



www.kodekloud.com



Notes regarding this deck:

- This deck is a study guide to accompany the Linux Basics course at KodeKloud - <https://kodekloud.com/p/linux-basics-course>
- Do not copy and paste commands from this directly as it might copy hidden characters too
- Lookup the options for the commands using man or help pages from the Linux terminal.
- All lab and hands-on activities are done best in the course at KodeKloud.

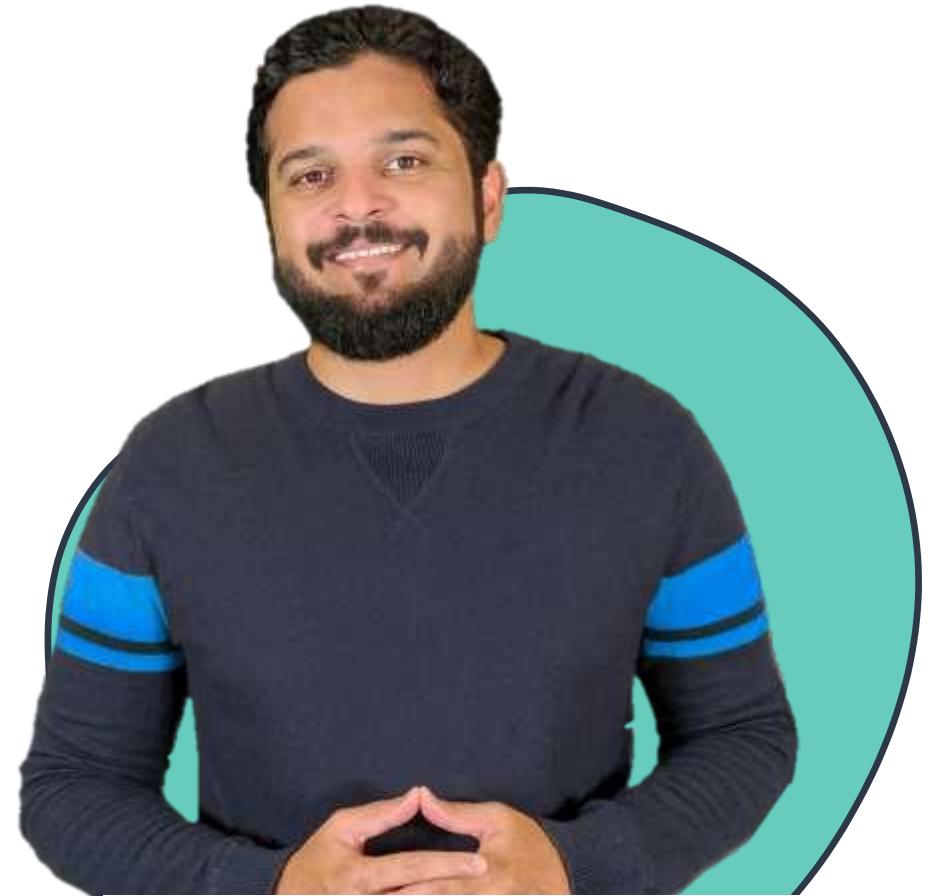
The Linux Basics Course

KODEKLOUD





**Vijin
Palazhi**

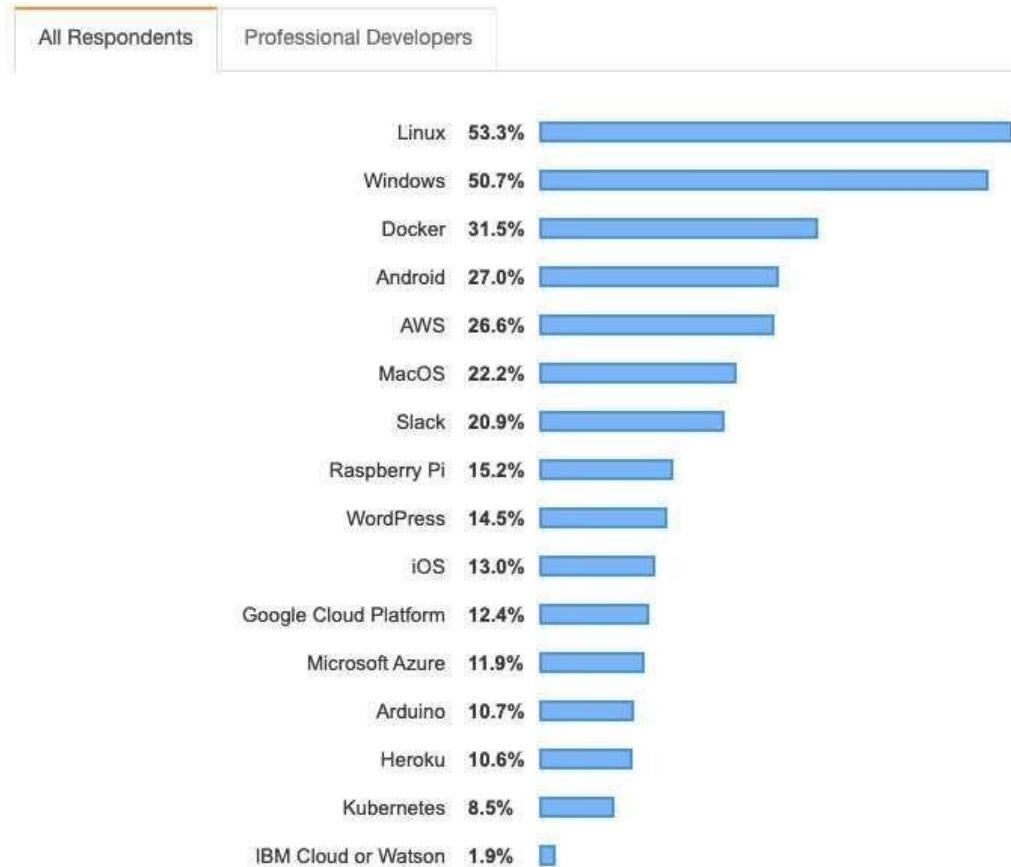


**Mumshad
Mannambeth**

...

Why Linux?

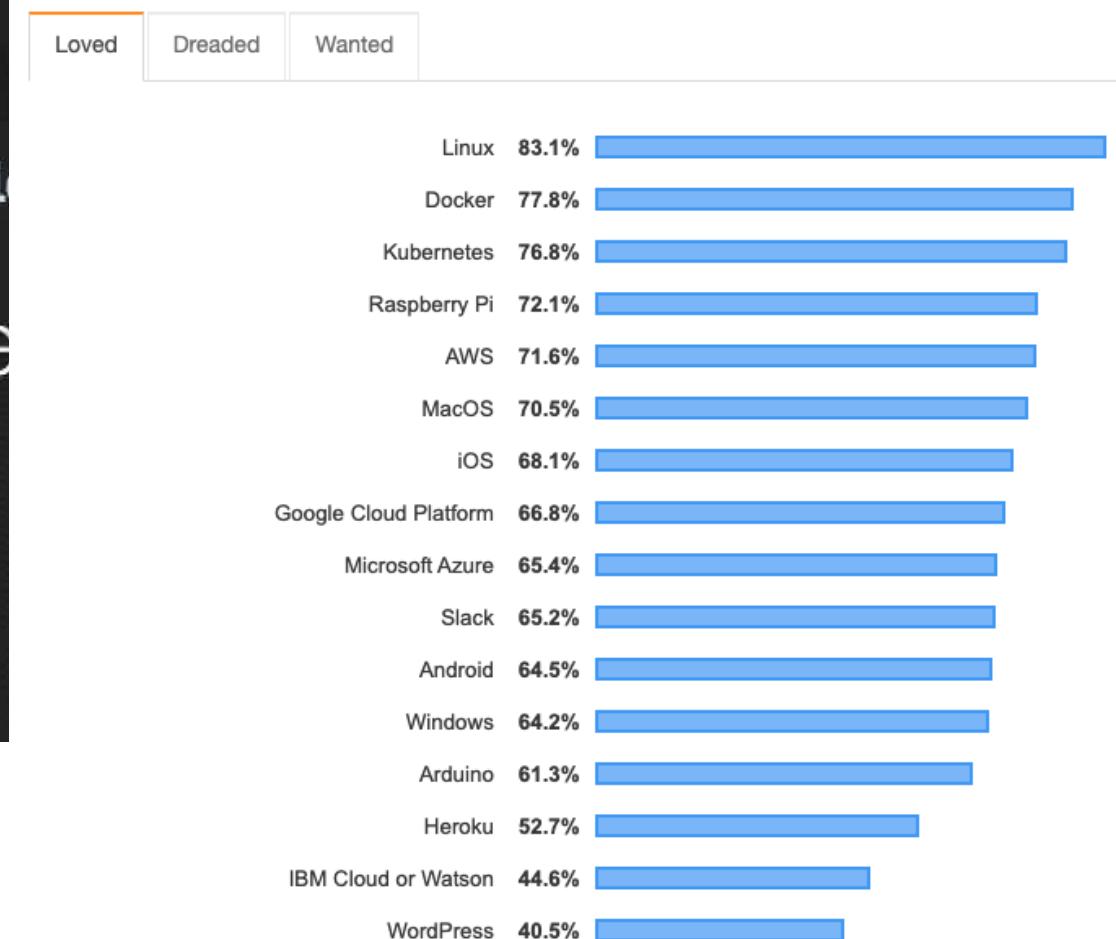
Platforms



80,144 responses; select all that apply



Most Loved, Dreaded, and Wanted Platforms



Why Linux?

As per the latest report from Top 500, Linux now runs on all of the fastest 500 supercomputers in the world. The previous number was 498 as remaining two supercomputers ran Unix.

[Top500](#) is an independent project that was launched in 1993 to benchmark supercomputers. It publishes the details about the top 500 fastest supercomputers known to them, twice a year. You can go the website and [filter out the list](#) based on various criteria such as country, OS type, vendors etc.

<https://itsfoss.com/linux-runs-top-supercomputers/>

Looking deeper, Linux's importance to the Web is even more extreme. By [W3Cook's analysis](#) of Alexa's data, 96.3 percent of the top 1 million web servers are running Linux. The remainder is split between Windows, 1.9 percent, and FreeBSD, 1.8 percent.

<https://www.zdnet.com/article/can-the-internet-exist-without-linux/>

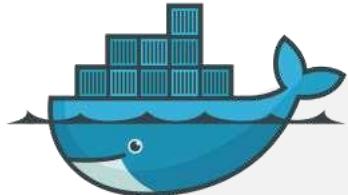
No, I didn't use a misleading blog title. Smartphones powered by Linux are in fact dominating the smartphone market. A few of you may be scratching your heads at this point (stop that, you'll go bald) while others are filled with that *Sound of Music – "The Hills are Alive!"* kind of Linux pride! Read on and I'll provide some pudding, filled with proof that ~~81%~~ 86% of all Smartphones are powered by Linux.

<https://haydenjames.io/81-percent-smartphones-powered-by-linux/>



<https://hostingtribunal.com/blog/linux-statistics>

Linux & DevOps



docker



Can Ansible run on Windows?

No, Ansible can only manage Windows hosts. Ansible cannot run on a Windows host natively, though it can run under the Windows Subsystem for Linux (WSL).

https://docs.ansible.com/ansible/latest/user_guide/windows_faq.html



Note: The Kubernetes control plane, including the [master components](#), continues to run on Linux. There are no plans to have a Windows-only Kubernetes cluster.

[Kubernetes Documentation](#)





devops

Worldwide

Jobs ▾

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Devops in Worldwide

122,547 results

Job Alert Off



Junior DevOps Engineer Promoted

Comcast

Mount Laurel, NJ, US



3 alumni work here

58 minutes ago



DevOps Specialist Promoted

UST Global

Midlands Occidental, Inglaterra, Reino Unido



23 connections work here

1 hour ago · Easy Apply



DevOps Engineer Promoted

Rakuten Viki

Singapore, Singapore

1 day ago · 19 applicants



Devops

Citi

Pune, IN



cloud

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381,406 results

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Cloud Platform Engineer Promoted

Capgemini

Cracow, Lesser Poland District, Poland



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Cloud Engineer Promoted

Fannie Mae

Reston, VA, US



7 connections work here

5 days ago · 12 applicants



Cloud Solution Architect Promoted

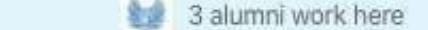
Swiss Re

Kansas City, MO, US



6 alumni work here

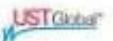
6 days ago · 6 applicants



3 alumni work here

58 minutes ago

DevOps Specialist Promoted



UST Global

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Citi

Pune, IN



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Devops

KWAN

Porto, PT

6 days ago · 1 applicant



DevOps Specialist

Amdocs

Toronto, Ontario, Canada



33 connections work here



121 connections work here

1 week ago · 24 applicants · Easy Apply

Cloud Engineer Promoted

Fannie Mae

Reston, VA, US

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5 days ago · 12 applicants

Cloud Solution Architect Promoted

Swiss Re

Kansas City, MO, US

6 alumni work here

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Cloud Architect

Anonymous

Dublin, IE

15 hours ago

Cloud Engineer

National Australia Bank

Melbourne, Victoria, Australia

6 connections work here

6 hours ago

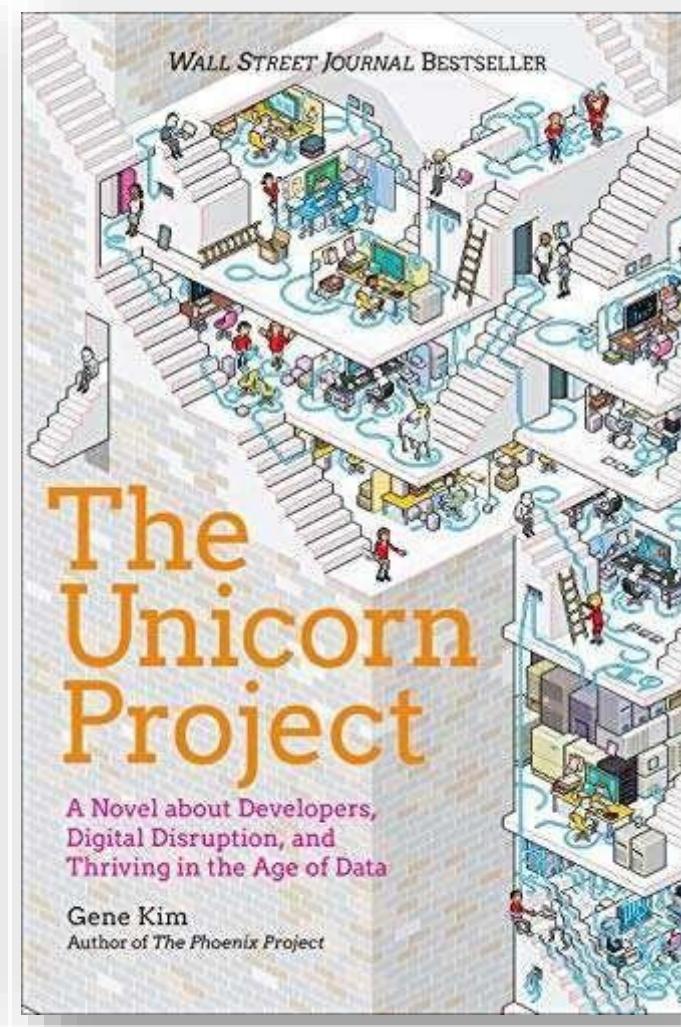
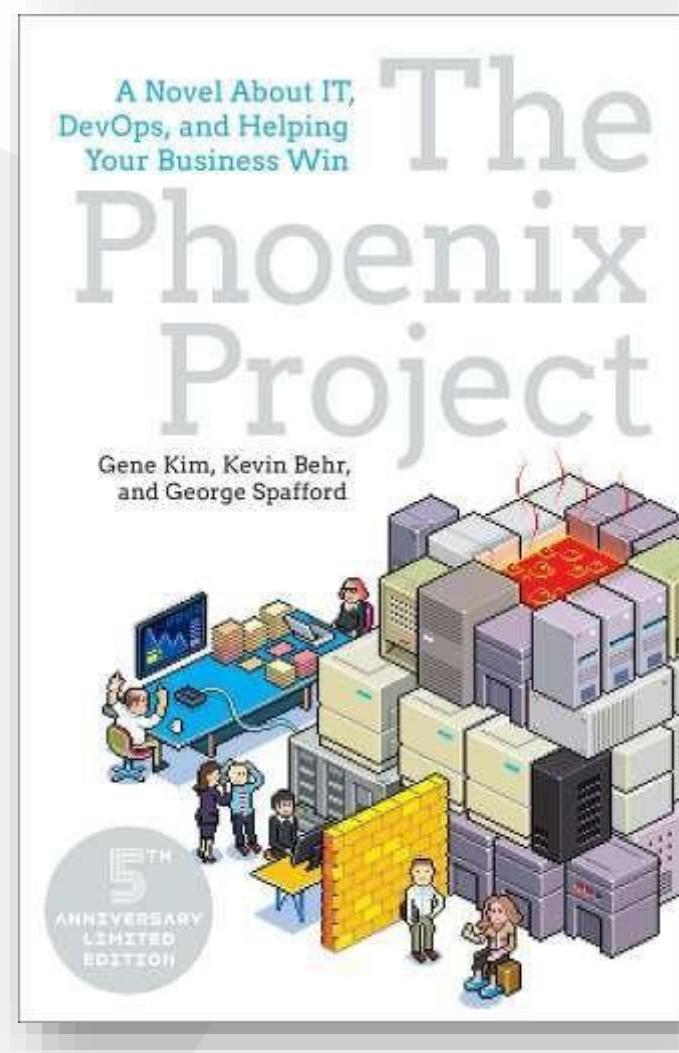


Common Challenges...

- Trouble with navigating Linux CLI
- Navigating directory structures and files
- No experience working with text editors- VI editor
- Different flavors of Linux
- Errors during installation of applications and /dependencies
 - rpm, dpkg, apt and yum
- Issues with networking between VMs
- Trouble with permissions and security in Linux
- Lack of hands-on practice

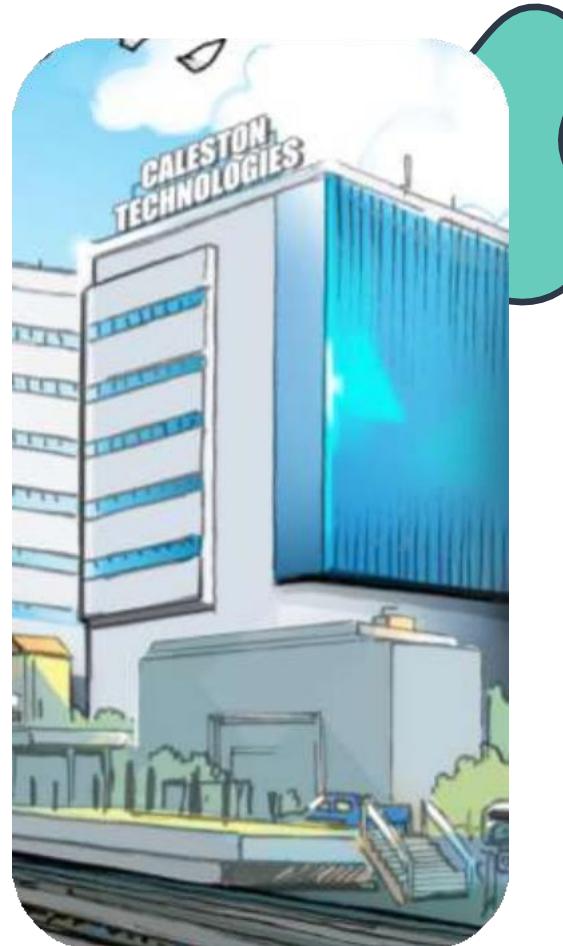
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Inspiration...



...

About this comic course...



...

Objectives

Working with Shell - I

Linux Core Concepts

Package Management

Shell & BASH

Security and File Permissions

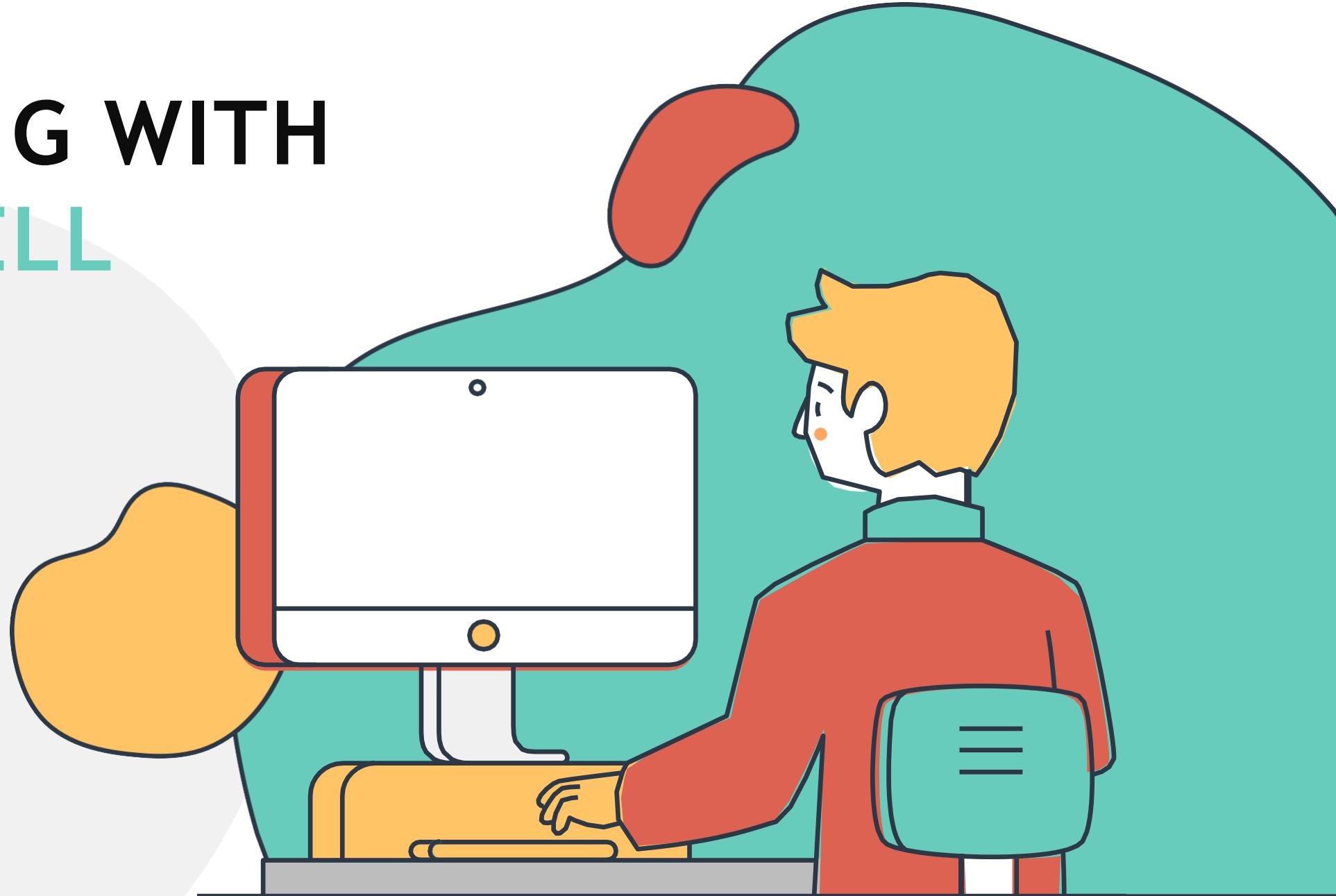
Linux Networking

Storage in Linux

SYSTEMD and Services

...

WORKING WITH THE SHELL





Working with the Shell - I

Linux Basic Commands

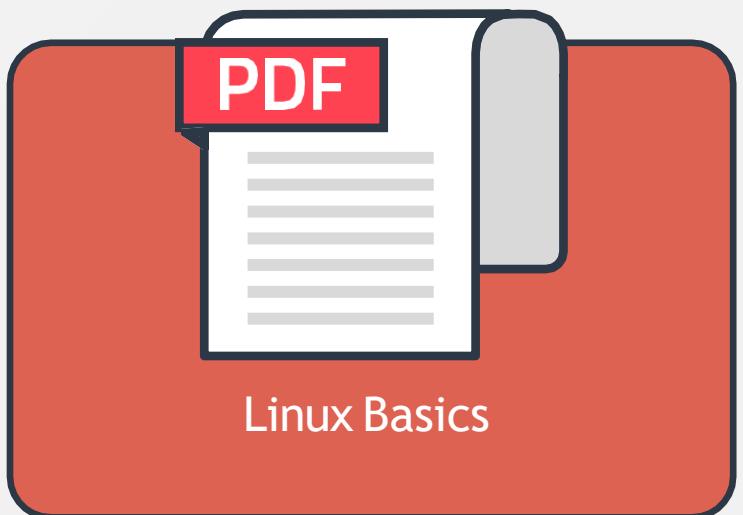
Lab: Linux Commands

Bash Shell

Lab: Bash Shell



Shell



Ubuntu Desktop
/ Graphical View



Linux Shell

```
$ echo Hello  
Hello  
$
```



The Home Directory



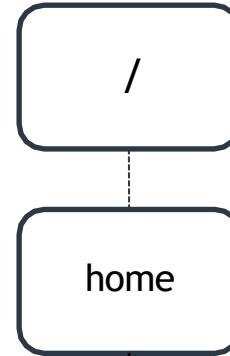
Allen

/home/allen

Important

code1

Payroll.txt



Michael

/home/michael

Directory1

file1

file2

Home Directory = ~ (tilde)

[~]\$

Command and Arguments

```
[~]$ echo  
[~]$
```

```
[~]$ uptime  
19:18:51 up 19:48, 2 users, load average:  
1.18, 0.49, 0.36
```

```
[~]$ echo Hello  
Hello  
[~]$
```

```
[~]$ echo -n Hello  
Hello[~]$
```

```
command <options> <arguments>  
echo = command  
option = -n  
Hello = argument
```



Command Types

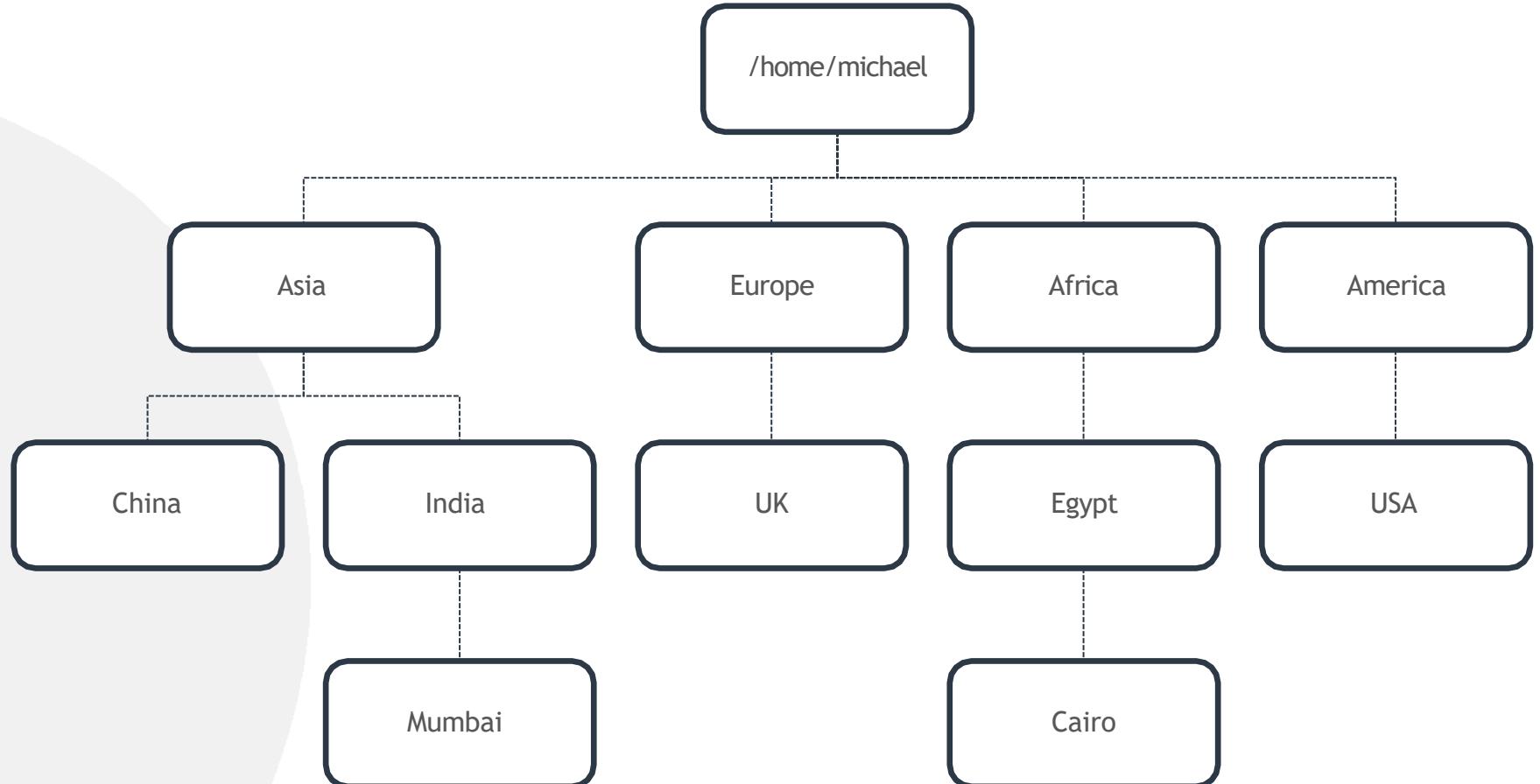
Internal or Built-in Commands
echo, cd, pwd, sete.t.c

```
[~]$ 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



Basic Linux Commands

pwd (presentworking directory)

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

ls (List contents)

```
[~]$ ls
```

mkdir (make a new directory)

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

mkdir (multiple directories)

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

/home/michael

Asia

Europe

Africa

America

ls (List contents)

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

...

Basic Linux Commands

cd (change directory)

```
[~]$ cd Asia  
[~/Asia]$
```

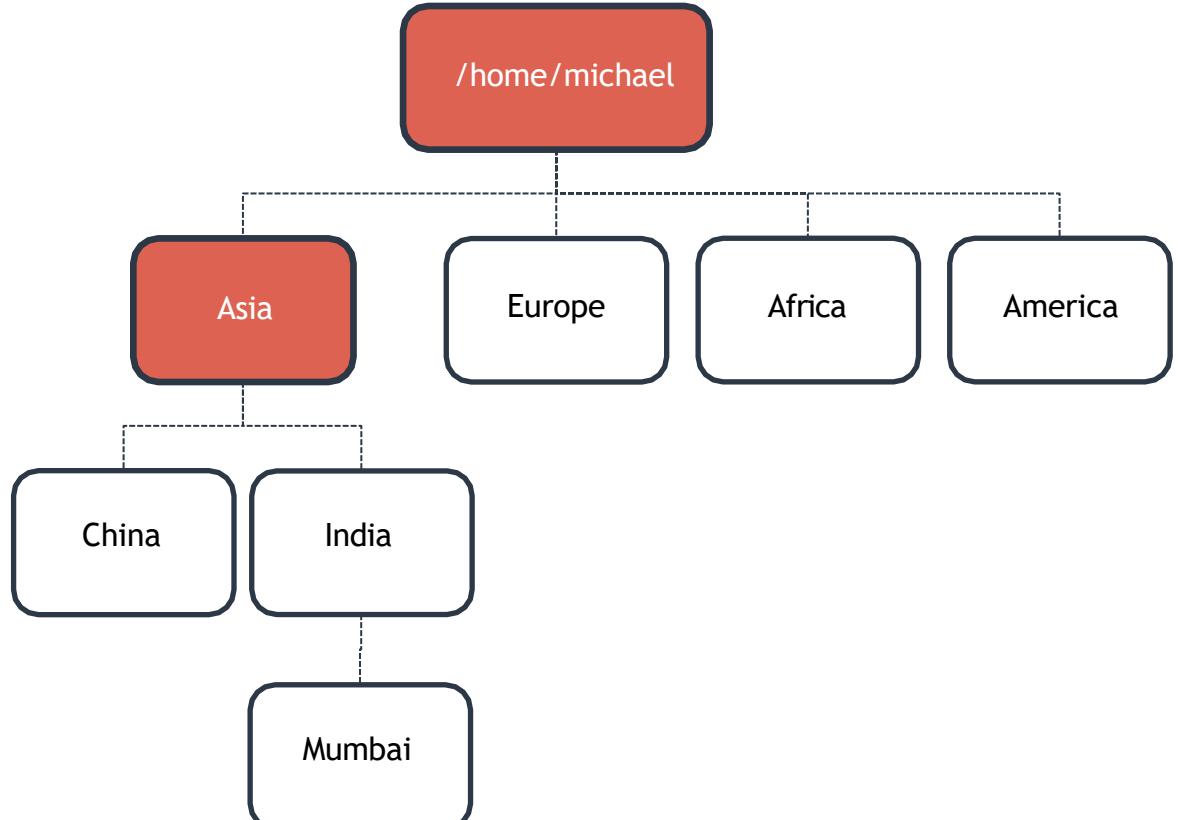
```
[~/Asia]$ pwd  
/home/Michael/Asia
```

