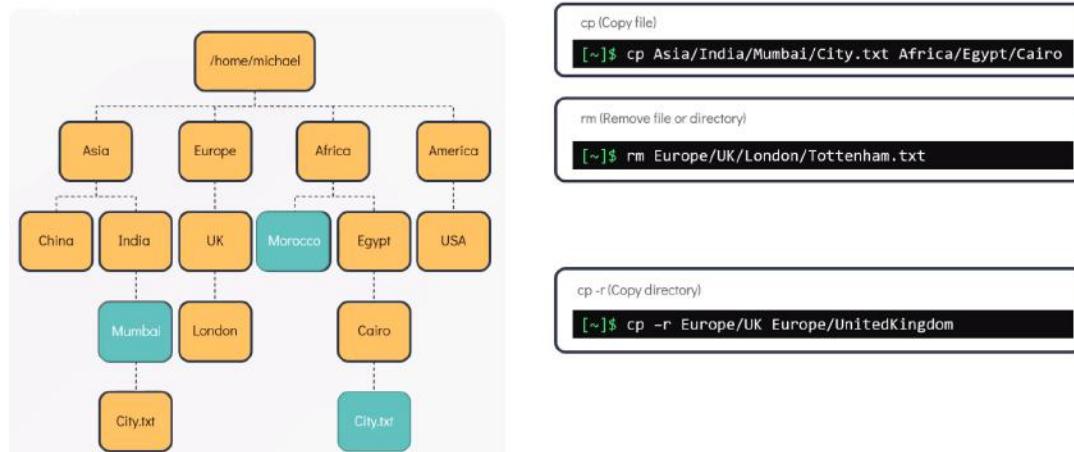
▼ mv

1st argument = src file, 2nd argument = dest file

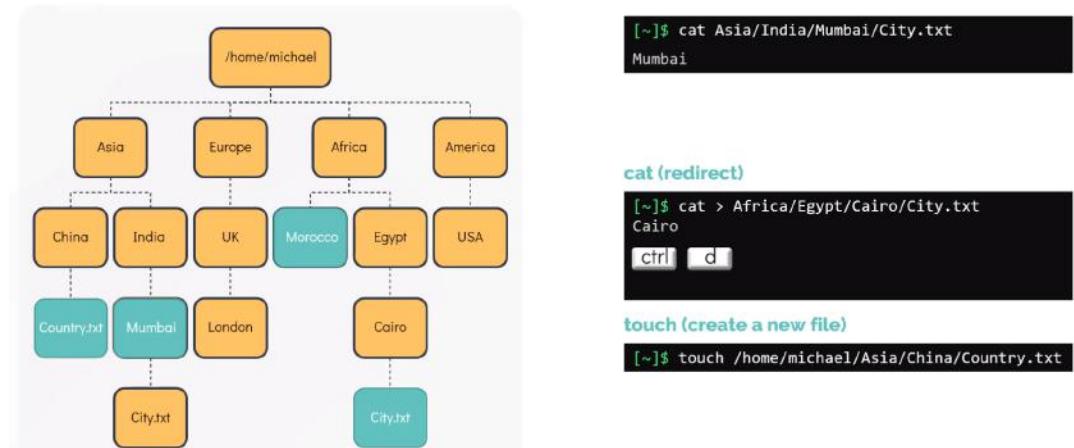
used to move and rename



▼ cp, rm, cp -r



▼ Working with files and directories (cat, touch)



▼ Pagers (more, less)

```
[~]$ more new_file.txt
```

[Space] - scrolls the display, one screenful of data at a time

[Enter] - scrolls the display one line

[b] - scrolls the display backwards one screenful of data

[/] – search text

```
[~]$ less new_file.txt
```

[Up Arrow] - scrolls up the display one line

[Down Arrow] – scrolls down the display one line

[/] – search text

▼ ls (long list)

LS (Long List)

ls -l (long list)

```
[~]$ ls -l
total 0
-rw-rw-r-- 1 bob bob 0 Mar 13 11:30 File.txt
-rw-rw-r-- 1 bob bob 0 Mar 13 11:30 index.html
-rw-rw-r-- 1 bob bob 0 Mar 13 11:30 caleston
```

ls -lt (long list files in order created)

```
[~]$ ls -lt
total 0
-rw-rw-r-- 1 bob bob 0 Mar 13 11:30 File.txt
-rw-rw-r-- 1 bob bob 0 Mar 13 11:28 index.html
-rw-rw-r-- 1 bob bob 0 Mar 13 11:27 caleston
```

ls -a (list all files including hidden)

```
[~]$ ls -a
. .. File.txt index.html caleston .test
```

ls -ltr (long list files in the reverse order created)

```
[~]$ ls -ltr
total 0
-rw-rw-r-- 1 bob bob 0 Mar 13 11:27 caleston
-rw-rw-r-- 1 bob bob 0 Mar 13 11:28 index.html
-rw-rw-r-- 1 bob bob 0 Mar 13 11:30 File.txt
```

▼ Command-line help

▼ using the CLI to get help

```
[~]$ whatis date
date (1)           - print or set the system date and time2
```

```
[~]$ man date
DATE(1)                           User Commands
DATE(1)

NAME
    date - print or set the system date and time

SYNOPSIS
    date [OPTION]... [+FORMAT]
    date [-u|--utc|--universal] [MMDDhhmm[[CC]YY][.ss]]

DESCRIPTION
    Display the current time in the given FORMAT, or set the system date.
```

▼ -- help, apropos

```
[~]$ date --help
Usage: date [OPTION]... [+FORMAT]
      or: date [-u|--utc|--universal] [MMDDhhmm[[CC]YY][.ss]]
Display the current time in the given FORMAT, or set the system date.
```

```
[~]$ apropos modpr
modprobe (8)           - Add and remove modules from the Linux Kernel
modprobe.d (5)          - Configuration directory for modprobe.
```

▼ Bash Shell

▼ Shell types

Shell Types

Bourne Shell (sh)

```
[~]$ echo $SHELL
/bin/bash
```

C Shell (csh or tcsh)

```
[~]$ chsh
Password:
Changing the login shell for michael
Enter the new value, or press ENTER for the default
      Login Shell [/bin/bash]: /bin/sh
```

Korn Shell (ksh)

Z Shell (zsh)

Bourne again Shell (bash)

▼ Bash features

Bash Shell Features

Bash Auto-Completion

```
[~]$ ls Documents          tab  
File1.txt file2.txt some_directory
```

Alias

```
[~]$ alias dt=date  
[~]$ dt  
Tue Mar  3 12:00:00 EST 2020
```

Command History

```
[~]$ history  
1 ls Documents  
2 alias dt=date  
3 dt
```

▼ Bash environment variables

```
[~]$ echo $SHELL  
/bin/bash
```

```
[~]$ env  
LANG=en_CA.UTF-8  
GDM_LANG=en_CA  
DISPLAY=:0  
GTK_OVERLAY_SCROLLING=1  
COLORTERM=truecolor  
XDG_VTNR=7  
USER=bob  
PWD=/home/bob  
HOME=/home/bob  
SSH_AGENT_PID=2023  
QT_ACCESSIBILITY=1  
XDG_SESSION_TYPE=x11  
GJS_DEBUG_OUTPUT=stderr  
GTK_MODULES=gail:atk-bridge  
TERM=xterm-256color  
SHELL=/bin/bash  
VTE_VERSION=5202  
XDG_SEAT_PATH=/org/freedesktop/DisplayManager/Seat0  
LANGUAGE=en_CA:en  
LOGNAME=bob  
PATH=/home/bob/bin:/home/bob/.local/bin:/home/bob/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin
```

Bash Environment Variables

```
[~]$ echo $LOGNAME  
bob
```

```
[~]$ export OFFICE=caleston
```

```
[~]$ OFFICE=caleston
```

```
~/.profile or ~/.pam_environment
```

▼ Path variable

```
[~]$ echo $PATH  
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/b  
in:/sbin:/bin
```

```
[~]$ which obs-studio
```

```
[~]$ obs-studio  
obs-studio: command not found
```

```
[~]$ export PATH=$PATH:/opt/obs/bin
```

```
[~]$ which obs-studio  
/opt/obs/bin/obs-studio
```

▼ Bash prompt

Bash Prompt

```
[~]$
```

~ = Present Working Directory
\$ = User Prompt Symbol

```
[michael@prod-server]$
```

```
[~]$ echo $PS1  
[ \W ]$
```

\W = Present Working Directory =~
\$ = Prompt Symbol

```
[~]$ PS1="ubuntu-server:"  
ubuntu-server:
```

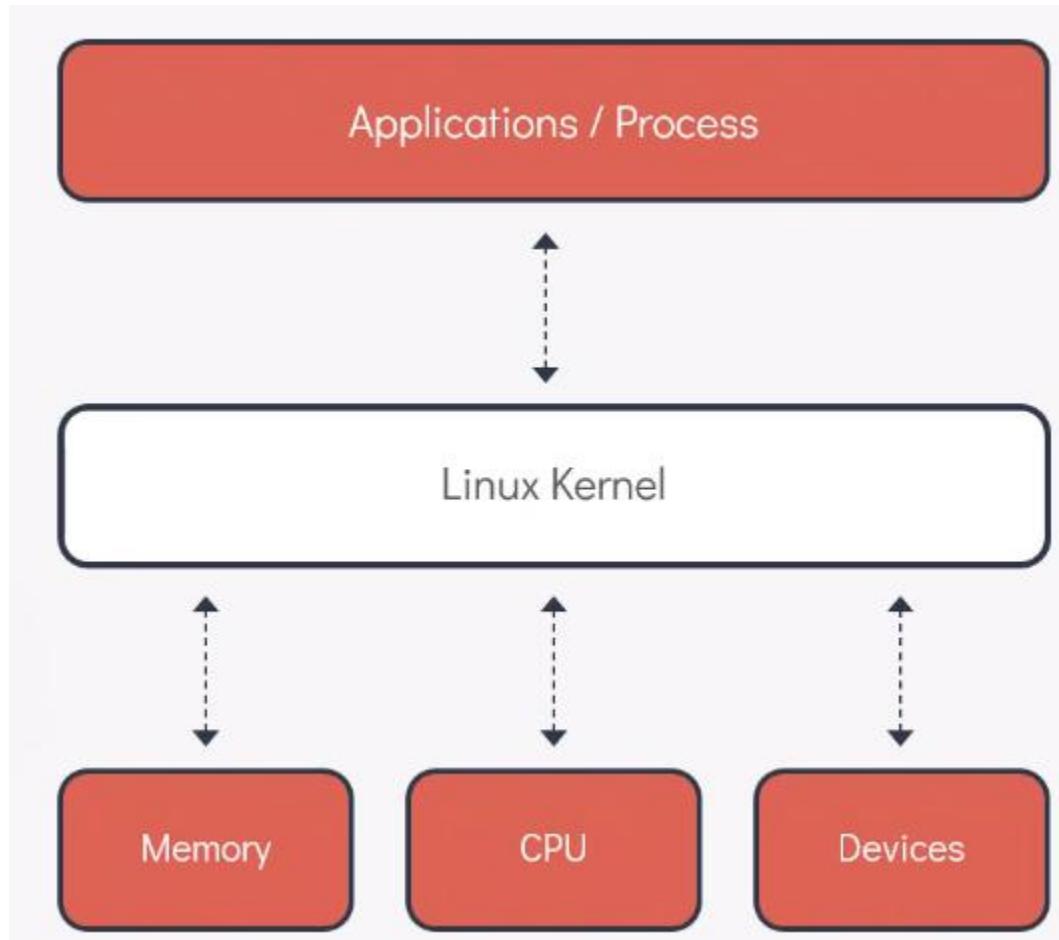
```
ubuntu-server: echo $PS1  
ubuntu-server:
```

```
ubuntu-server: PS1="[\d \t \u@\h:\w ] $ "  
[Thu Mar 12 22:12:54 bob@caleston:~] $
```

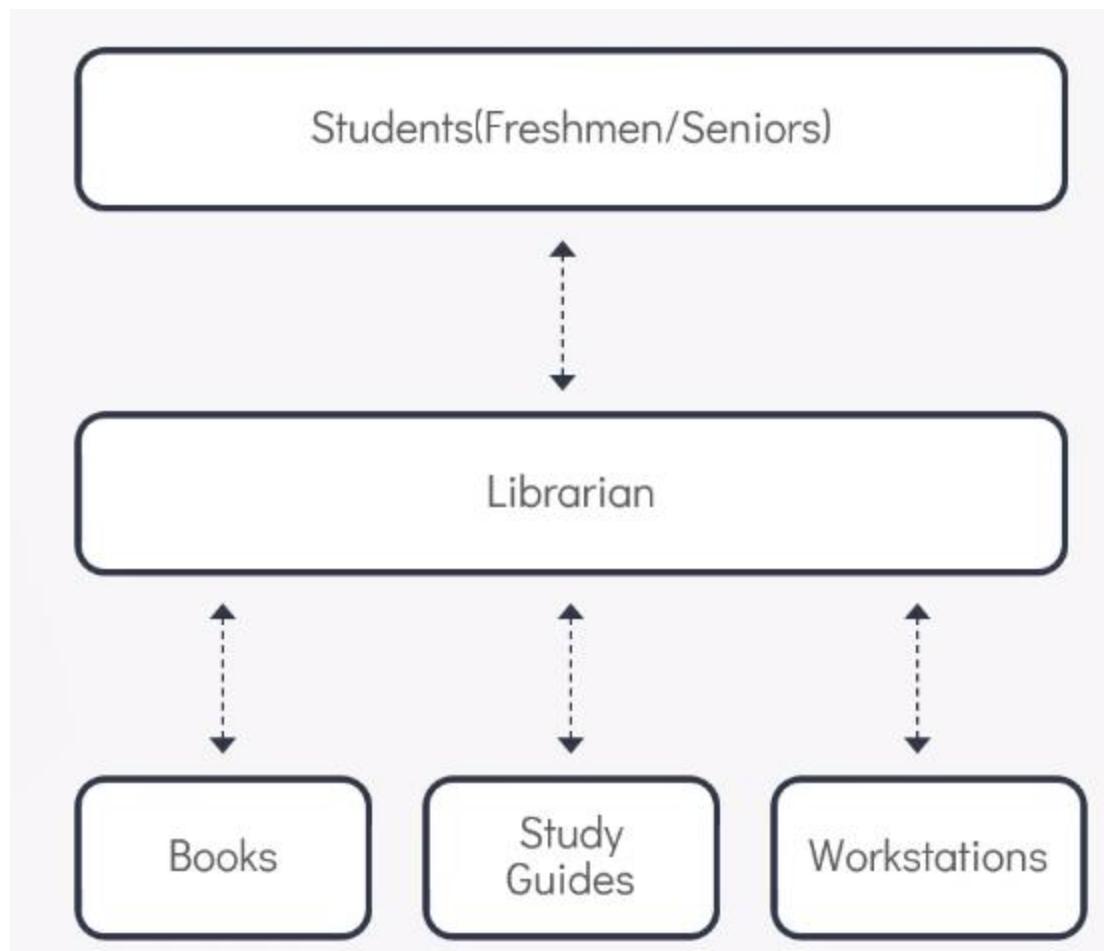
\d : the date in “Weekday Month Date” format (e.g., “Tue May 26”)
\e : an ASCII escape character (033)
\h : the hostname HQDN
\H : the complete hostname
\n : newline
\r : carriage return
\s : the name of the shell
\t : the current time in 24-hour HH:MM:SS format
\T : the current time in 12-hour HH:MM:SS format
\@ : the current time in 12-hour am/pm format
\A : the current time in 24-hour HH:MM format
\u : the username of the current user
\w : the current working directory, with \$HOME abbreviated with a tilde
\W : the basename of the current working directory, with \$HOME abbreviated with a tilde
\\$: if the effective UID is 0, a #, otherwise a \$

▼ Linux core concepts

▼ Linux Kernel



think of a college library - the kernel is the librarian, the library is the computer system