```
[~/Asia]$ mkdir China India
```

```
[~/Asia]$ mkdir India/Mumbai
```

```
[~/Asia]$ mkdir -p India/Mumbai
```

```
/home/michael
```



...

Basic Linux Commands

```
[ ~/Asia]$ cd ..  
[ ~]$
```

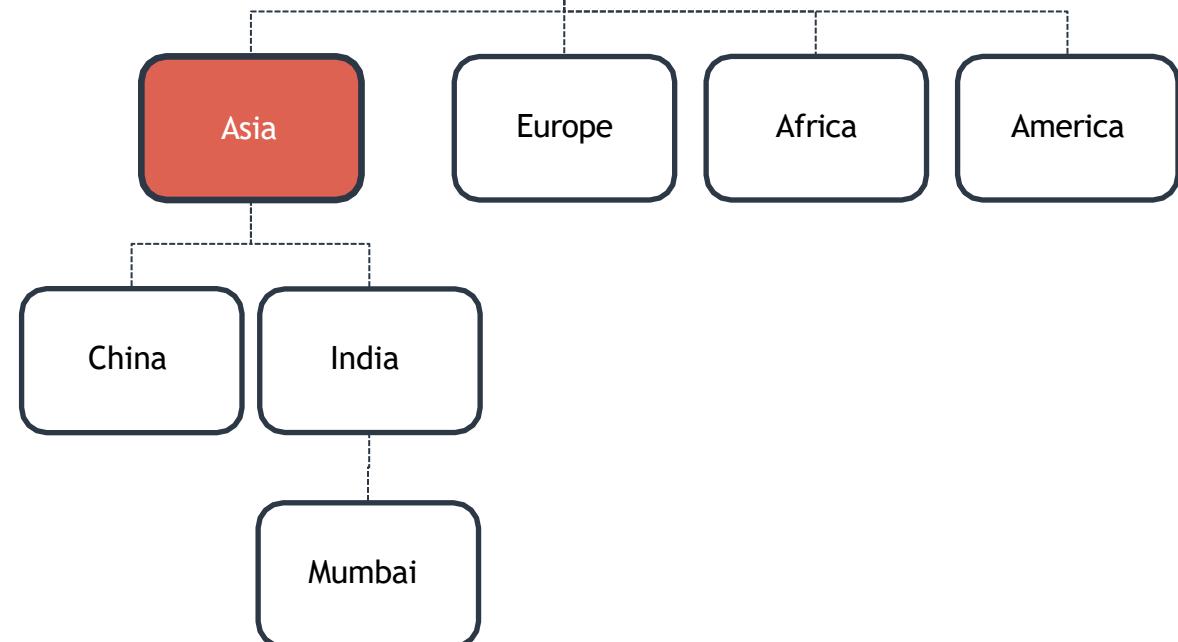
OR

```
[ ~/Asia]$ cd  
[ ~]$
```

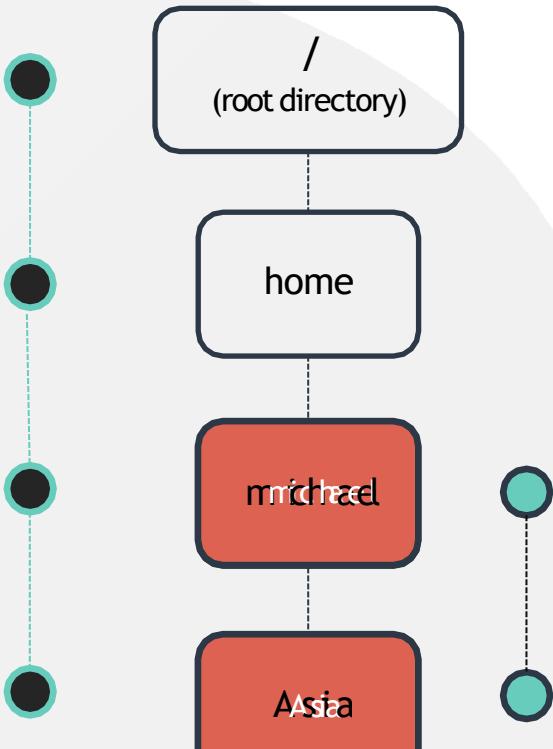
OR

```
[ ~/Asia]$ cd /home/michael  
[ ~]$
```

/home/michael



Absolute and Relative Path



cd = change directory

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

Absolute Path

```
[~]$ cd /home/michael/Asia
```

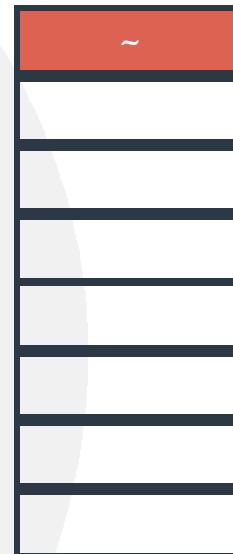
Relative Path

```
[~] cd Asia
```

pwd = print present working directory

Pro Tip - pushd/popd

Push



Pop



```
[~] pushd /etc  
/etc ~
```

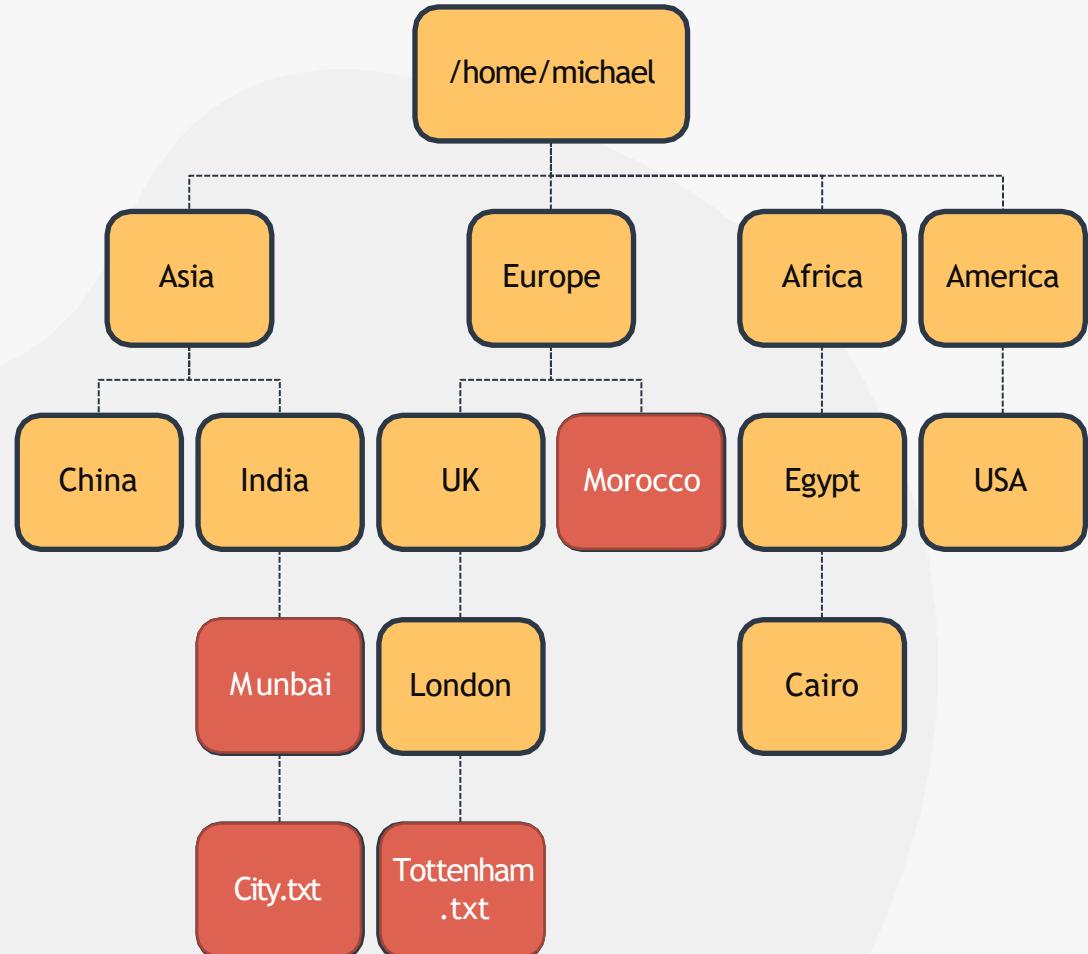
```
[/etc] cd /var
```

```
[/var] cd /tmp
```

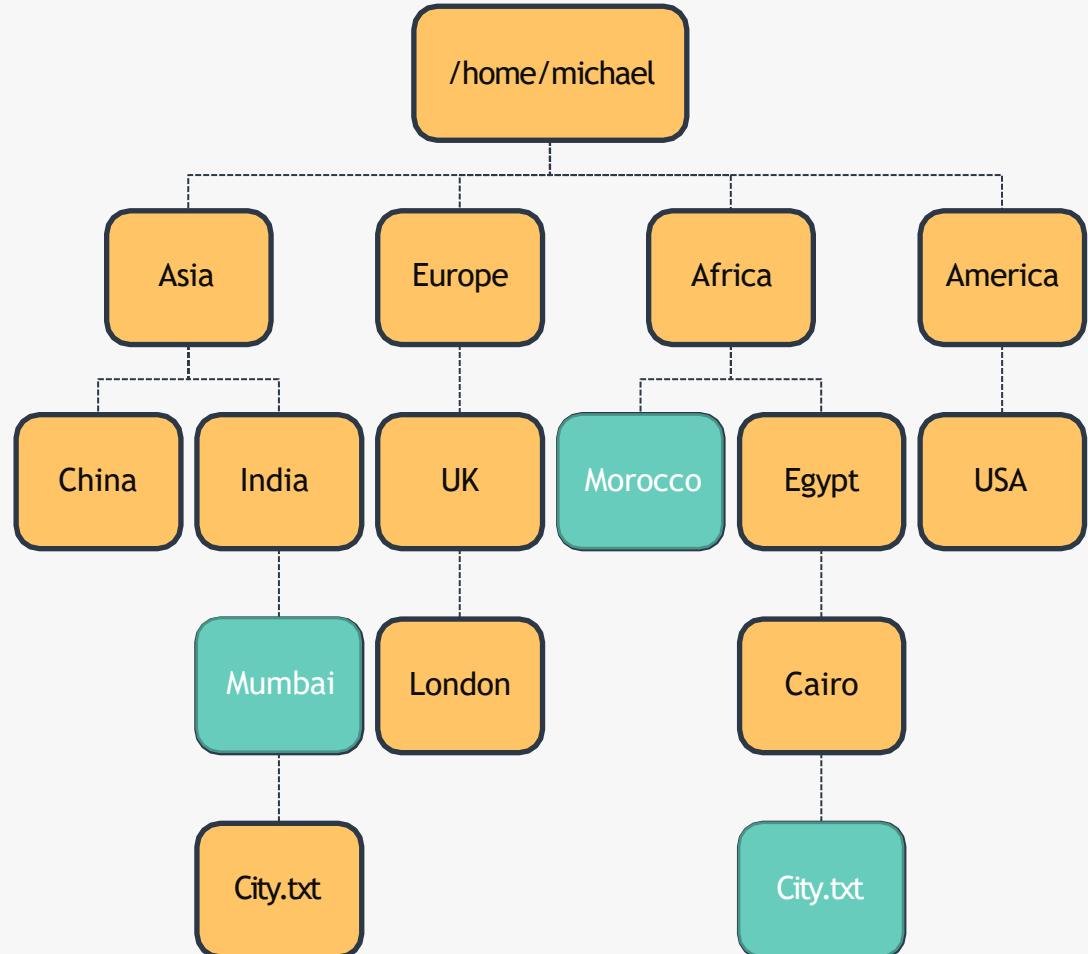
```
[/tmp] popd  
[~]
```

Basic Linux Commands

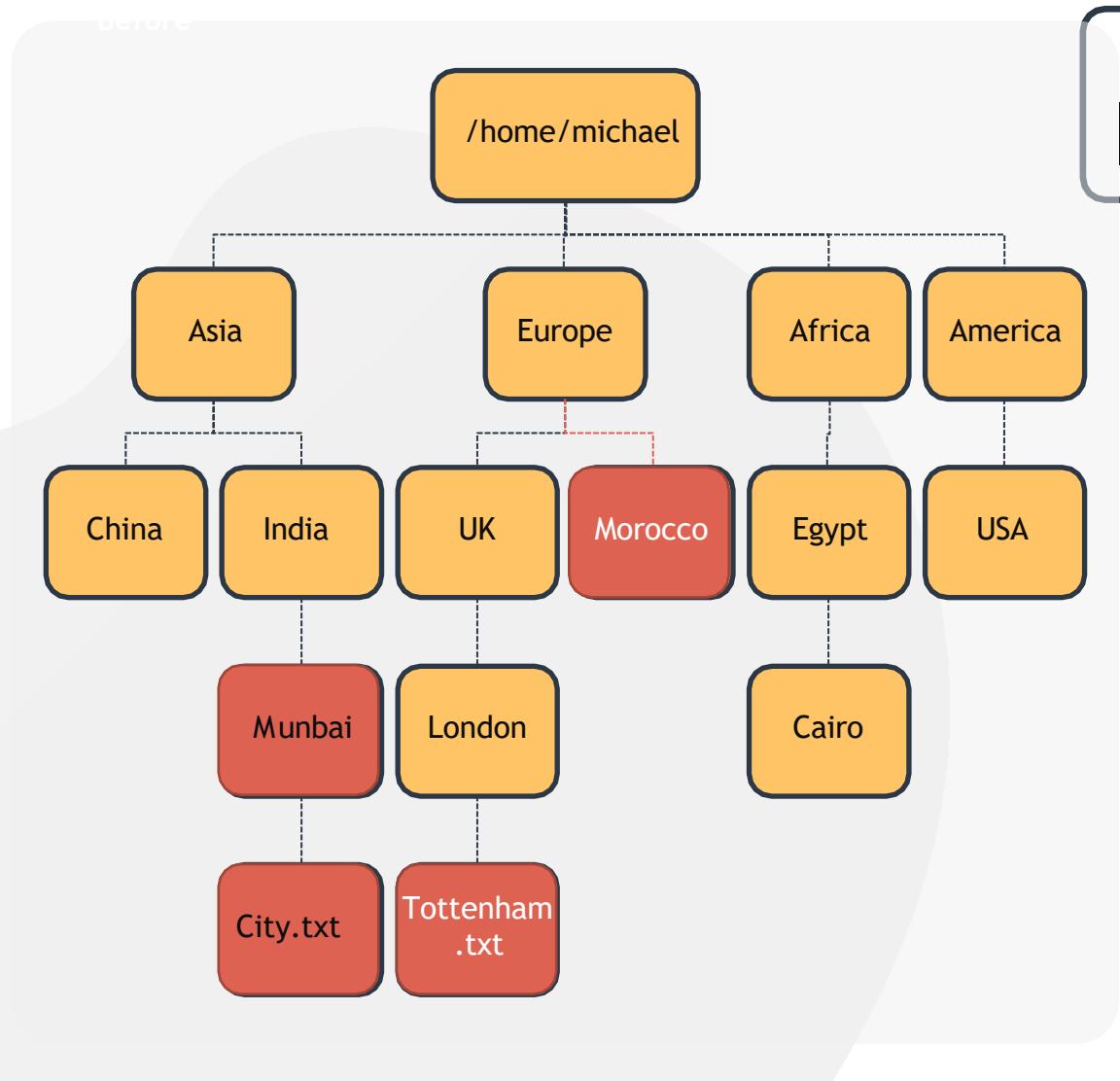
Before



After



Basic Linux Commands

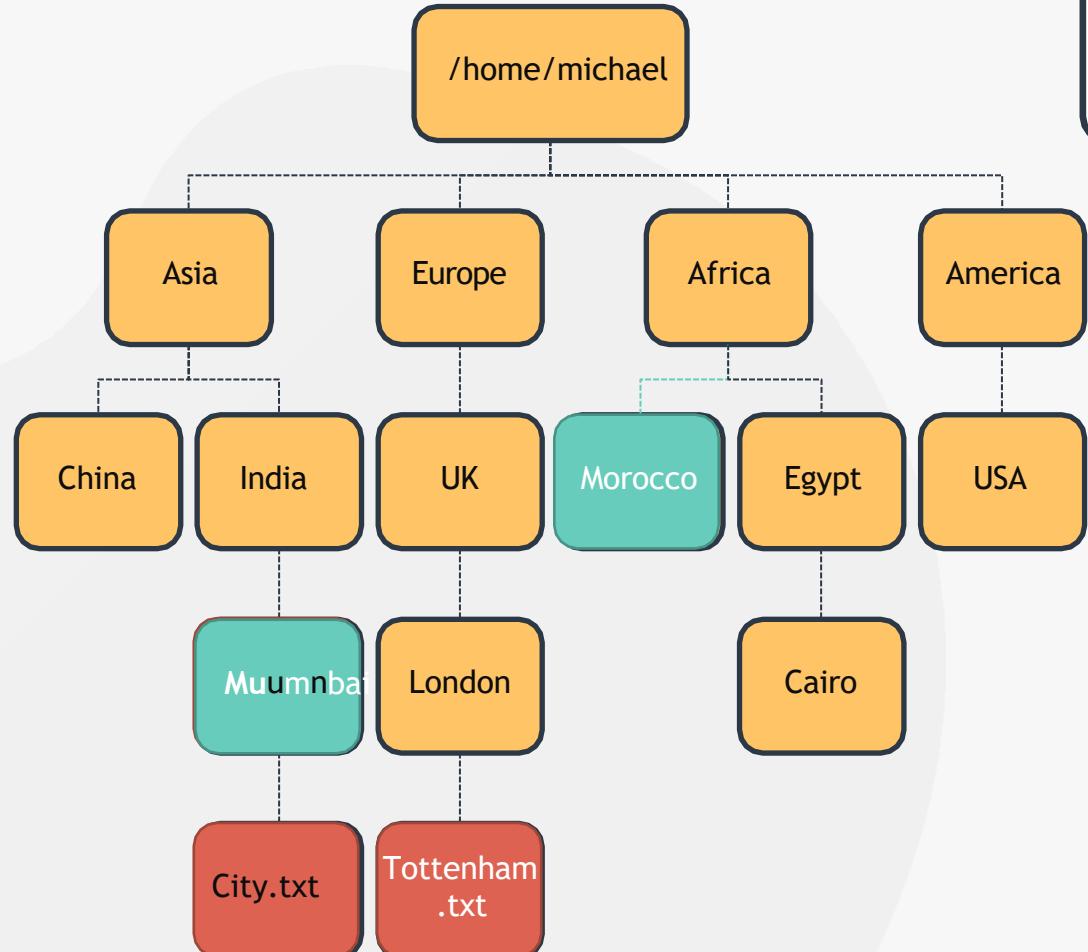


mv (Move file or directory)

```
[~]$ mv /home/michael/Europe/Morocco /home/michael/Africa/
```

Basic Linux Commands

BEFORE



mv (Move file or directory)

```
[~]$ mv /home/michael/Europe/Morocco /home/michael/Africa/
```

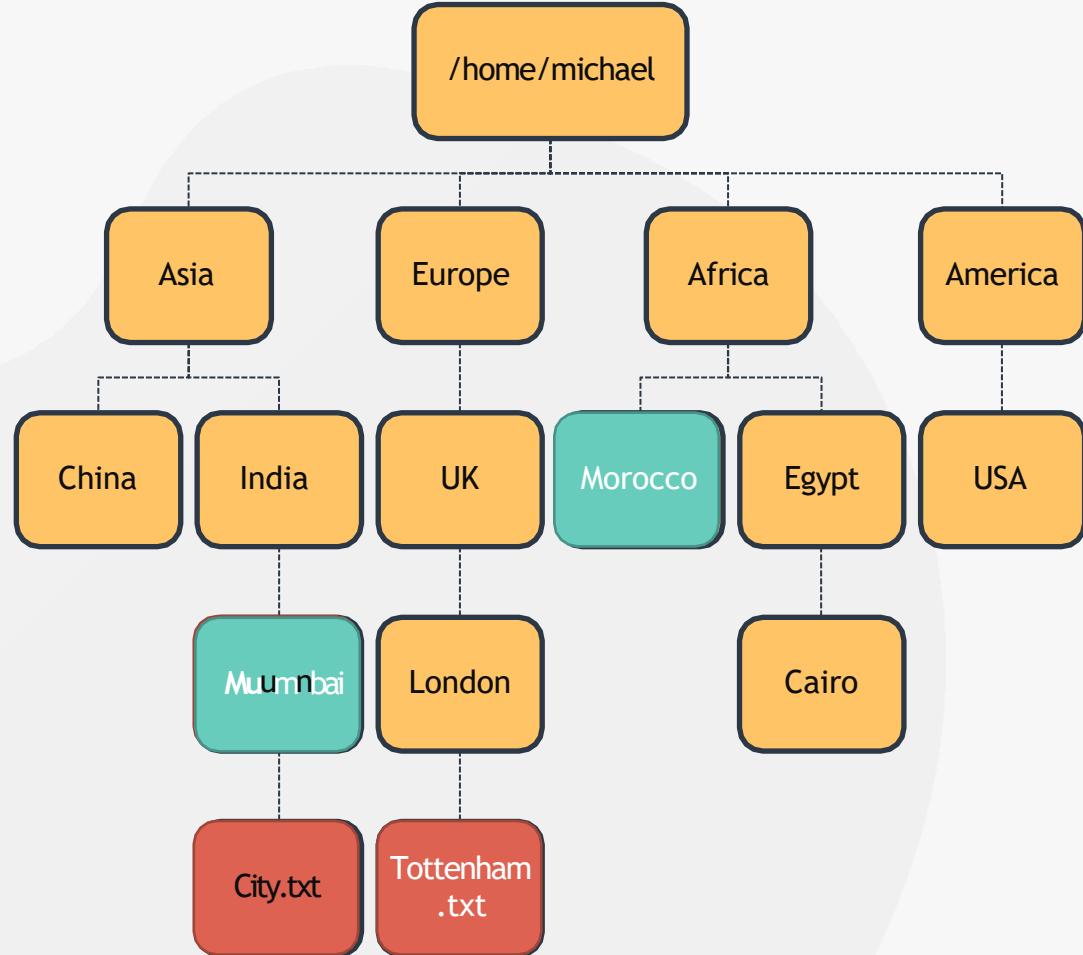
OR

```
[~]$ mv Europe/Morocco Africa/  
[~]$
```

```
[~]$ mv Asia/India/Mumbai Asia/India/Mumbai
```

Basic Linux Commands

Before



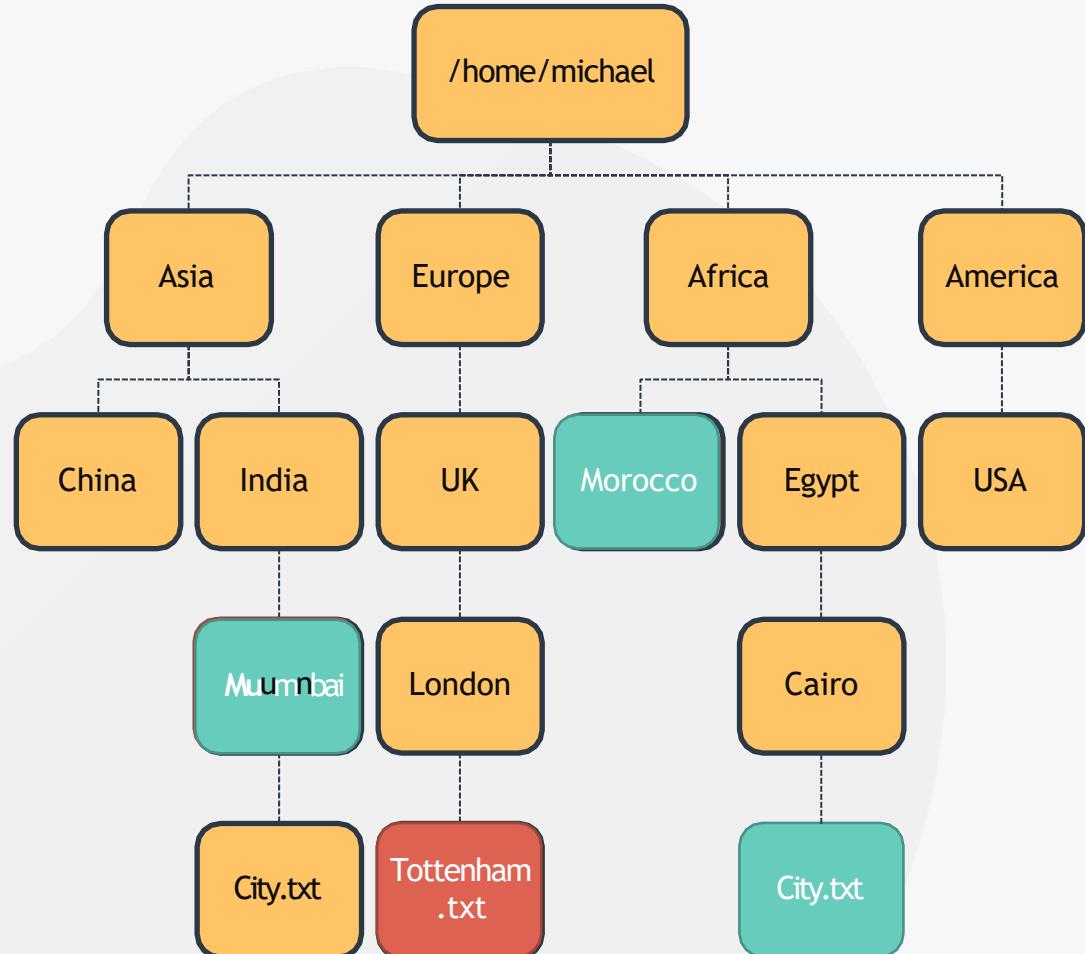
cp (Copy file)

```
[~]$ cp Asia/India/Mumbai/City.txt Africa/Egypt/Cairo
```



Basic Linux Commands

Before

**cp (Copy file)**

```
[~]$ cp Asia/India/Mumbai/City.txt Africa/Egypt/Cairo
```

rm (Remove file or directory)

```
[~]$ rm Europe/UK/London/Tottenham.txt
```

cp -r (Copy directory)

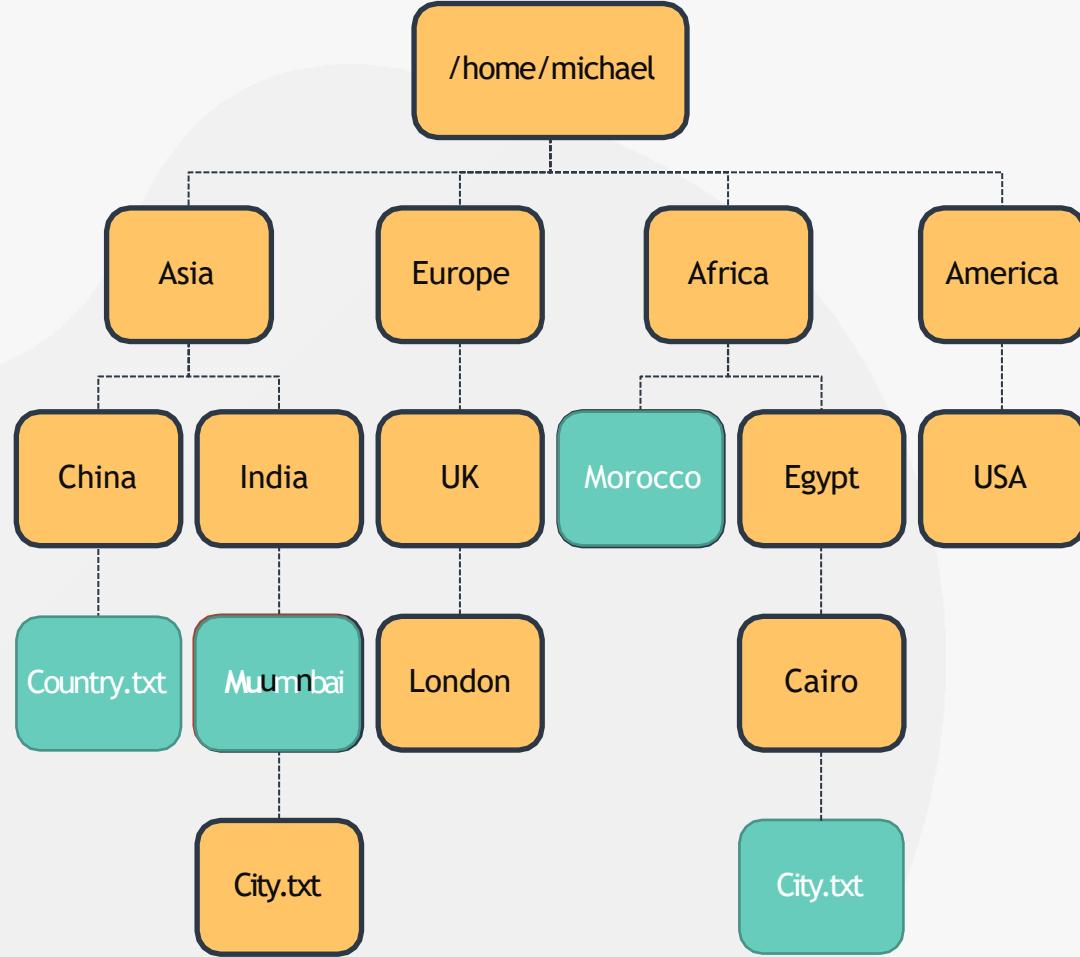
```
[~]$ cp -r Europe/UK Europe/UnitedKingdom
```





Working with Files and Directories

Before



```
[~]$ cat Asia/India/Mumbai/City.txt
```

```
Mumbai
```

```
[~]$
```

cat (redirect)

```
[~]$ cat > Africa/Egypt/Cairo/City.txt Cairo
```

```
ctrl d
```

touch (create a new file)

```
[~]$ touch /home/michael/Asia/China/Country.txt
```





Pagers



```
[~]$ 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 -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
```





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GETTING HELP IN COMMAND LINE



Using Command Line 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.
```





Using Command Line to Get Help

```
[~]$ 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.
```





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SHELL TYPES





Shell Types

Bourne Shell (sh)

C Shell (csh or tcsh)

Korn Shell (ksh)

Z Shell (zsh)

Bourne again Shell (bash)

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

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





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
```



```
[~]$ 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

```
[ ~ ]$
```

~ = Present Working Directory

\$ = User PromptSymbol

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

```
[ ~ ]$ echo $PS1
```

```
[ \W ]$
```