▼ Kernel Tasks

01
Memory Management

02
Process Management

03
Device Drivers

04
System Calls and Security

Monolithic

Modular

▼ Kernel Versions

```
[~]$ uname  
Linux
```

4 = Kernel Version

<https://kernel.org>

```
[~]$ uname -r  
4.15.0-72-generic
```

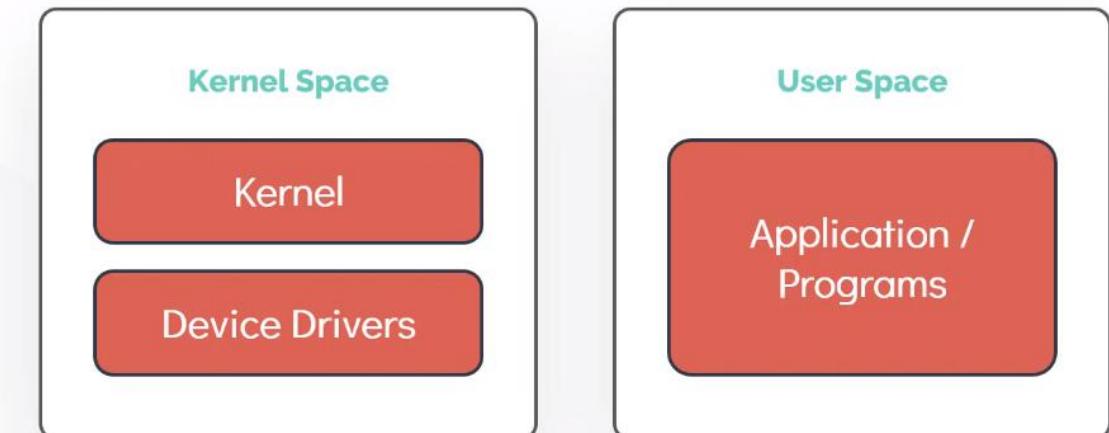
15 = Major version

0 = Minor Version

72 = patch release

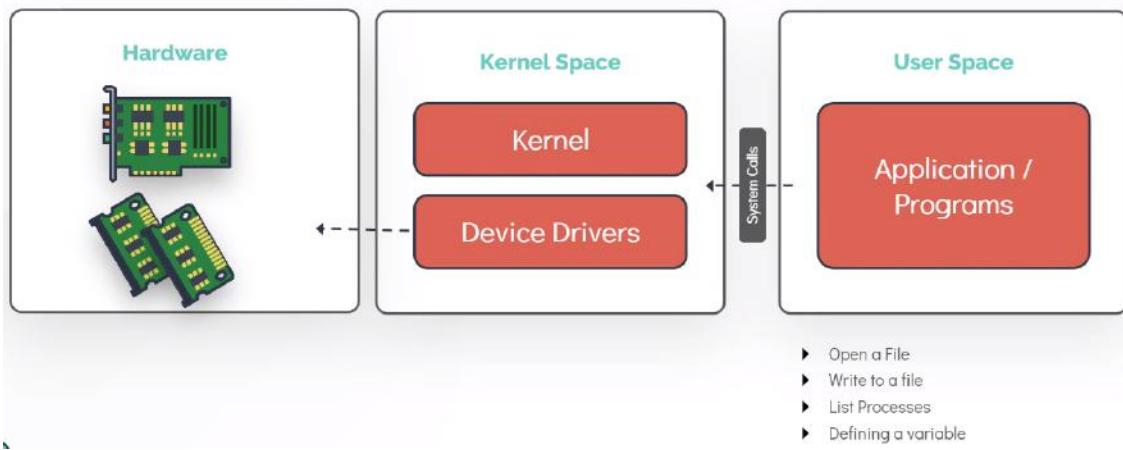
Generic = Distro Specific Info

▼ Memory mgmt: Kernel & User space

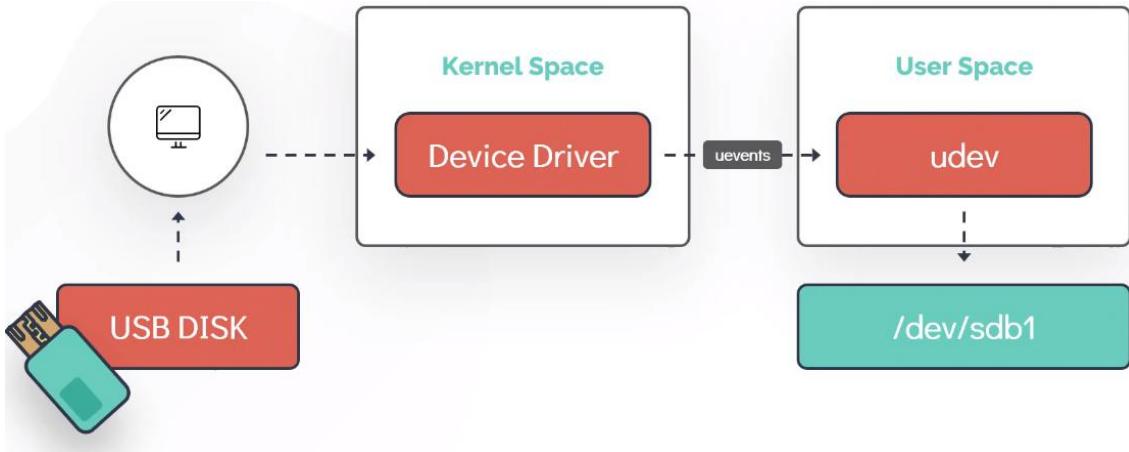


- ▶ Kernel Code
- ▶ Kernel Extensions
- ▶ Device Drivers
- ▶ C
- ▶ Java
- ▶ Python
- ▶ Ruby
- ▶ Docker Containers

how user space works:



▼ Working with hardware



▼ dmesg , grep

```

[~]$ dmesg | grep -i usb
[ 0.082019] ACPI: Power Resource [USBC] (on)
[ 0.132167] ACPI: bus type USB registered
[ 0.132167] usbc: registered new interface driver usbf
[ 0.132167] usbc: registered new interface driver hub
[ 0.132167] usbc: registered new device driver usb
[ 0.840295] ehci_hcd: USB 2.0 'Enhanced' Host Controller (EHCI) Driver
[ 0.840306] ohci_hcd: USB 1.1 'Open' Host Controller (OHCI) Driver
[ 0.840315] uhci_hcd: USB Universal Host Controller Interface driver
[ 0.840446] xhci_hcd 0000:00:14.0: new USB bus registered, assigned bus number 1
[ 0.841764] usb usb1: New USB device found, idVendor=1d6b, idProduct=0002
[ 0.841765] usb usb1: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[ 0.841765] usb usb1: Product: xHCI Host Controller
[ 0.841766] usb usb1: Manufacturer: Linux 4.15.0-72-generic xhci-hcd
[ 0.841767] usb usb1: SerialNumber: 0000:00:14.0
[ 0.841905] hub 1-0:1.0: USB hub found

```

▼ udevadm

handy to determine details of newly attached or removed device

```
[~]$ udevadm info --query=path --name=/dev/sda5  
/devices/pci0000:00/0000:00:17.0/ata3/host2/target2:0:2:0:0/block/sda/sda5
```

```
[~]$ udevadm monitor  
monitor will print the received events for:  
UDEV - the event which udev sends out after rule processing  
KERNEL - the kernel uevent  
  
KERNEL[6532.487876] remove /devices/pci0000:00/0000:00:14.0/usb1/1-4/1-4:1.0/0003:03F0:094A.0001/input/input6/mouse0 (input)  
UDEV [6532.492641] remove /devices/pci0000:00/0000:00:14.0/usb1/1-4/1-4:1.0/0003:03F0:094A.0001/input/input6/mouse0 (input)  
KERNEL[6532.500425] remove /devices/pci0000:00/0000:00:14.0/usb1/1-4/1-4:1.0/0003:03F0:094A.0001/input/input6/event6 (input)  
UDEV [6532.502186] remove /devices/pci0000:00/0000:00:14.0/usb1/1-4/1-4:1.0/0003:03F0:094A.0001/input/input6/event6 (input)  
KERNEL[6532.532441] remove /devices/pci0000:00/0000:00:14.0/usb1/1-4/1-4:1.0/0003:03F0:094A.0001/input/input6 (input)
```

▼ lspci

list all pic devices, e.g. video controllers, raid devices, wireless adapters
(Attach to pci slots on the mobo)

```
[~]$ lspci  
00:00.0 Host bridge: Intel Corporation Device 3e34 (rev 0c)  
00:02.0 VGA compatible controller: Intel Corporation Device 3ea0 (rev 02)  
00:08.0 System peripheral: Intel Corporation Xeon E3-1200 v5/v6 / E3-1500 v5 / 6th/7th Gen Core Processor Gaussian Mixture Model  
00:12.0 Signal processing controller: Intel Corporation Device 9df9 (rev 30)  
00:14.0 USB controller: Intel Corporation Device 9ded (rev 30)  
00:14.2 RAM memory: Intel Corporation Device 9def (rev 30)  
00:14.3 Network controller: Intel Corporation Device 9df0 (rev 30)  
00:15.0 Serial bus controller [0c80]: Intel Corporation Device 9de8 (rev 30)  
00:15.1 Serial bus controller [0c80]: Intel Corporation Device 9de9 (rev 30)  
00:16.0 Communication controller: Intel Corporation Device 9de0 (rev 30)  
00:17.0 RAID bus controller: Intel Corporation 82801 Mobile SATA Controller [RAID mode] (rev 30)  
00:1d.0 PCI bridge: Intel Corporation Device 9db0 (rev f0)  
00:1f.0 ISA bridge: Intel Corporation Device 9d84 (rev 30)  
00:1f.3 Audio device: Intel Corporation Device 9dc8 (rev 30)  
00:1f.4 SMBus: Intel Corporation Device 9da3 (rev 30)  
00:1f.5 Serial bus controller [0c80]: Intel Corporation Device 9da4 (rev 30)  
01:00.0 Unassigned class [ff00]: Realtek Semiconductor Co., Ltd. RTL8411B PCI Express Card Reader (rev 01)  
01:00.1 Ethernet controller: Realtek Semiconductor Co., Ltd. RTL8111/8168/8411 PCI Express Gigabit Ethernet Controller (rev 12)  
(linux-mint) ~ #
```

▼ lsblk

list info about block devices (storage and partition)

```
[~]$ lsblk
NAME      MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda        8:0    0 119.2G  0 disk
└─sda1     8:1    0   100M  0 part /boot/efi
sda2      8:2    0   16M  0 part
sda3      8:3    0  71.5G  0 part
sda4      8:4    0   1G  0 part
└─sda5     8:5    0  46.6G 0 part /
```

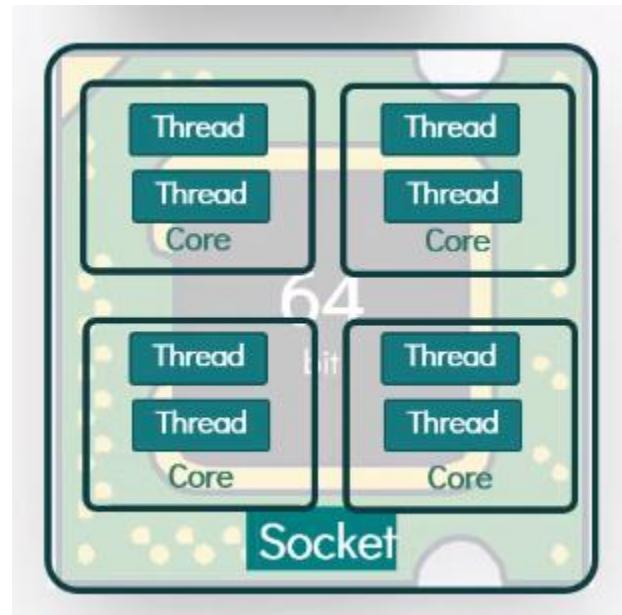


▼ lsblk

cpu architecture info

```
[~]$ lscpu
Architecture:          x86_64
CPU op-mode(s):        32-bit, 64-bit
Byte Order:            Little Endian
CPU(s):                8
On-line CPU(s) list:  0-7
Thread(s) per core:   2
Core(s) per socket:   4
Socket(s):             1
NUMA node(s):          1
Vendor ID:             GenuineIntel
CPU family:            6
Model:                 142
Model name:            Intel(R) Core(TM) i5-8265U CPU @ 1.60GHz
Stepping:               12
CPU MHz:                700.060
CPU max MHz:           3900.0000
CPU min MHz:           400.0000
BogoMIPS:              3600.00
Virtualization:        VT-x
L1d cache:              32K
L1i cache:              32K
L2 cache:                256K
L3 cache:                6144K
NUMA node0 CPU(s):     0-7
```

▼ sockets x cores x threads = CPUs



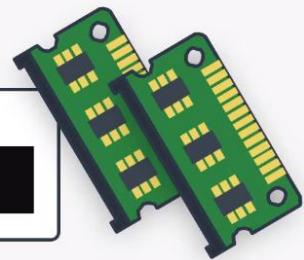
this one has 8

▼ lsmem, free - m

memory, use lsmem --summary

```
[~]$ lsmem --summary
Memory block size:      128M
Total online memory:    8G
Total offline memory:   0B
```

```
[~]$ free -m
              total        used        free      shared  buff/cache   available
Mem:       7824       2518       541        525        4764       4481
Swap:      2047          0       2047
```

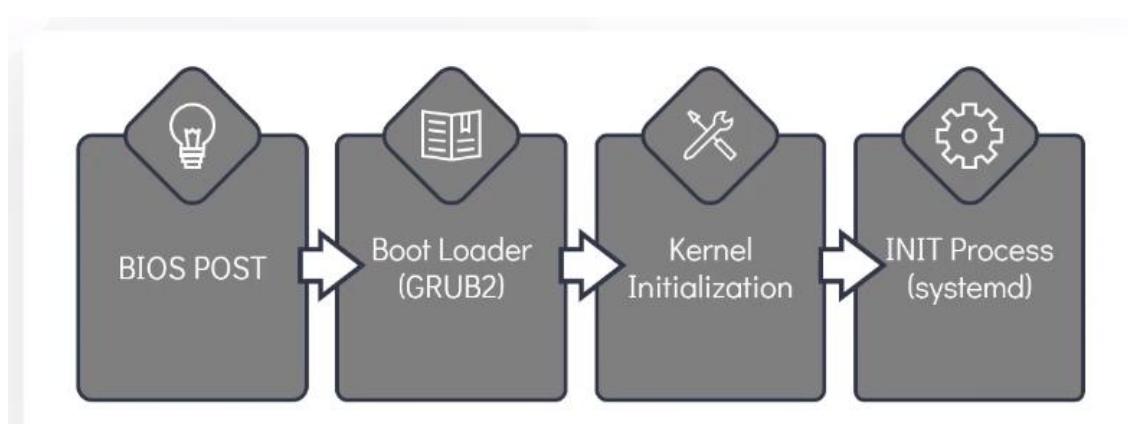


▼ lshw

configuration of the hardware on the machine

```
[~]$ lshw
description: Notebook
product: Aspire A515-52 (0000000000000000)
vendor: Acer
version: V1.12
serial: NXH89AA00262680A13400
width: 64 bits
capabilities: smbios-3.0 dmi-3.0 smp vsyscall32
configuration: chassis=notebook family=Aspire 5 sku=0000000000000000 uuid=D74676912-9EFF-ABCDE-8192-085643E554D
*-core
    description: Motherboard
    product: Raticate_WL
    vendor: WL
    physical id: 0
    version: V1.12
    serial: LAC12110069561AB521500
    slot: Type2 - Board Chassis Location
    *-firmware
        description: BIOS
        vendor: Insyde Corp.
        physical id: 0
        version: V1.12
        date: 04/26/2019
        size: 128KiB
        capacity: 15MiB
```

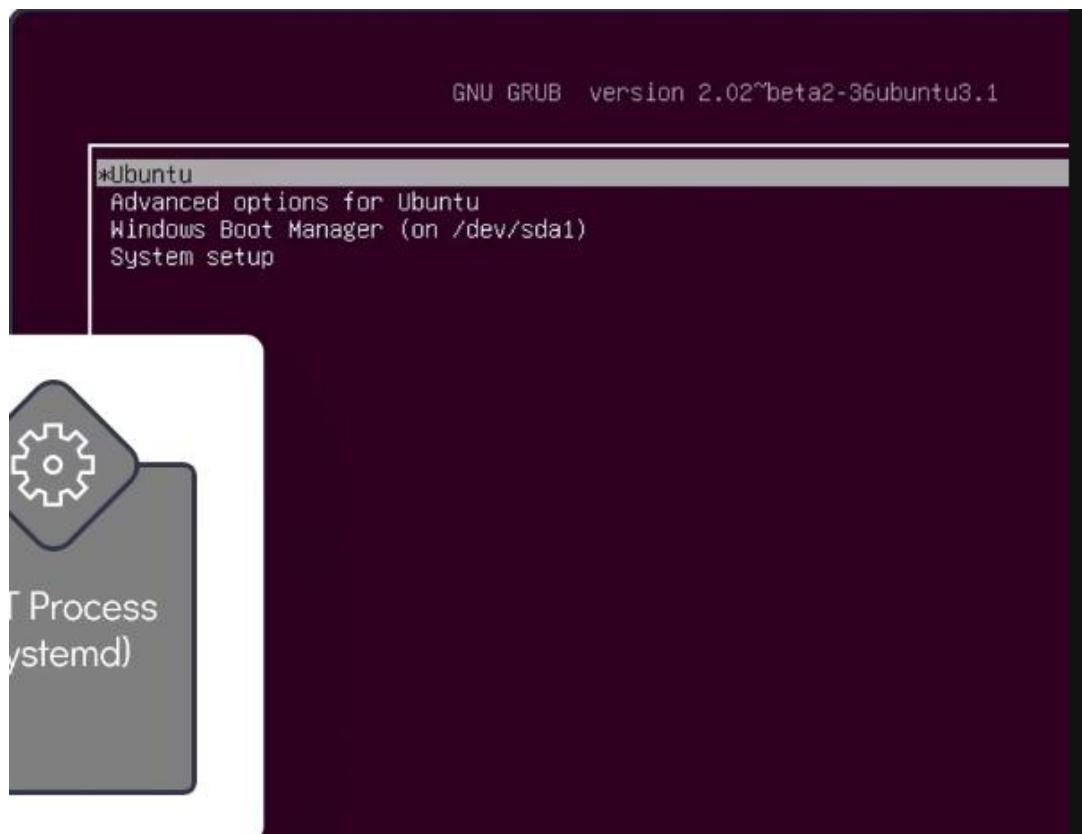
▼ Linux Boot



▼ BIOS



▼ Boot Loader (GRUB2)