\W = Present Working Directory =~

\$ = PromptSymbol

Bash Prompt

```
[~]$ 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 currenttime in 24-hour HH:MM:SS format
\T :the current time in 12-hour HH:MM:SS format
\@ :the currenttime in 12-hour am/pm format
\A :the currenttime in 24-hour HH:MM format
\u :the username of the currentuser
\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 \$

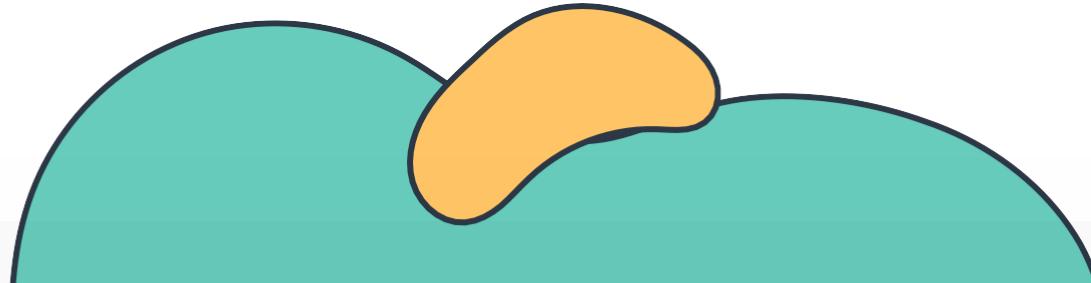
HANDS-ON LABS





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Core Concepts



The Linux Basics Course





Linux Core Concepts

Introduction to the Linux Kernel

Linux Boot Sequence

Kernel Space and User Space

SYSTEMD TARGETS (RUNLEVELS)

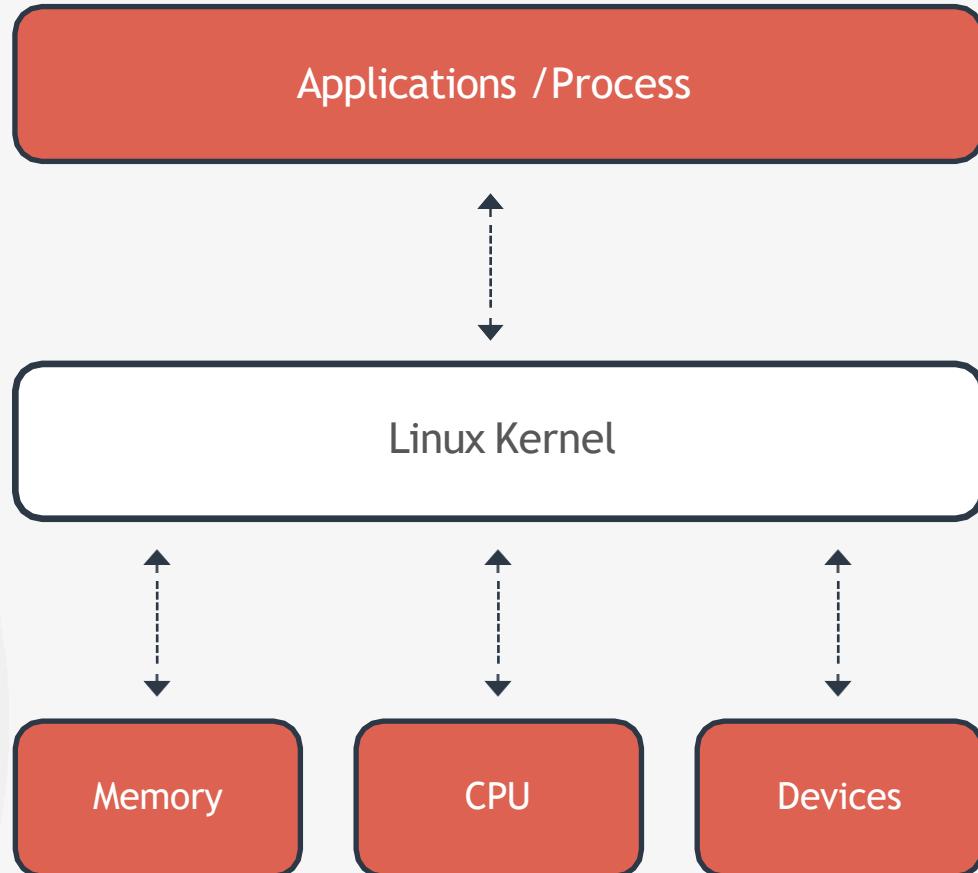
Working with Hardware

Filesystems and Hierarchy

Labs: Linux Core Concepts

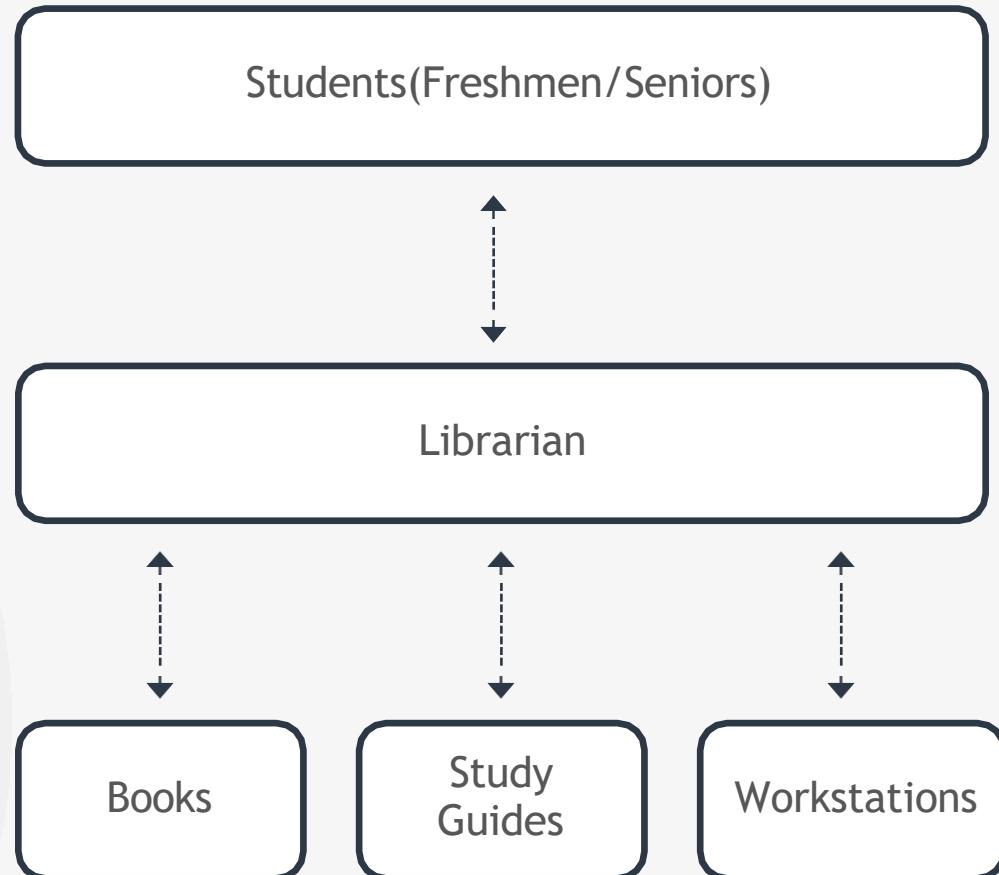


Linux Kernel





Linux Kernel





Linux Kernel

01
Memory Management

02
Process Management

03
Device Drivers

04
System Calls and Security

Monolithic

Modular

...



Kernel Versions

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

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

4 = Kernel Version

15 = Major version

0 = Minor Version

72 = patch release

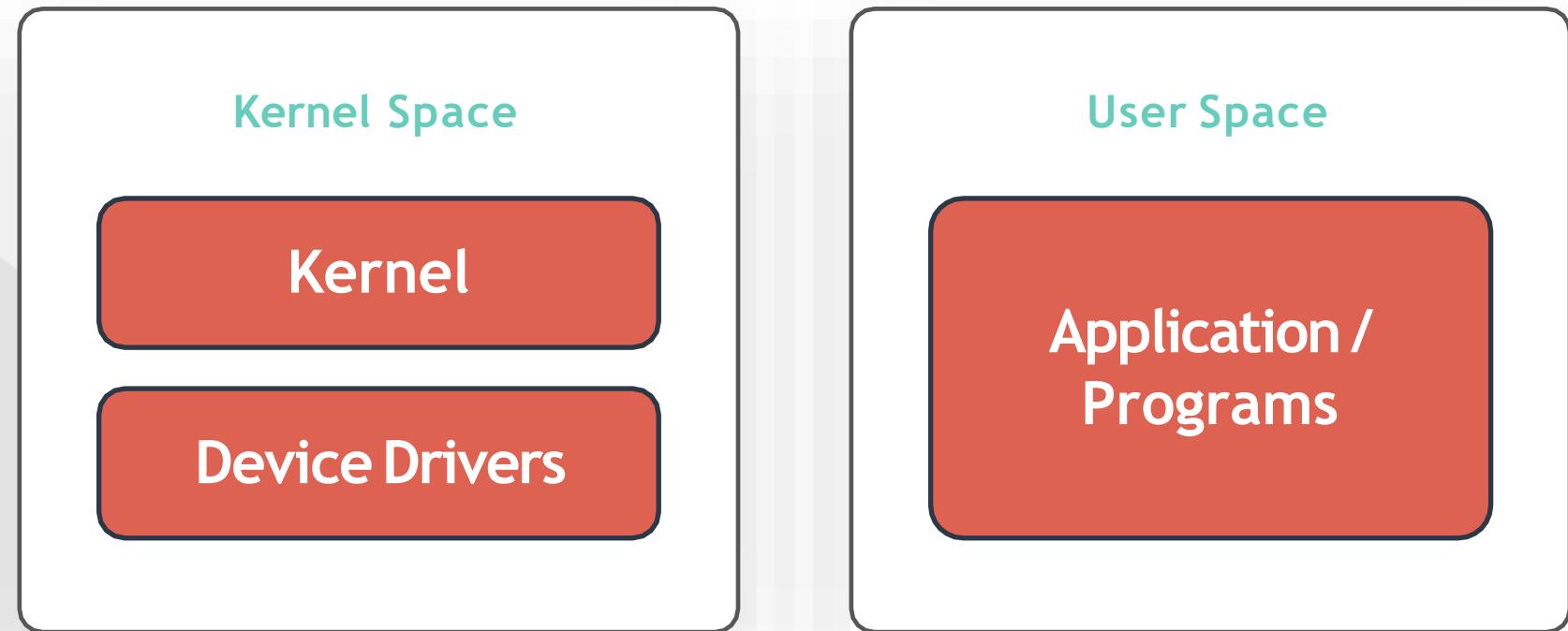
Generic = Distro Specific Info

<https://kernel.org>





Kernel And User Space

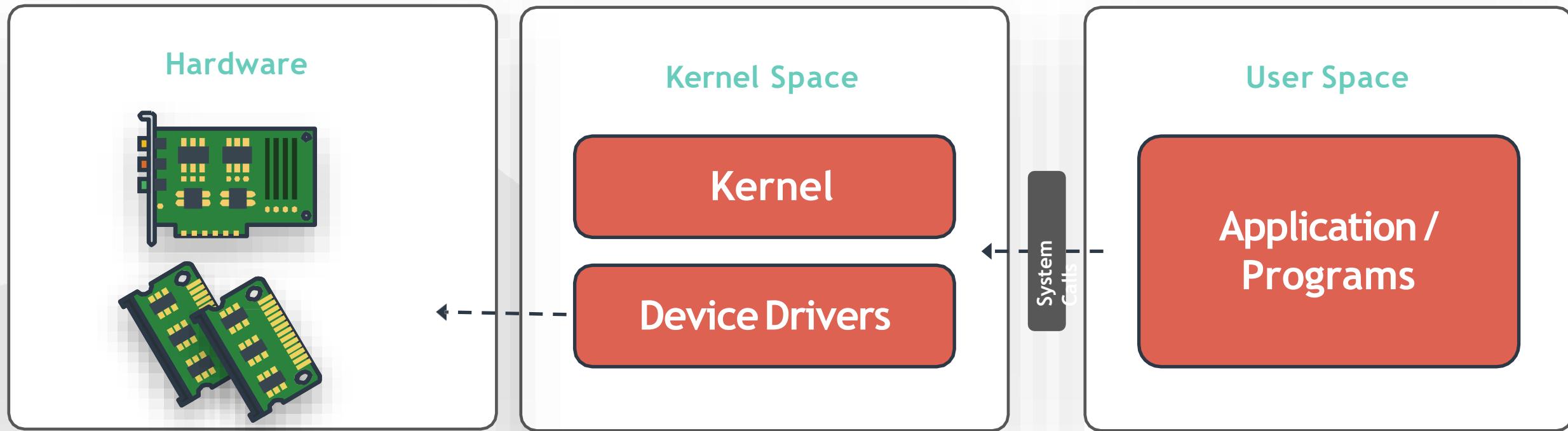


- Kernel Code
- Kernel Extensions
- Device Drivers

- C
- Java
- Python
- Ruby
- Docker Containers



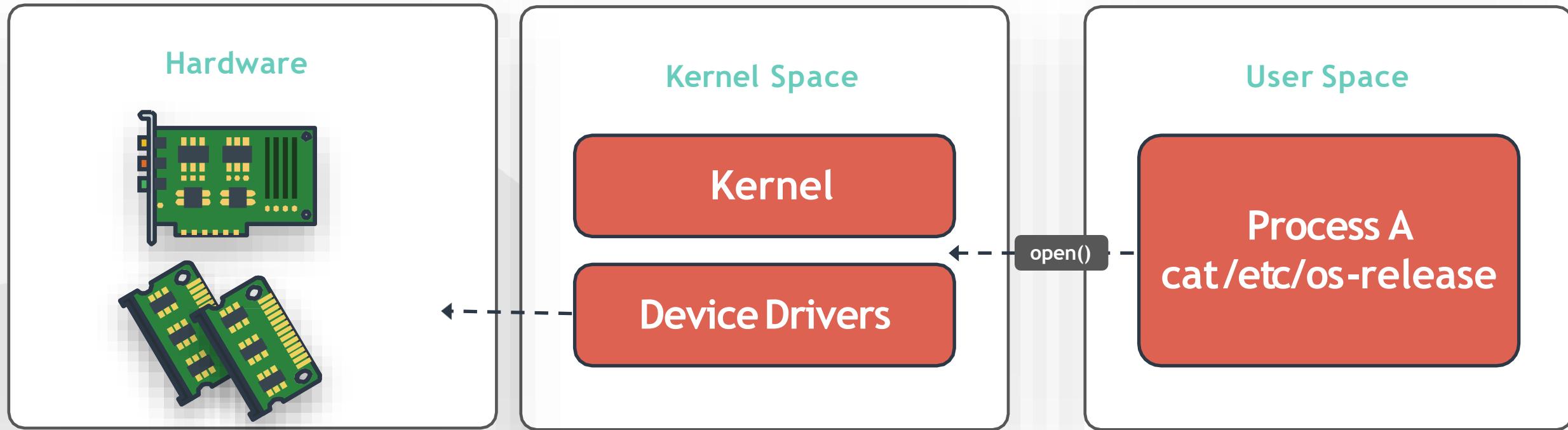
Kernel And User Space



- Open a File
- Write to a file
- List Processes
- Defining a variable



Kernel And User Space

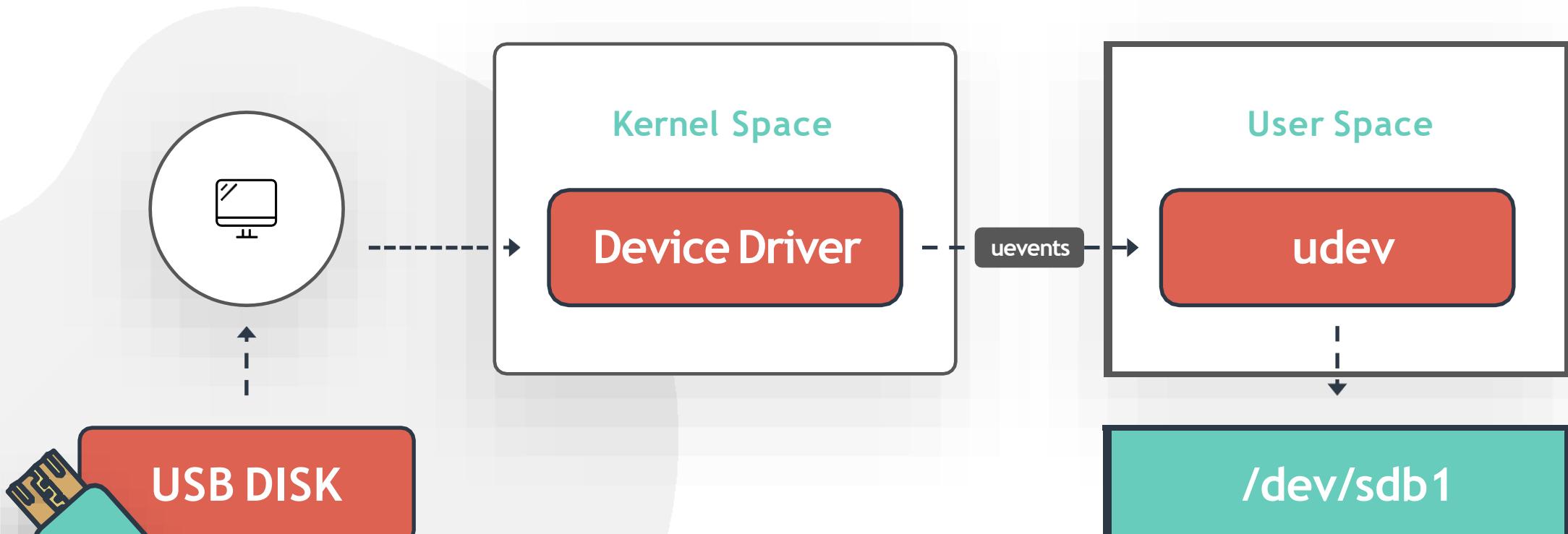


- `open()`
- `close()`
- `readdir()`
- `strlen()`
- `closedir()`



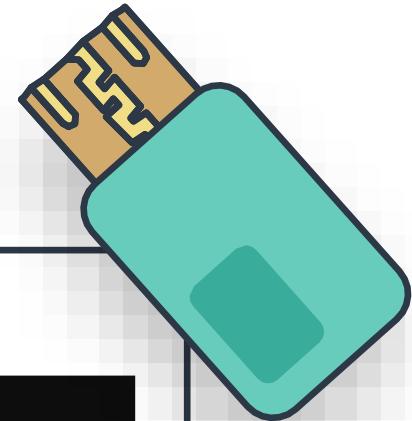


Working with Hardware



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Working with Hardware



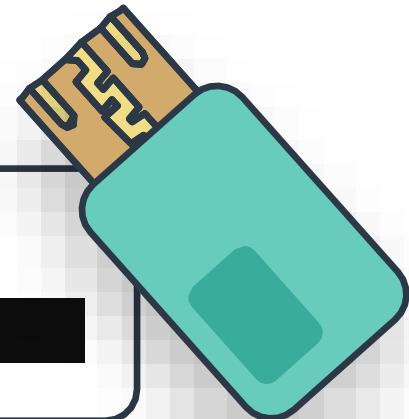
```
[~]$ dmesg
```

```
[~]$ dmesg | grep -i usb
[ 0.082019] ACPI: Power Resource [USBC]
[on] 0.132167] ACPI: bus type USB
registered
[ 0.132167] usbcore: registered new interface driver
usbfs 0.132167] usbcore: registered new interface
driver hub 0.132167] usbcore: 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
```





Working with Hardware

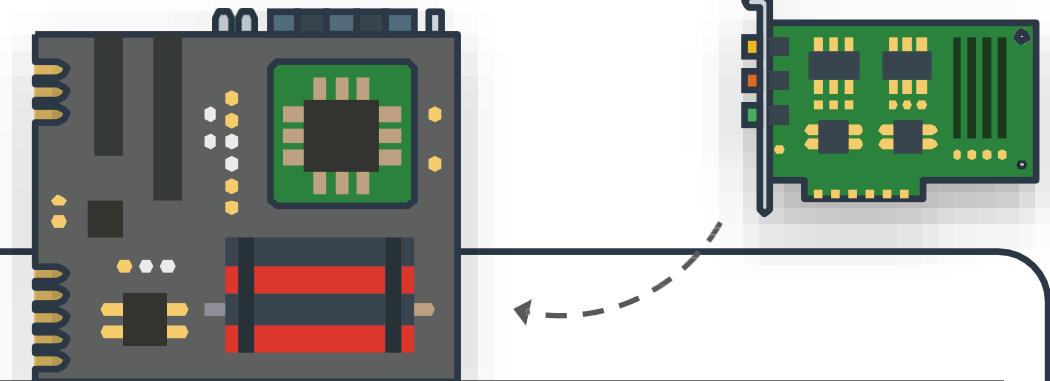


```
[~]$ udevadm info --query=path --name=/dev/sda5  
/devices/pci0000:00/0000:00:17.0/ata3/host2/target2:0:0/2:0:0:0/block/sda/sda5
```

```
[~]$ 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  
UDEV [6532.492641] remove (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/mouse0 (input)  
UDEV [6532.502180] remove /devices/pci0000:00/0000:00:14.0/usb1/1-4/1-4:1.0/0003:03F0:094A.0001/input/input6/event6  
KERNEL[6532.532441] remove (input)  
/devices/pci0000:00/0000:00:14.0/usb1/1-4/1-4:1.0/0003:03F0:094A.0001/input/input6/event6  
(input)  
/devices/pci0000:00/0000:00:14.0/usb1/1-4/1-4:1.0/0003:03F0:094A.0001/input/input6 (input)
```



Working with Hardware



```
[~]$ lspci
```

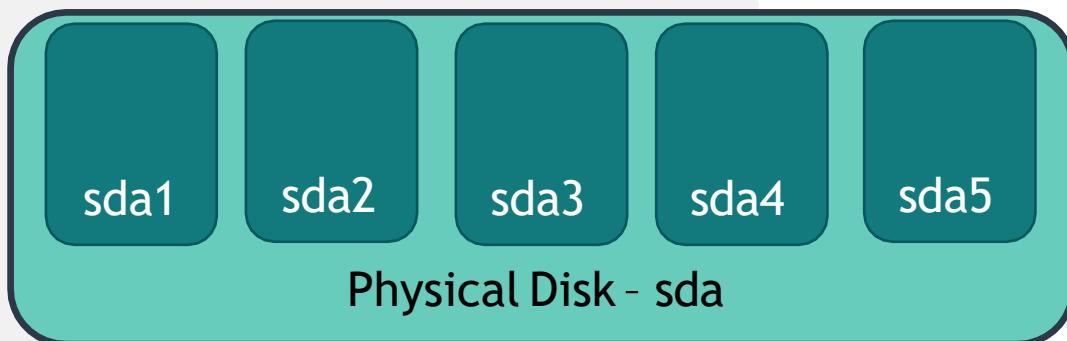
```
00:00.0 Host bridge: Intel Corporation Device 3e34 (rev 0c)
00:02.0 VGA compatible controller: Intel Corporation Device 3ea0 (rev 02)
00:08.0 System peripheral: Intel Corporation Xeon E3-1200 v5/v6 / E3-1500 v5 / 6th/7th Gen Core Processor Gaussian
Mixture Model
00:12.0 Signal processing controller: 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) ~ #
```

Working with Hardware

```
[~]$ lsblk
```

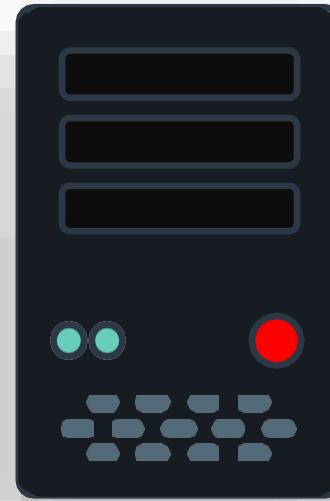
NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINT
sda	8:0	0	119.2G	0	disk	
└─sda1	8:1	0	100M	0	part	/boot/efi
└─sda2	8:2	0	16M	0	part	
└─sda3	8:3	0	71.5G	0	part	
└─sda4	8:4	0	1G	0	part	
└─sda5	8:5	0	46.6G	0	part	/

Major Number	Device Type
1	RAM
3	HARD DISK or CD ROM
6	PARALLEL PRINTERS
8	SCSI DISK



Working with Hardware

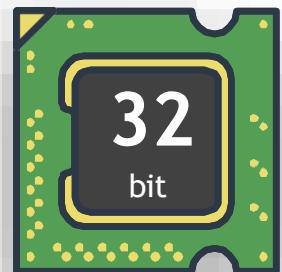
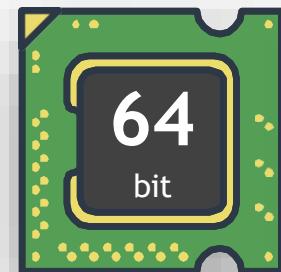
```
[~]$ lscpu  
Architecture:          x86_64  
CPU op-mode(s):       32-bit, 64-bit  
Byte Order:           Little Endian  
CPU(s):               8  
On-line CPU(s) list: 0-7  
Thread(s) per core:   2  
Core(s) per socket:   4  
Socket(s):            1  
NUMA node(s):         1  
Vendor ID:            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
```

2⁶⁴

18 EB

2³²

4 GB



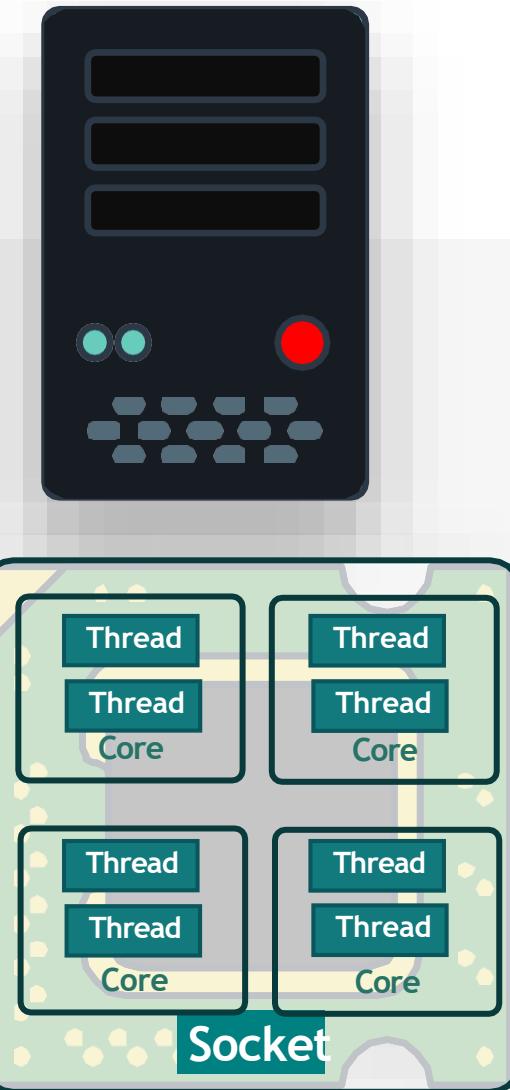
...

Working with Hardware

```
[~]$ 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



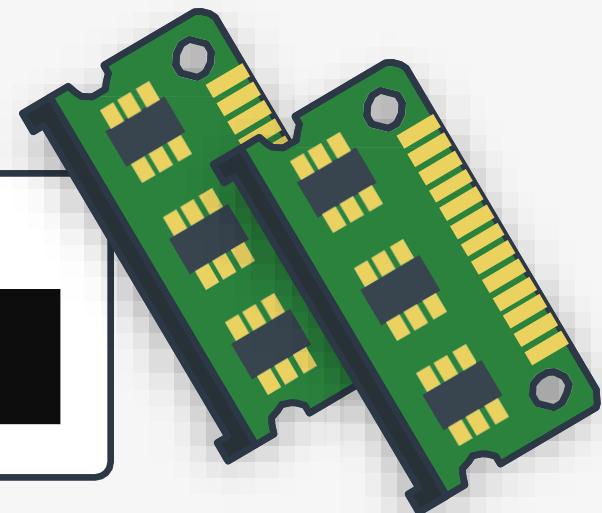
Working with Hardware

```
[~]$ 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			





Working with Hardware

```
[~]$ lshw
description: Notebook
product: Aspire A515-52 (0000000000000000)
vendor: Acer
version: V1.12
serial: NXH89AA0026262680A13400
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
```

SUDO

```
[~]$ lshw
```

WARNING: output may be incomplete or inaccurate, you should run this program as super-user.

```
[~]$ sudo lshw
```

```
[sudo] password for bob:  
description: Notebook  
    product: Aspire A515-52 (0000000000000000)  
    vendor: Acer  
    version: V1.12  
    serial: NXH89AA0026262680A13400  
    width: 64 bits  
capabilities: smbios-3.0 dmi-3.0 smp vsyscall132  
    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
```



HANDS-ON LABS



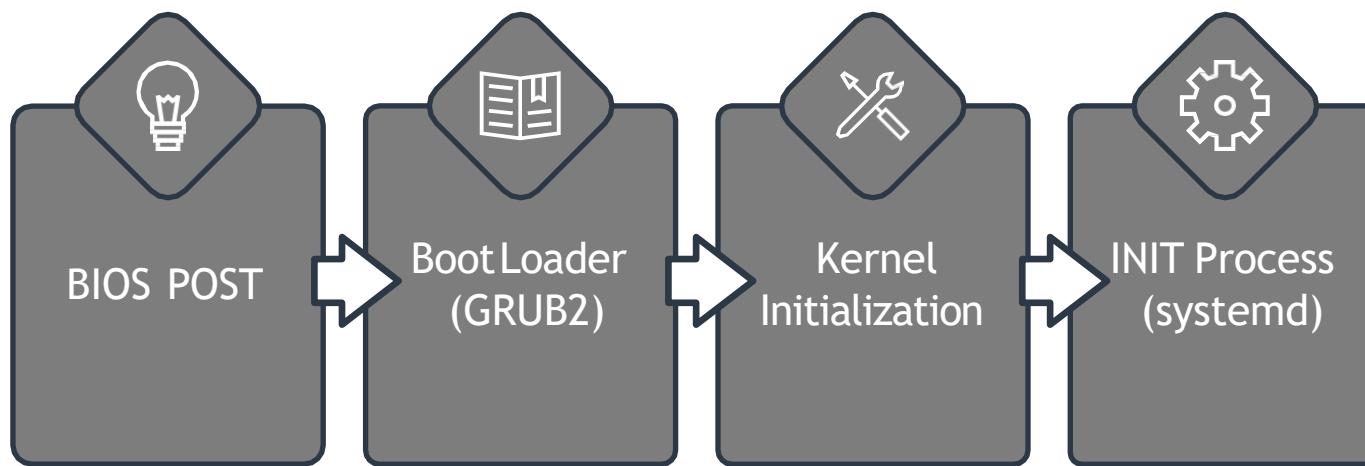


{KODE}{LOUD}

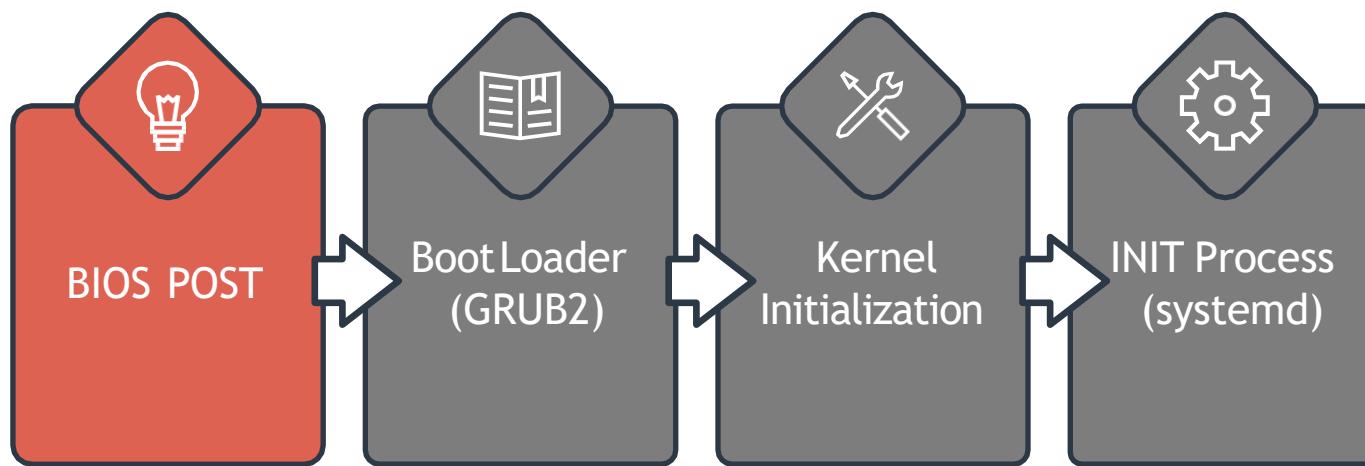
...



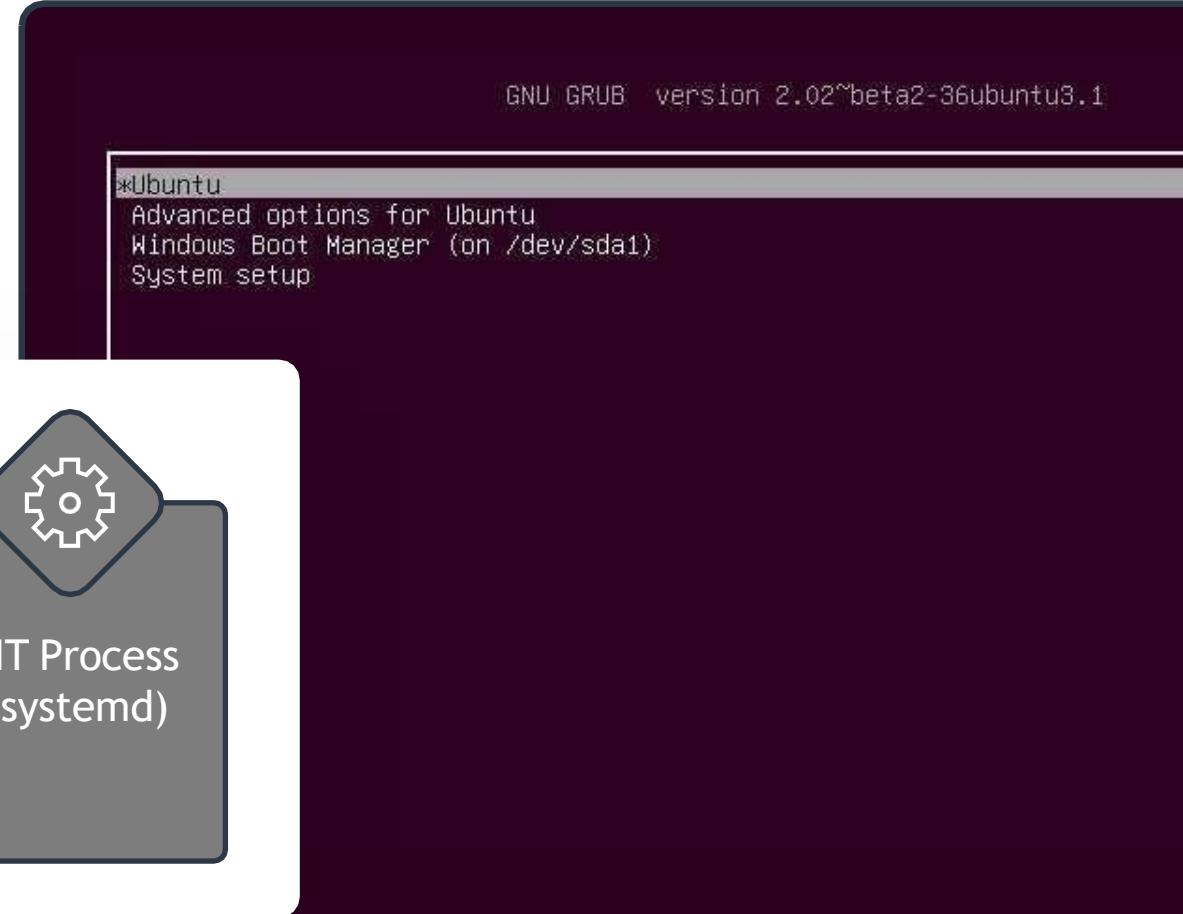
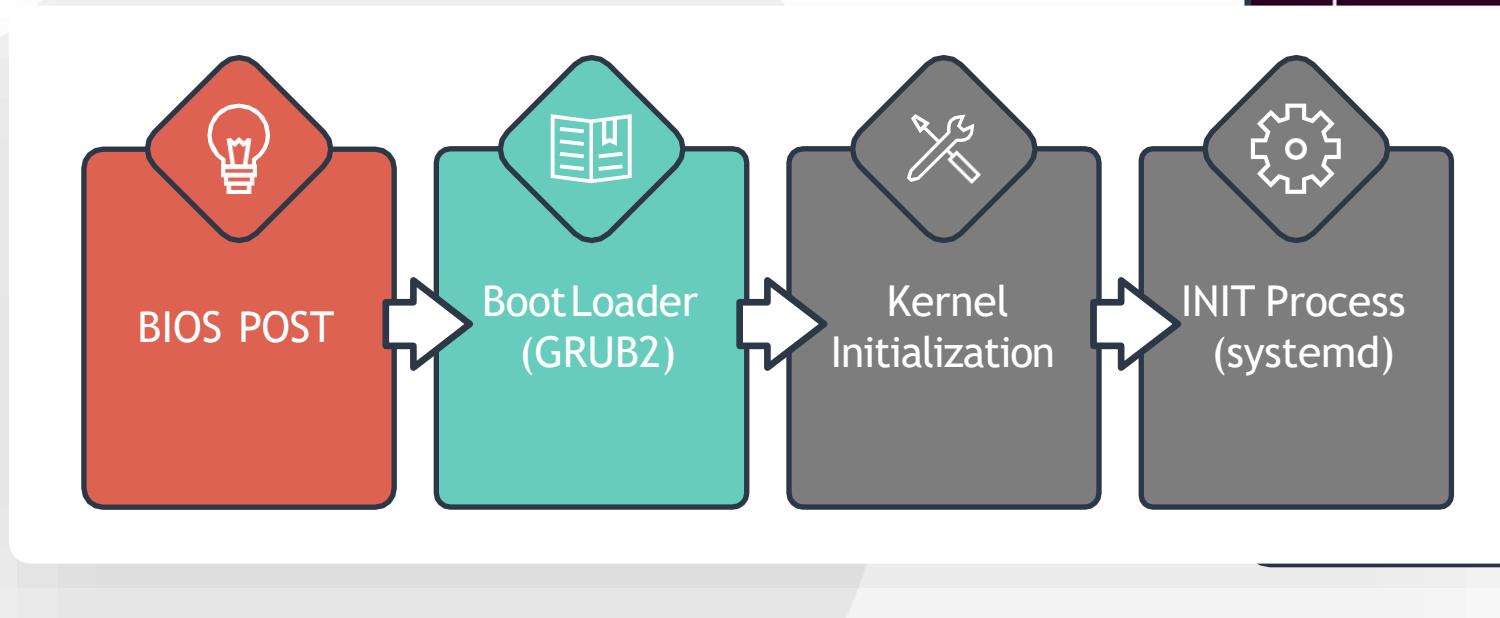
Linux Boot Sequence Overview



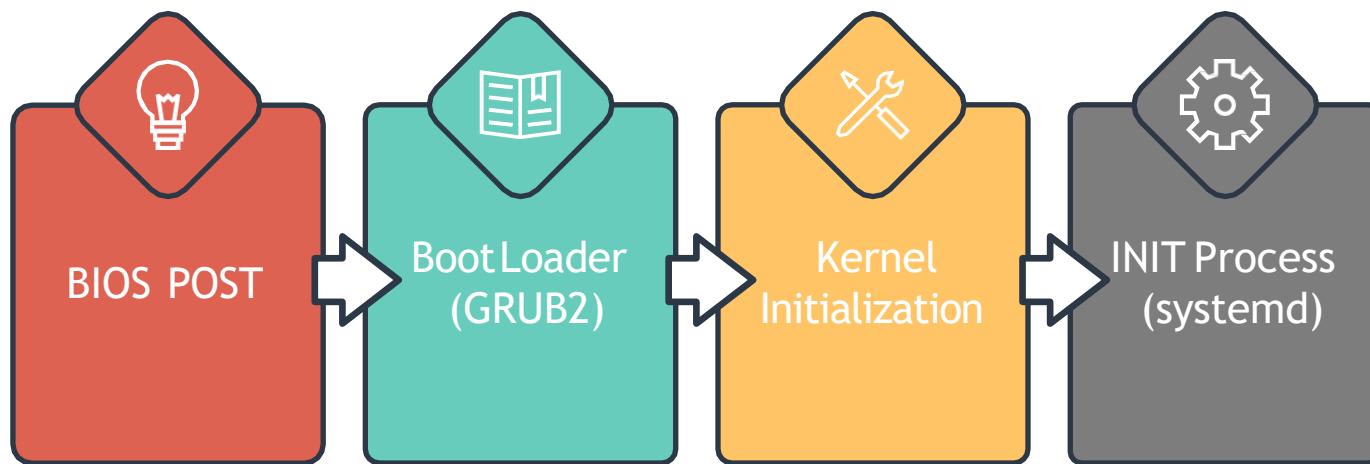
Linux Boot Sequence Overview



Linux Boot Sequence Overview



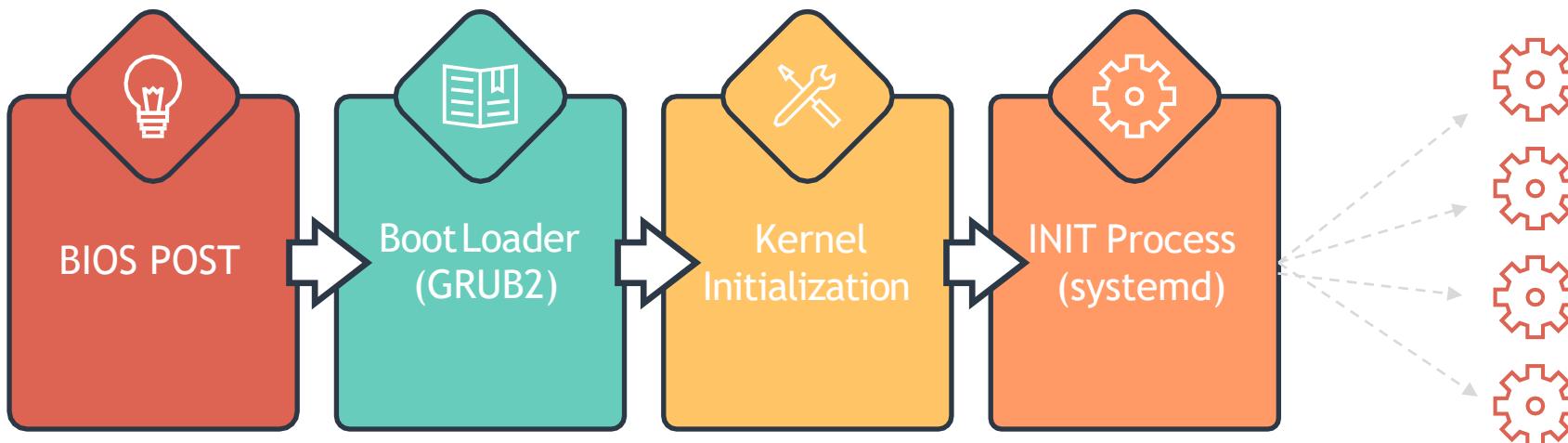
Linux Boot Sequence Overview



```
0.553b2b] 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
0.710662] Freeing unused kernel image memory: 2008K
reeing 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:00:00:00
1000 0000:00:03.0 eth0: Intel(R) PRO/1000 Network Con
ptbase: ioc0: Initiating bringup
```

Linux Boot Sequence Overview

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



```
[ 5.574670] EXT4-fs (sda1): mounted filesystem with ordered data mod  
(null)  
[ 5.720090] ip_tables: (C) 2000-2006 Netfilter Core Team  
[ 5.730446] systemd[1]: systemd 237 running in system mode. (+PAM +A  
INUX +IMA +APPARMOR +SMACK +SYSVINIT +UTMP +LIBCRYPTSETUP +GCRYPT +GNUT  
XZ +LZ4 +SECCOMP +BLKID +ELFUTILS +KMOD -IDN -PCRE2 default-hiera  
id)  
[ 5.732961] systemd[1]: Detected virtualization oracle.  
[ 5.733587] systemd[1]: Detected architecture x86-64.  
[ 5.748912] systemd[1]: Set hostname to <kubemaster>.  
[ 5.750000] systemd[1]: Reached target User and Group Name Lookups.  
[ 5.750000] systemd[1]: Reached target System Time Synchronized.  
[ 5.750000] systemd[1]: Reached target User Session Slice.  
[ 5.750000] systemd[1]: Reached target Arbitrary Executable File F  
[ 5.750000] ap.  
[ 5.750000] password Requests to Wall Di  
[ 5.750000] v2.0-870.  
[ 5.750000] (tcp)  
[ 5.750000] iser)  
[ 5.750000] pts: (null)  
[ 5.750000] ed request to flush runtime
```



Bob's Laptop

Ubuntu 18.04.4 LTS caleston-1p03 tty1

caleston-lp03 login:



```
[~]$ runlevel
```

N (



Systemd Target (Runlevels)

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



✓ display-manager Service Enabled

```
Ubuntu 18.04.4 LTS caleston-  
lp03 tty1  
  
caleston-lp03 login:
```

✗ display-manager Service Disabled

Systemd Target (Runlevels)

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

RHEL6 / Ubuntu 14.04



Runlevels

RHEL7 / Ubuntu 18.04



Systemd Targets



Viewing and Changing Systemd Target

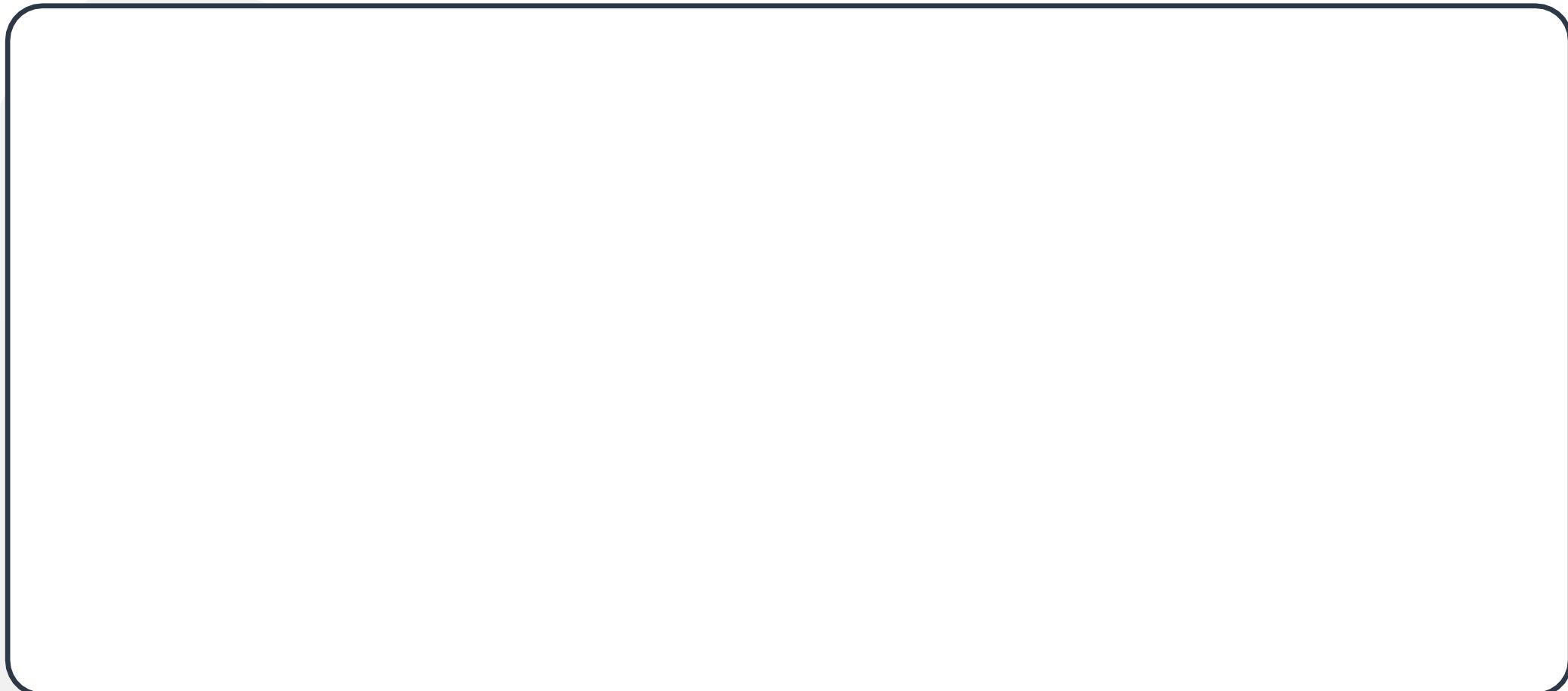
```
[~]$ systemctl get-default  
graphical.target
```

```
[~]$ 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
```



Questions?



...

File Types in Linux



Regular File



Directory



Special Files



Images

Scripts

Configuration /Data files

/home/bob

/root

/home/bob/code-directory



File Types in Linux



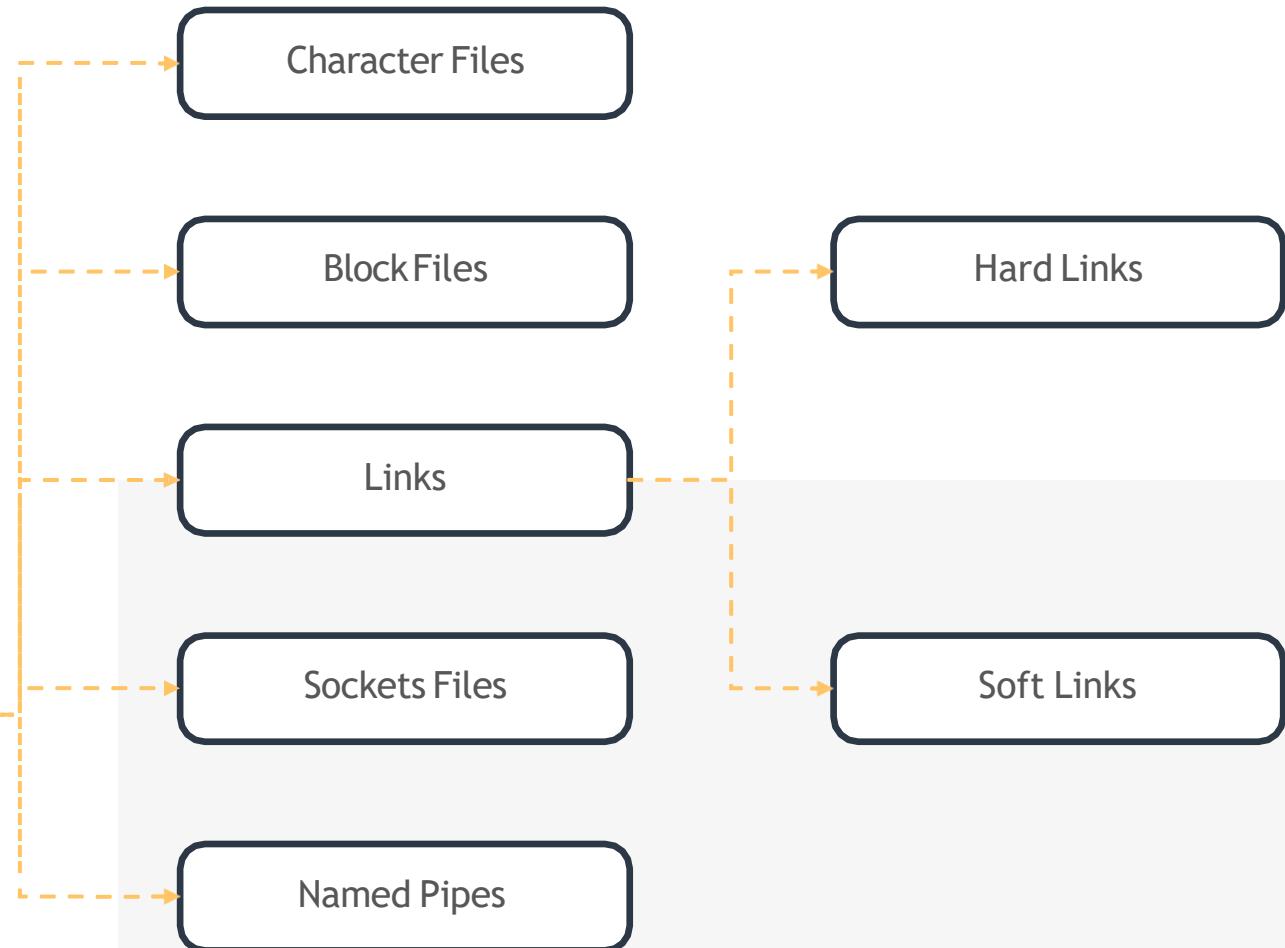
Regular File



Directory



Special Files



File Types in Linux

```
[~]$ 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
```

File Types in Linux

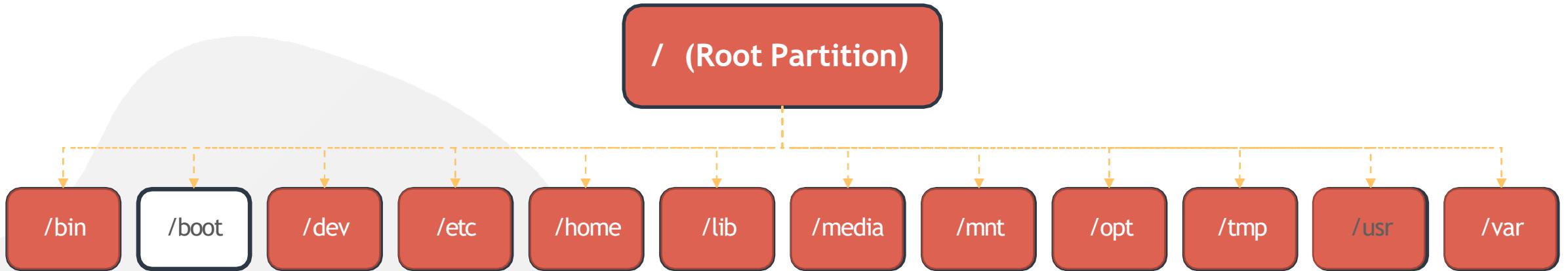
```
[~]$ ls -ld /home/michael/  
drwxr-xr-x 3 root root 4096 Mar 18 17:20  
/home/michael/
```

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





Filesystem Hierarchy



HANDS-ON LABS





{KODE}{LOUD}

...

Linux Package Management

The Linux Basics Course





Linux Package Management

Introduction to Package Management

RPM and YUM

APT and DPKG

Labs: Package Management





Introduction to Package Managers

DPKG / APT



debian

RPM



Red Hat

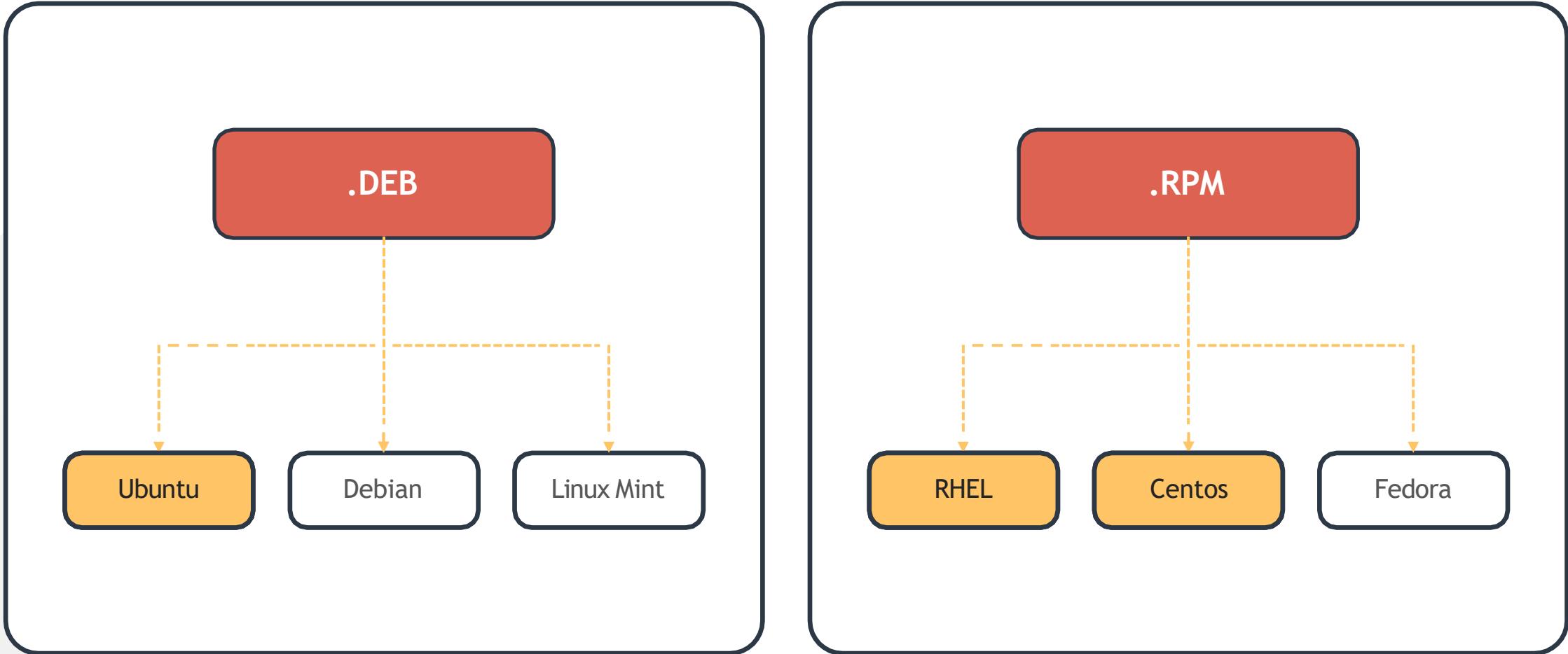


CentOS

...

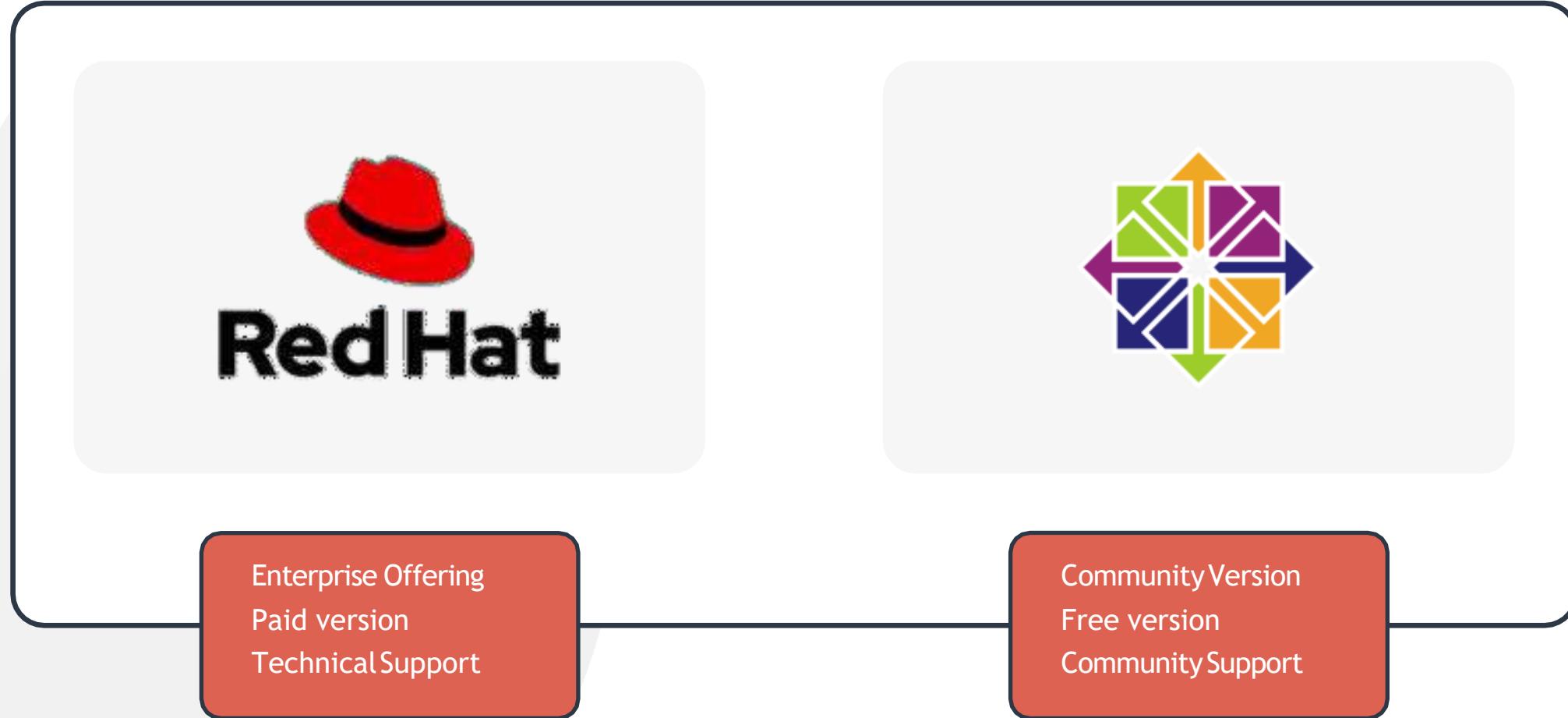


Introduction to Package Managers





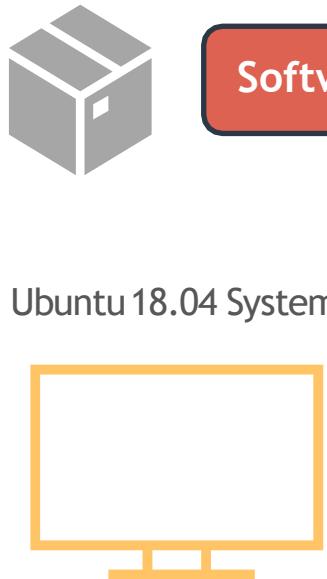
Introduction to Package Managers



...



Introduction to Package Managers





Introduction to Package Managers

Ubuntu 18.04 System



gimp.deb package



```
[~]$ dpkg -i gimp.deb
(Reading database ... 419857 files and directories
 currently installed.)
Preparing to unpack gimp.deb ...
Unpacking gimp (2.10.8-2) over (2.10.8-2) ...
dpkg: dependency problems prevent configuration of
gimp:
  gimp depends on libgimp2.0 (>= 2.10.8); however:
    Version of libgimp2.0 on system is 2.8.22-1.
dpkg: error processing package gimp (--install):
dependency problems - leaving unconfigured
Processing triggers for gnome-menus (3.13.3-
11ubuntu1.1) ...
Processing triggers for desktop-file-utils
(0.23+linuxmint6) ...
Processing triggers for mime-support (3.60ubuntu1)
...
Processing triggers for man-db (2.8.3-2ubuntu0.1)
...
Errors were encountered while processing:
  gimp
```



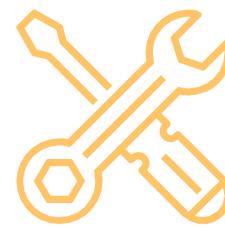


Introduction to Package Managers

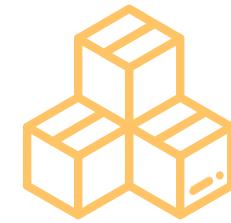
LINUX System



Package Manager



Package + dependencies



Repository



Functions of Package Managers

Package Integrity and Authenticity

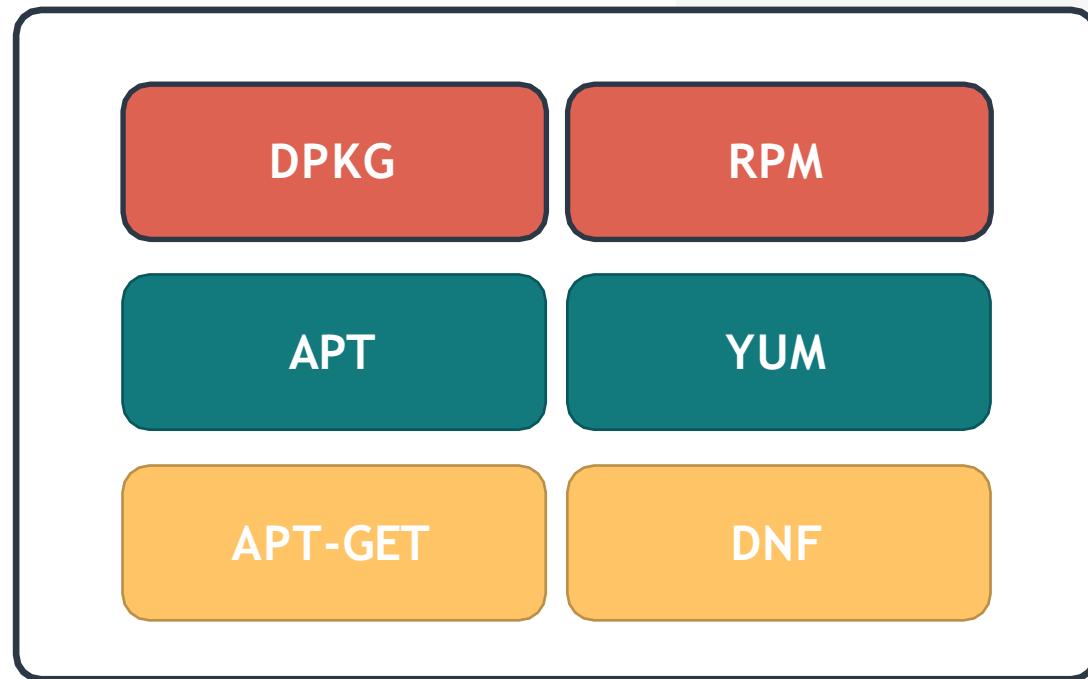
Simplified Package Management

Grouping Packages

Manage Dependencies

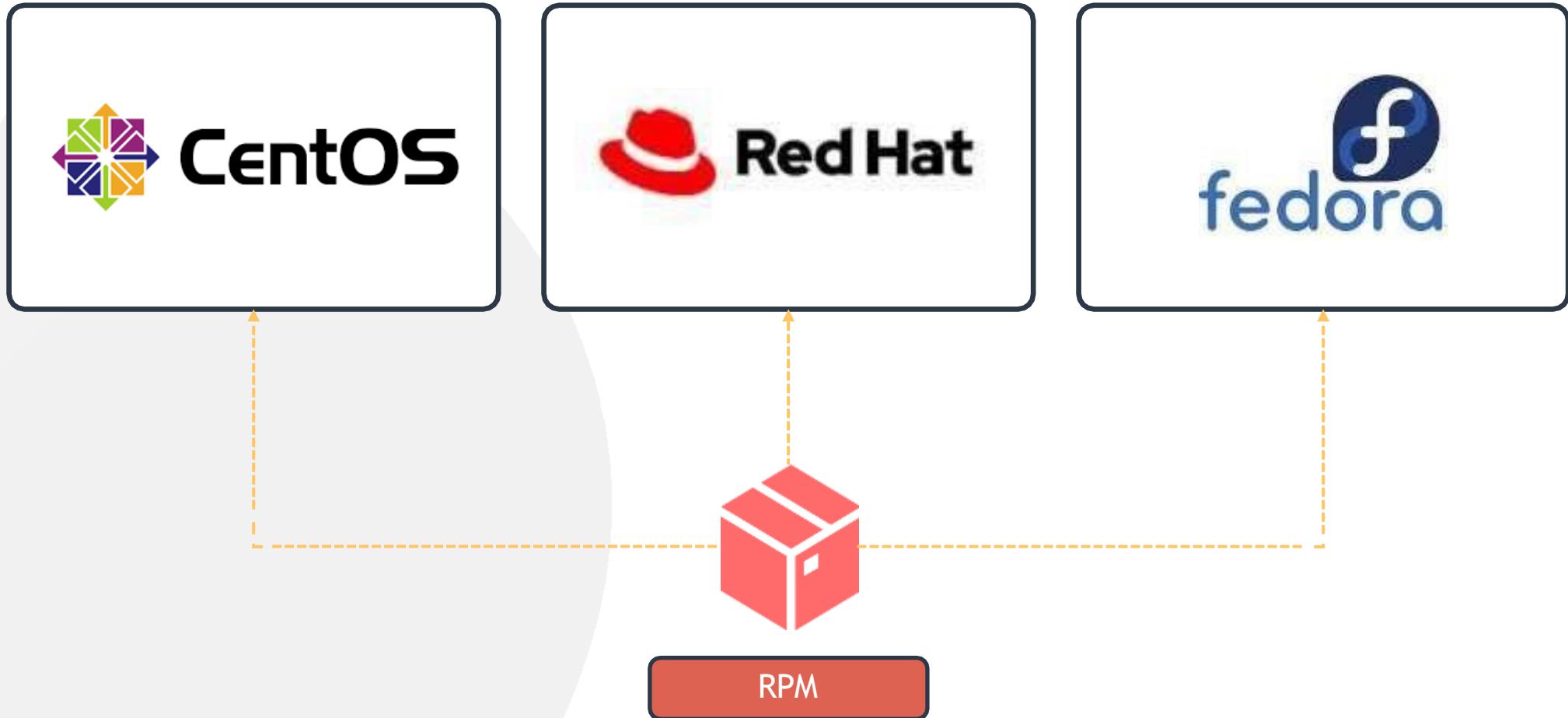


Types of Package Managers





RPM



Working with RPM

Installation