▼ Kernel Initialization

kernel will look for init process to run, to setup user space



```
0.553626] evm: HMAC attrs: 0x1
0.554274] Magic number: 0:465:215
0.557297] event_source software: hash matches
0.557984] rtc_cmos rtc_cmos: setting system clock to 2020-04-09
(1586412850)
0.559123] BIOS EDD facility v0.16 2004-Jun-25, 0 devices found
0.559857] EDD information not available.
0.697079] Freeing unused kernel image memory: 2432K
0.709461] Write protecting the kernel read-only data: 20480K
0.710673] Freeing unused kernel image memory: 2008K
Freeing unused kernel image memory: 1880K
86/mm: Checked W+X mappings: passed, no W+X pages fo
1000: Intel(R) PRO/1000 Network Driver - version 7.3
1000: Copyright (c) 1999-2006 Intel Corporation.
usion MPT base driver 3.04.20
opyright (c) 1999-2008 LSI Corporation
usion MPT SPI Host driver 3.04.20
UX2 version of gcm_enc/dec engaged.
ES CTR mode by8 optimization enabled
nput: ImExPS/2 Generic Explorer Mouse as /devices/pl
put4
1000 0000:00:03.0 eth0: (PCI:33MHz:32-bit) 02:12:4b:
1000 0000:00:03.0 eth0: Intel(R) PRO/1000 Network Co
ptbase: ioc0: Initiating bringup
```

▼ INIT Processes

universal standard

to see init being used:

```
[~]$ ls -l /sbin/init
lrwxrwxrwx /sbin/init -> /lib/systemd/systemd
```

▼ Runlevels

▼ Systemd Targets

Runlevels:



during INIT, it will check runlevel:

Systemd Target (Runlevels)

Runlevel	Function
5	Boots into a Graphical Interface
3	Boots into a Command Line Interface



Runlevel	Systemd Targets	Function
5	graphical.target	Boots into a Graphical Interface
3	multiuser.target	Boots into a Command Line Interface

- ▼ Viewing and changing systemd target

```
[~]$ systemctl get-default  
graphical.target
```



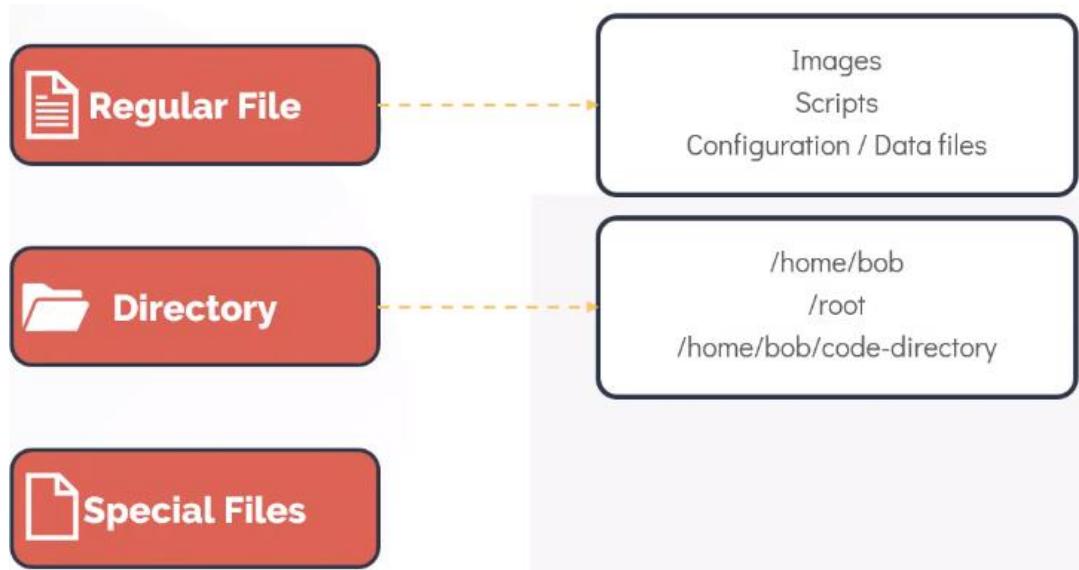
```
[~]$ ls -ltr /etc/systemd/system/default.target  
/etc/systemd/system/default.target -> /lib/systemd/system/graphical.target
```



```
[~]$ systemctl set-default multi-user.target  
Created symlink /etc/systemd/system/default.target → /lib/systemd/system/multi-user.target
```

▼ File Types

▼ 3 types of files



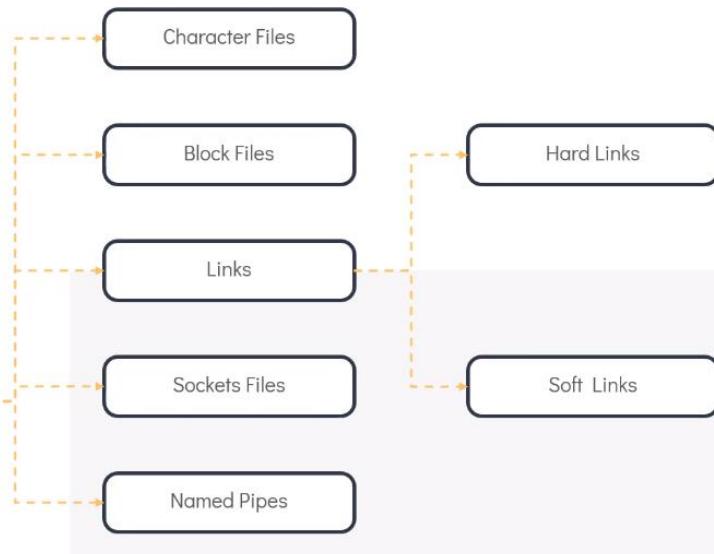
File Types

UX

Regular File

Directory

Special Files



▼ commands

```
[~]$ file /home/michael/  
/home/michael/: directory
```

```
[~]$ file bash-script.sh  
bash-script.sh: Bourne-Again shell script, UTF-8 Unicode text  
executable
```

```
[~]$ file insync1000.sock  
insync1000.sock: socket
```

```
[~]$ file /home/michael/bash-script  
/home/michael/bash-script: symbolic link to /home/sara/bash-script.sh
```

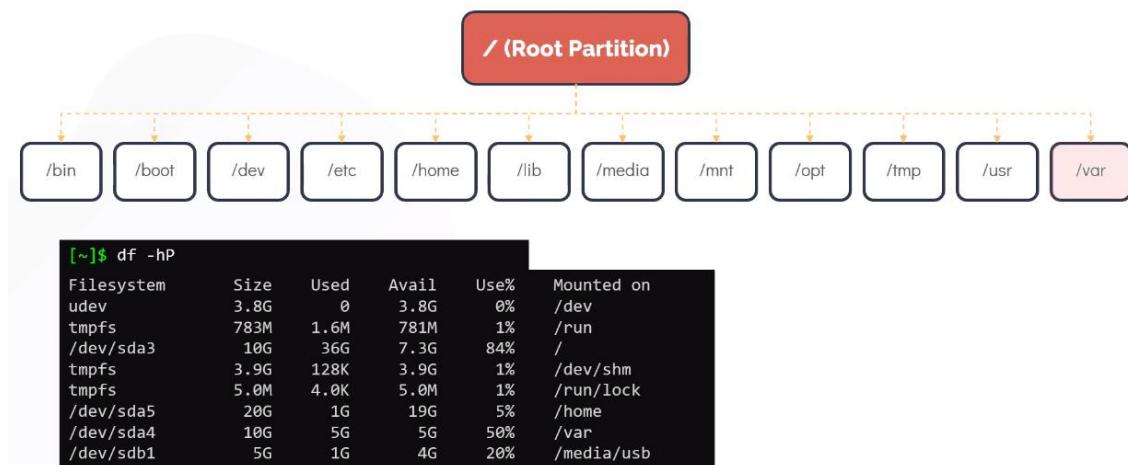
can use ls -ld and identify file type by first letter:

File Types in Linux

```
[~]$ ls -ld /home/michael/
drwxr-xr-x 3 root root 4096 Mar 18 17:20 /home/michael/
```

File Type	Identifier
DIRECTORY	d
REGULAR FILE	-
CHARACTER DEVICE	c
LINK	l
SOCKET FILE	s
PIPE	p
BLOCK DEVICE	b

▼ Filesystem hierarchy



/home = root user's home directory

/opt = place where 3rd party programs/files are usually installed

/mnt = temporary location for mounting

/tmp = used to store temporary data

/media = all external media mounted here, use df -hP command to see all mounted media

/dev = contains special block and character device files - external hdds, mouses, keyboards, etc

/bin = basic programs in binary

/etc = store config files

/lib = shared libraries to be imported into system

/usr = user applications and data

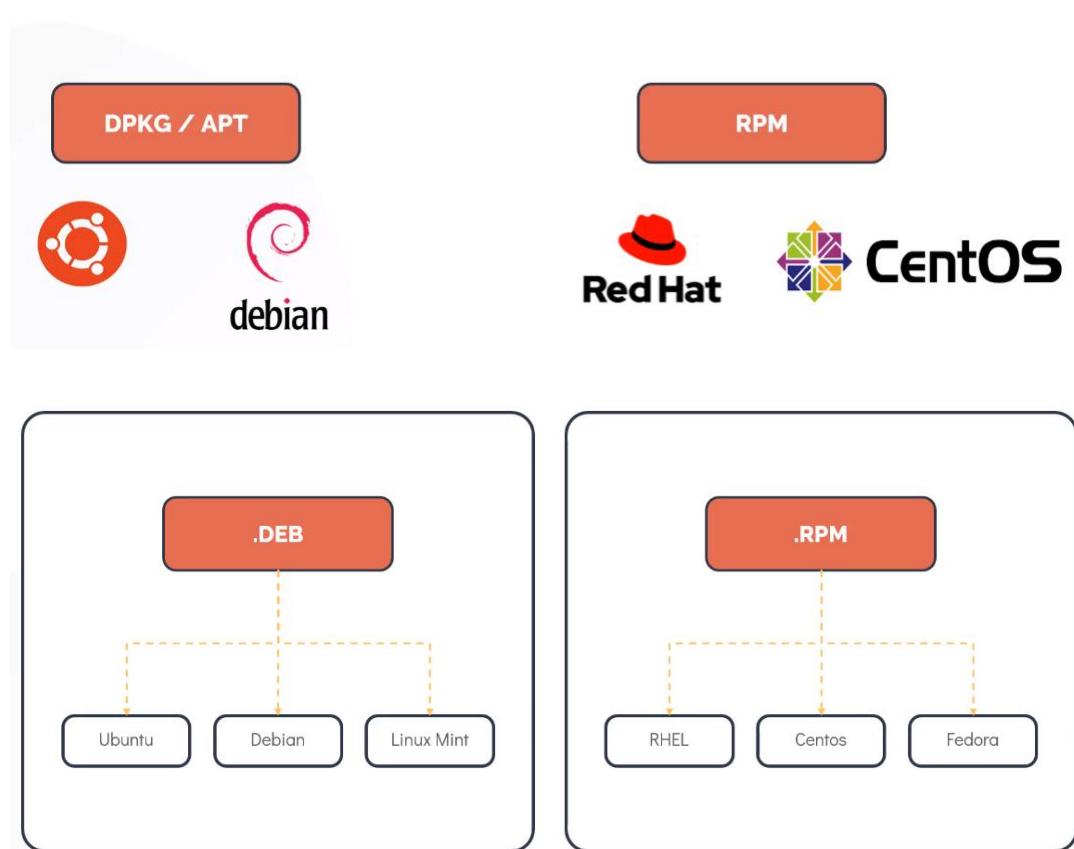
/var = logs and cached data

▼ Package Management

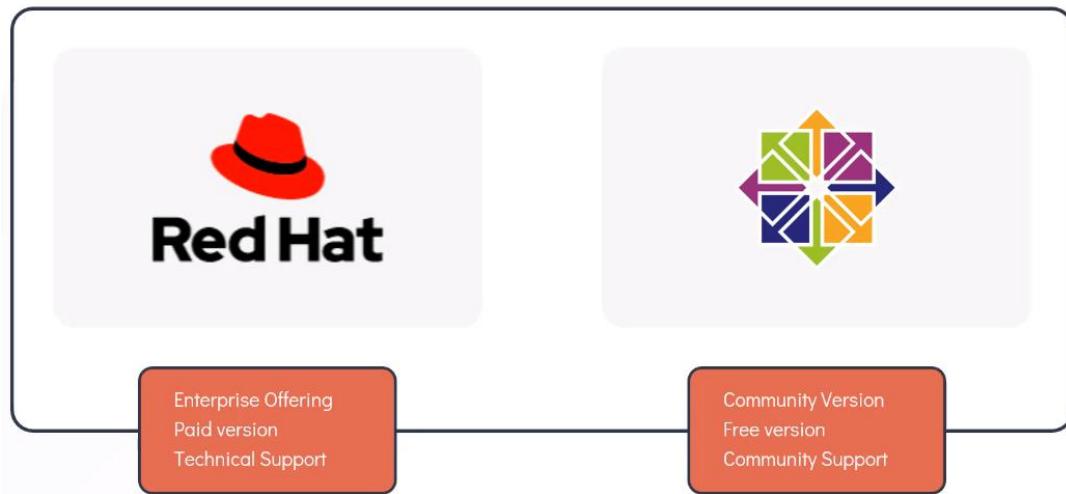
▼ Intro

▼ Core

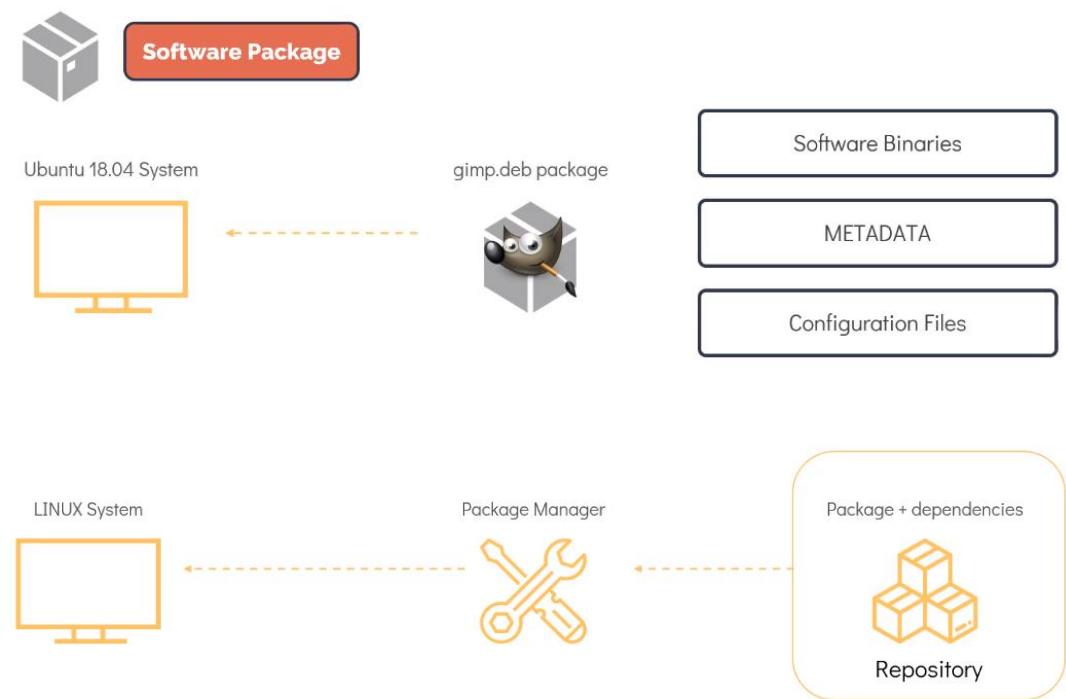
can categorize distro by package mgr they use