```
[~]$ rpm -ivh telnet.rpm
```

Uninstalling

```
[~]$ rpm -e telnet.rpm
```

Upgrade

```
[~]$ rpm -Uvh telnet.rpm
```

Query

```
[~]$ rpm -q telnet.rpm
```

Verifying

```
[~]$ rpm -Vf <path to file>
```



YUM Package Manager

RPM Based Distros

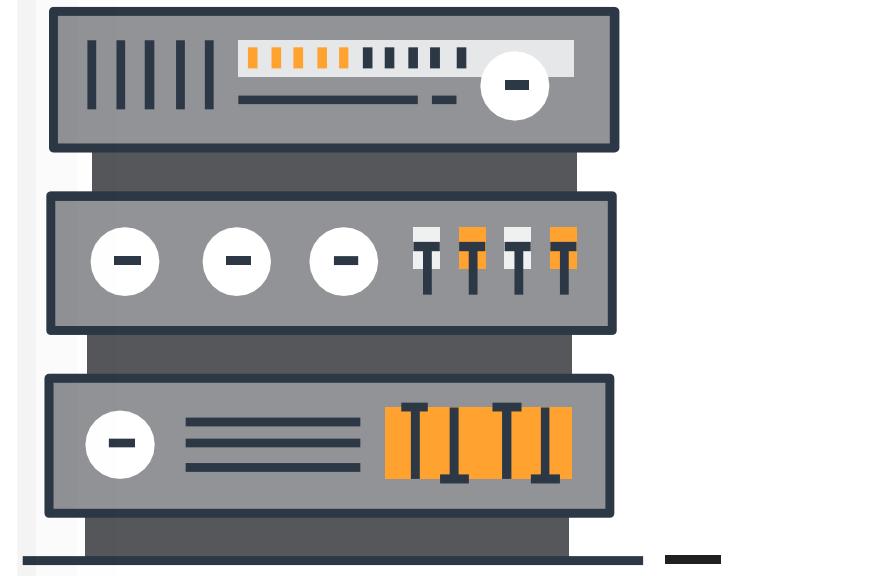
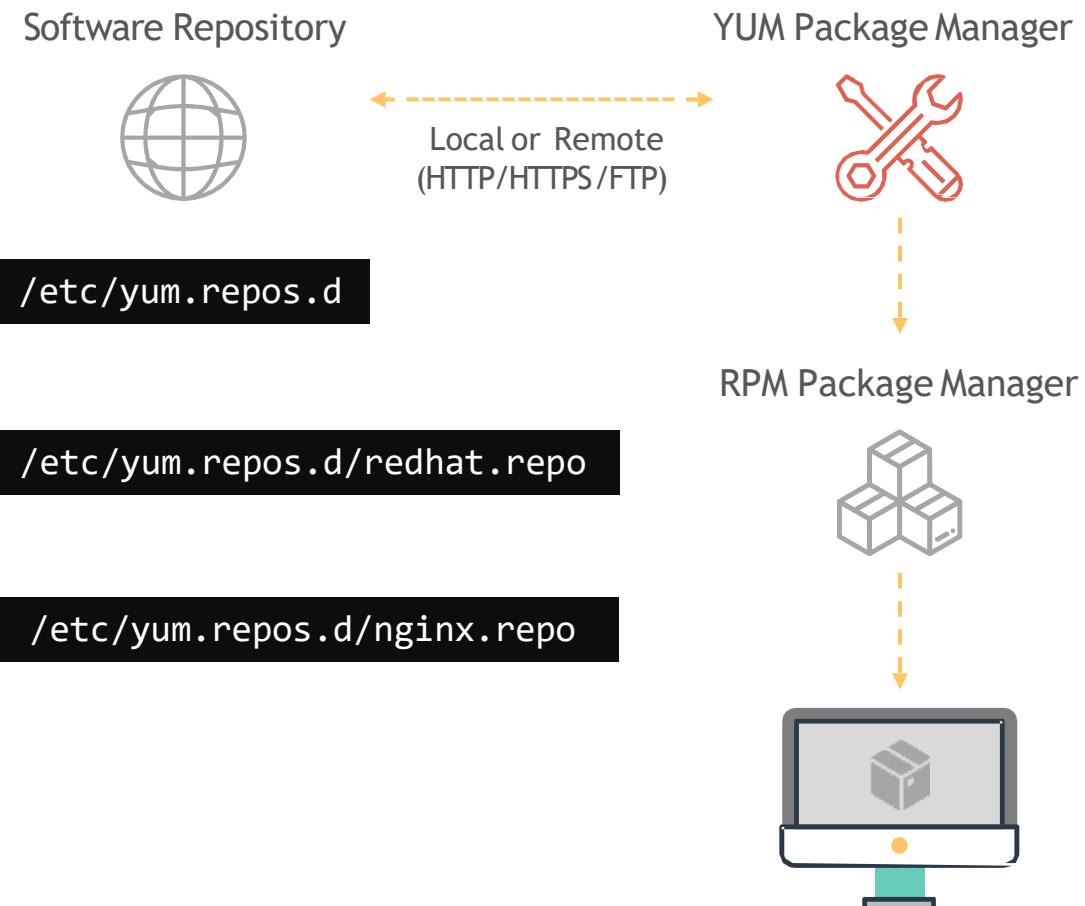
Software Repositories

High Level Package Manager

Automatic Dependency Resolution



YUM Package Manager





YUM Package Manager

```
[~]$ 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: mir01.syntis.net
 * remi-safe: mir01.syntis.net
 * updates: linux.darMMenguin.net
Resolving Dependencies
--> Running transaction check
---> Package httpd.x86_64 0:2.4.6-90.el7.centos will be installed
--> Finished Dependency Resolution

Dependencies Resolved

=====
Package           Arch      Version       Repository      Size
=====
Installing:
httpd            x86_64   2.4.6-90.el7.centos  base          2.7 M

Transaction Summary
=====
Install 1 Package
```





YUM Package Manager

```
Transaction Summary
=====
Install 1 Package

Total download size: 2.7 M
Installed size: 9.4 M
Is this ok [y/d/N]: y

Downloading packages:
httpd-2.4.6-
90.el7.centos.x86_64.rpm  Running | 2.7 MB  00:00:00
transaction check
Running transaction test
Transaction test succeeded
Running transaction
  Verifying : httpd-2.4.6-90.el7.centos.x86_64  1/1
                                         1/1

Installed:
  httpd.x86_64 0:2.4.6-90.el7.centos

Complete!
```





YUM Package Manager

```
[~]$ 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 Package Manager

```
[~]$ 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
```

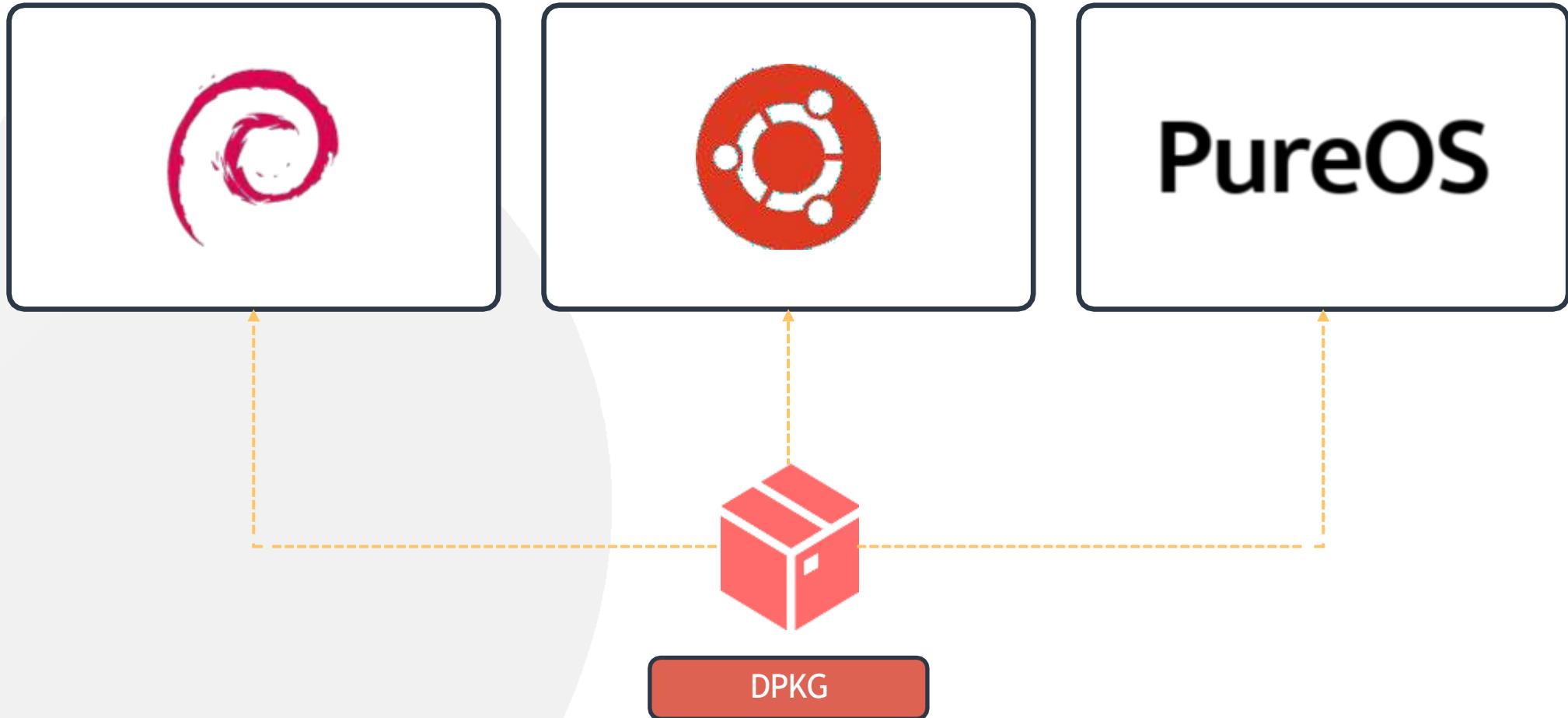
```
Total download size: 64 M
```

```
Is this ok [y/d/N]:
```





DPKG UTILITY



Working with DPKG

Installation / Upgrade

```
[~]$ dpkg -i telnet.deb
```

Uninstalling

```
[~]$ dpkg -r telnet.deb
```

List

```
[~]$ dpkg -l telnet
```

Status

```
[~]$ dpkg -s telnet
```

Verifying

```
[~]$ dpkg -p <path to file>
```





APT / APT-GET

```
[~]$ dpkg -i gimp.deb
```

```
(Reading database ... 419857 files and
directories currently installed.)
Preparing to unpack gimp.deb ...
Unpacking gimp (2.10.8-2) over (2.10.8-2) ...
dpkg: dependency problems prevent configuration
of
gimp:
  gimp depends on libgimp2.0 (>= 2.10.8);
    however: Version of libgimp2.0 on system is
    2.8.22-1.
  dpkg: error processing package gimp (
  Unconfigured: dependency problems - leaving
  unconfigured
  Processing triggers for gnome-
  menus (3.13.3- 11ubuntu1.1) ...
  Processing triggers for desktop-file-utils
  (0.23+linuxmint6) ...
  Processing triggers for mime-support
  (3.60ubuntu1)
...
  Processing triggers for man-db (2.8.3-2ubuntu0.1)
gimp
```

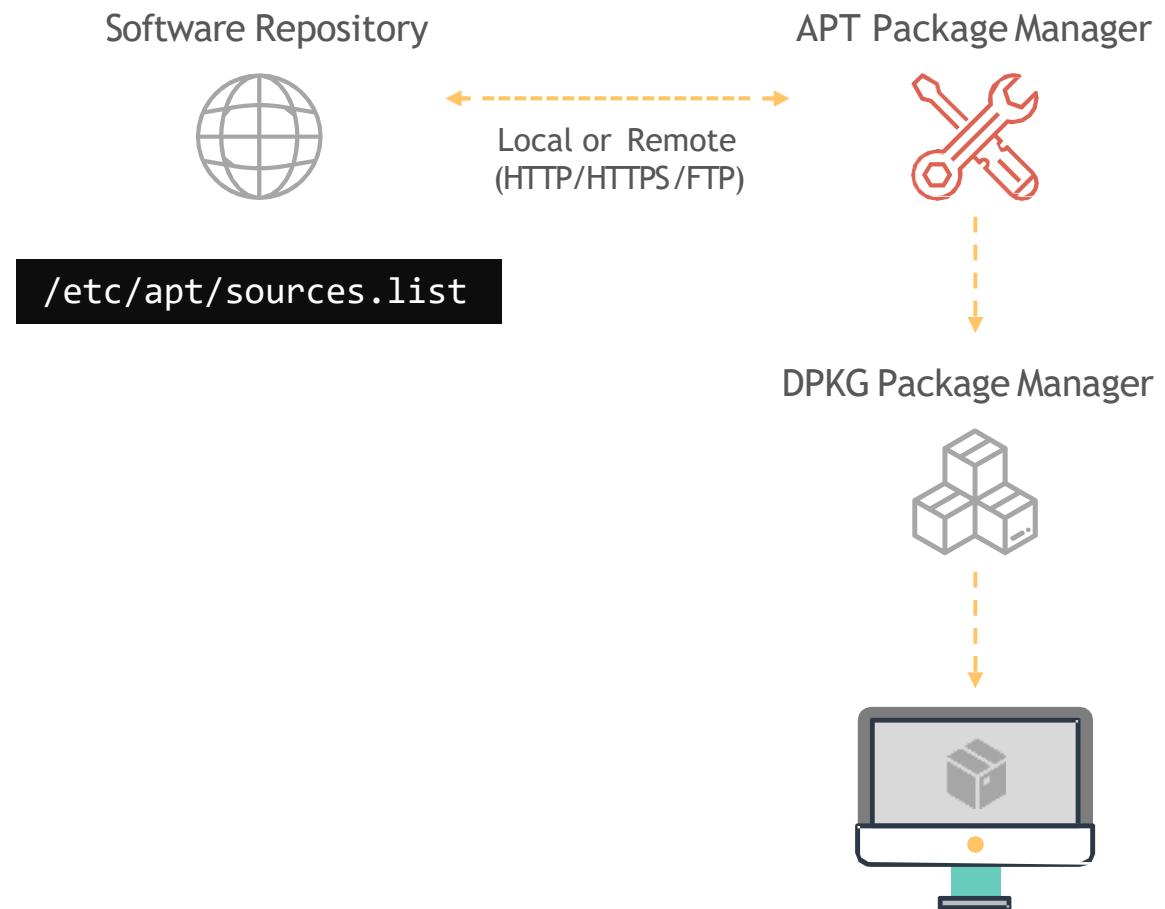
Errors were encountered while
processing: gimp

```
apt install gimp
```

```
apt-get install gimp
```



APT





APT

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

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

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





APT

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

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

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

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





APT VS APT-GET

```
[~]$ apt install firefox
```

Recommended packages:

xul-ext-ubufox

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) ...





APT VS APT-GET

```
[~]$ 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
```

```
- telnet tunnel for
  dCache
- telnet tunnel for
  dCache
- telnet client
- telnet client
- telnet server
- telnet server
- basic telnet
  client
- basic telnet
  client
```

```
[~]$ 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
```



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
```



Archiving Files

tar -cf

```
[~]$ tar -cf test.tar file1 file2 file3
```

```
[~]$ ls -ltr test.tar
```

```
-rw-rw-r-- 1281054720 Mar 13 19:48 test.tar
```

tar -tf

```
[~]$ tar -tf test.tar
```

```
./file1
```

```
./file2
```

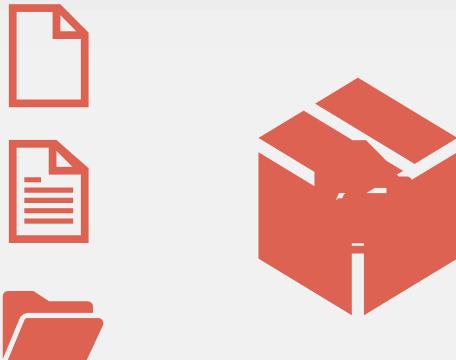
```
./file3
```

tar -xf

```
[~]$ tar -xf test.tar
```

tar -zcf

```
[~]$ tar -zcf test.tar file1 file2 file3
```





Compressing

bzip2

```
[~]$ bzip2 test.img
```

```
[~]$ du -sh test.img.bz2  
4.0K    test.img.bz2
```

gzip

```
[~]$ gzip test1.img
```

```
[~]$ du -sh test1.img.gz  
100K    test1.img.gz
```

xz

```
[~]$ xz test2.img
```

```
[~]$ du -sh test2.img.xz  
16K     test2.img.xz
```

Uncompressing

bunzip2

```
[~]$ bunzip2 test.img.bz2
```

```
[~]$ du -sh test.img  
99M     test.img
```

gunzip

```
[~]$ gunzip test1.img
```

```
[~]$ du -sh test1.img  
99M     test1.img
```

unxz

```
[~]$ unxz test2.img
```

```
[~]$ du -sh test2.img.xz  
99M     test2.img
```



Compressing Files

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 Directories

locate

```
[~]$ locate City.txt
```

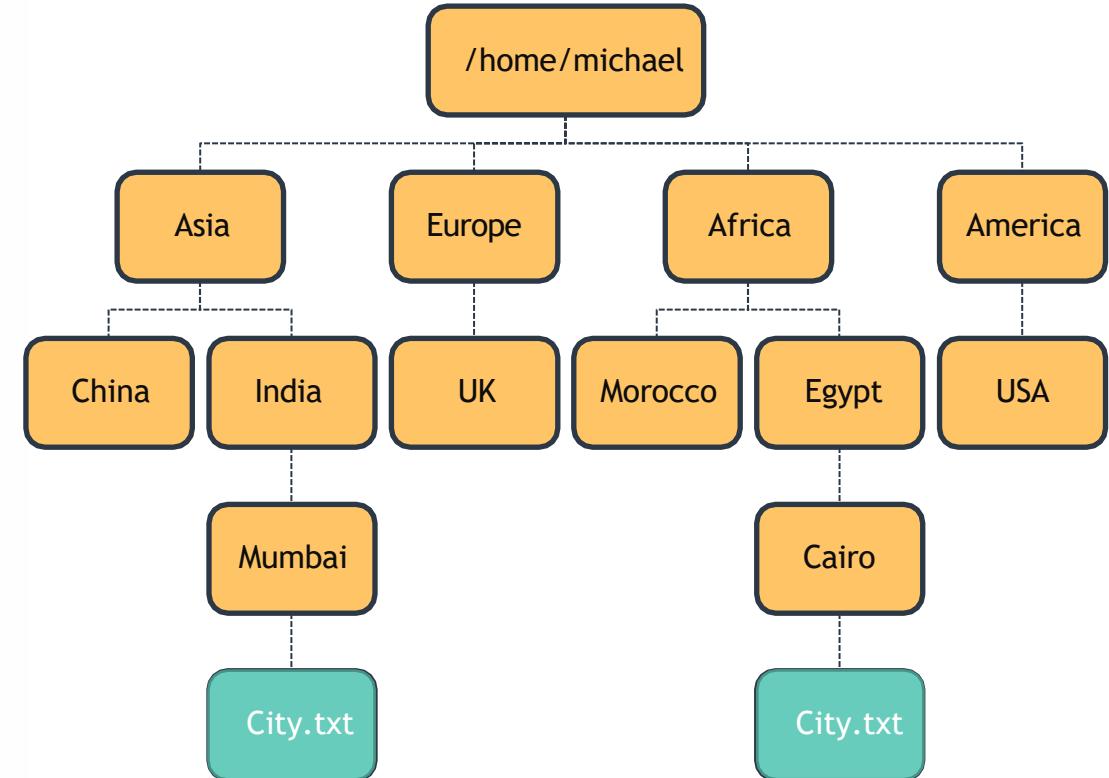
```
/home/michael/Africa/Egypt/Cairo/City.txt  
/home/michael/Asia/India/Mumbai/City.txt
```

updatedb

```
[~]$ updatedb
```

find

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



GREP

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.
```



GREP

```
[~]$ 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
```

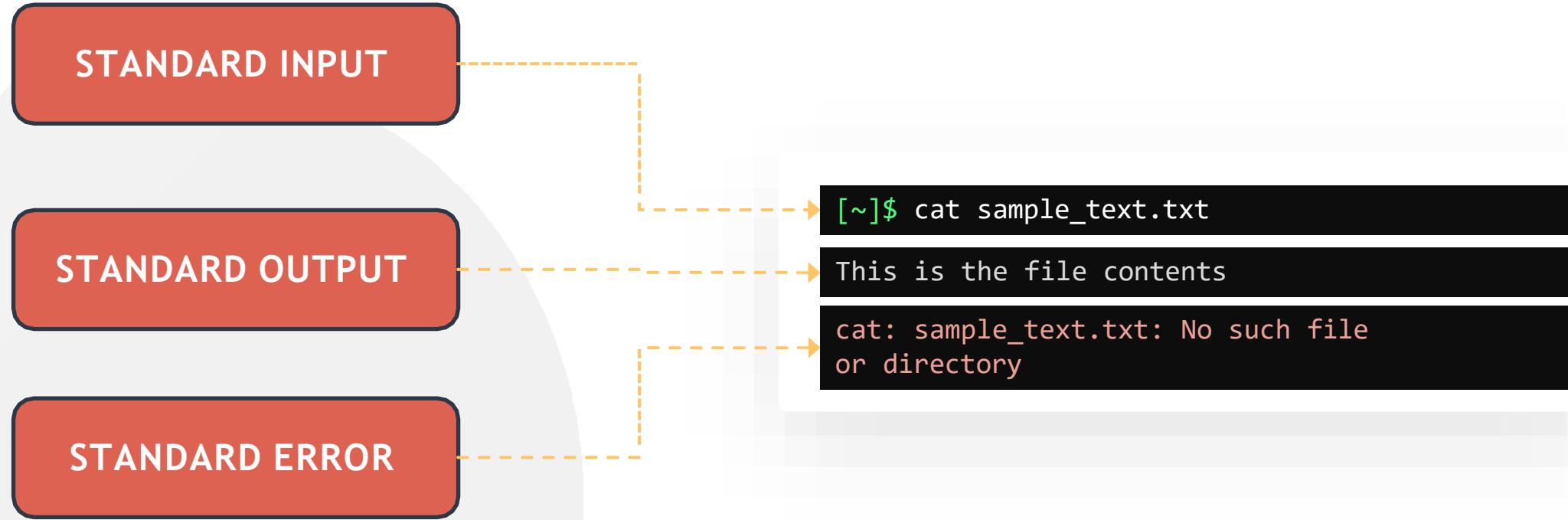
GREP

```
[~]$ 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





```
[~]$ 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
```

REDIRECT STDOUT



REDIRECT STDERR

```
[~]$ 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

```
[~]$ 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)
```

COMMAND LINE PIPES

```
[~]$ 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
```

HANDS-ON LABS





{KODE}{LOUD}

...

TEXT EDITORS

```
[~]$ cat Asia/India/Mumbai/City.txt
```

```
Mumbai
```

```
[~]$
```

```
[~]$ cat > Africa/Egypt/Cairo/City.txt Cairo
```

```
ctrl d
```

VI EDITOR





VI EDITOR

```
[~]$ vi/home/michael/sample.txt
```

COMMAND MODE

INSERT MODE

LAST LINE

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!

~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~

"sample.txt" 5L, 139C

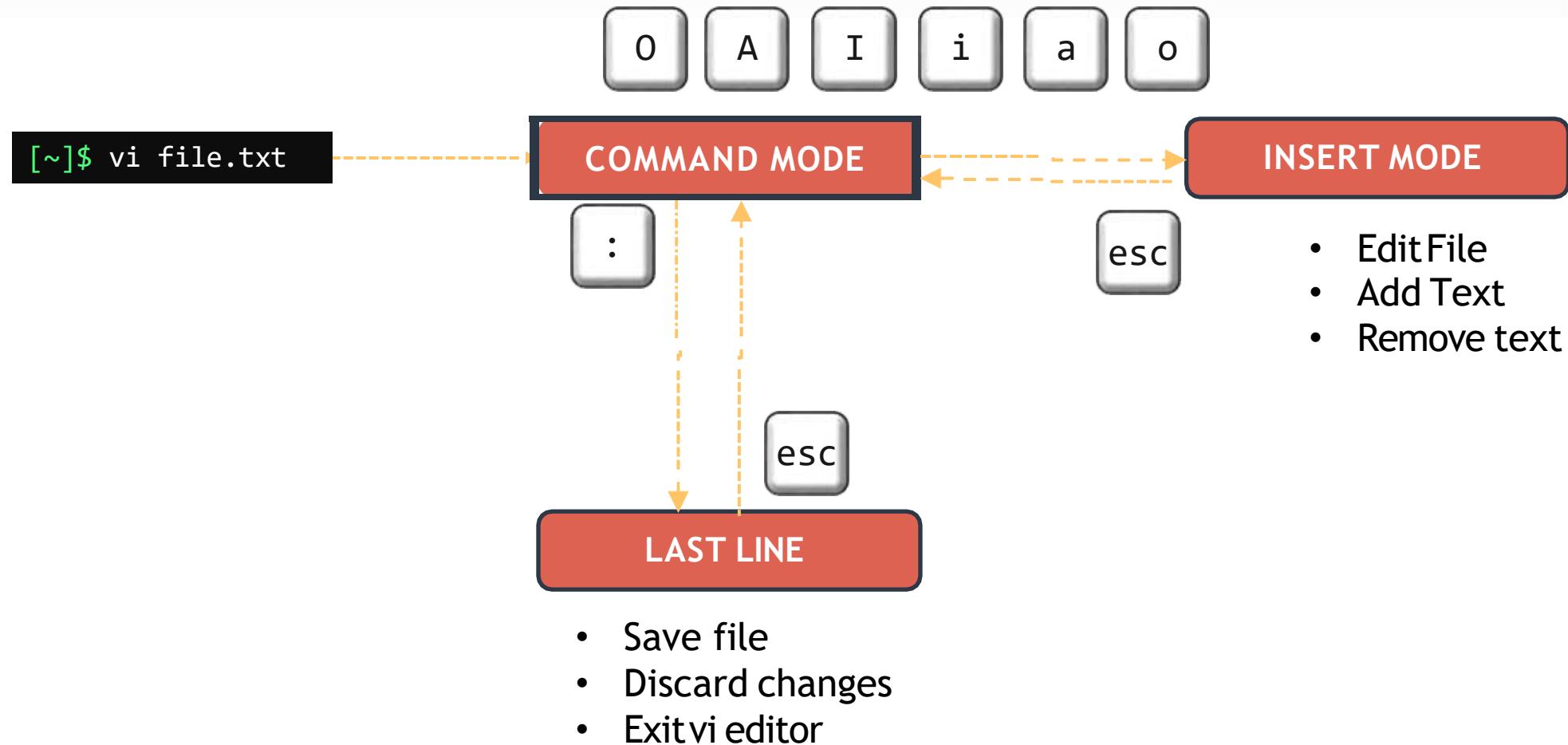
1,1

All





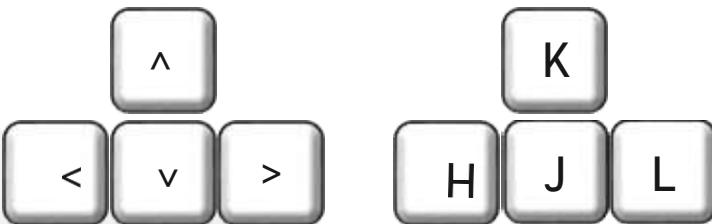
VI EDITOR MODES





COMMAND MODE

Move Around



Copy a Line



Paste



Delete a letter



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!

~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~

"sample.txt" 5L, 139C

1,1

All



COMMAND MODE

Delete a line

d d

Delete 3 lines

d 3 d

Undo

u

Redo

r

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!

~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~

"sample.txt" 5L, 139C

1,1

All





COMMAND MODE

Find

/line

?line

Find Next

n

Find Previous

N





INSERT MODE

Insert Mode

i,o,a

I,O,A

Command
Mode

esc

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!

~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~

-- INSERT --

1,1

All





LASTLINE MODE

Save

:W

Quit

:q

Save & Quit

:wq

Quit
Without Confirmation

:q!

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!
I made some changes to this file.

1,1

All



VIM

VIM =VI IMPROVED

COMPLETION
SPELL CHECK
COMPARISON
MERGING
GUI

PLUGINS
SYNTAX
HIGHLIGHTING
...and many more

```
[~]$ which vi
/usr/bin/vi

[~]$ ls -ltr /usr/bin/vi
lrwxrwxrwx 1 root root 20 Apr 10 08:31 /usr/bin/vi -> /etc/alternatives/vi

[~]$ ls -ltr /etc/alternatives/vi
lrwxrwxrwx 1 root root 18 Apr 24 02:06 /etc/alternatives/vi -> /usr/bin/vim.basic
```

Differences between Vim and Vi

1. Simulated command
2. Missing options
3. Limits
4. The most interesting additions
5. Other vim features
6. Supported Vi features
7. Command-line arguments
8. POSIX compliance

vi-differences

simulated-command
missing-options
limits
vim-additions
other-features
vi-features
cmdline-arguments
posix-compliance

1. Simulated command

simulated-command

vi_diff.txt [Help][R0]

7,35-57 0%

This is the first line.

sample.txt

Top

"vi_diff.txt" [readonly] 1370L, 57621C

HANDS-ON LABS





{KODE}{LOUD}

...

Security and File Permissions

The Linux Basics Course





Security and File Permissions

Basic Security and Identifying File Types

Labs: File Permissions

Creating Users and Groups

Special Directories and Files

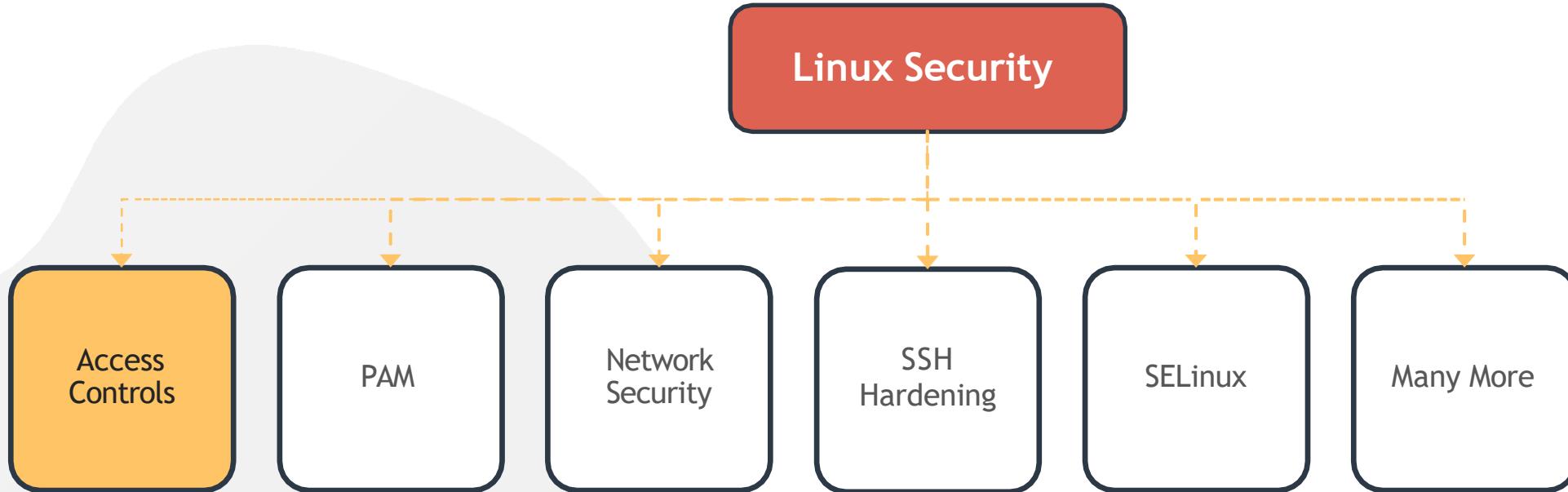
Labs: Users and Groups

Labs: Special Directories and Files

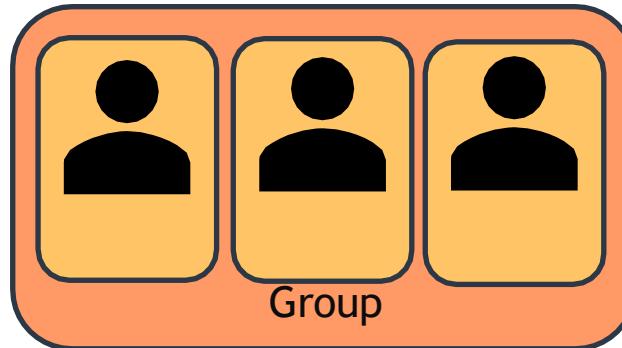
Managing file permission and ownership



Linux Accounts



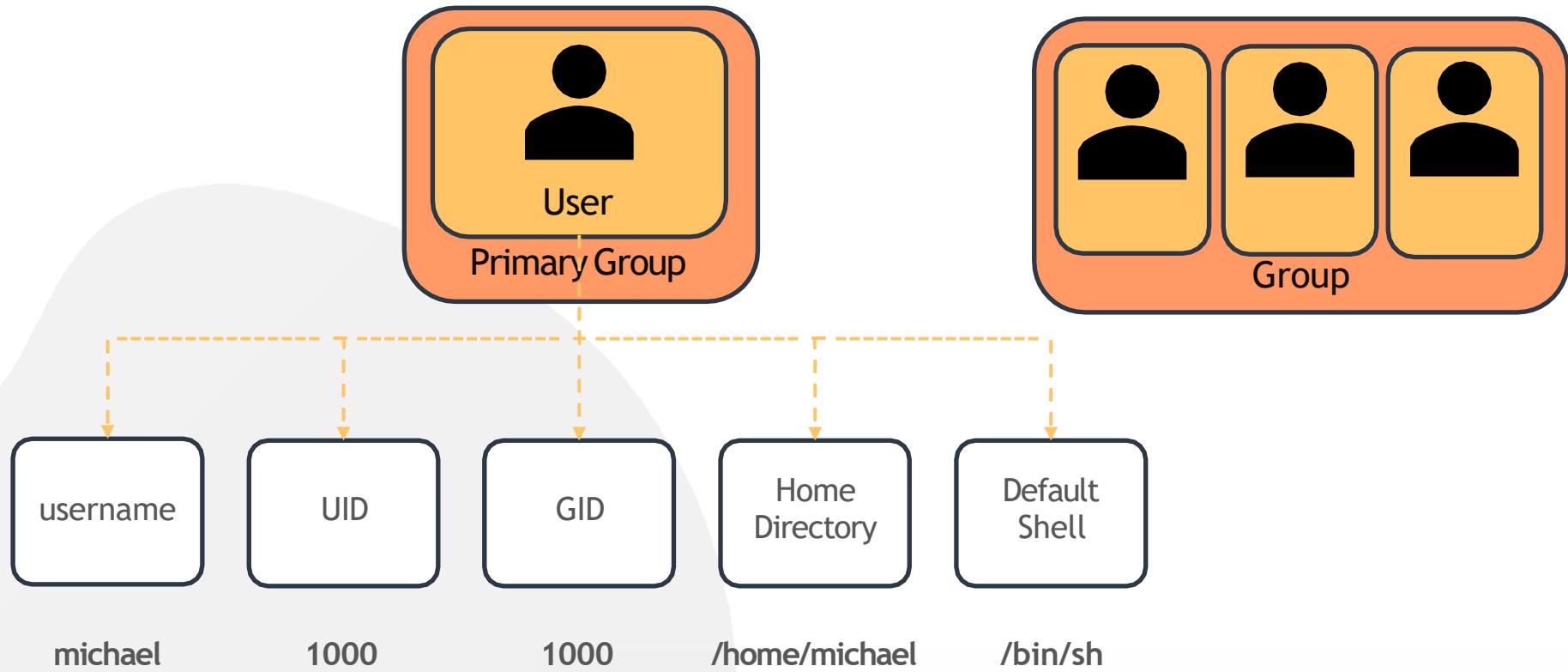
Linux Accounts



```
[~]$ cat /etc/passwd
root:x:0:0:root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
www-data:x:33:33:www-
data:/var/www:/usr/sbin/nologin
bob:1000:1000:Bob Kingsley,,,:/home/bob:/bin/bash
```

```
[~]$ cat /etc/group
ssh:x:118:
lpadmin:x:119:
scanner:x:120:saned
avahi:x:121:
saned:x:122:
colord:x:123:
geoclue:x:124:
pulse:x:125:
pulse-access:x:126:
gdm:x:127:
systemd-coredump:x:999:
bob:x:1000:
developers:x:1003:bob,michael
```

Linux Accounts



```
[~]$ id michael  
uid=1001(michael) gid=1001(michael)groups=1001(michael),1003(developers)
```

```
[~]$ grep -i michael /etc/passwd  
michael:x:1001:1001::/home/michael:/bin/s
```



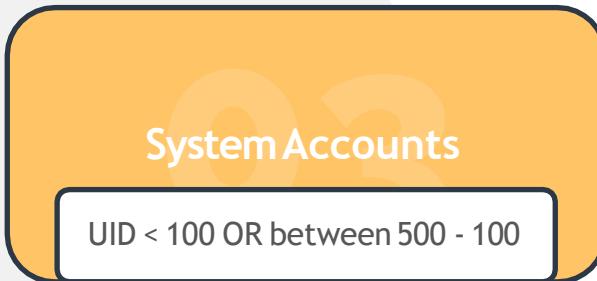
Account Types

- Bob
- michael
- dave



- root

- ssh
- mail



- nginx
- mercury





COMMAND

```
[~]$ 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

visudo

/etc/sudoers

```
[~]$ grep -i ^root /etc/passwd  
/root:x:0:0:root:/root:/usr/sbin/nologin
```

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

```
[~]$ 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
```

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:
#include /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)

Access Control Files

/etc/passwd

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

/etc/shadow

```
[~]$ grep -i ^bob /etc/shadow  
/bob:$6$0h0ut0t0$5JcuRxR7y72LLQk4Kdog7u09LsNFS0yZPkIC8pV9tgD0wXCHut  
YcWF/7.eJ3TfGfG0lj4JF63PyuPwKC18tJS.:18188:0:99999:7:::
```

/etc/group

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



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
```



Access Control Files

/ 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



Access Control Files

/ etc/group

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

NAME:PASSWORD:GID:MEMBERS



Managing Users

```
[~]$ 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
```

Managing Users

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

```
[~]$ id bob  
uid=1009(bob) gid=1009(avenger) groups=1009(avenger)
```

```
[~]$ grep -i bob /etc/passwd  
bob:x:1009:1009:Robert Downey Jr,Avenger:/home/bob:/bin/bash
```

-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

Managing Users

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

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

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



HANDS-ON LABS





{KODE}{LOUD}

...

Linux File Permissions

```
[~]$ ls -l bash-script.sh  
-rwxrwxr-x 1 bob bob 89 Mar 17 01:35 bash-script.sh
```

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

Linux File Permissions

- rwx rwx r - x



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



Directory Permissions

Bit	Purpose	Octal Value
r	Read	4
w	Write	2
x	Execute	1
-	No permission	0

```
[~]$ ls -ld /home/bob/random_dir  
d--xrwxrwx 1 bob bob 89 Mar 17 01:35 .
```

```
[~]$ whoami  
bob
```

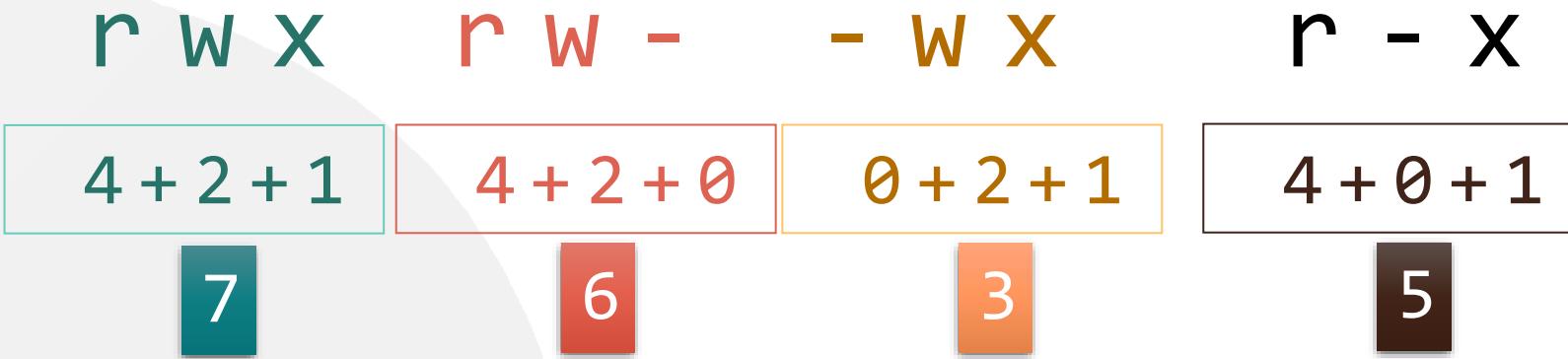
```
[~]$ ls /home/bob/random_dir  
ls: cannot open directory 'random_dir/': Permission denied
```

```
[~]$ cd /home/bob/random_dir  
[bob@ubuntu-server random_dir]$
```





Linux File Permissions



Bit	Purpose	Octal Value
r	Read	4
w	Write	2
x	Execute	1
-	No permission	0





Modifying File Permissions

```
chmod <permissions> file
```

```
[~]$ chmod u+rwx test-file
```

Provide full access to Owners

```
[~]$ chmod ugo+r-x test-file
```

Provide Read access to Owners, groups
and others, Remove execute access

```
[~]$ chmod o-rwx test-file
```

Remove all access for others

```
[~]$ chmod u+rwx,g+r-x,o-rwx test-file
```

Full access for Owner, add read ,remove
execute for group and no access for others



Modifying File Permissions

```
chmod <permissions> file
```

```
[~]$ chmod 777 test-file
```

Provide full access to Owners, group and others

```
[~]$ chmod 555 test-file
```

Provide Read and execute access to Owners, groups and others

```
[~]$ chmod 660 test-file
```

Read and Write access for Owner and Group, No access for others

```
[~]$ chmod 750 test-file
```

Full access for Owner, read and execute for group and no access for others

Modifying File Permissions

```
chown owner:group file
```

```
[~]$ chown bob:developer test-file
```

Changes owner to bob and group to developer

```
[~]$ chown bob android.apk
```

Changes just the owner of the file to bob. Group unchanged.

```
[~]$ chgrp android test-file
```

Change the group for the test-file to the group called android.

HANDS-ON LABS





{KODE}{LOUD}

...

SSH

```
ssh <hostname OR IP Address>
```

```
ssh <user>@<hostname OR IP Address>
```

```
ssh -l <user> <hostname OR IP Address>
```

```
[bob@caleston-1p10 ~]$ ssh devapp01  
bob@devapp01's password:  
Last login: Tue Apr  7 20:08:58 2020  
from 192.168.1.109  
[bob@devapp01 ~]$
```



PASSWORD-LESS SSH

Key Pair = Private Key +Public Key





PASSWORD-LESS SSH

Client

```
[bob@caleston-lp10 ~]$ ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/home/bob/.ssh/id_rsa):
/home/bob/.ssh/id_rsa already exists.
Overwrite (y/n)? y
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/bob/.ssh/id_rsa.
Your public key has been saved in /home/bob/.ssh/id_rsa.pub.
The key fingerprint is:
SHA256:PCRTdbxxzffzmi8uunjn5V/1LZCG0BvhVJYXBr9gYsE bob@caleston-lp10
The key's randomart image is:
+---[RSA 2048]  +
|   .o=o=oo+
|   . +E=+oo +
| o o * o=. o|
| = o *.o o.|
| S o + . +|
|   . . . =
|       oo+
|   .. oo+..
|   ..o=.oo+o|
+---[SHA256] ---- +
```

Public Key: /home/bob/.ssh/id_rsa.pub

Private Key: /home/bob/.ssh/id_rsa



PASSWORD-LESS SSH

Client

```
[bob@caleston-1p10 ~]$ ssh-copy-id bob@devapp01
/usr/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "/home/bob/.ssh/id_rsa.pub"
/usr/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that
are already installed
/usr/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is
to install the new keys
bob@devapp01's password:
```

Number of key(s) added: 1

Now try logging into the machine, with: "ssh 'bob@devapp01'"
and check to make sure that only the key(s) you wanted were added.

```
[bob@caleston-1p10 ~]$ ssh devapp01
Last login: Tue Apr  7 20:10:58 2020 from 192.168.1.109
[bob@devapp01 ~]$
```



PASSWORD-LESS SSH

Remote Server

```
[bob@caleston-1p10 ~]$ cat /home/bob/.ssh/authorized_keys
ssh-rsa
AAAAB3NzaC1yc2EAAAQABAAQCGVV5wgH37kNwjnEIxgeX4j6LASNckjKi4bRpjPGecyxEiEeJhIU4x31XPEFzUFp/1xX2rj
eiM2Ko3oPmTGCCTEQMpQogerR7NS+bA9eXs34jWIg+xoSQjeQu1+lXgrRippJn2YhWYVAY3sKWIiiklowuMXmxjmBBr48L52di1J+
8EASwnM4ILX/YL72Czq3uFFhVw1fNUKBPUbw58h4QSAd2r9abzzfrHH48ThPJW4/5i8LOHEo3W0BXl3foEV0c6pk3TgxcjTuZQ0im
d48mM2pxWJh9WxA0xcXwbD3+JrcnZeMJq4TbrKjaXQ0pBGenglxurxnRT2og9DeTIqGN3 bob@caleston-1p10
```



SCP



```
[bob@caleston-lp10 ~]$ scp /home/bob/caleston-code.tar.gz devapp01:/root  
bob@devapp01's password:  
Scp /root/caleston-code.tar.gz: Permission denied
```

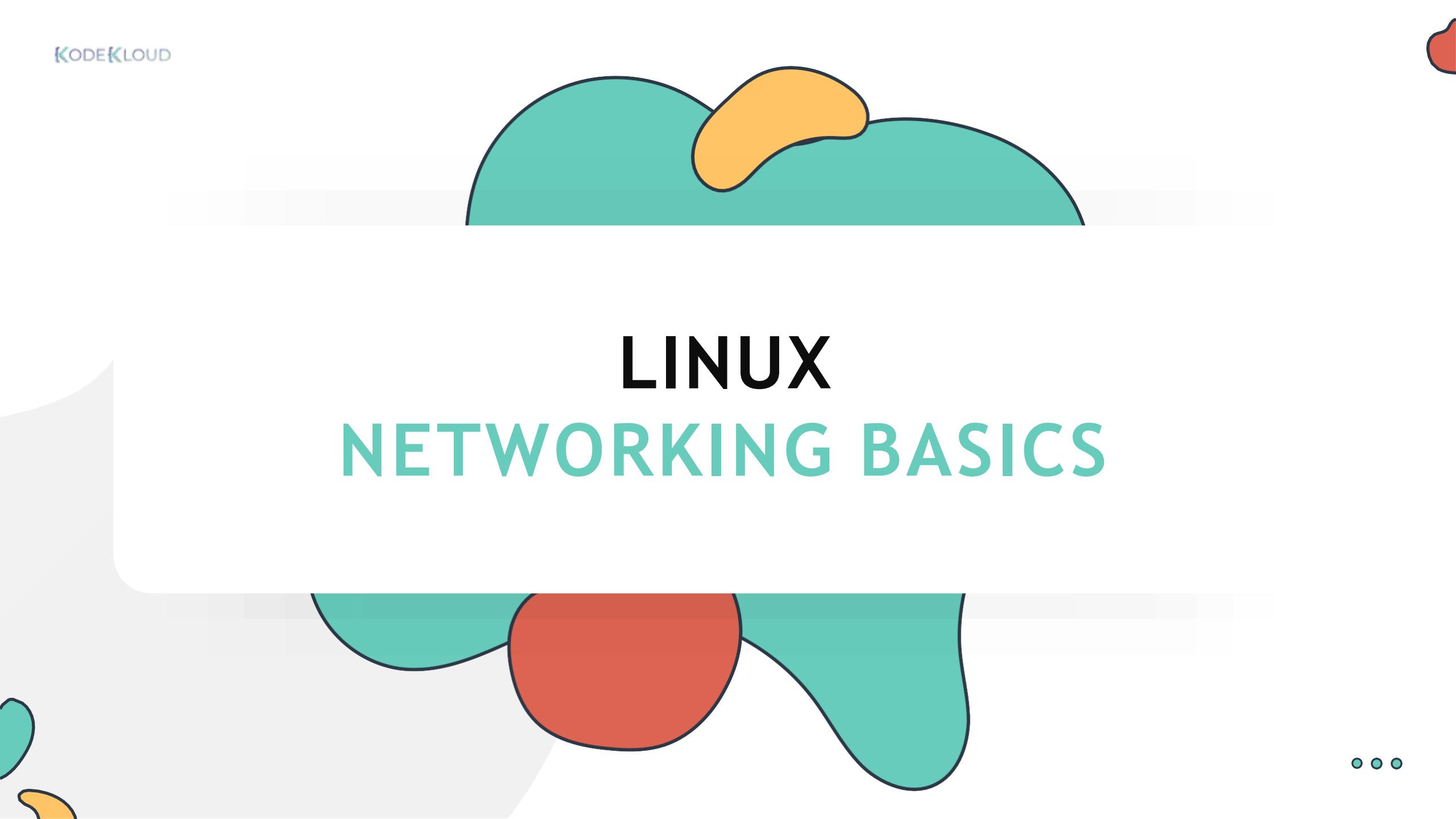
HANDS-ON LABS





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...



LINUX NETWORKING BASICS



Networking Basics

DNS

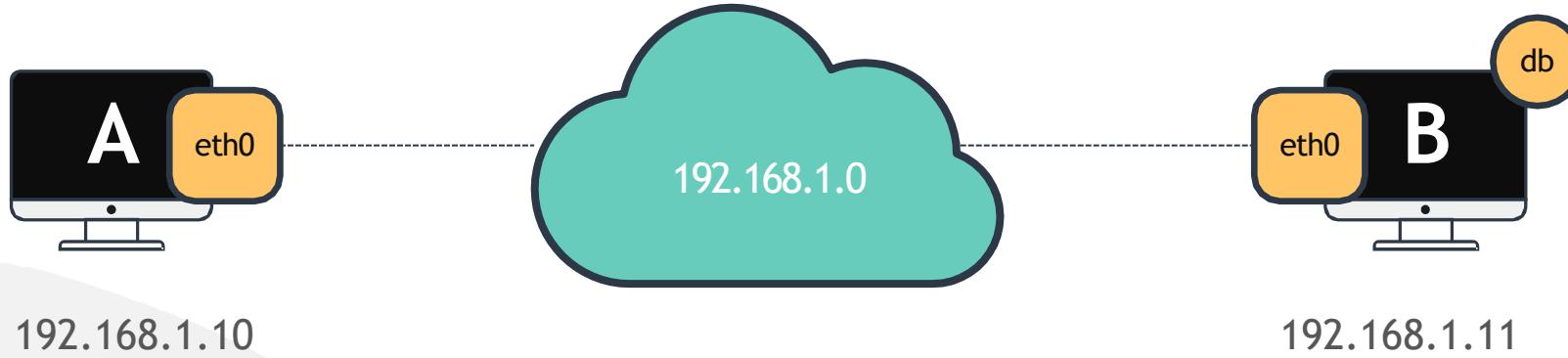
Troubleshooting

Labs: DNS

Networking Basics

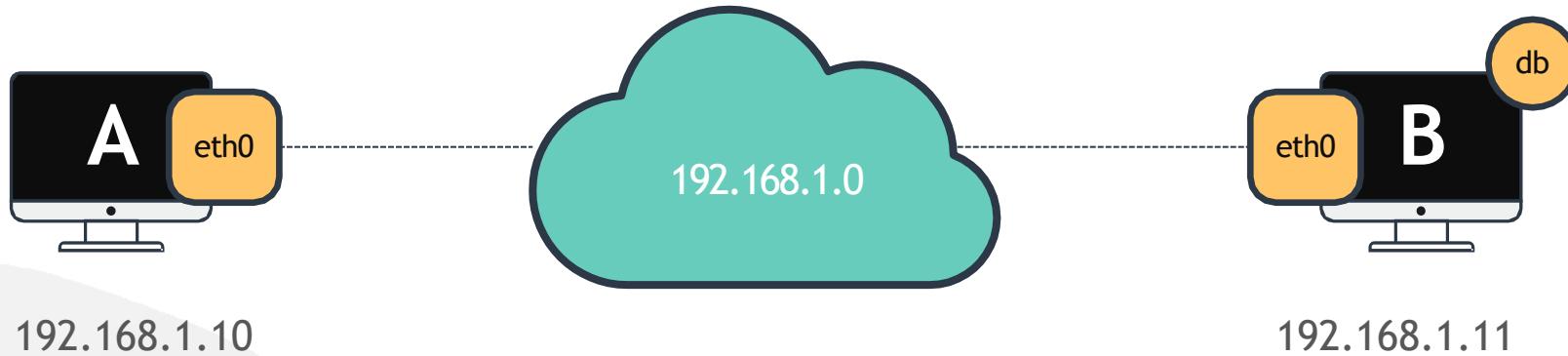
Labs: Networking Basics





```
[~]$ ping 192.168.1.11  
Reply from 192.168.1.11: bytes=32 time=4ms TTL=117  
Reply from 192.168.1.11: bytes=32 time=4ms TTL=117
```

```
[~]$ ping db  
ping: unknown host db
```



```
[~]$ ping db
```

```
ping: unknown host db
```

```
[~]$ cat >> /etc/hosts
```

```
192.168.1.11      db
```

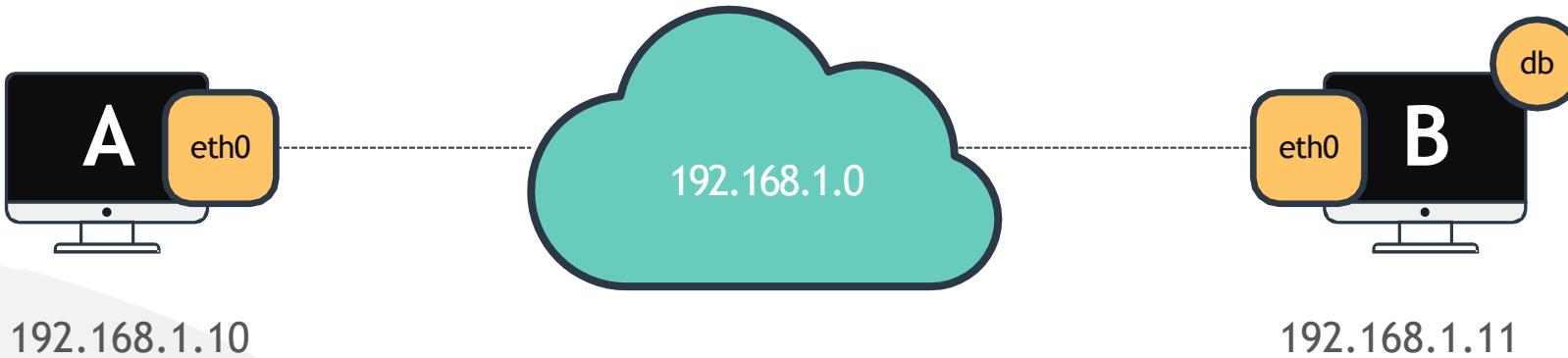
```
[~]$ ping db
```

```
PING db (192.168.1.11) 56(84) bytes of data.  
64 bytes from db (192.168.1.11): icmp_seq=1 ttl=64 time=0.052 ms  
64 bytes from db (192.168.1.11): icmp_seq=2 ttl=64 time=0.079 ms
```

```
[~]$ hostname
```

```
host-2
```





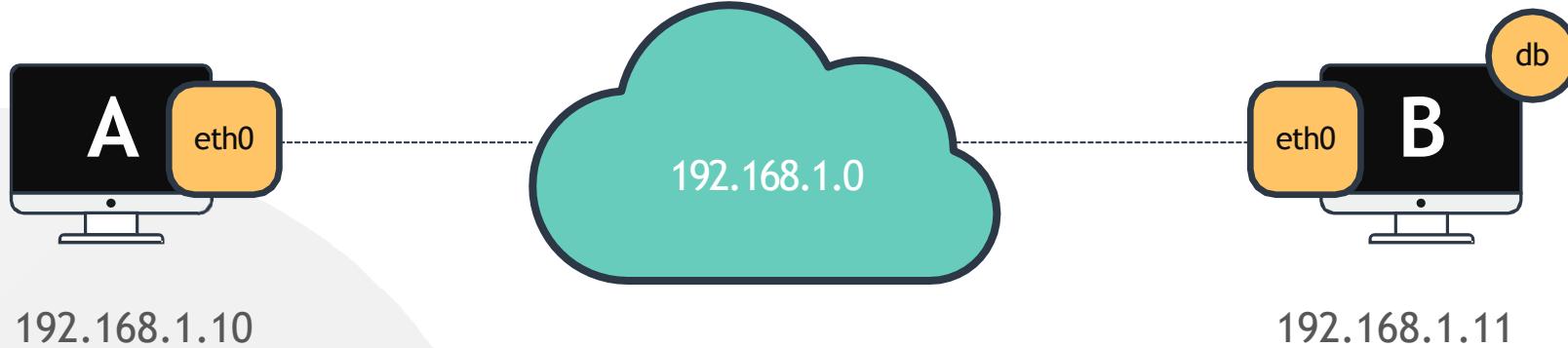
```
[~]$ cat >> /etc/hosts  
192.168.1.11      db  
192.168.1.11      www.google.com
```

```
[~]$ ping db  
PING db (192.168.1.11) 56(84) bytes of data.  
64 bytes from db (192.168.1.11): icmp_seq=1 ttl=64 time=0.052 ms  
64 bytes from db (192.168.1.11): icmp_seq=2 ttl=64 time=0.079 ms
```

```
[~]$ hostname  
host-2
```

```
[~]$ ping www.google.com  
PING www.google.com (192.168.1.11) 56(84) bytes of data.  
64 bytes from www.google.com (192.168.1.11): icmp_seq=1 ttl=64 time=0.052 ms  
64 bytes from www.google.com (192.168.1.11): icmp_seq=2 ttl=64 time=0.079 ms
```

Name Resolution



```
[~]$ cat >> /etc/hosts  
192.168.1.11      db  
192.168.1.11      www.google.com
```

```
[~]$ ping db
```

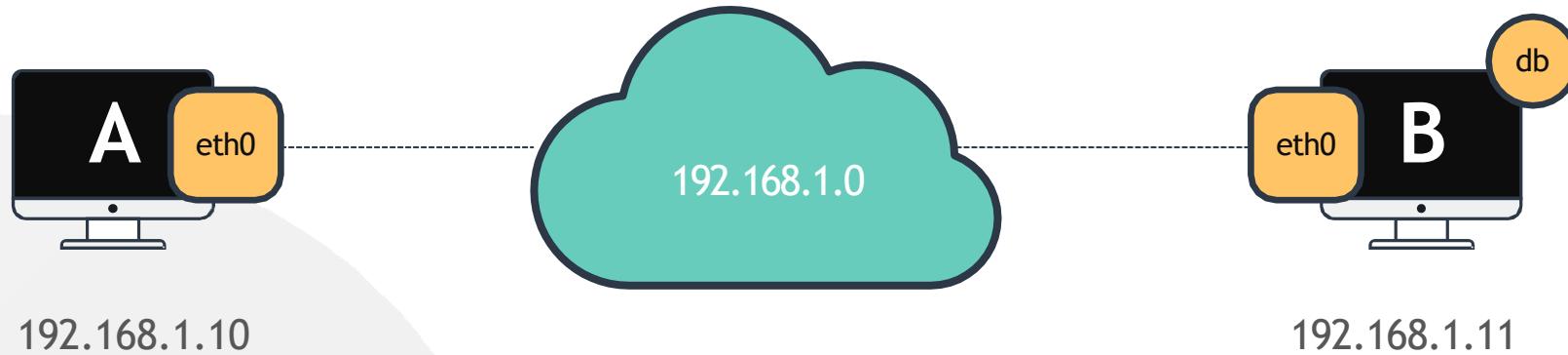
```
[~]$ ssh db
```

```
[~]$ curl http://www.google.com
```

```
[~]$ hostname  
host-2
```



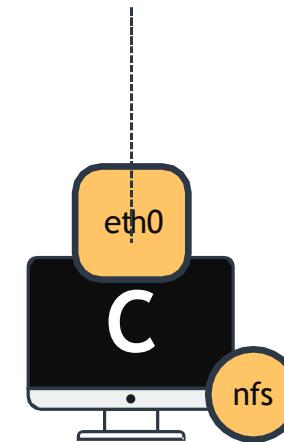
Name Resolution



```
[~]$ cat >> /etc/hosts  
192.168.1.10      web  
192.168.1.11      db  
192.168.1.12      nfs
```

```
[~]$ cat >> /etc/hosts  
192.168.1.10      web  
192.168.1.11      db  
192.168.1.12      nfs
```

```
[~]$ cat >> /etc/hosts  
192.168.1.10      web  
192.168.1.11      db  
192.168.1.12      nfs
```

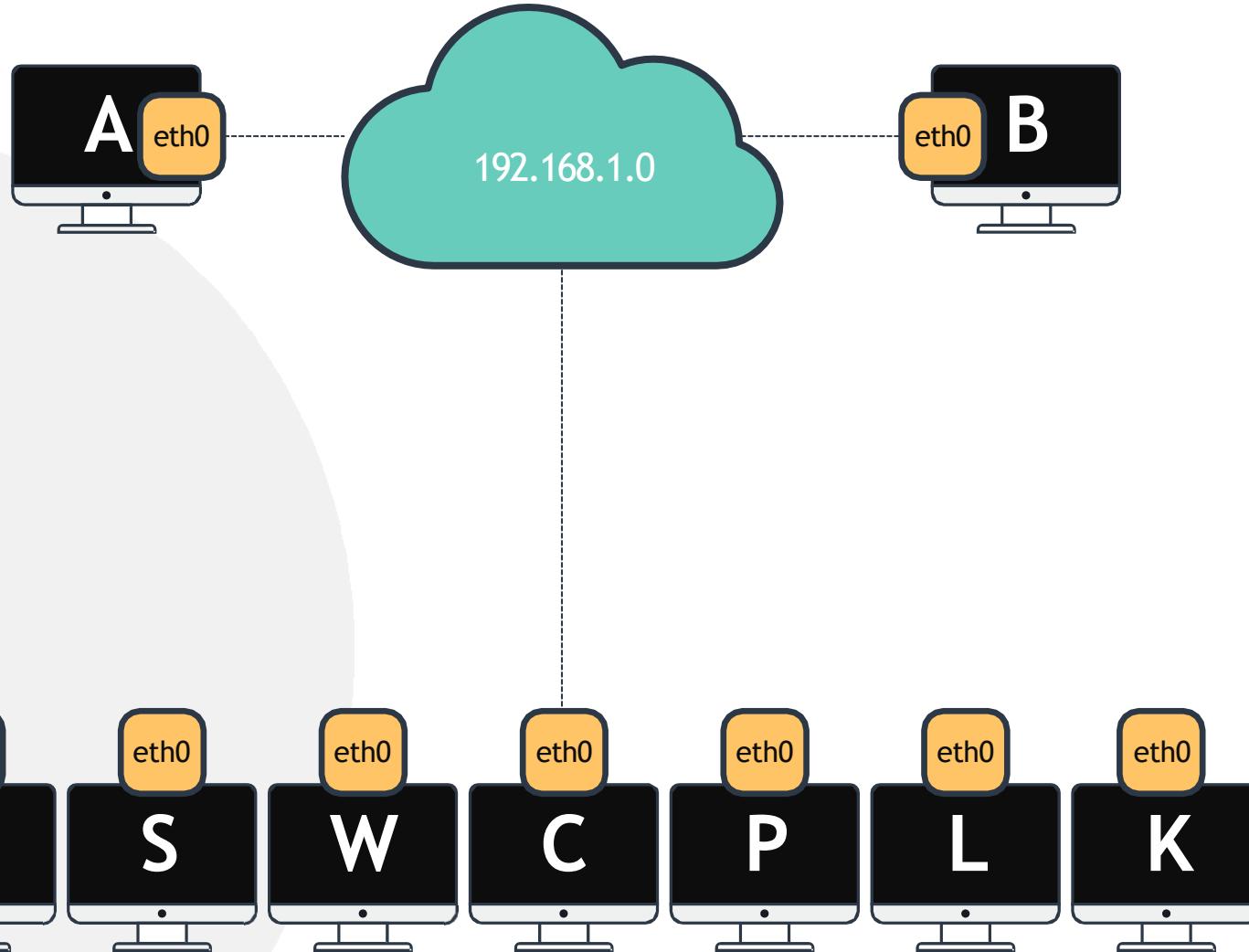


192.168.1.12

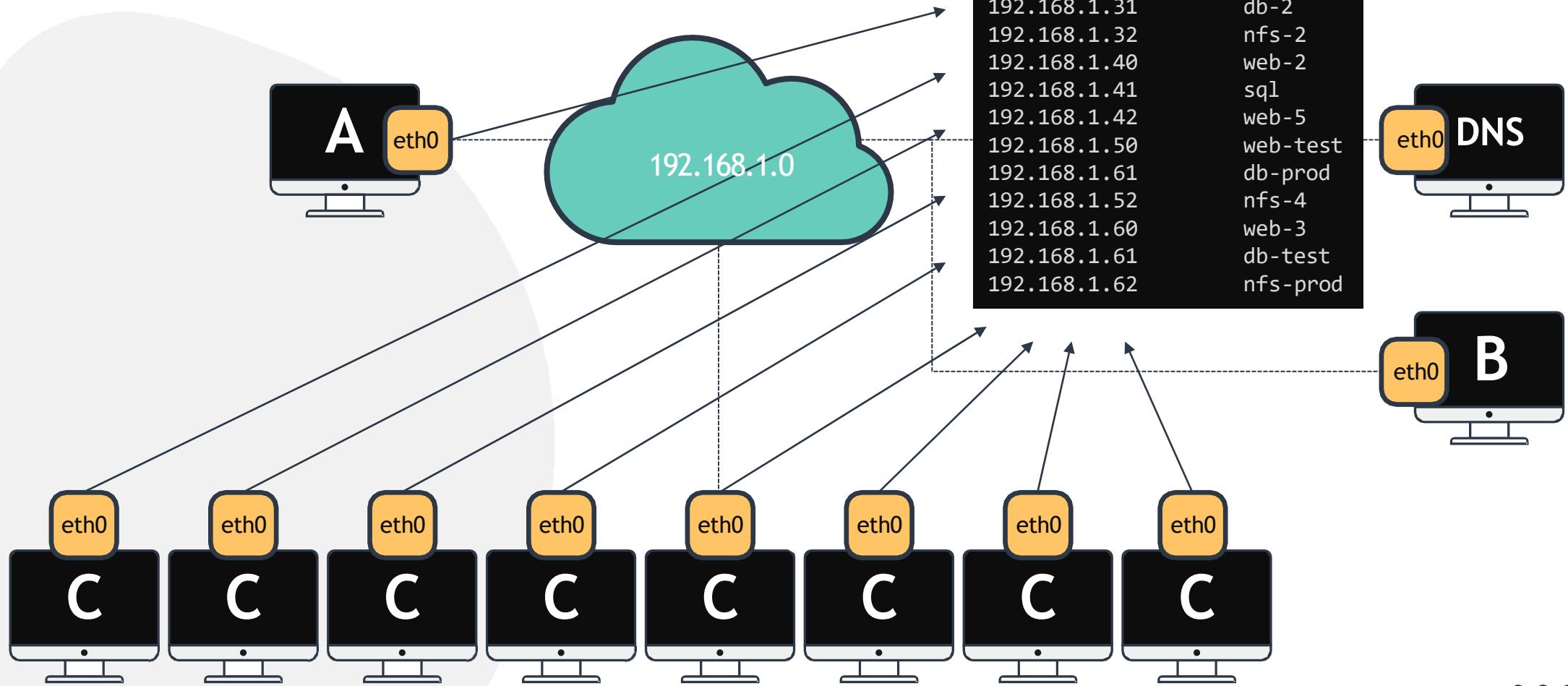


Name Resolution

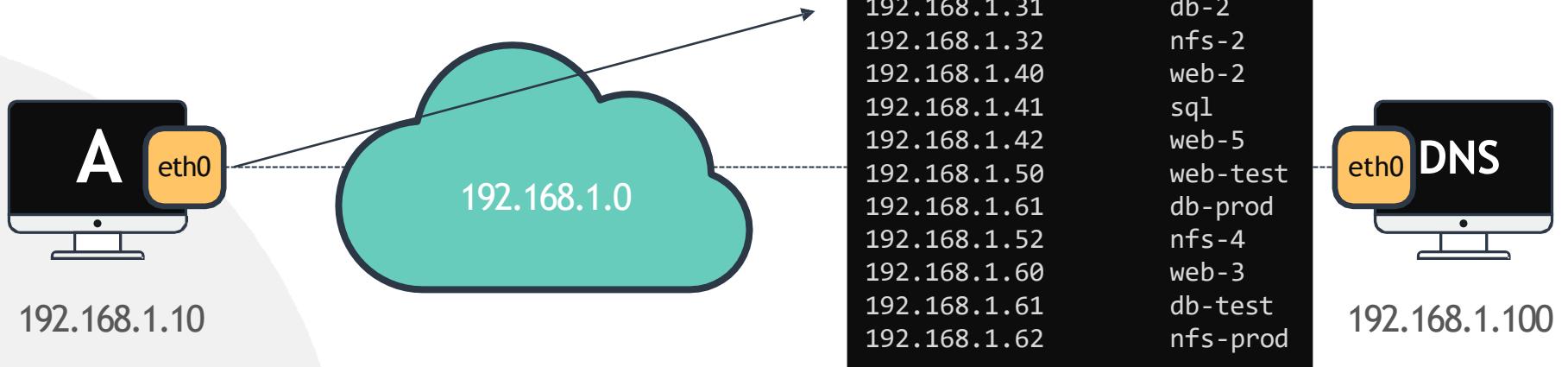
```
[~]$ cat >> /etc/hosts  
192.168.1.10      web  
192.168.1.11      db  
192.168.1.12      nfs  
192.168.1.20      web  
192.168.1.21      db-1  
192.168.1.22      nfs-1  
192.168.1.30      web-1  
192.168.1.31      db-2  
192.168.1.32      nfs-2  
192.168.1.40      web-2  
192.168.1.41      sql  
192.168.1.42      web-5  
192.168.1.50      web-test  
192.168.1.61      db-prod  
192.168.1.52      nfs-4  
192.168.1.60      web-3  
192.168.1.61      db-test  
192.168.1.62      nfs-prod
```