redhat vs centos



▼ Flow



▼ Essential functions

Package Integrity and Authenticity

Simplified Package Management

Grouping Packages

Manage Dependencies

▼ Types

DPKG

RPM

APT

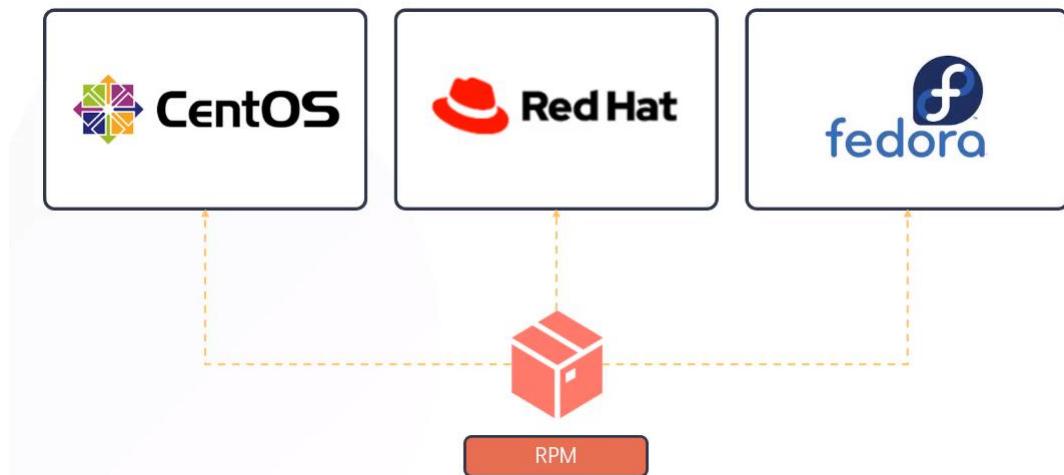
YUM

APT-GET

DNF

▼ RPM & YUM

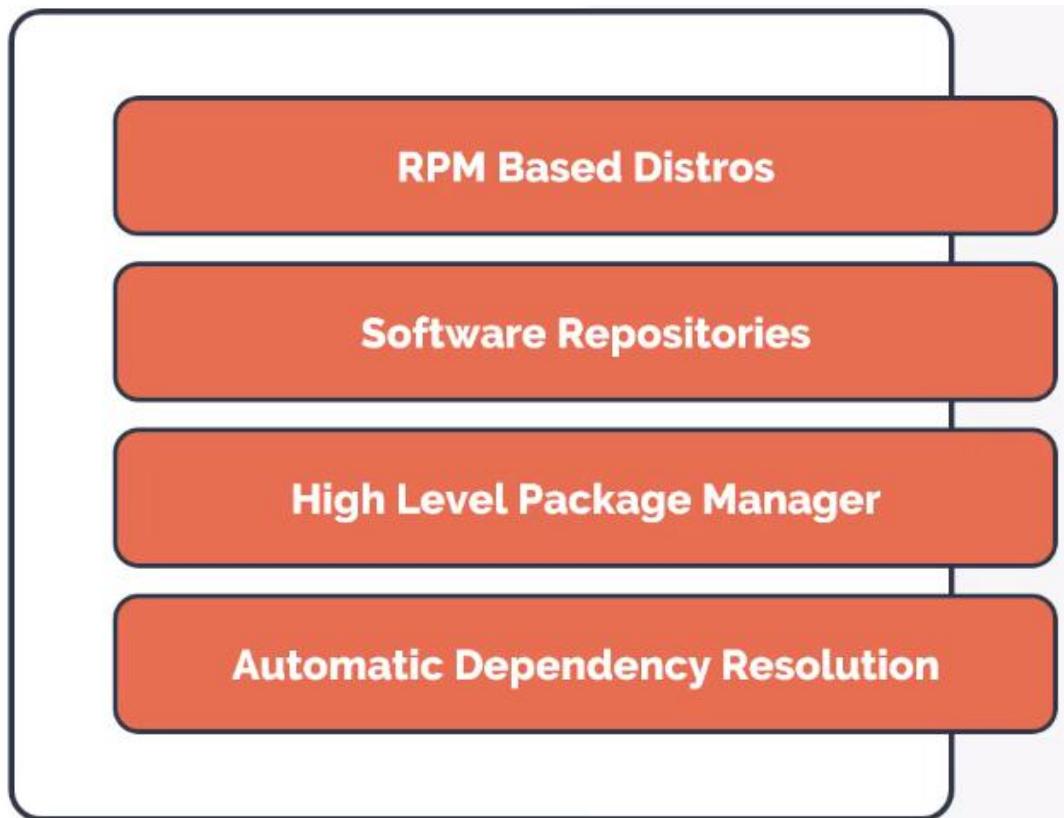
- ▼ RPM = redhat package mgr



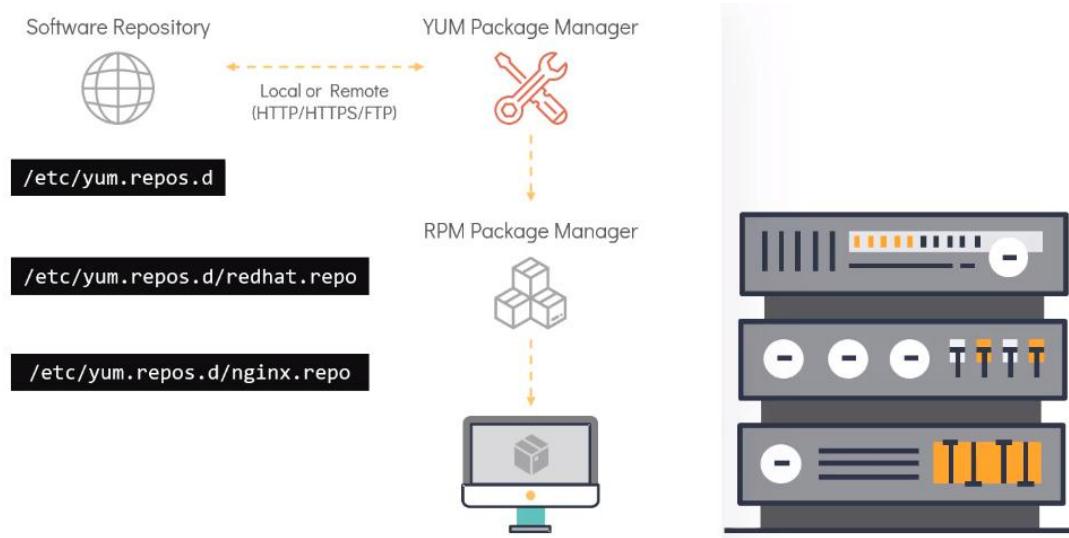
- ▼ working with RPM



- ▼ YUM = yellowdog update modifier (free/opensource)



▼ How YUM installs a package



```
[~]$ yum install httpd
Loading mirror speeds from cached hostfile
 * base: centos.mirror.net-d-sign.de
 * epel: mirror.nl.leaseweb.net
 * extras: mirror.softaculous.com
 * remi-php72: miro1.syntis.net
 * remi-safe: miro1.syntis.net
 * updates: linux.darHMenquin.net
Resolving Dependencies
--> Running transaction check
---> Package httpd.x86_64 0:2.4.6-90.el7.centos will be installed
```

```
[~]$ yum repolist
Repo id          repo name           status
base/7/x86_64    CentOS-7 - Base      10,097
epel/x86_64      Extra Packages for Enterprise Linux 7 - x86_64 13,229
extras/7/x86_64  CentOS-7 - Extras    341
```

```
[~]$ yum provides scp
openssh-clients-7.4p1-21.el7.x86_64 : An open source SSH client applications
Repo        : base
Matched from:
Filename   : /usr/bin/scp
```

```
[~]$ yum remove httpd
```

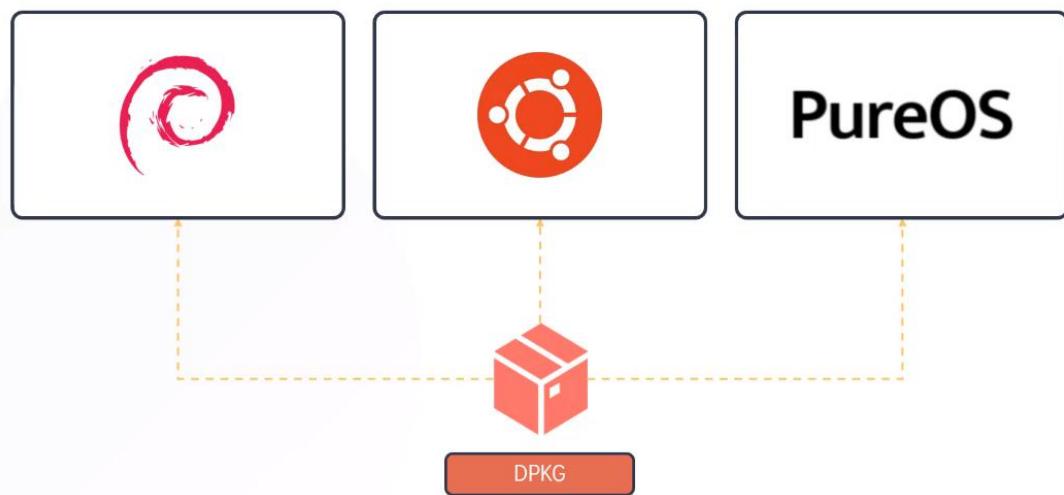
```
[~]$ yum update telnet
Loaded plugins: fastestmirror, ovl
Loading mirror speeds from cached hostfile
 * base: centos.mirror.net-d-sign.de
 * epel: mirror.nl.leaseweb.net
 * extras: mirror.softaculous.com
No packages marked for update
```

```
[~]$ yum update
Transaction Summary
=====
Install     ( 4 Dependent packages)
Upgrade   78 Packages

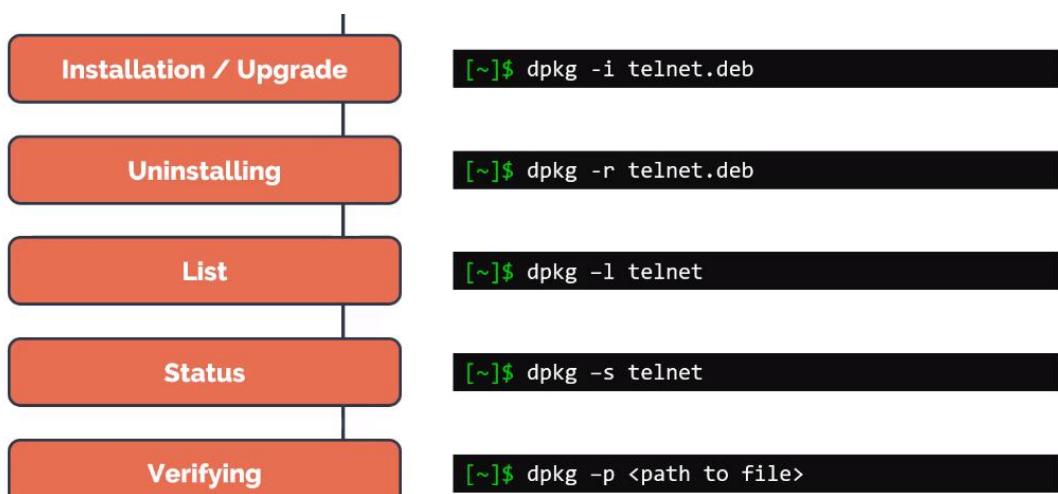
Total download size: 64 M
Is this ok [y/d/N]:
```

▼ DPKG & APT

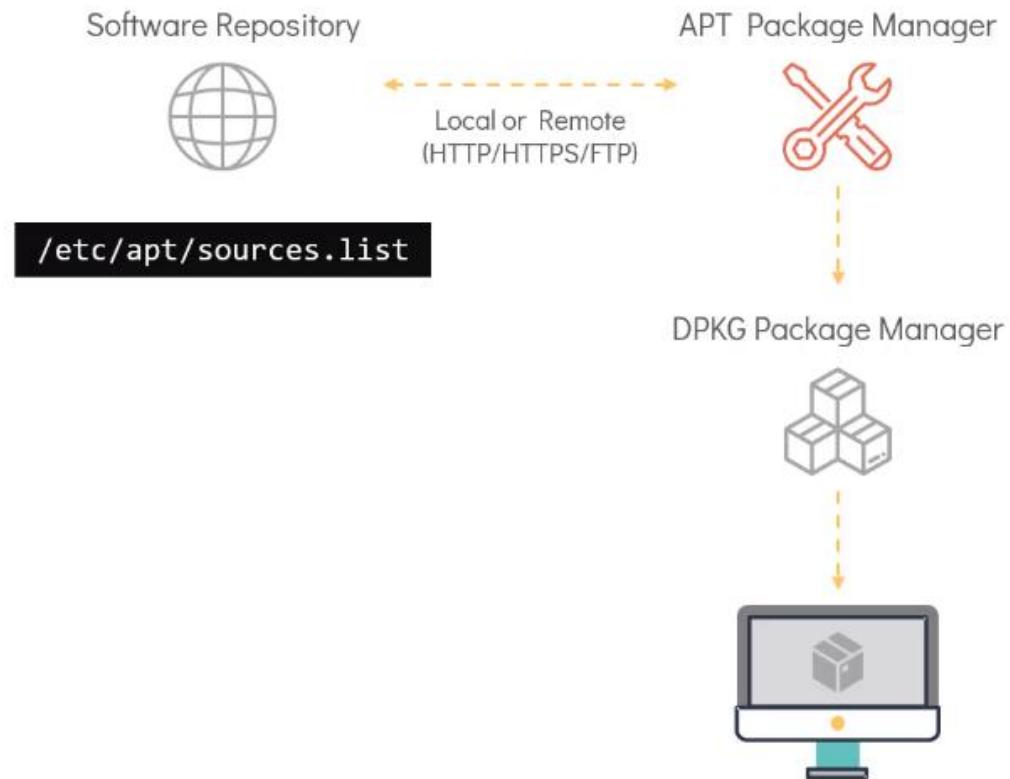
▼ DPKG



▼ Working with dpkg



▼ APT (better to use)



▼ Common Apt commands

```
[~]$ apt update
```

```
[~]$ apt upgrade
```

```
[~]$ apt edit-sources
```

```
[~]$ apt install telnet
```

```
[~]$ apt remove telnet
```

```
[~]$ apt search telnet
```

```
[~]$ apt list | grep telnet
```

▼ APT vs APT-GET (apt is better)

install is more user friendly

```
[~]$ apt install firefox
Recommended packages:
  xul-ext-ubfox
The following NEW packages will be installed:
  firefox
0 upgraded, 1 newly installed, 0 to remove and 36 not
upgraded.
Need to get 0 B/52.0 MB of archives.
After this operation, 202 MB of additional disk space will
be used.
Selecting previously unselected package firefox.
(Reading database ... 416280 files and directories currently
installed.)
Preparing to unpack ...
.../firefox_74.0+linuxmint2+tricia_amd64.deb ...
Unpacking firefox (74.0+linuxmint2+tricia) ...
Progress: [ 17%]
[#####.....]
.....]
```

```
[~]$ apt-get install firefox
The following NEW packages will be installed:
  firefox
0 upgraded, 1 newly installed, 0 to remove and 36 not
upgraded.
Need to get 0 B/52.0 MB of archives.
After this operation, 202 MB of additional disk space will
be used.
Selecting previously unselected package firefox.
(Reading database ... 416280 files and directories currently
installed.)
Preparing to unpack ...
.../firefox_74.0+linuxmint2+tricia_amd64.deb ...
Unpacking firefox (74.0+linuxmint2+tricia) ...
Setting up firefox (74.0+linuxmint2+tricia) ...
Please restart all running instances of firefox, or you will
experience problems.
Processing triggers for gnome-menus (3.13.3-11ubuntu1.1) ...
Processing triggers for hicolor-icon-theme (0.17-2) ...
Processing triggers for mime-support (3.60ubuntu1) ...
Processing triggers for desktop-file-utils (0.23+linuxmint8)
...
Processing triggers for mintsystem (8.4.6) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
```

can search for package more easily

```
[~]$ apt search telnet
p  dcap-tunnel-telnet
p  dcap-tunnel-telnet:i386
p  inetutils-telnet
p  inetutils-telnet:i386
p  inetutils-telnetd
p  inetutils-telnetd:i386
i  telnet
p  telnet:i386

[~]$ apt-cache search telnet
curl - command line tool for transferring data with URL
syntax
libcurl3-gnutls - easy-to-use client-side URL transfer
library (GnuTLS flavour)
libcurl3-nss - easy-to-use client-side URL transfer library
(NSS flavour)
libcurl4-doc - documentation for libcurl
libcurl4-gnutls-dev - development files and documentation
for libcurl (GnuTLS flavour)
libcurl4-nss-dev - development files and documentation for
libcurl (NSS flavour)
libcurl4-openssl-dev - development files and documentation
for libcurl (OpenSSL flavour)
redir - Redirect TCP connections
ser2net - Serial port to network proxy
socks4-clients - Socks4 enabled clients as rtelnet and rftp
sredird - RFC 2217 compliant Telnet serial port redirector
swaks - SMTP command-line test tool
telnet-ssl - telnet client with SSL encryption support
telnetd - basic telnet server
telnetd-ssl - telnet server with SSL encryption support
```

▼ Working with Shell II

▼ File compression and archival

▼ viewing file sizes

```
[~]$ du -sk test.img
100000
```

```
[~]$ du -sh test.img
98M    test.img
```

```
[~]$ ls -lh test.img
-rw-rw-r-- 1 99M Mar 13 15:48 test.img
```

▼ Tar (Take archive) - grouping multiple files and/or directories into a single file



▼ Compressing

Compressing

bzip2	bunzip2
[~]\$ bzip2 test.img	[~]\$ bunzip2 test.img.bz2
[~]\$ du -sh test.img.bz2	[~]\$ du -sh test.img
4.0K test.img.bz2	99M test.img

gzip	gunzip
[~]\$ gzip test1.img	[~]\$ gunzip test1.img
[~]\$ du -sh test1.img.gz	[~]\$ du -sh test1.img
100K test1.img.gz	99M test1.img

xz	unxz
[~]\$ xz test2.img	[~]\$ unxz test2.img
[~]\$ du -sh test2.img.xz	[~]\$ du -sh test2.img
16K test2.img.xz	99M test2.img