DNS



DNS

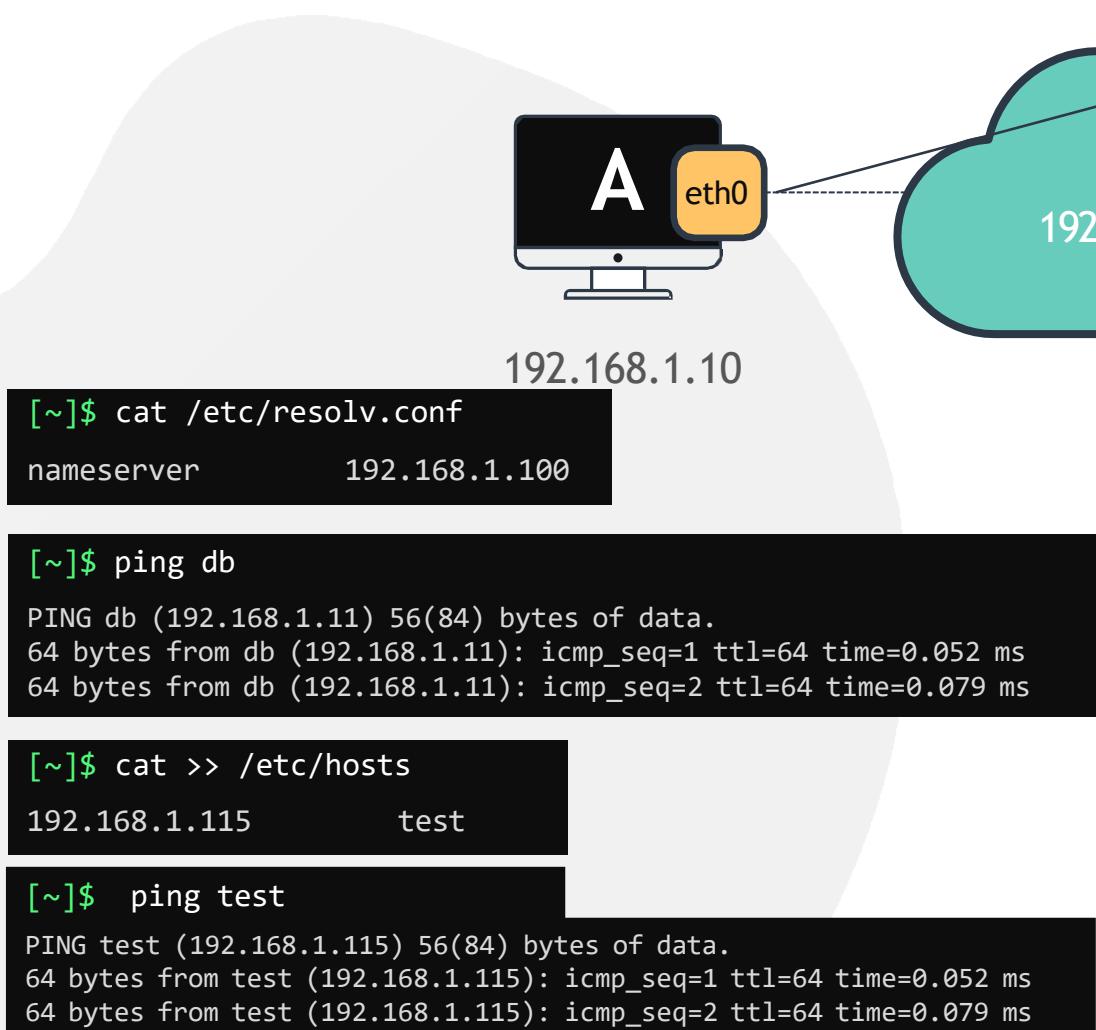


```
[~]$ cat /etc/resolv.conf
nameserver 192.168.1.100
```

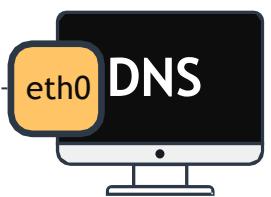
```
[~]$ ping db
PING db (192.168.1.11) 56(84) bytes of data.
64 bytes from db (192.168.1.11): icmp_seq=1 ttl=64 time=0.052 ms
64 bytes from db (192.168.1.11): icmp_seq=2 ttl=64 time=0.079 ms
```



DNS



192.168.1.20	web
192.168.1.21	db-1
192.168.1.22	nfs-1
192.168.1.30	web-1
192.168.1.31	db-2
192.168.1.32	nfs-2
192.168.1.40	web-2
192.168.1.41	sql
192.168.1.42	web-5
192.168.1.50	web-test
192.168.1.61	db-prod
192.168.1.52	nfs-4
192.168.1.60	web-3
192.168.1.61	db-test
192.168.1.62	nfs-prod



192.168.1.100



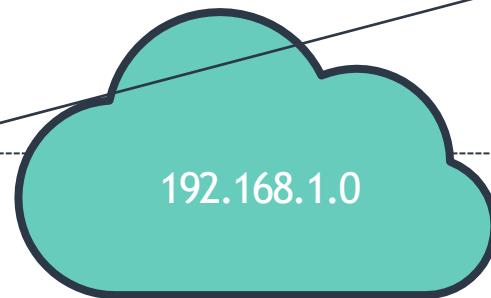
192.168.1.115



DNS

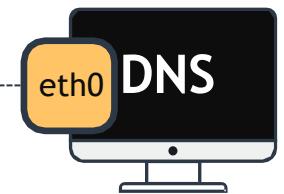


192.168.1.10



192.168.1.0

192.168.1.10	web
192.168.1.11	db
192.168.1.12	nfs
192.168.1.20	web
192.168.1.21	db-1
192.168.1.22	nfs-1
192.168.1.30	web-1
192.168.1.31	db-2
192.168.1.32	nfs-2
192.168.1.40	web-2
192.168.1.41	sql
192.168.1.42	web-5
192.168.1.50	web-test
192.168.1.61	db-prod
192.168.1.52	nfs-4
192.168.1.60	web-3
192.168.1.61	db-test
192.168.1.62	nfs-prod
192.168.1.116	test



192.168.1.100



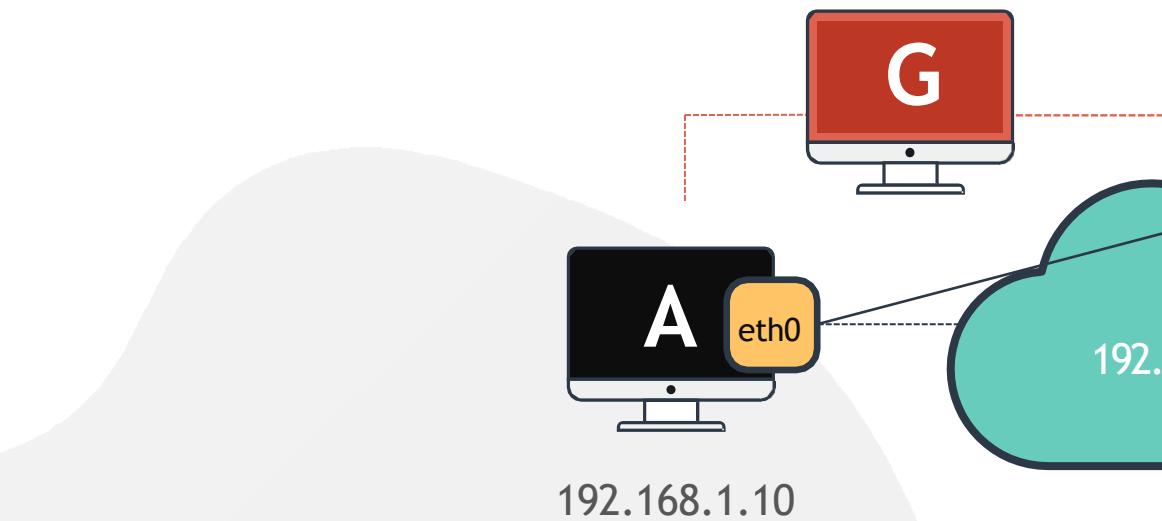
192.168.1.115

```
[~]$ cat >> /etc/hosts  
192.168.1.115      test
```

```
[~]$ cat /etc/nsswitch.conf  
...  
hosts:      files dns  
...
```



DNS



```
[~]$ cat >> /etc/hosts
192.168.1.115      test
```

```
[~]$ ping www.facebook.com
ping: www.facebook.com: Temporary failure in name resolution
```

```
[~]$ cat >> /etc/resolv.conf
nameserver      192.168.1.100
nameserver      8.8.8.8
```

```
[~]$ ping www.facebook.com
PING star-mini.c10r.facebook.com (157.240.13.35) 56(84) bytes of data.
64 bytes from edge-star-mini-shv-02-sin6.facebook.com (157.240.13.35): icmp_seq=1 ttl=50 time=5.70 ms
```

192.168.1.10	web
192.168.1.11	db
192.168.1.12	nfs
192.168.1.20	web
192.168.1.21	db-1
192.168.1.22	nfs-1
192.168.1.30	web-1
192.168.1.31	db-2
192.168.1.32	nfs-2
192.168.1.40	web-2
192.168.1.41	sql
192.168.1.42	web-5
192.168.1.50	web-test
192.168.1.61	db-prod
192.168.1.52	nfs-4
192.168.1.60	web-3
192.168.1.61	db-test
192.168.1.62	nfs-prod
192.168.1.116	test

Forward All to 8.8.8.8



192.168.1.100



192.168.1.115





Domain Names

www.kubernetes.io

www.codepen.io

www.un.org

www.facebook.com

www.mit.edu

www.behance.net

www.google.com

www.speedtest.net

www.stanford.edu

www.care.org



Domain Names

.com

.net

.edu

.org

.io

www.google

www.behance

www.stanford

www.care

www.kubernetes

www.facebook

www.speedtest

www.mit

www.un

www.codepen

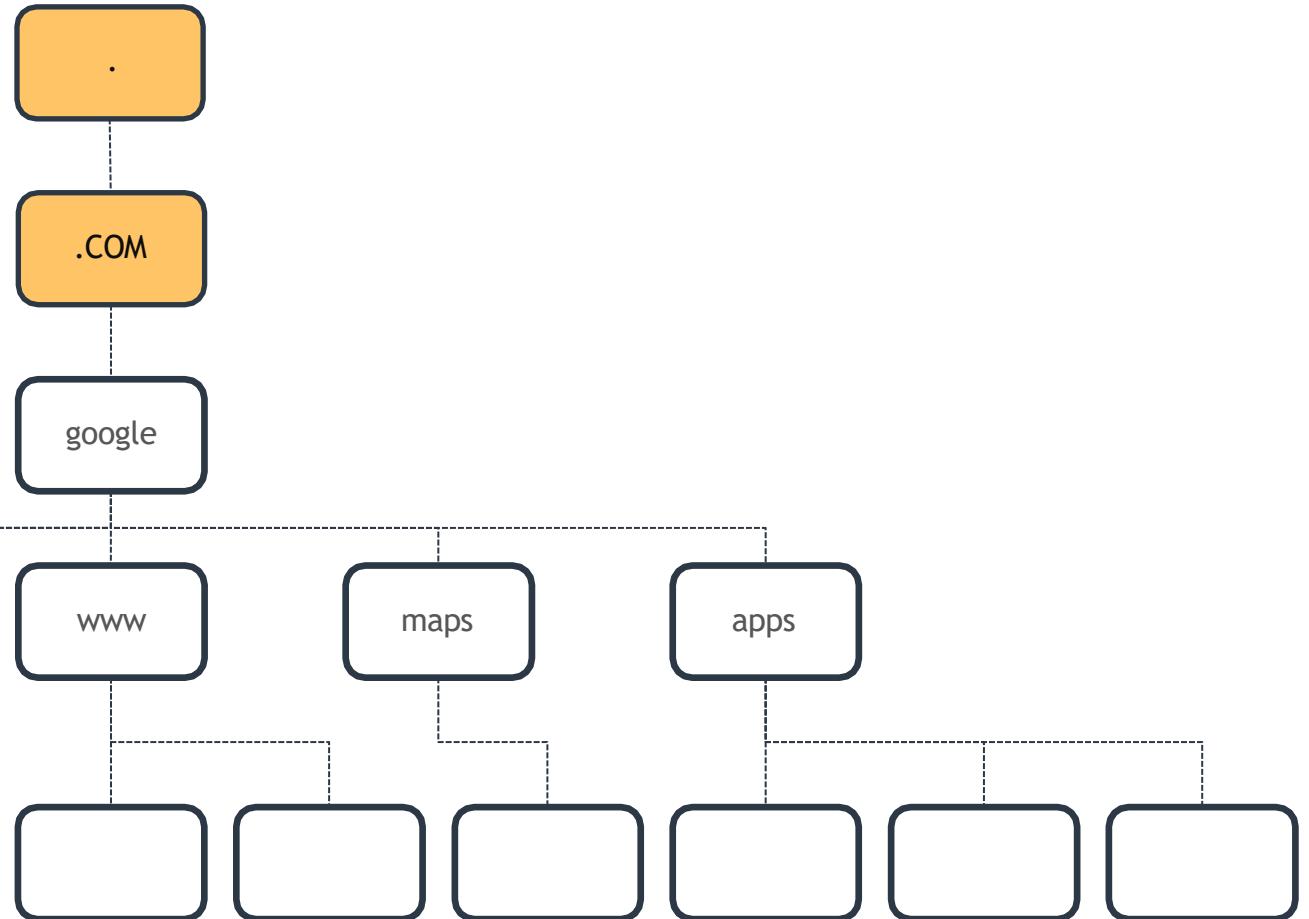


Domain Names

Root

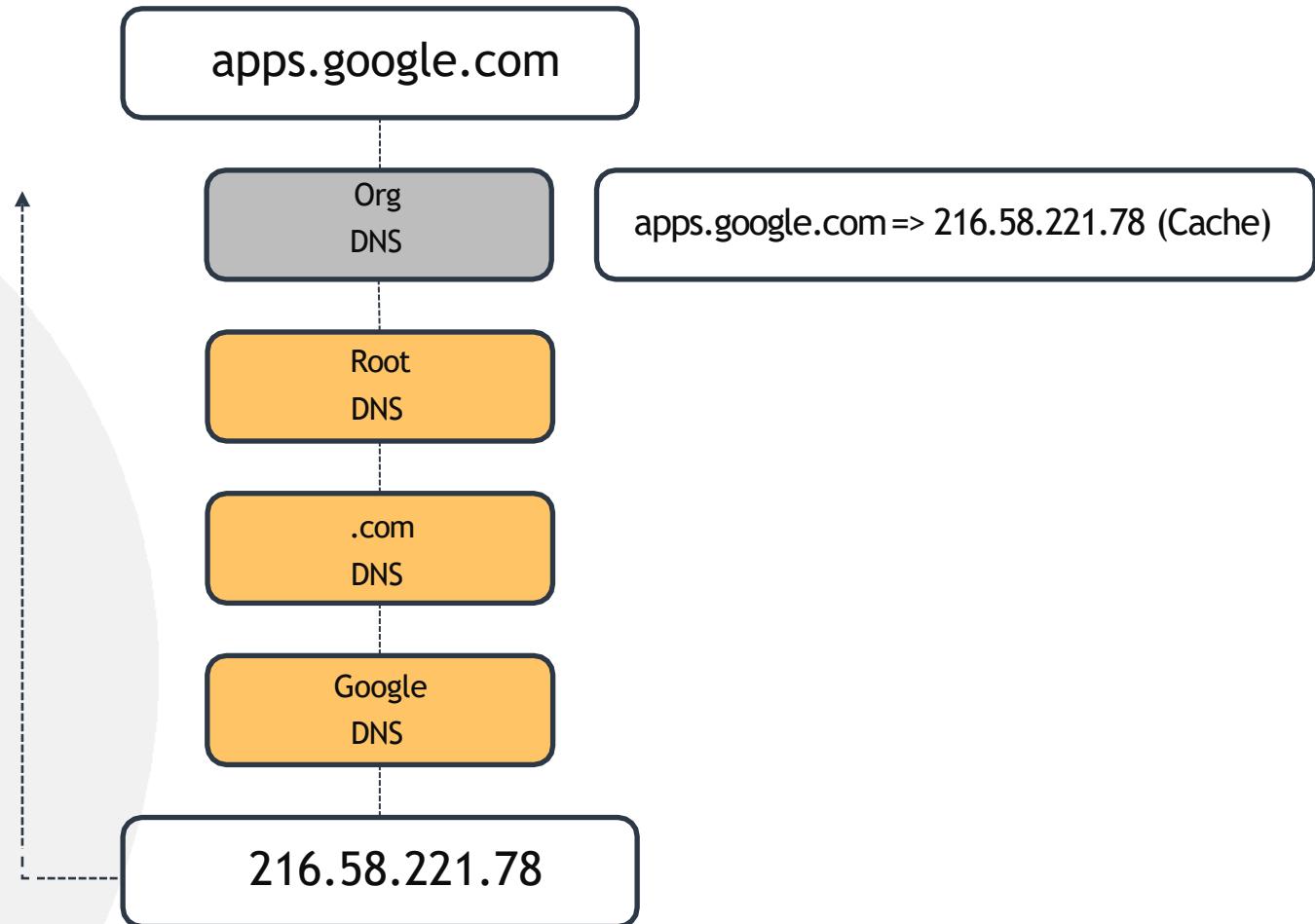
Top Level Domain Name

Subdomain



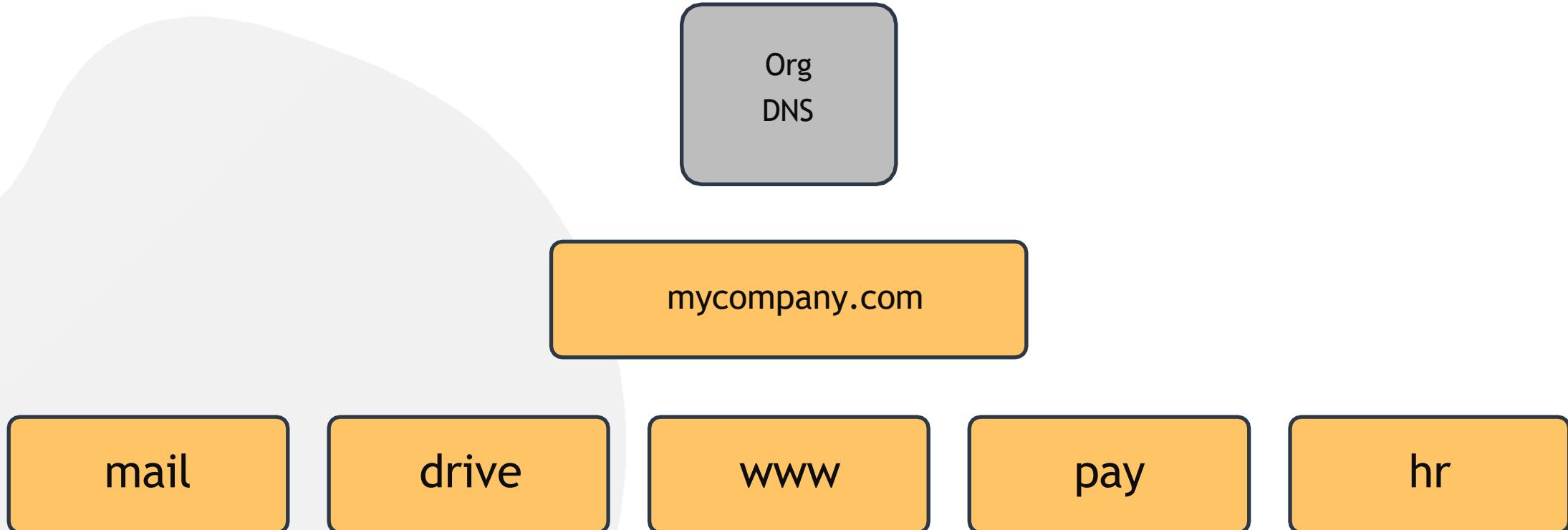


Domain Names





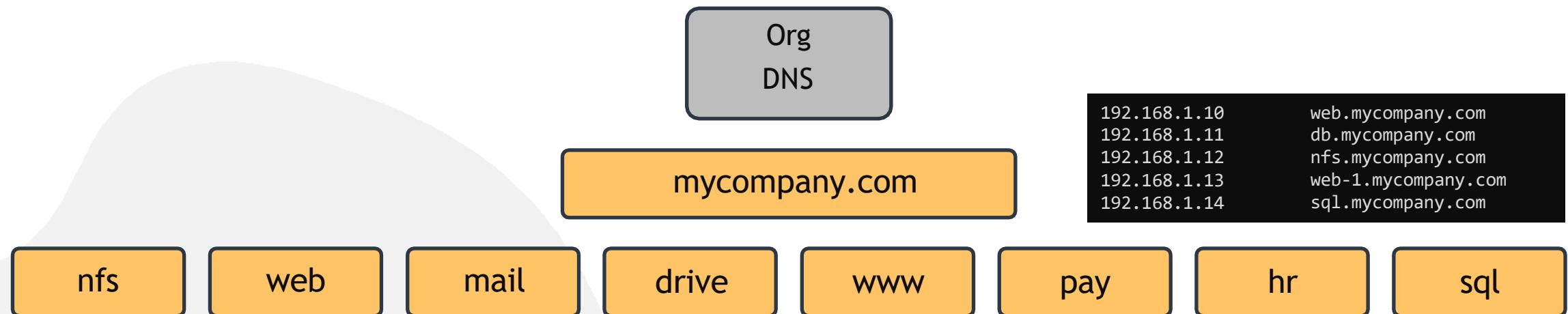
Domain Names



...



Search Domain



```
[~]$ cat >> /etc/resolv.conf
nameserver      192.168.1.100
search          mycompany.com    prod.mycompany.com
```

```
[~]$ ping web
PING web.mycompany.com (192.168.1.10) 56(84) bytes of data.
64 bytes from web.mycompany.com (192.168.1.10): ... time=0.052 ms
64 bytes from web.mycompany.com (192.168.1.10): ... time=0.079 ms
```

```
[~]$ ping web.mycompany.com
PING web.mycompany.com (192.168.1.10) 56(84) bytes of data.
64 bytes from web.mycompany.com (192.168.1.10): ttl=64 time=0.052 ms
```

```
[~]$ ping web
PING web (192.168.1.10) 56(84) bytes of data.
64 bytes from web (192.168.1.10): icmp_seq=1 ttl=64 time=0.052 ms
64 bytes from web (192.168.1.10): icmp_seq=2 ttl=64 time=0.079 ms
```

```
[~]$ ping web
ping: web: Temporary failure in name resolution
```

```
[~]$ ping web.mycompany.com
PING web.mycompany.com (192.168.1.10) 56(84) bytes of data.
64 bytes from web.mycompany.com (192.168.1.10): ttl=64 time=0.052 ms
```



Record Types

A	web-server	192.168.1.1
AAAA	web-server	2001:0db8:85a3:0000:0000:8a2e:0370:7334
CNAME	food.web-server	eat.web-server, hungry.web-server





nslookup

```
[~]$ nslookup www.google.com
```

```
Server:      8.8.8.8  
Address:     8.8.8.8#53
```

```
Non-authoritative answer:
```

```
Name:   www.google.com  
Address: 172.217.0.132
```





DIG

```
[~]$ dig www.google.com
; <>> DiG 9.10.3-P4-Ubuntu <>> www.google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 28065
;; flags: qr rd ra; QUERY: 1, ANSWER: 6, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 512
;; QUESTION SECTION:
;www.google.com.                      IN      A

;; ANSWER SECTION:
www.google.com.          245    IN      A      64.233.177.103
www.google.com.          245    IN      A      64.233.177.105
www.google.com.          245    IN      A      64.233.177.147
www.google.com.          245    IN      A      64.233.177.106
www.google.com.          245    IN      A      64.233.177.104
www.google.com.          245    IN      A      64.233.177.99

;; Query time: 5 msec
;; SERVER: 8.8.8.8#53(8.8.8.8)
;; WHEN: Sun Mar 24 04:34:33 UTC 2019
;; MSG SIZE  rcvd: 139
```





{KODE}{LOUD}

...

Switching & Routing

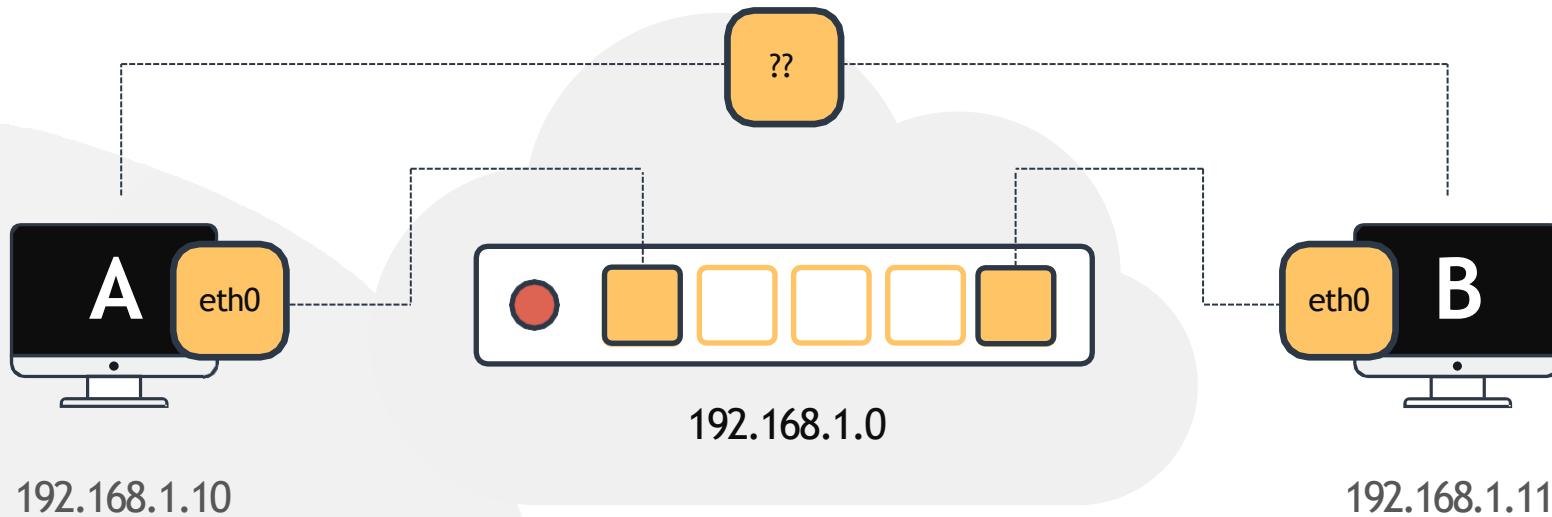


The Linux Basics Course

...



Switching



```
[~]$ ip link  
eth0: <POINT-TO-POINT,BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP mode  
DEFAULT group default qlen 1000
```

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

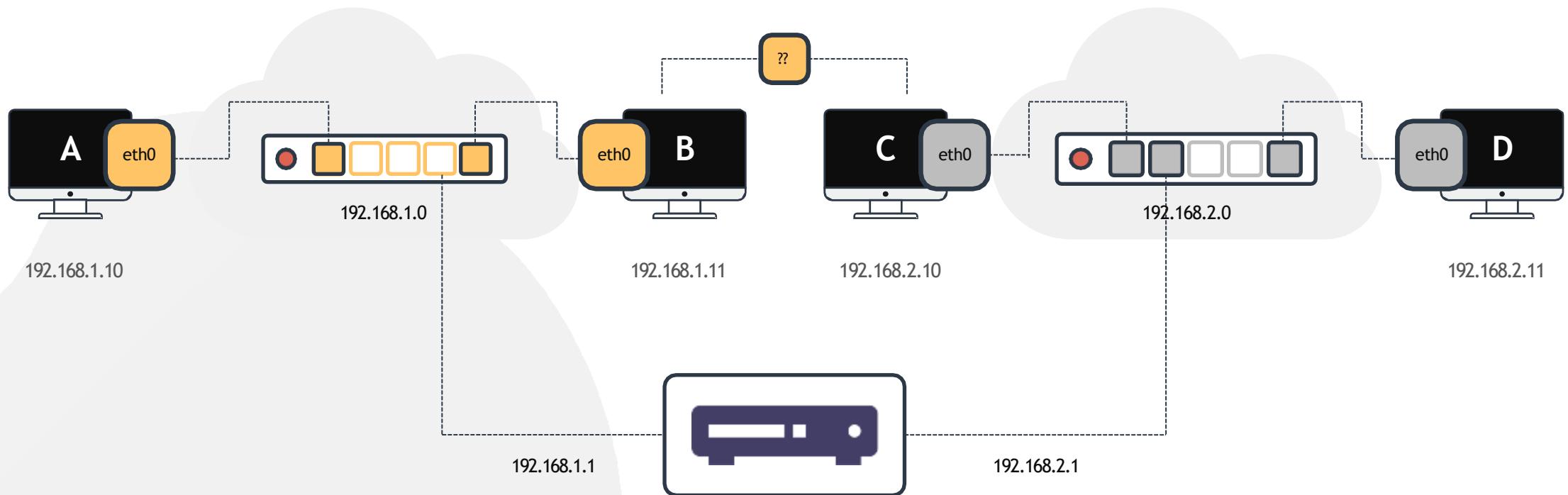
```
[~]$ ip link  
eth0: <POINT-TO-POINT,BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP mode  
DEFAULT group default qlen 1000
```

```
[~]$ ip addr add 192.168.1.11/24 dev eth0
```

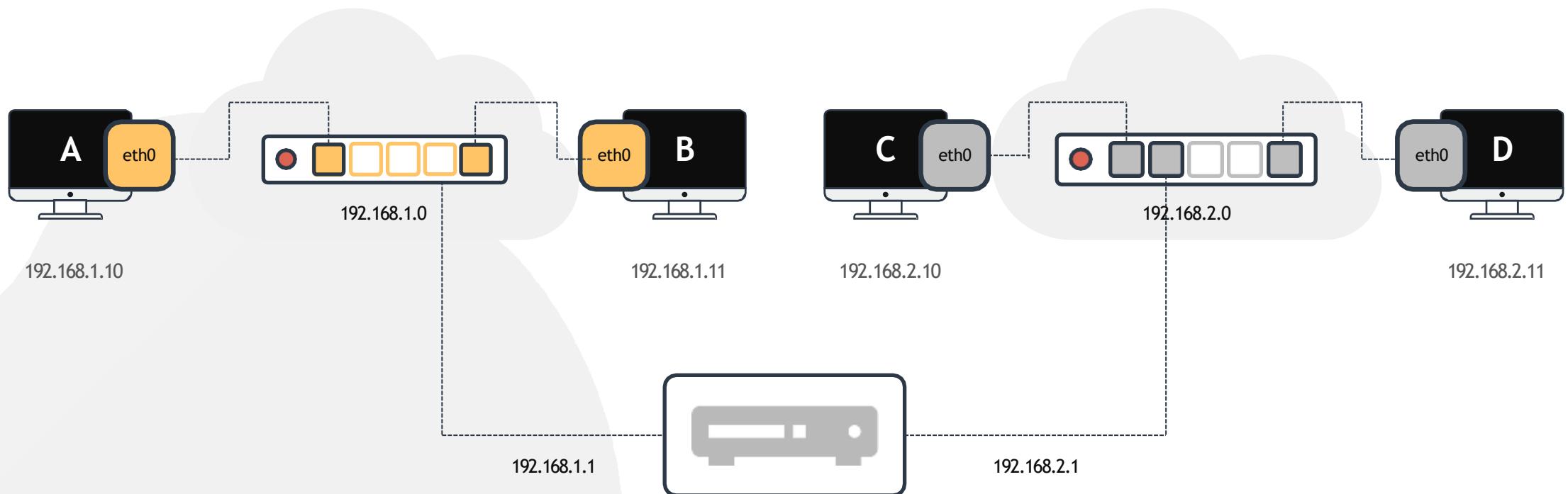
```
[~]$ ping 192.168.1.11  
Reply from 192.168.1.11: bytes=32 time=4ms TTL=117  
Reply from 192.168.1.11: bytes=32 time=4ms TTL=117
```