Uncompressing

tools that allow file to be read without uncompressing:

zcat / bzcat / xzcat

```
[~]$ zcat hostfile.txt.bz2
127.0.0.1      localhost
127.0.1.1      Minty-Bionic

# The following lines are desirable for IPv6
# capable hosts
::1      ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
```

▼ Searching for files and patterns

▼ searching for files and directories

locate

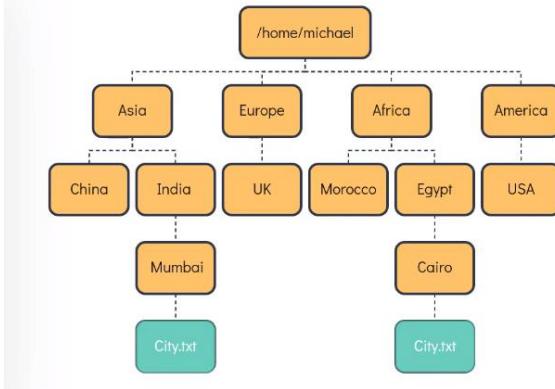
```
[~]$ locate City.txt
/home/michael/Africa/Egypt/Cairo/City.txt
/home/michael/Asia/India/Mumbai/City.txt
```

updatedb

```
[~]$ updatedb
```

find

```
[~]$ find /home/michael -name City.txt
/home/michael/Africa/Egypt/Cairo/City.txt
/home/michael/Asia/India/Mumbai/City.txt
```



▼ GREP

commonly used to print lines of a file matching pattern

case sensitive, use -i flag to search for case insensitive

-r to search for a pattern recursively in a directory

-v , lists all lines that do not contain a matching string

grep

```
[~]$ grep second sample.txt
Followed by the second line.
```

```
[~]$ grep capital sample.txt
```

[~]\$ cat sample.txt

```
This is the first line.
Followed by the second line.
And then the third line.
The fourth line has CAPITAL LETTERS
The fifth line does not want to be printed
```

grep -i

```
[~]$ grep -i capital sample.txt
The fourth line has CAPITAL LETTERS
```

grep -v

```
[~]$ grep -v "printed" sample.txt
```

```
This is the first line.
Followed by the second line.
And then the third line.
The fourth line has CAPITAL LETTERS
```

grep -r

```
[~]$ grep -r "third line" /home/michael
./sample.txt:And then the third line.
```

-w , to search for only whole word/pattern only

can combine multiple options: -vw

-A(n) , print lines after matching command

-B(n) , print lines before matching command

```
[~]$ cat examples.txt
grep examples
linux exam on 19th
```

```
[~]$ grep exam examples.txt
grep examples
linux exam on 19th
```

grep -w

```
[~]$ grep -w exam examples.txt
linux exam on 19th
```

grep -w & -v

```
[~]$ grep -vw exam examples.txt
grep examples
```

```
[~]$ cat premier-league-table.txt
1 Arsenal
2 Liverpool
3 Chelsea
4 Manchester City
```

grep -A

```
[~]$ grep -A1 Arsenal premier-league-table.txt
1 Arsenal
2 Liverpool
```

grep -B

```
[~]$ grep -B1 4 premier-league-table.txt
3 Chelsea
4 Manchester City
```

can combine A(n) and B(n)

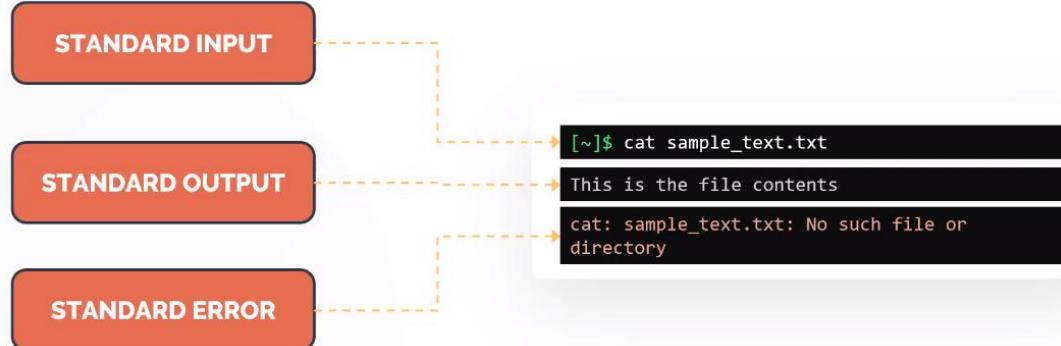
```
[~]$ cat premier-league-table.txt  
1 Arsenal  
2 Liverpool  
3 Chelsea  
4 Manchester City
```

grep -A and grep -B

```
[~]$ grep -A1 -B1 Chelsea premier-league-table.txt  
2 Liverpool  
3 Chelsea  
4 Manchester City
```

▼ IO Redirection

▼ standard data streams in Linux



▼ redirect, STDOUT, STDERR

```
[~]$ echo $SHELL > shell.txt
```

```
[~]$ cat shell.txt  
/bin/bash
```

```
[~]$ echo "This is the Bash shell" >> shell.txt
```

```
[~]$ cat shell.txt  
/bin/bash  
This is the Bash shell
```

```
[~]$ cat missing_file 2> error.txt
```

```
[~]$ cat error.txt  
cat: missing_file: No such file or directory
```

```
[~]$ cat missing_file 2>> shell.txt
```

```
[~]$ cat shell.txt  
/bin/bash  
This is the Bash shell  
cat: missing_file: No such file or directory
```

```
[~]$ cat missing_file 2> /dev/null
```

▼ Command-line PIPES

allow linking of multiple terms: allow the first line of standard out to be used as the standard input for the 2nd command

```
[~]$ cat sample.txt  
hello there!  
Nice to see you here!
```

```
[~]$ grep Hello sample.txt > file.txt
```

```
[~]$ less file.txt
```

command 1 | command 2

```
[~]$ grep Hello sample.txt | less  
Hello There!  
(END)
```

```
[~]$ less sample.txt  
hello there!  
Nice to see you here!  
sample.txt (END)
```

tee command

```
[~]$ echo $SHELL | tee shell.txt  
/bin/bash
```

```
[~]$ cat shell.txt  
/bin/bash
```

```
[~]$ echo "This is the bash shell" | tee -a shell.txt
This is the bash shell
```

```
[~]$ cat shell.txt  
/bin/bash  
This is the Bash shell
```

▼ VI editor

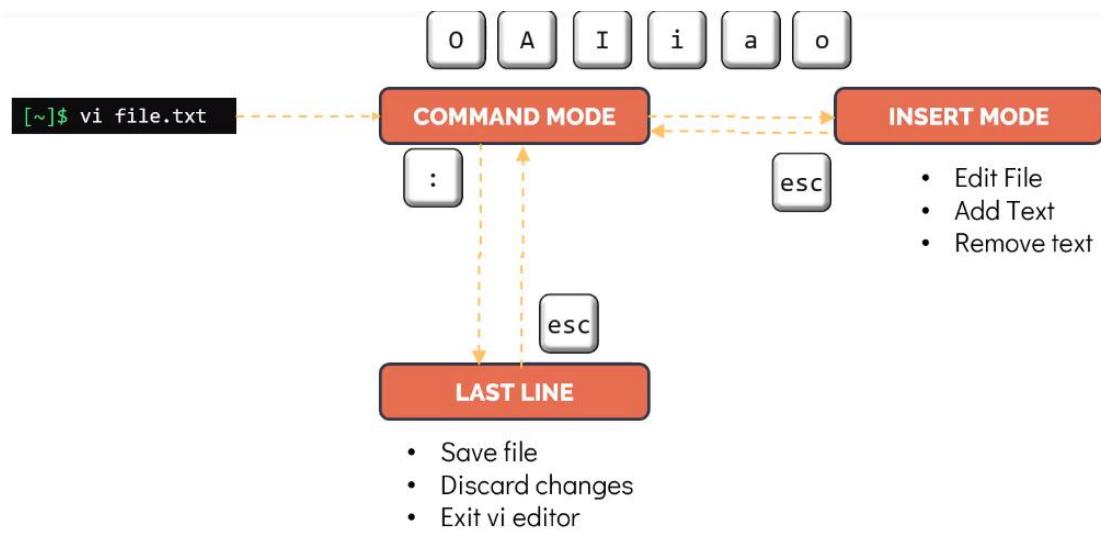
```
[~]$ vi/home/michael/sample.txt
This is the first line.
Followed by the second line.
Third line is very long compared to the previous two lines.
Hello there!
hello there!
```

COMMAND MODE

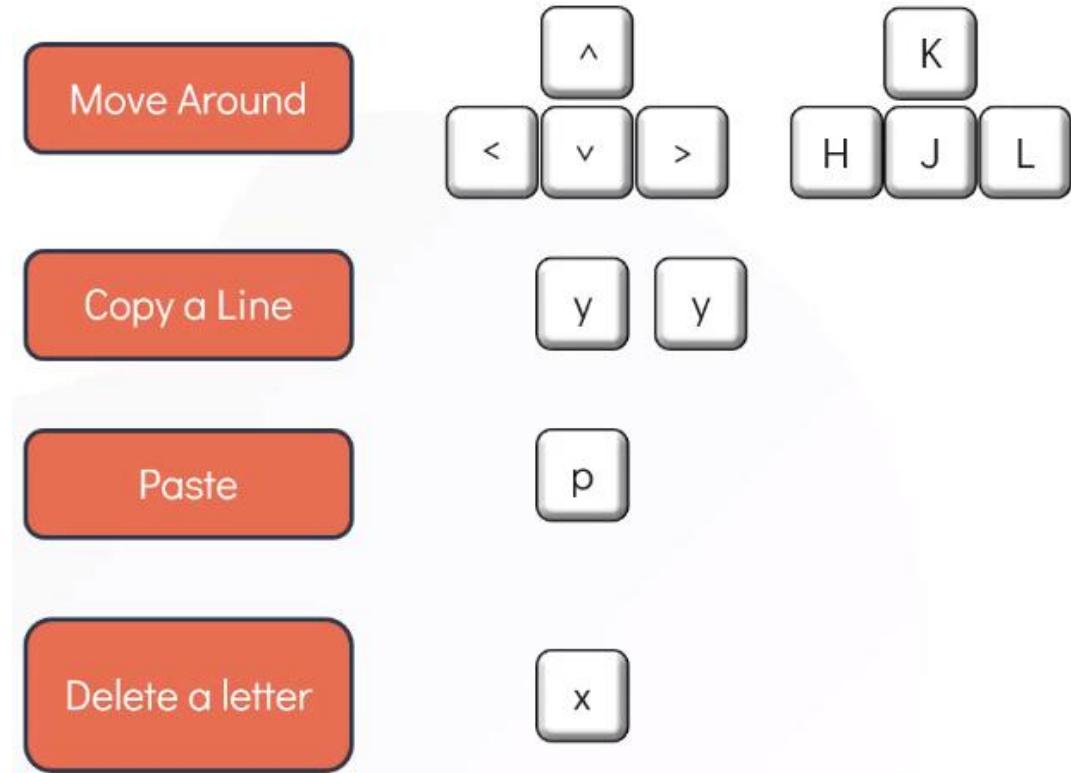
INSERT MODE

LAST LINE

1,1 All



▼ command mode:



Delete a line

d d

Delete 3 lines

d 3 d

Undo

u

Redo

r

Find

/line

?line

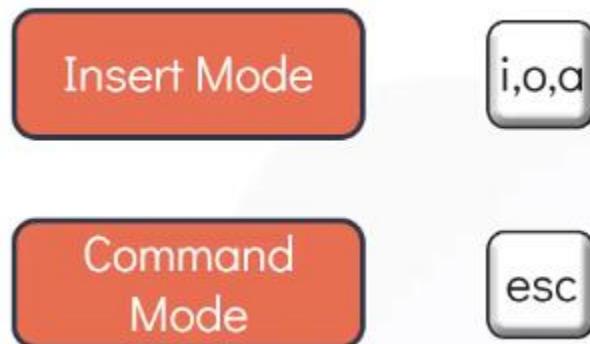
Find Next

n

Find Previous

N

▼ insert mode:



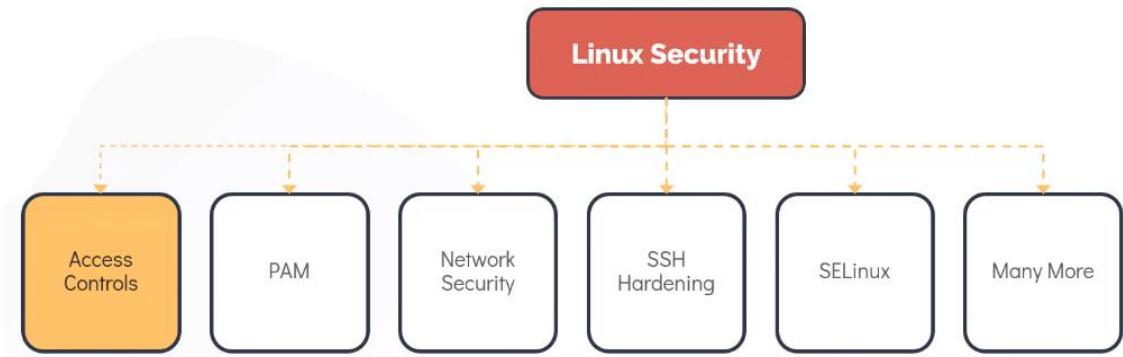
▼ lastline mode:



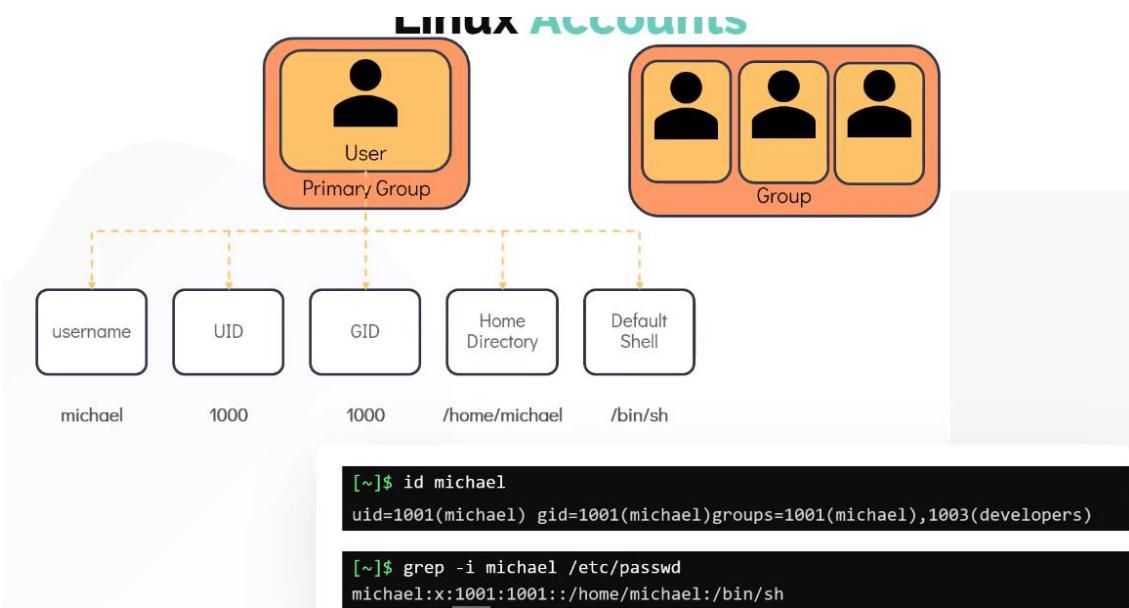
▼ Security and file permissions

▼ Linux Accounts

PAM = pluggable authentication module



user info in /etc/passwd, user group info in /etc/group



Account Types:



Commands:

```
[~]$ id  
uid=1000(michael) gid=1000(michael) groups=1000(michael)
```

```
[~]$ who  
bob pts/2 Apr 28 06:48 (172.16.238.187)
```

```
[~]$ last  
michael :1 :1 Tue May 12 20:00 still logged in  
sarah :1 :1 Tue May 12 12:00 still running  
reboot system boot 5.3.0-758-gen Mon May 11 13:00 - 19:00 (06:00)
```

Switching users:

```
[~]$ su -  
Password:  
root ~#
```

```
[michael@ubuntu-server ~]$ su -c "whoami"  
Password:  
root
```

```
[michael@ubuntu-server ~]$ sudo apt-get install nginx  
[sudo] password for michael:
```

SUDO:

```
[~]$ cat /etc/sudoers  
User privilege specification  
root    ALL=(ALL:ALL) ALL  
# Members of the admin group may gain root  
privileges  
%admin  ALL=(ALL) ALL  
# Allow members of group sudo to execute any  
command  
%sudo   ALL=(ALL:ALL) ALL  
# Allow Bob to run any command  
bob    ALL=(ALL:ALL) ALL  
# Allow Sarah to reboot the system  
sarah  localhost=/usr/bin/shutdown -r now  
# See sudoers(5) for more information on "#include"  
directives:  
#includedir /etc/sudoers.d
```

Field	Description	Example
1	User or Group	bob, %sudo (group)
2	Hosts	localhost, ALL(default)
3	User	ALL(default)
4	Command	/bin/ls, ALL(unrestricted)

▼ User mgmt

basic commands

```
[~]$ useradd bob  
[~]$ grep -i bob /etc/passwd  
bob:x:1002:1002::/home/bob:/bin/sh  
[~]$ grep -i bob /etc/shadow  
bob:!18341:0:99999:7:::  
[~]$ passwd bob  
Changing password for user bob.  
New UNIX password:  
Retype new UNIX password:  
passwd: all authentication tokens updated  
successfully.
```

```
[~]$ whoami  
bob  
[~]$ passwd  
Changing password for bob.  
(current) UNIX password:  
Enter new UNIX password:  
Retype new UNIX password:  
passwd: password updated successfully
```

```
[~]$ useradd -u 1009 -g 1009 -d /home/robert -s /bin/bash -c "Mercury Project member" bob
```

-c Custom Comments

-d custom home directory

-e Expiry date

-g specific GID

-G create user with multiple secondary groups

-s specify login shells

-u specific UID

group commands:

```
[~]$ userdel bob
```

```
[~]$ groupadd -g 1011 developer
```

```
[~]$ groupdel developer
```

▼ Access control files

/etc/passwd:

```
[~]$ grep -i ^bob /etc/passwd  
bob:x:1001:1001::/home/bob:/bin/bash
```

USERNAME:PASSWORD:UID:GID:GECOS:HOMEDIR:SHELL

/etc/shadow:

```
[~]$ grep -i ^bob /etc/shadow  
bob:$6$0h0ut0t0$5JcuRxR7y72LLQk4Kdog7u09LsNFS0yZPkIC8pV9tgD0wXCHutY  
cWF/7.eJ3TfGfG0lj4JF63PyuPwKC18tJS.:18188:0:99999:7:::
```

USERNAME:PASSWORD:LASTCHANGE:MINAGE:MAXAGE:WARN:INACTIVE:~~EXPDATE~~

/etc/group:

```
[~]$ grep -i ^bob /etc/group  
developer:x:1001:bob,sara
```

```
NAME:PASSWORD:GID:MEMBERS
```

▼ File permissions

- r w X r w X r - X

owner u Group g Others o

Bit	Purpose	Octal Value
r	Read	4
w	Write	2
x	Execute	1

Octal values:

r w X r w - - w X r - X

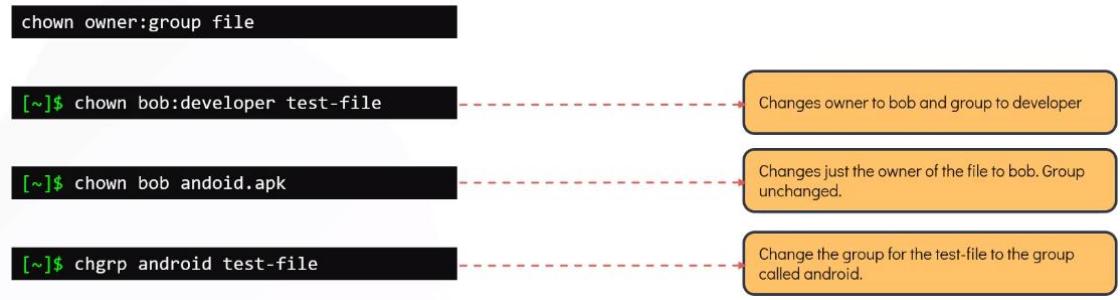
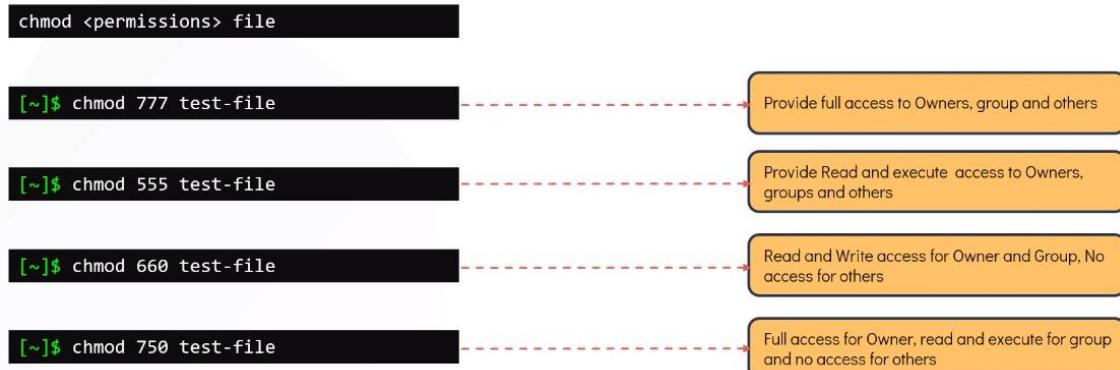
4 + 2 + 1 4 + 2 + 0 0 + 2 + 1 4 + 0 + 1

7 6 3 5

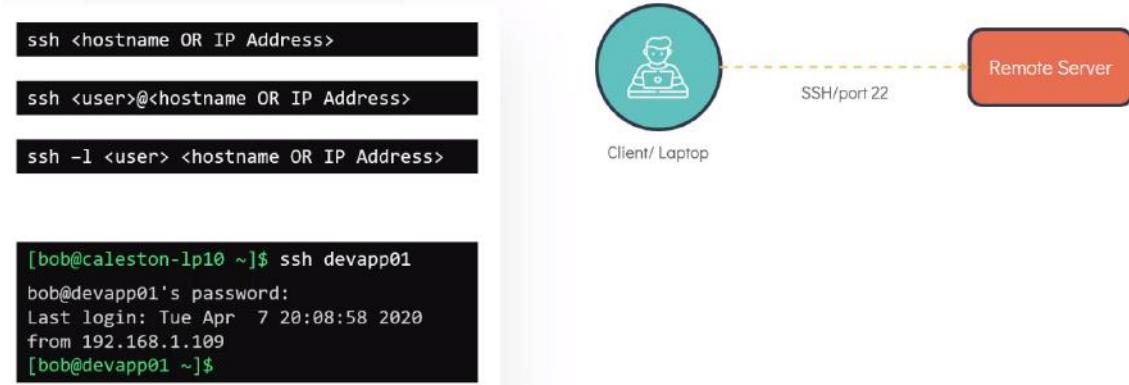
chmod



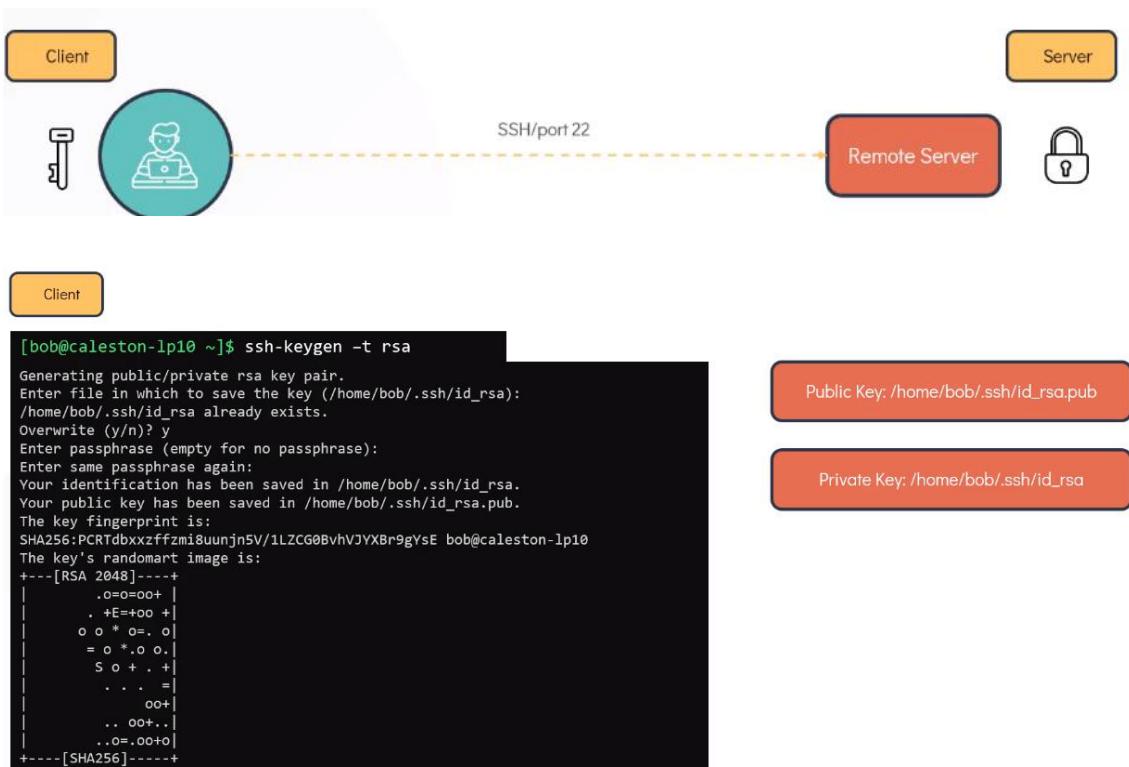
modifying file permissions



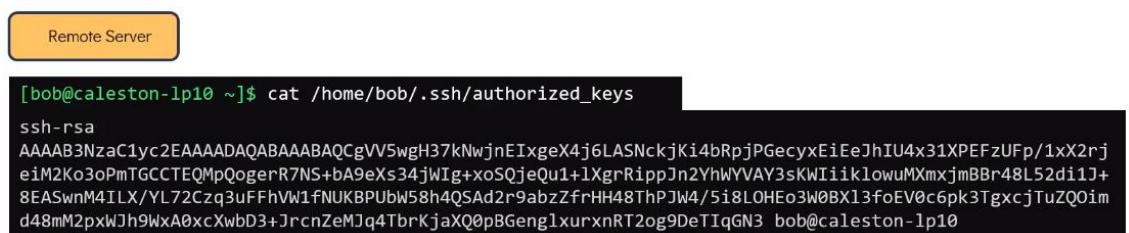
▼ SSH and SCP



password-less ssh, need key pair (private + public key)



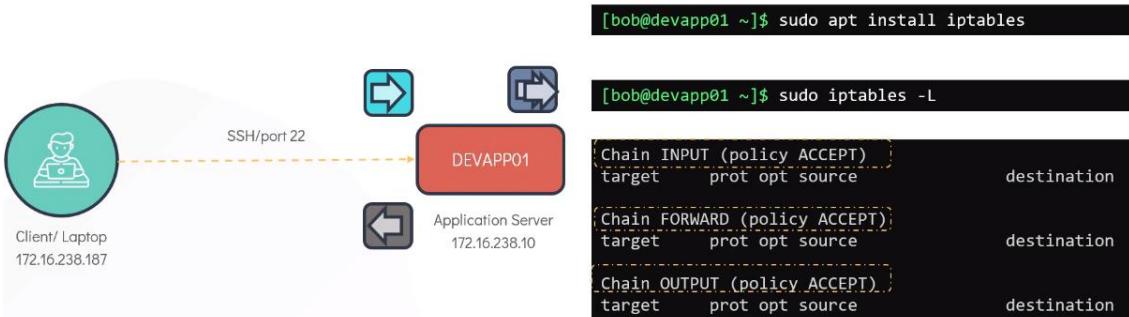
public key location:



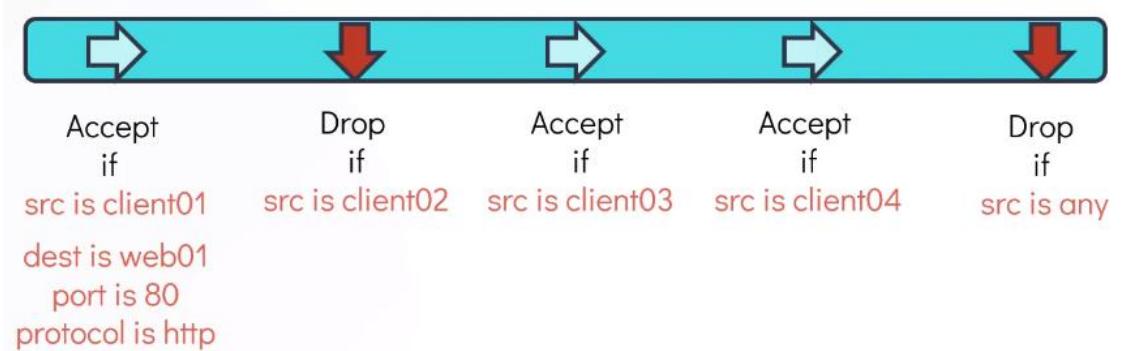
SCP:



▼ IPTABLES Intro

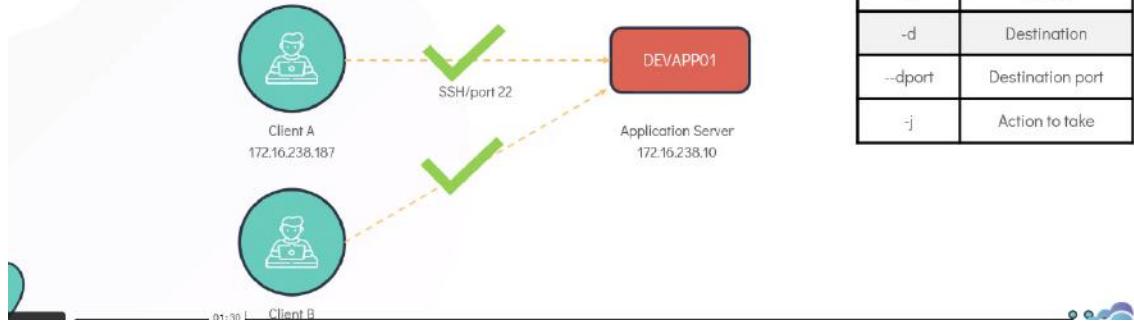


chain of rules



▼ IPTABLES - securing the environment

```
[bob@devapp01 ~]$ iptables -A INPUT -p tcp --s 172.16.238.187 --dport 22 -j ACCEPT
[bob@devapp01 ~]$ iptables -L
Chain INPUT (policy ACCEPT)
target     prot opt source               destination
ACCEPT     tcp  --  anywhere             anywhere            tcp dpt:ssh
```



Option	Description
-A	Add Rule
-p	Protocol
-s	Source
-d	Destination
--dport	Destination port
-j	Action to take

Source/ Destination	Action
devdb01	Allow outgoing connection to port 5432
caleston-repo-01	Allow outgoing connection to port 80
Internet	Drop all outgoing connections, port 80/443 (HTTP/HTTPS)
caleston-lp10	Allow incoming on port 80

```
[bob@devapp01 ~]$ iptables -A OUTPUT -p tcp -d 172.16.238.11 --dport 5432 -j ACCEPT
```

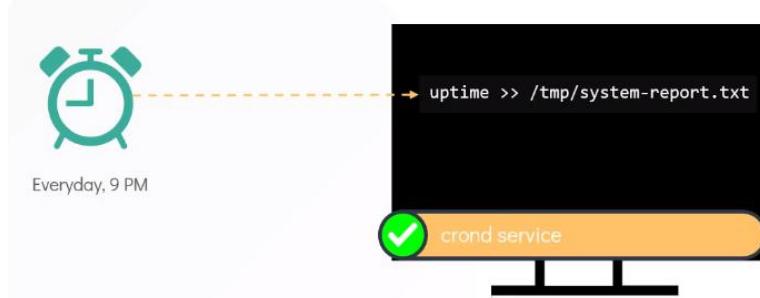
```
[bob@devapp01 ~]$ iptables -A OUTPUT -p tcp -d 172.16.238.15 --dport 80 -j ACCEPT
```

```
[bob@devapp01 ~]$ iptables -A OUTPUT -p tcp --dport 443 -j DROP
[bob@devapp01 ~]$ iptables -A OUTPUT -p tcp --dport 80 -j DROP
```

```
[bob@devapp01 ~]$ iptables -A INPUT -p tcp -s 172.16.238.187 --dport 80 -j ACCEPT
```

▼ Cronjobs

```
[michael@caleston-lp01 ~]$ uptime >> /tmp/system-report.txt
```



how to schedule jobs:

00	21	*	*	*
minute	hour	day	month	weekday

```
0 21 * * * uptime >> /tmp/system-report.txt
```

Requirement	Minute	Hour	Day	Month	Weekday
February 19 th , 08:10 AM, Only if it's a Monday	10	8	19	2	1
February 19 th , 08:10 AM, any weekday	10	8	19	2	*
19 th of every month at 08:10 AM, any weekday	10	8	19	*	*
Every day of every month at 08:10 AM, any weekday	10	8	*	*	*
Every day of every month at 10 minutes past every hour or any weekday	10	*	*	*	*
Every day of every month at every minute past every hour or any weekday	*	*	*	*	*
Every day of every month at every other minute past every hour or any weekday, eg: 08:02, 08:04, 08:06... 09:02, 09:04, 09:06	*/2	*	*	*	*
Every day of every month at every other minute past every other hour or any weekday. eg: 08:02, 08:04, 08:06... 10:02, 10:04, 10:06... 12:02, 12:04, 12:06	*/2	*/2	*	*	*

list job and inspect log to see if it ran correctly:

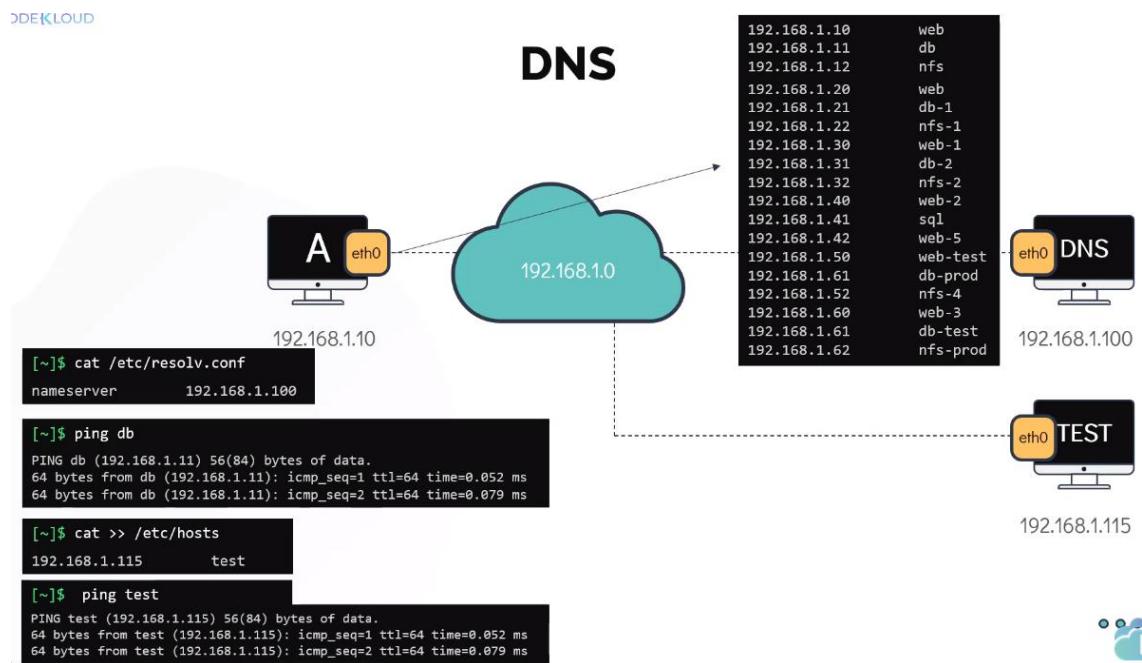
```
[michael@caleston-lp01 ~]$ crontab -l
# Notice that tasks will be started based on the cron's system
# daemon's notion of time and timezones.
#
# Output of the crontab jobs (including errors) is sent through
# email to the user the crontab file belongs to (unless redirected).
#
# For example, you can run a backup of all your user accounts
# at 5 a.m every week with:
# 0 5 * * 1 tar -zcf /var/backups/home.tgz /home/
#
# For more information see the manual pages of crontab(5) and cron(8)
#
# m h dom mon dow   command
0 21 * * * uptime >> /tmp/system-report.txt
```

```
[michael@caleston-lp01 ~]$ cat /tmp/system-report.txt
21:00:00 up 20:15,  1 user,  load average: 0.47, 0.50, 0.52
```

```
[michael@caleston-lp01 ~]$ tail /var/log/syslog
Jul 22 21:00:01 caleston-lp10 CRON[1720]: (michael) CMD (uptime >> /tmp/system-report.txt)
```

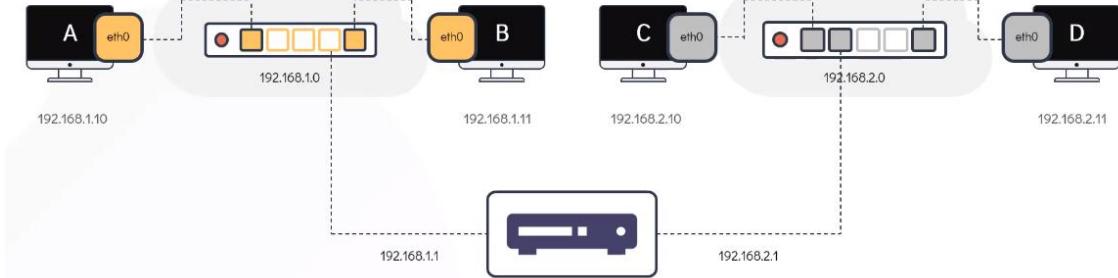
▼ Networking

▼ DNS



▼ Networking basics

Routing



```
[~]$ ip link
```

```
[~]$ ip addr
```

```
[~]$ ip addr add 192.168.1.10/24 dev eth0
```

```
[~]$ route
```

```
[~]$ ip route add 192.168.1.0/24 via 192.168.2.1
```

```
[~]$ ip route
```

▼ Troubleshooting

```
[~]$ ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue
    state UNKNOWN mode DEFAULT group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: enp1s0f1: <BROADCAST,BROADCAST,MULTICAST,UP> mtu 1500 qdisc fq_codel state UP mode DEFAULT group default qlen 1000
    link/ether 08:97:98:6e:55:4d brd ff:ff:ff:ff:ff:ff
```

Check
Interfaces

```
[~]$ nslookup caleston-repo-01
Server:      192.168.1.100
Address:     192.168.1.100 #53

Non-authoritative answer:
Name:   caleston-repo-01
Address: 192.168.2.5
```

Check DNS
Resolution

```
[~]$ ping caleston-repo-01
PING caleston-repo-01 (192.168.2.5) 56(84) bytes of data.
^C
--- localhost ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 2034ms
```

Check
Connectivity

```
[~]$ traceroute 192.168.2.5
Tracing route to example.com [192.168.2.5]
over a maximum of 30 hops:
1 <1 ms <1 ms <1 ms 192.168.1.1
2 <2 ms <1 ms <1 ms 192.168.2.1
3 * * * Request timed out.
```

Check Route

```
[caleston-repo-01: ~]$ netstat -an | grep 80 | grep -i LISTEN
tcp6      0      0 :::80          ::::*                  LISTEN
```

Check Services

```
[caleston-repo-01: ~]$ ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue
    state UNKNOWN mode DEFAULT group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: enp1s0f1: <BROADCAST,BROADCAST,MULTICAST,UP> mtu 1500 qdisc fq_codel
    state DOWN mode DEFAULT group default qlen 1000
    link/ether 08:97:98:34:52:12 brd ff:ff:ff:ff:ff:ff
```

Check Interfaces

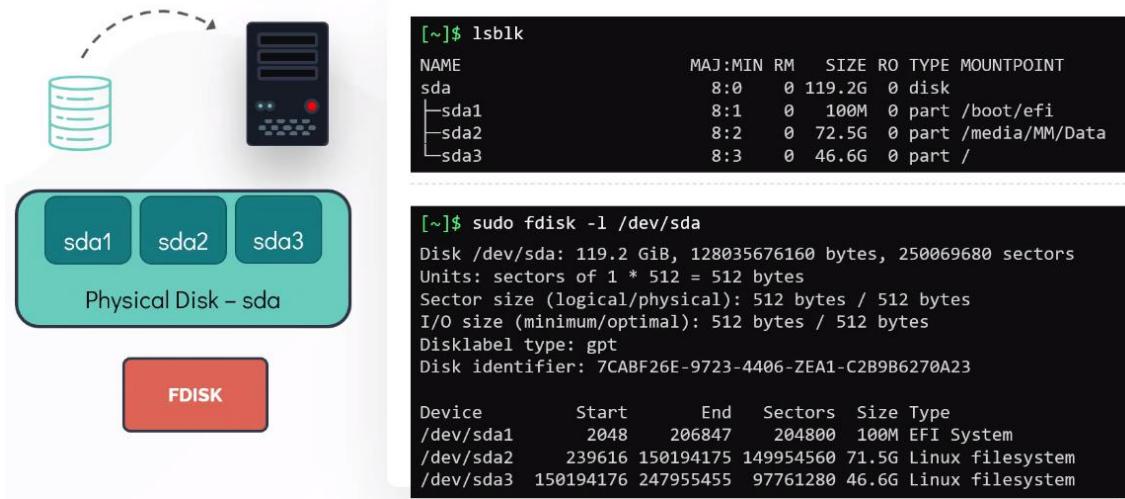
▼ Storage in Linux

▼ Disk partitions

INTRODUCTION TO STORAGE BASICS

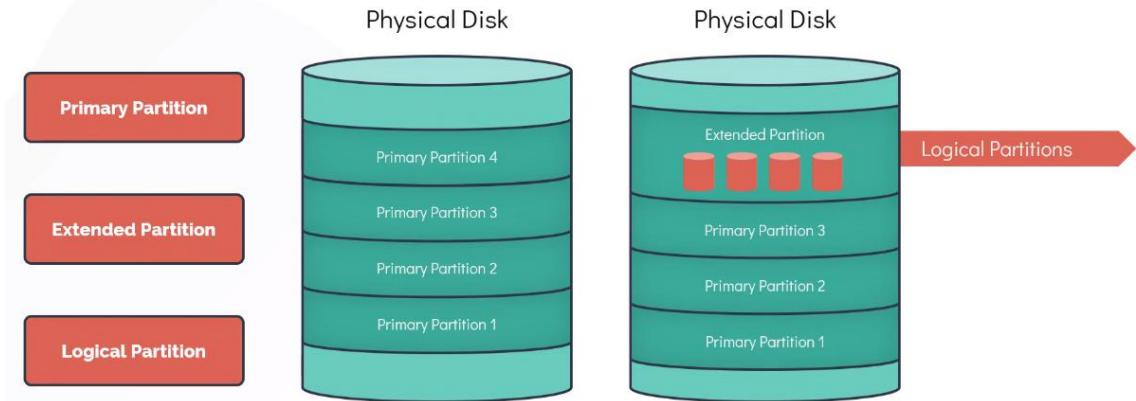


partitions

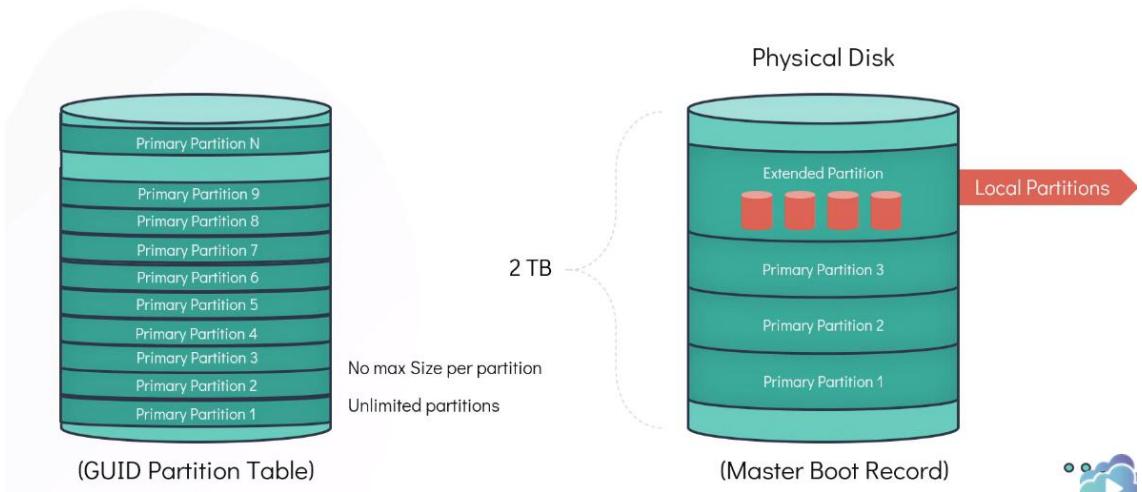


partition types

PARTITION TYPES – PRIMARY, EXTENDED AND LOGICAL



partition scheme - MBR & GPT (better)



▼ File systems in Linux

EXT2	EXT3	EXT4
2 TB File size	2 TB File size	16 TB File size
4 TB volume size	4 TB volume size	1 Exabyte
Supports Compression	Uses Journal	Uses Journal
Supports Linux Permissions	Backwards Compatible	Uses checksum for journal
Long Crash Recovery		Backwards Compatible

Working with EXT4

```
[~]$ mkfs.ext4 /dev/sdb1
Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done
```

```
[~]$ mkdir /mnt/ext4;
[~]$ mount /dev/sdb1 /mnt/ext4
```

```
[~]$ mount | grep /dev/sdb1
/dev/sdb1 on /mnt/ext4 type ext4 (rw,relatime,data=ordered)
```

```
[~]$ df -hP | grep /dev/sdb1
/dev/sdb1      20G      52K     20G      0%      /mnt/ext4
```

FSTAB

```
/etc/fstab
# /etc/fstab: static file system information.
#
# Use 'blkid' to print the universally unique identifier for a
# device; this may be used with UUID= as a more robust way to name devices
# that works even if disks are added and removed. See fstab(5).
#
# <file system> <mount point> <type> <options> <dump> <pass>
/dev/sda1   /          ext4    defaults,relatime,errors=panic  0      1 ~
```

```
echo "/dev/sdb1 /mnt/ext4 ext4 rw 0 0" >> /etc/fstab
```

FIELD	Purpose
Filesystem	Such as /dev/vdb1 to be mounted
Mountpoint	Directory to be mounted on
Type	Example ext2, ext3, ext4
Options	Such as RW = Read-write, RO = Read Only
Dump	0 = Ignore, 1 = take backup
Pass	0 = ignore, 1 or 2 = FSCK filesystem check enforced.



▼ DAS NAS and SAN

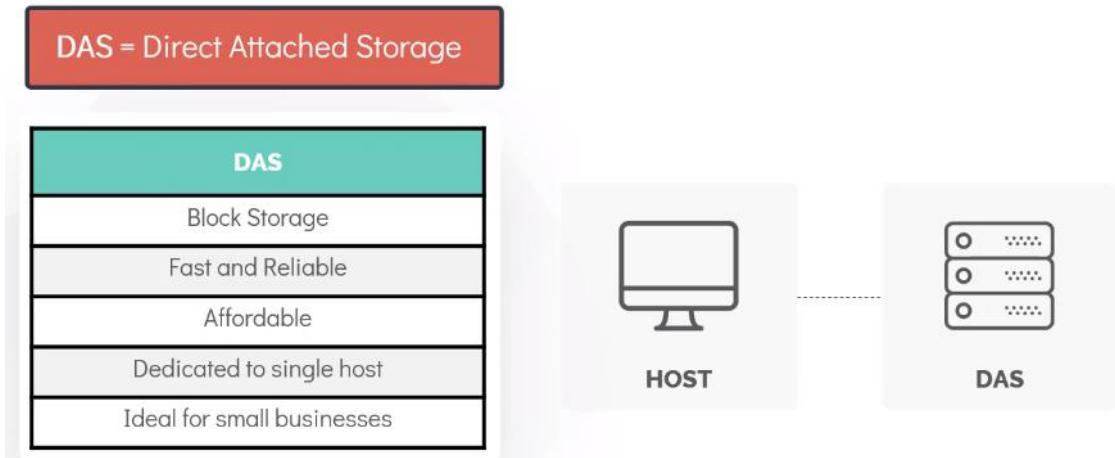
DAS = Direct Attached Storage

NAS = Network Attached Storage

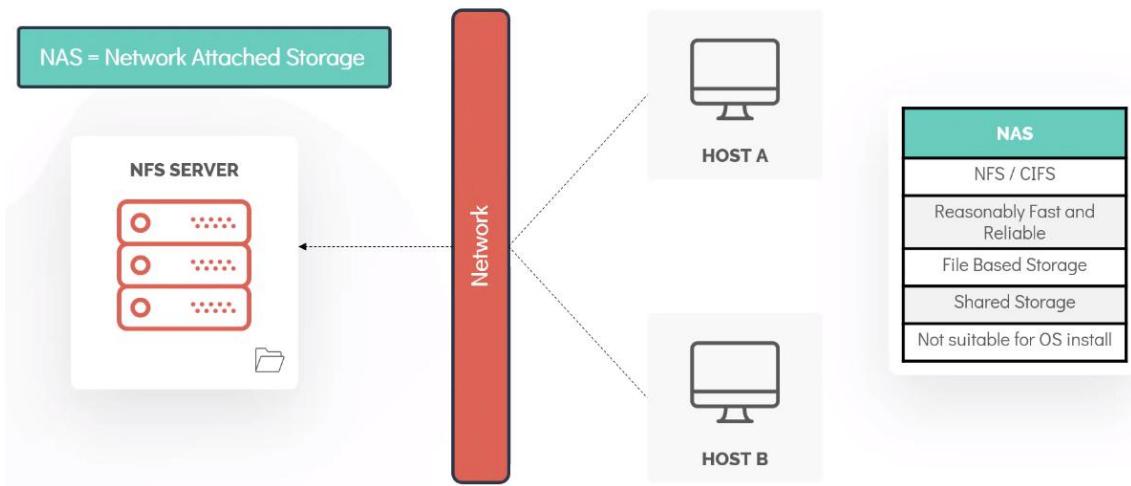
SAN = Storage Area Network



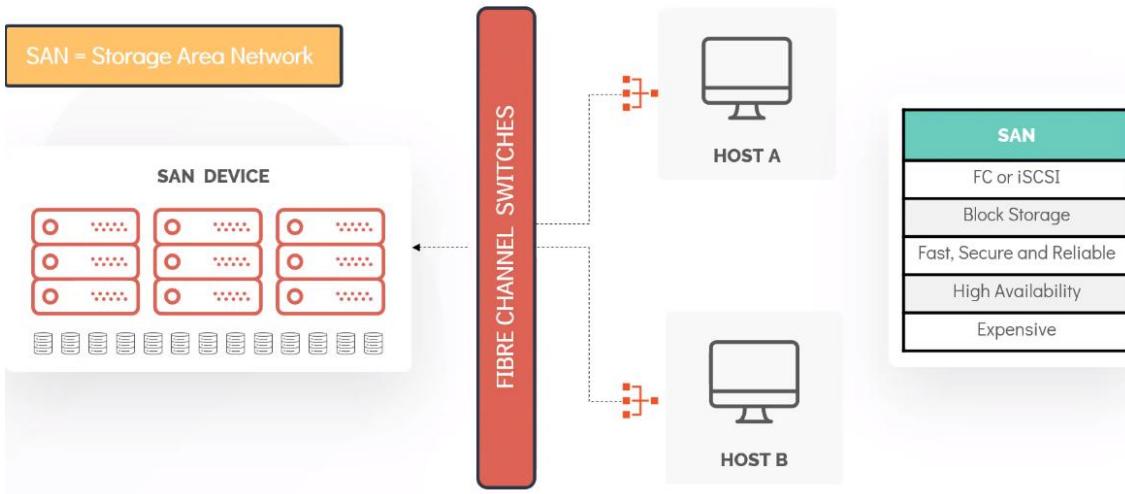
DAS



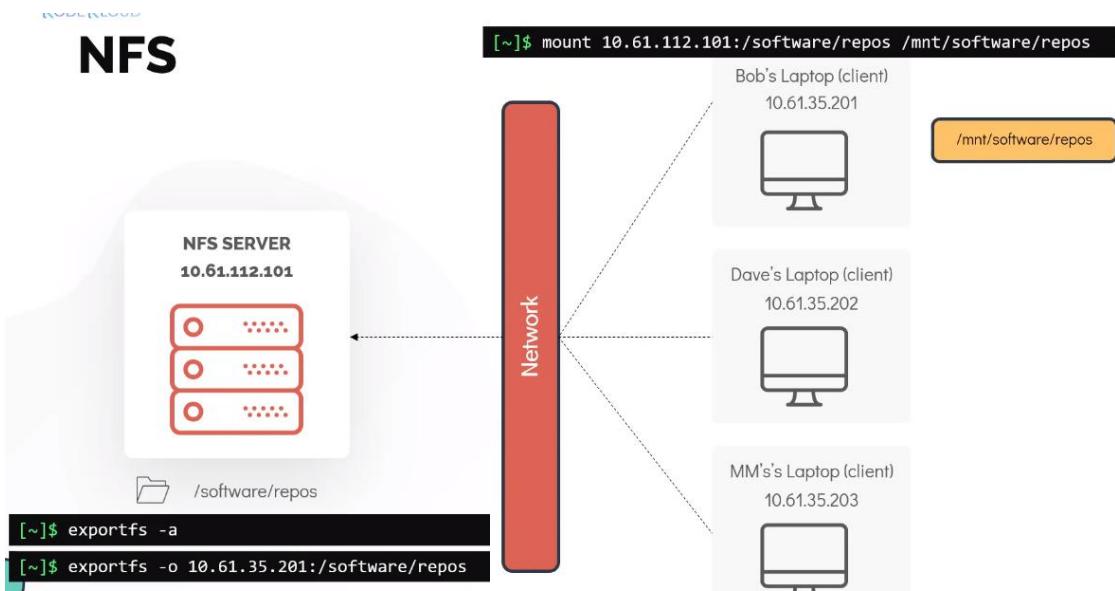
NAS



SAN



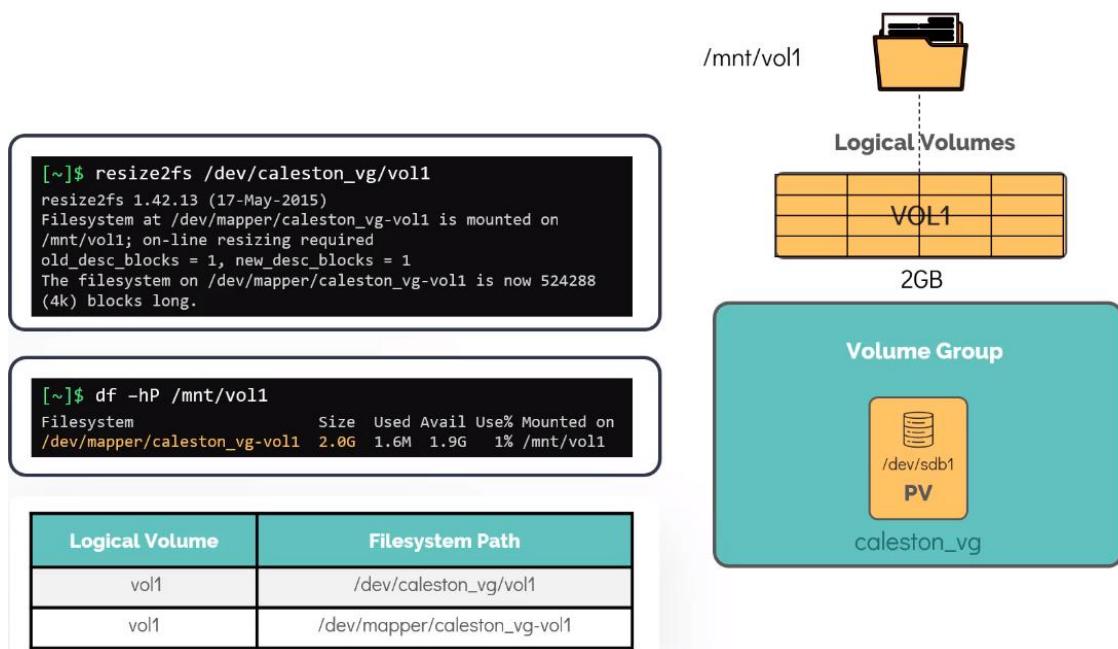
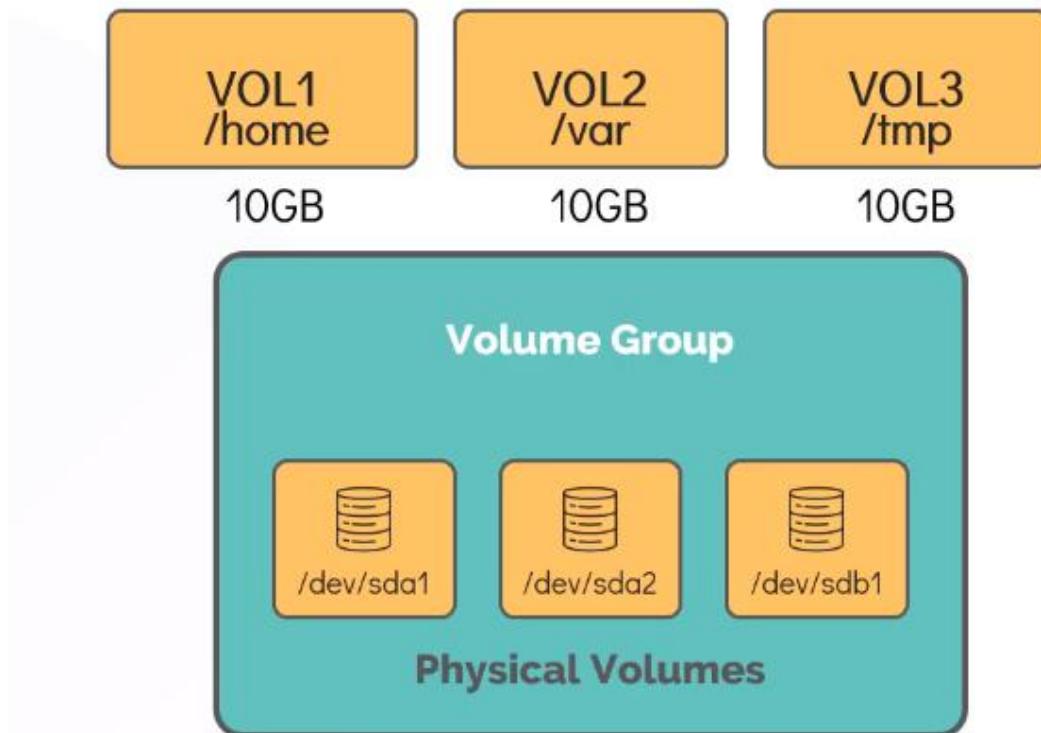
▼ NFS Filesystem



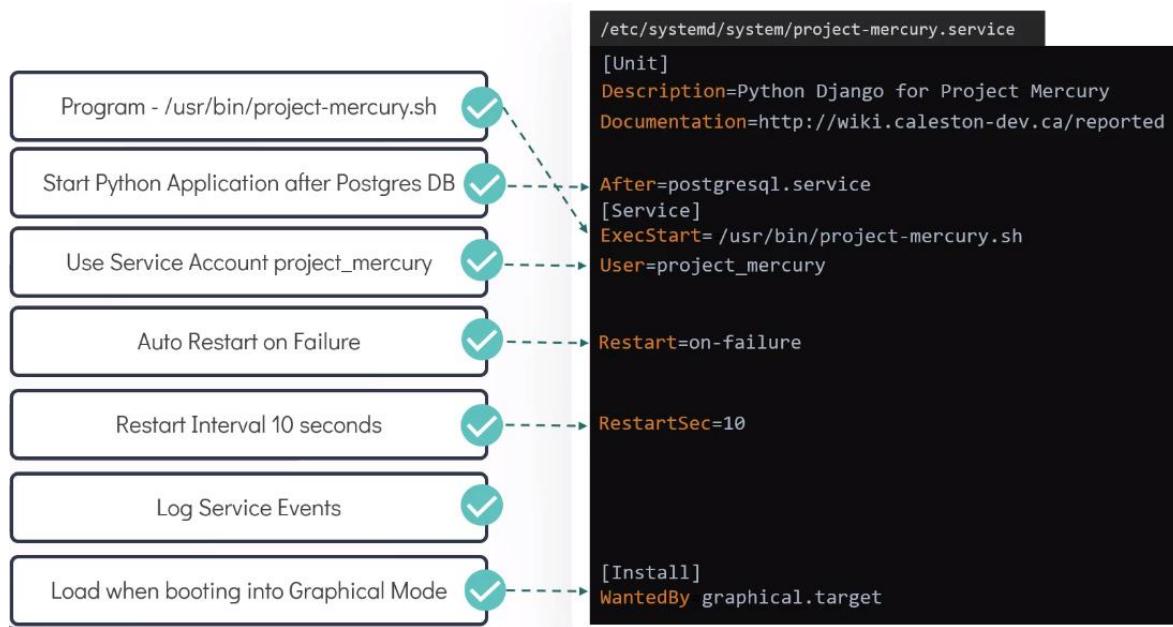
▼ LVM - logical volume manager

allows grouping of multiple physical volumes - then can carve out logical volumes

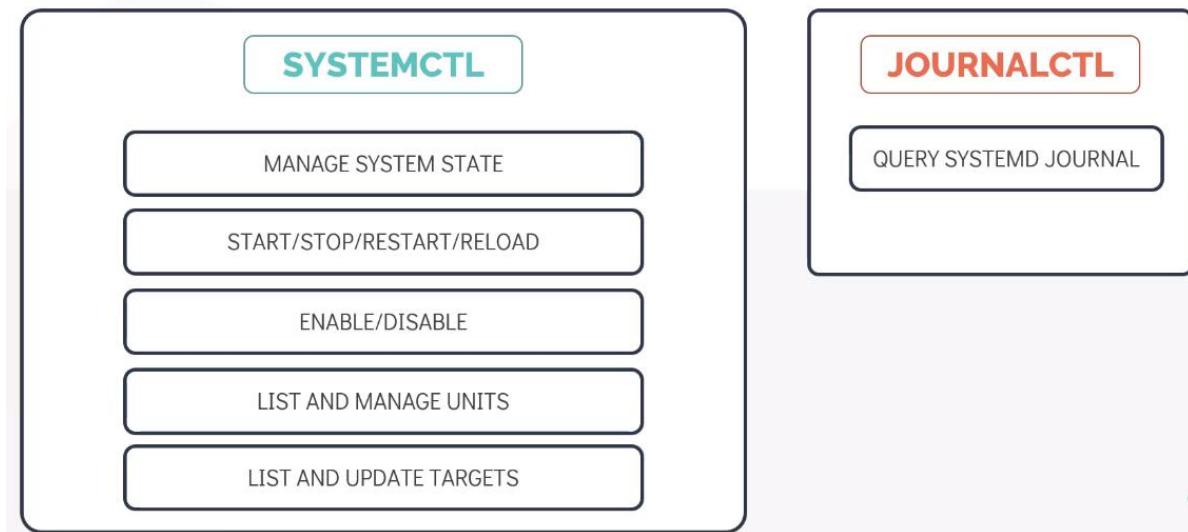
Logical Volumes



▼ Service management with SYSTEMD



▼ SYSTEMD tools



Service Management with SYSTEMD

```
[~]$ systemctl start docker
[~]$ systemctl stop docker
[~]$ systemctl restart docker
[~]$ systemctl reload docker
[~]$ systemctl enable docker
[~]$ systemctl disable docker
```

```
[~]$ systemctl status docker
● docker.service - Docker Application Container Engine
   Loaded: loaded (/lib/systemd/system/docker.service; enabled; vendor preset: enabled)
     Active: active (running) since Sat 2020-03-21 00:45:22 EDT; 43s ago
       Docs: https://docs.docker.com
   Main PID: 23340 (dockerd)
     Tasks: 18
    CGroup: /system.slice/docker.service
            └─23340 /usr/bin/dockerd -H fd:// --containerd=/run/containerd/containerd.sock

Mar 21 00:45:21 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:21.628503806-04:00" level=warning msg="Your kernel does not
Mar 21 00:45:21 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:21.628577159-04:00" level=warning msg="Your kernel does not
Mar 21 00:45:21 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:21.628609304-04:00" level=warning msg="Your kernel does not
Mar 21 00:45:21 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:21.629107989-04:00" level=info msg="Loading containers: sta
Mar 21 00:45:21 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:21.827189916-04:00" level=info msg="Default bridge (docker0)
Mar 21 00:45:22 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:22.037716885-04:00" level=info msg="Loading containers: do
Mar 21 00:45:22 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:22.140093558-04:00" level=info msg="Docker daemon" commit=6
Mar 21 00:45:22 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:22.140093558-04:00" level=info msg="Daemon has completed in
Mar 21 00:45:22 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:22.188345103-04:00" level=info msg="API listen on /var/run/
Mar 21 00:45:22 bob-Bionic systemd[1]: Started Docker Application Container Engine.
```

STATE	Meaning
Active	Service Running
Inactive	Service Stopped
Failed	Crashed/Error/Timeout e.t.c

SYSTEMCTL TO MANAGE STATE

```
[~]$ systemctl get-default
[~]$ systemctl set-default multi-user.target
[~]$ systemctl list-units --all
UNIT                                     LOAD   ACTIVE   SUB    JOB  DESCRIPTION
network.target                           loaded  active   active      Network
nss-lookup.target                         loaded  active   active      Host and Network Name Look
nss-user-lookup.target                   loaded  active   active      User and Group Name Lookup
paths.target                             loaded  active   active      Paths
remote-fs-pre.target                    loaded  inactive dead      Remote File Systems (Pre)
remote-fs.target                         loaded  active   active      Remote File Systems
rescue.target                           loaded  inactive dead      Rescue Mode
shutdown.target                          loaded  inactive dead      Shutdown
```

```
[~]$ systemctl list-units
```

JOURNALCTL

```
[~]$ journalctl
[~]$ journalctl -b
[~]$ journalctl -u UNIT
```

```
[~]$ journalctl -u docker.service
-- Logs begin at Fri 2020-03-13 19:47:52 EDT, end at Sat 2020-03-21 02:29:48 EDT. --
Mar 19 17:43:21 systemd[1]: Starting Docker Application Container Engine...
Mar 19 17:43:22 dockerd[2590]: level=info msg="Starting up"
Mar 19 17:43:22 dockerd[2590]: level=info msg="ClientConn switching bal
Mar 19 17:43:22 dockerd[2590]: level=warning msg="[graphdriver] WARNING
Mar 19 17:43:22 dockerd[2590]: level=warning msg="Usage of loopback dev
Mar 19 17:43:22 dockerd[2590]: level=warning msg="Base device already e
Mar 19 17:43:23 dockerd[2590]: level=info msg="Default bridge (docker0)
Mar 19 17:43:23 dockerd[2590]: level=info msg="Loading containers: done
Mar 19 17:43:23 dockerd[2590]: level=info msg="Docker daemon" commit=63
Mar 19 17:43:23 dockerd[2590]: level=info msg="Daemon has completed ini
Mar 19 17:43:23 dockerd[2590]: level=info msg="API listen on /var/run/d
Mar 19 17:43:23 systemd[1]: Started Docker Application Container Engine.
```