Routing



Gateway



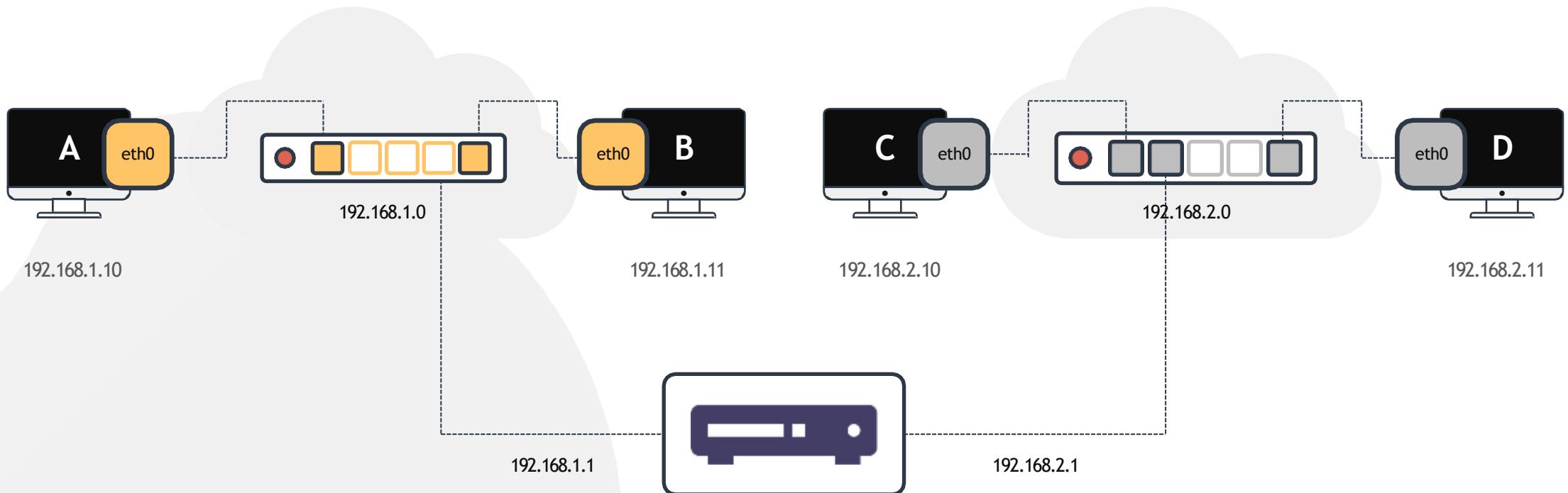
```
[~]$ route  
Kernel IP routing table  
Destination      Gateway          Genmask        Flags Metric Ref  Use Iface
```

```
[~]$ ip route add 192.168.2.0/24 via 192.168.1.1
```

```
[~]$ route  
Kernel IP routing table  
Destination      Gateway          Genmask        Flags Metric Ref  Use Iface  
192.168.2.0      192.168.1.1      255.255.255.0  UG     0      0      0 eth0
```



Gateway



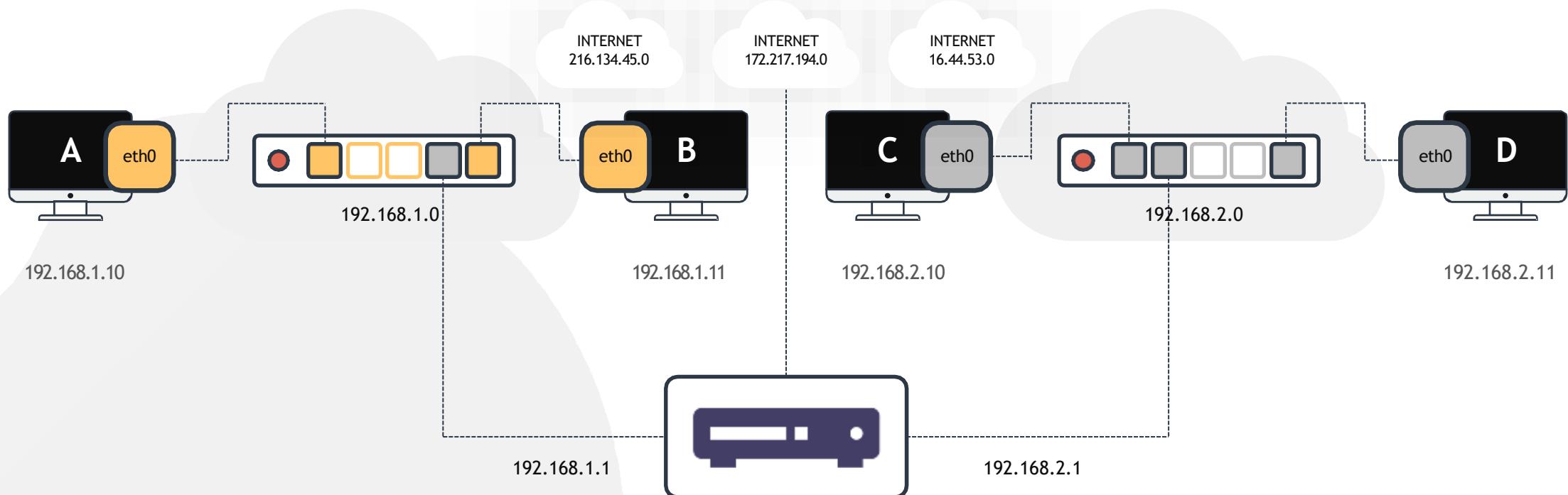
```
[~]$ ip route add 192.168.1.0/24 via 192.168.2.1
```

```
[~]$ route  
Kernel IP routing table  
Destination      Gateway          Genmask         Flags Metric Ref  Use Iface  
192.168.1.0      192.168.2.1    255.255.255.0  UG     0      0      0 eth0
```





Default Gateway



```
[~]$ ip route add default via 192.168.2.1
```

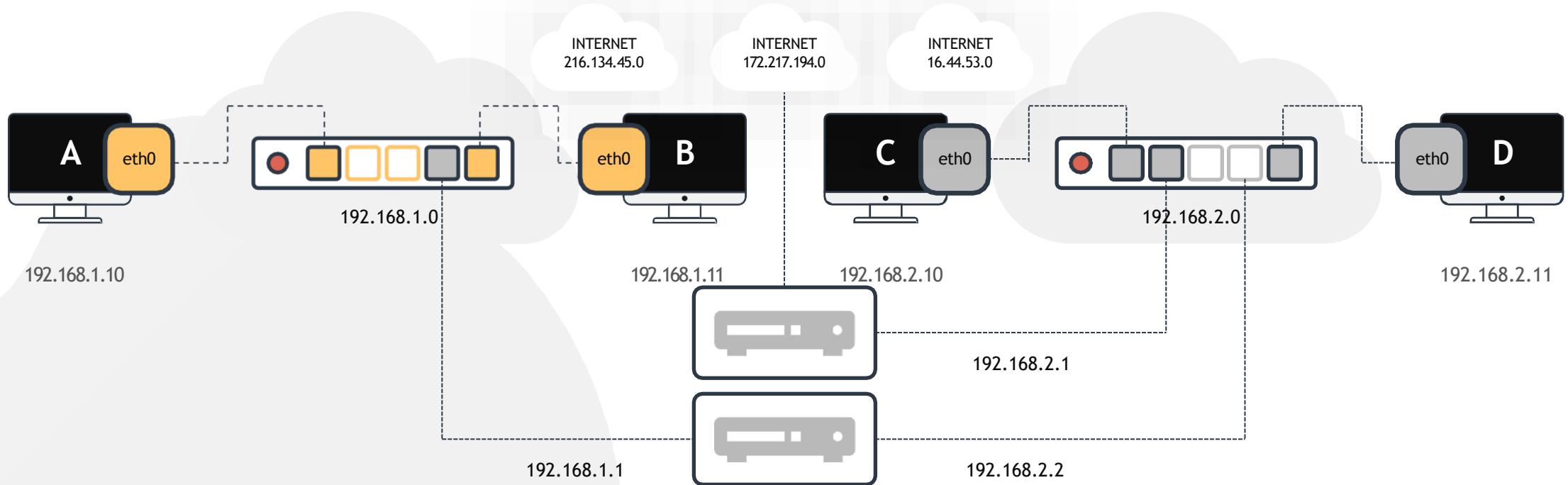
```
[~]$ ip route add 192.168.1.0/24 via 192.168.2.1
```

```
[~]$ route  
Kernel IP routing table  
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface  
192.168.1.0     192.168.2.1   255.255.255.0 UG      0      0      0 eth0  
192.168.2.0     0.0.0.0       255.255.255.0 UG      0      0      0 eth0
```





Default Gateway



```
[~]$ ip route add 192.168.1.0/24 via 192.168.2.2
```

```
[~]$ route  
Kernel IP routing table  
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface  
default         192.168.2.1   255.255.255.0  UG    0      0      0  eth0  
192.168.1.0    192.168.2.2   255.255.255.0  UG    0      0      0  eth0
```





Take Aways

```
[~]$ 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
```





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...



Troubleshooting Network



The Linux Basics Course

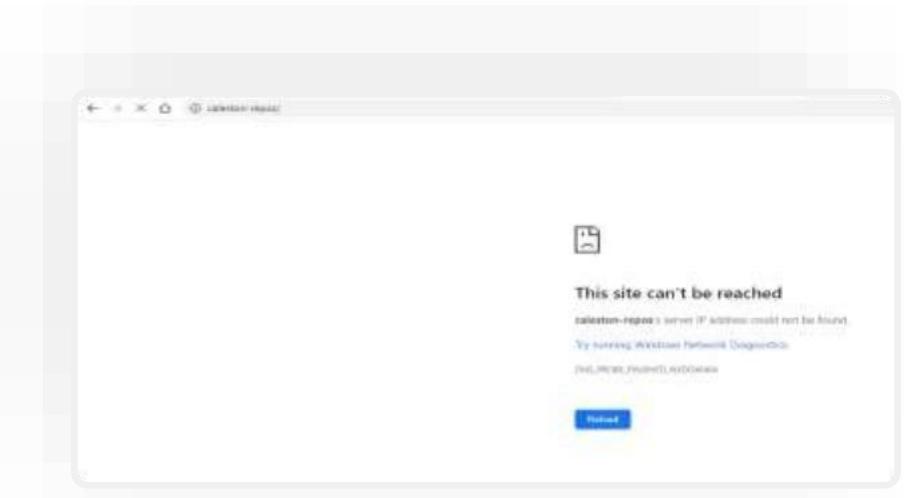




<http://caleston-repo-01>



Repository Server

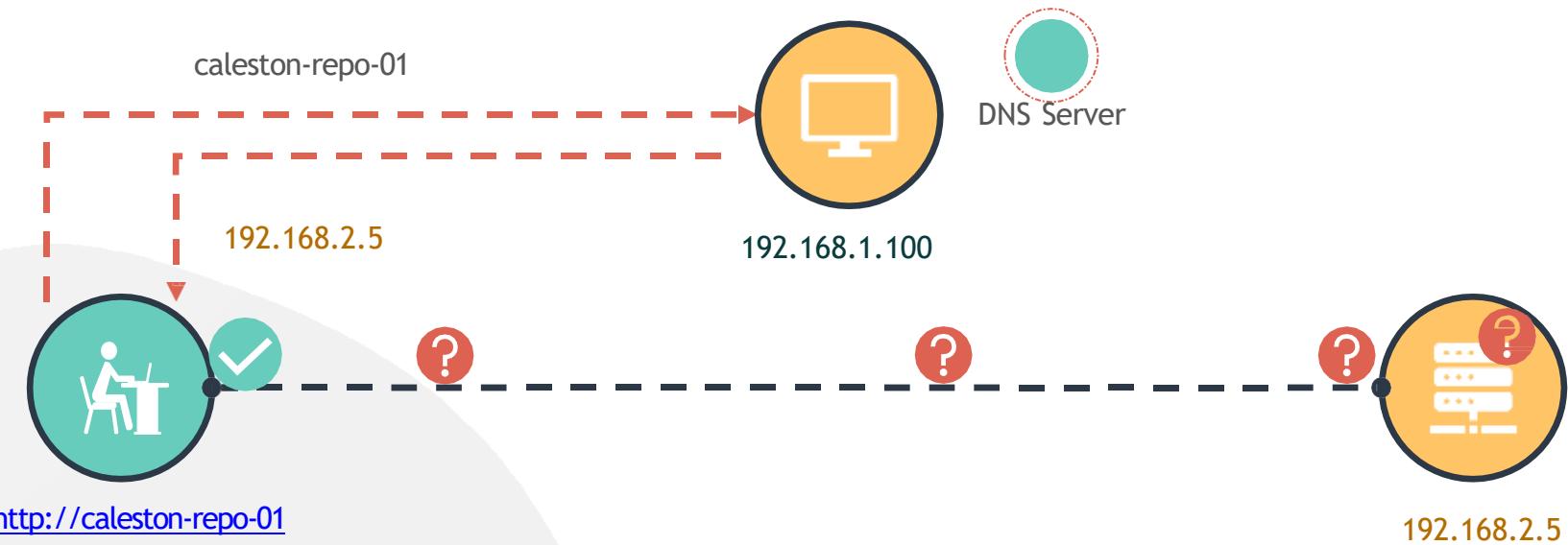




```
[~]$ ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc
    noqueue state UNKNOWN mode DEFAULT group default qlen
    1000 link/loopback 00:00:00:00:00:00 brd
    00:00:00:00:00:00
2: enp1s0f1: <BROADCAST,BROADCAST,MULTICAST,UP> mtu 1500 qdisc
    fq_codel state UP mode DEFAULT group default qlen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

Check Interfaces



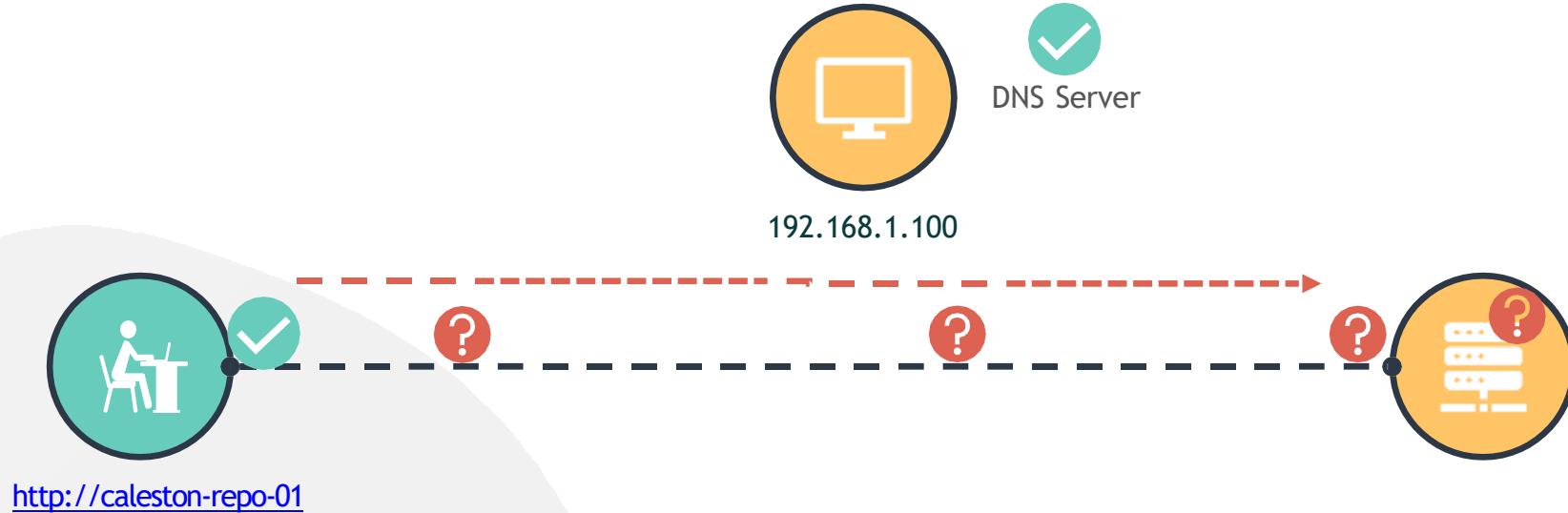


```
[~]$ nslookup caleston-repo-01
Server:      192.168.1.100
Address:     192.168.1.100 #53

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

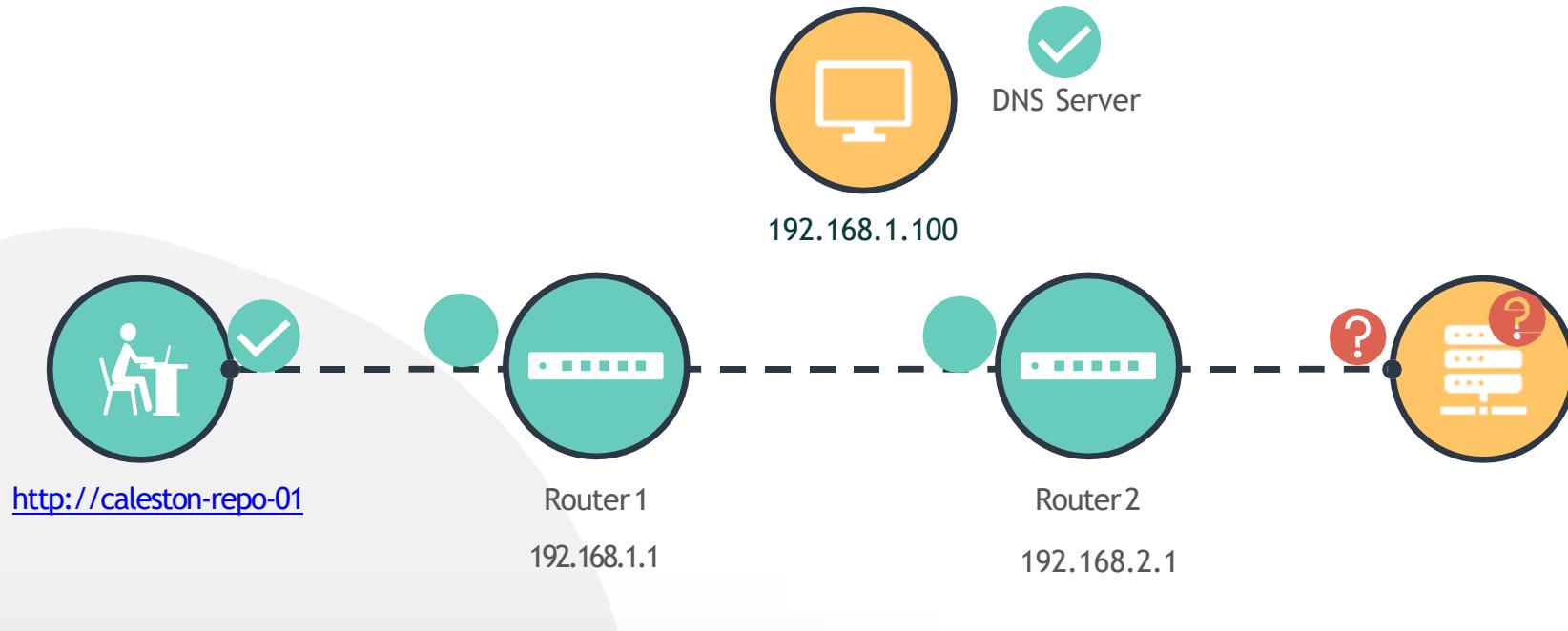
Check DNS
Resolution





```
[~]$ 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
```

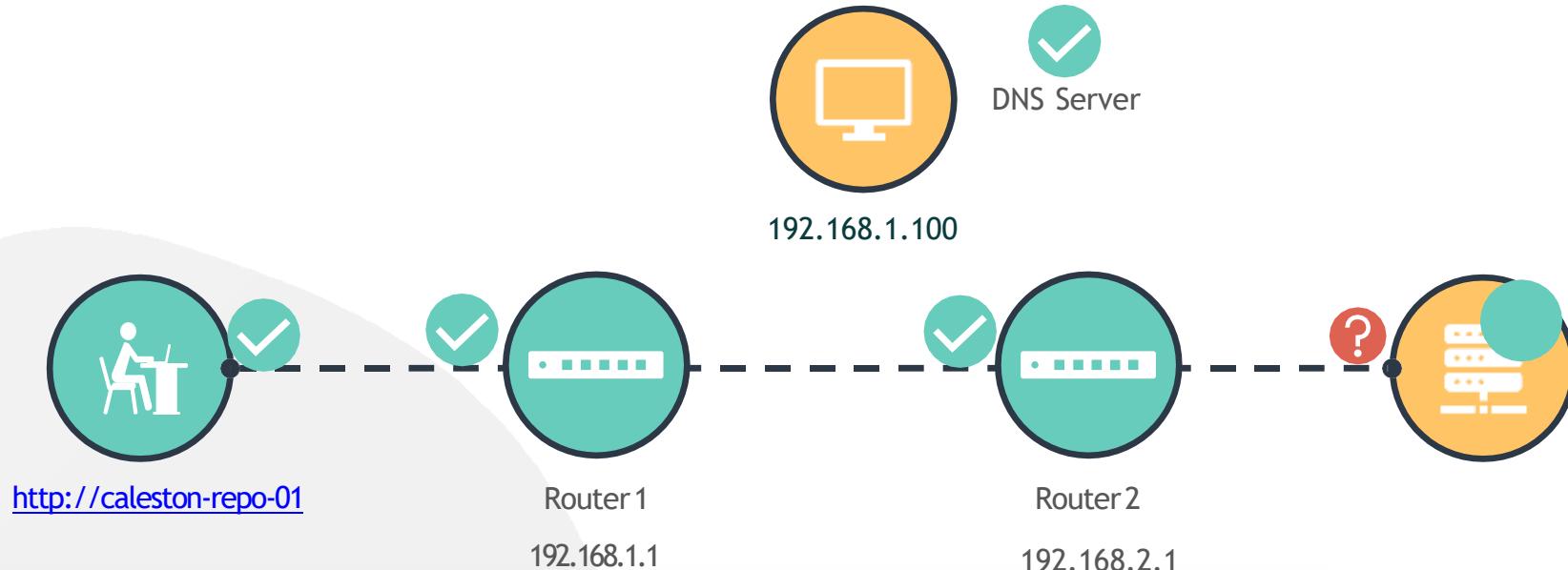
Check
Connectivit...
y



```
[~]$ 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

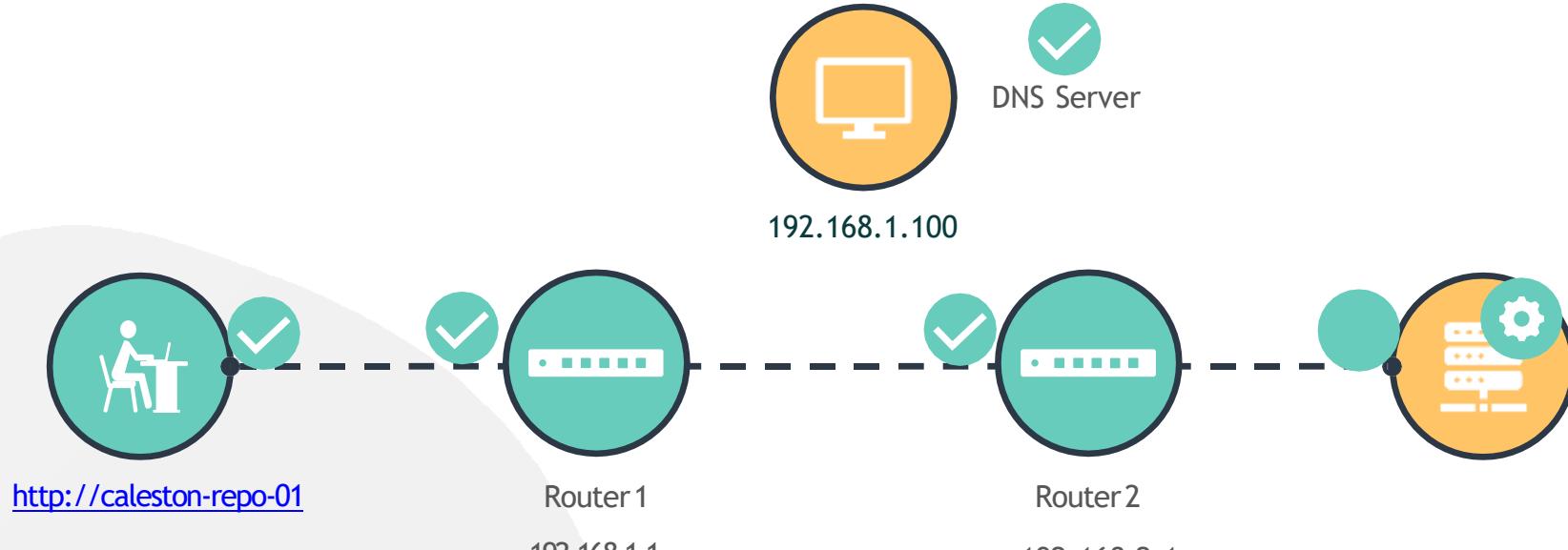




```
[caleston-repo-01: ~]$ netstat -an | grep      | grep -i LISTEN
80  tcp6      0      0 ::::80                  ::::*          LISTEN
```

Check
Service
s

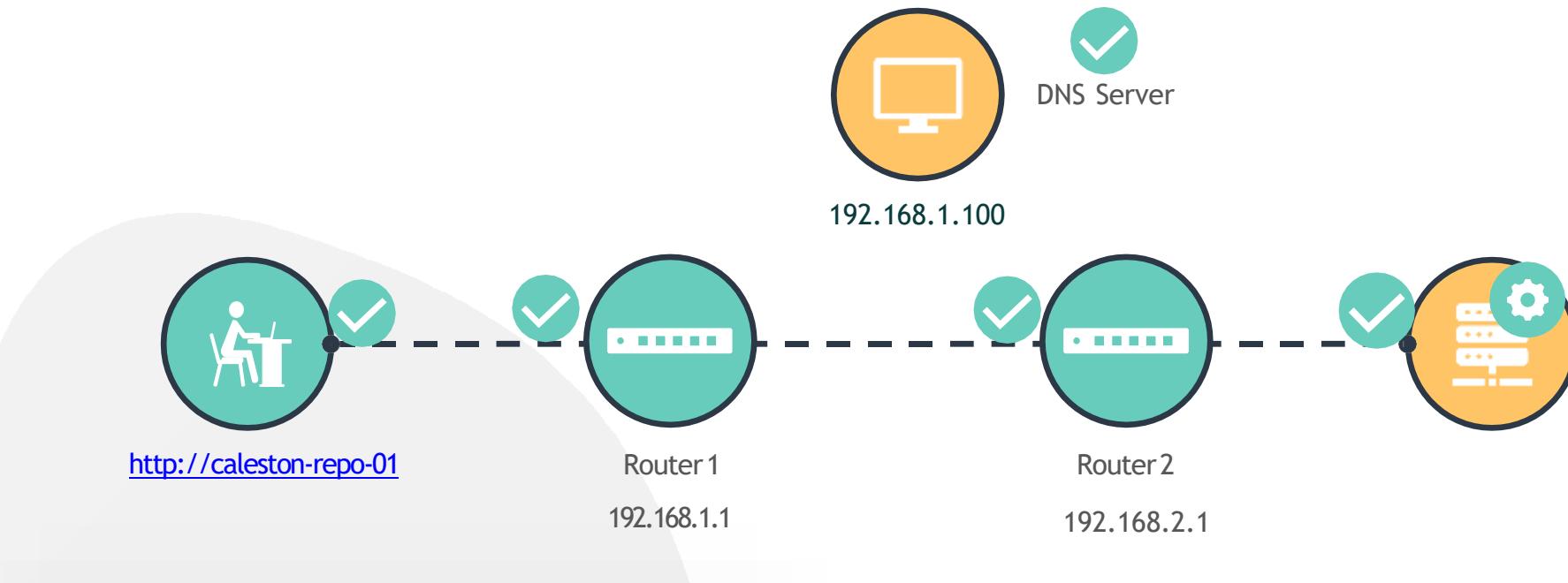




```
[caleston-repo-01: ~]$ ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc
    noqueue state UNKNOWN mode DEFAULT group default qlen
    1000 link/loopback 00:00:00:00:00:00 brd
    00:00:00:00:00:00
2: enp1s0f1: <BROADCAST,BROADCAST,MULTICAST,UP> mtu 1500 qdisc
    fq_codel state DOWN mode DEFAULT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

Check Interfaces





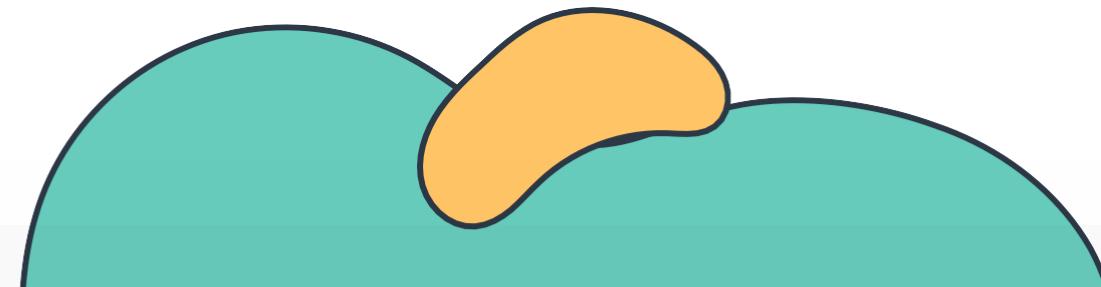
Index of /packages

<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
Parent Directory		-	
Debian/	2020-03-30 20:41	-	
RedHat/	2020-03-30 20:41	-	



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Storage Basics



The Linux Basics Course





Storage Basics

Disk Partitions

External Storage Devices (DAS/NAS/SAN)

Linux Filesystems (EXT2-EXT4)

Logical Volume Manager

Labs: Partitions and Filesystems

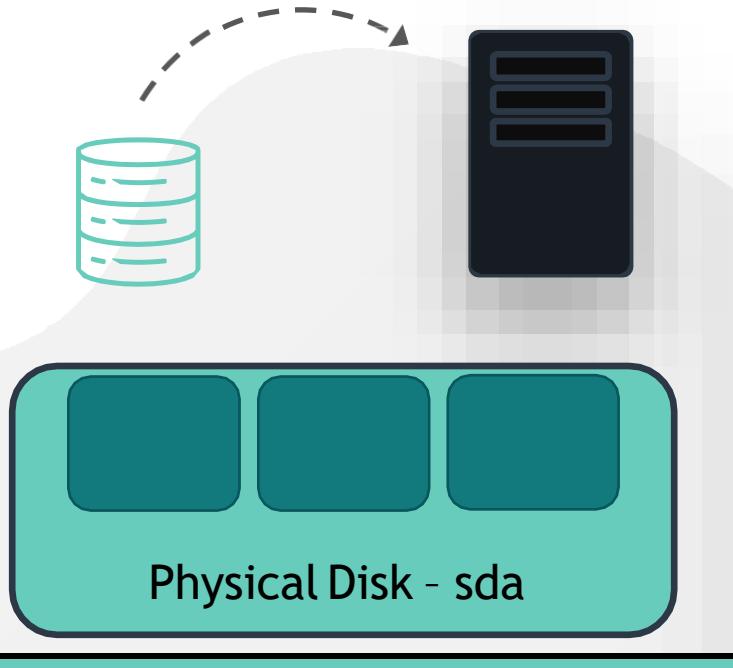
Labs: LVM

NFS





INTRODUCTION TO STORAGE BASICS



Major Number	Device Type
1	RAM
3	HARD DISK or CD ROM
6	PARALLEL PRINTERS
8	SCSI DISK

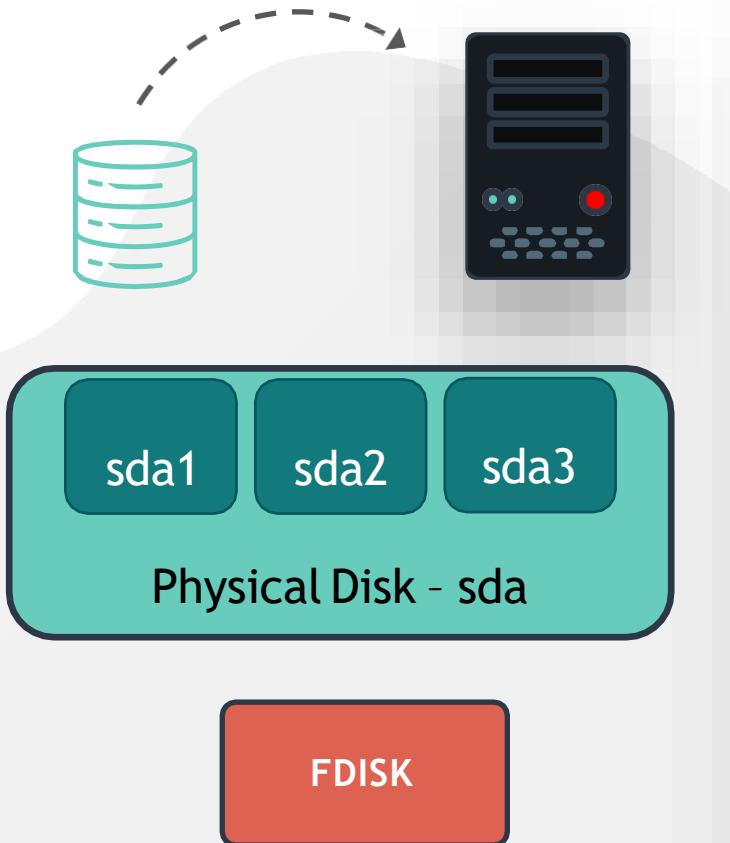
```
[~]$ lsblk
```

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	72.5G	0	part	/media/MM/Data
└─sda3	8:3	0	46.6G	0	part	/

```
[~]$ ls -l /dev/ | grep "^\b"
```

brw-rw----	1	root	disk	8,	0	Mar 19 17:43	sda
brw-rw----	1	root	disk	8,	1	Mar 19 17:43	sda1
brw-rw----	1	root	disk	8,	2	Mar 19 17:43	sda2
brw-rw----	1	root	disk	8,	3	Mar 19 17:43	sda3

DISK PARTITIONS



```
[~]$ 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	72.5G	0	part	/media/MM/Data
└─sda3	8:3	0	46.6G	0	part	/

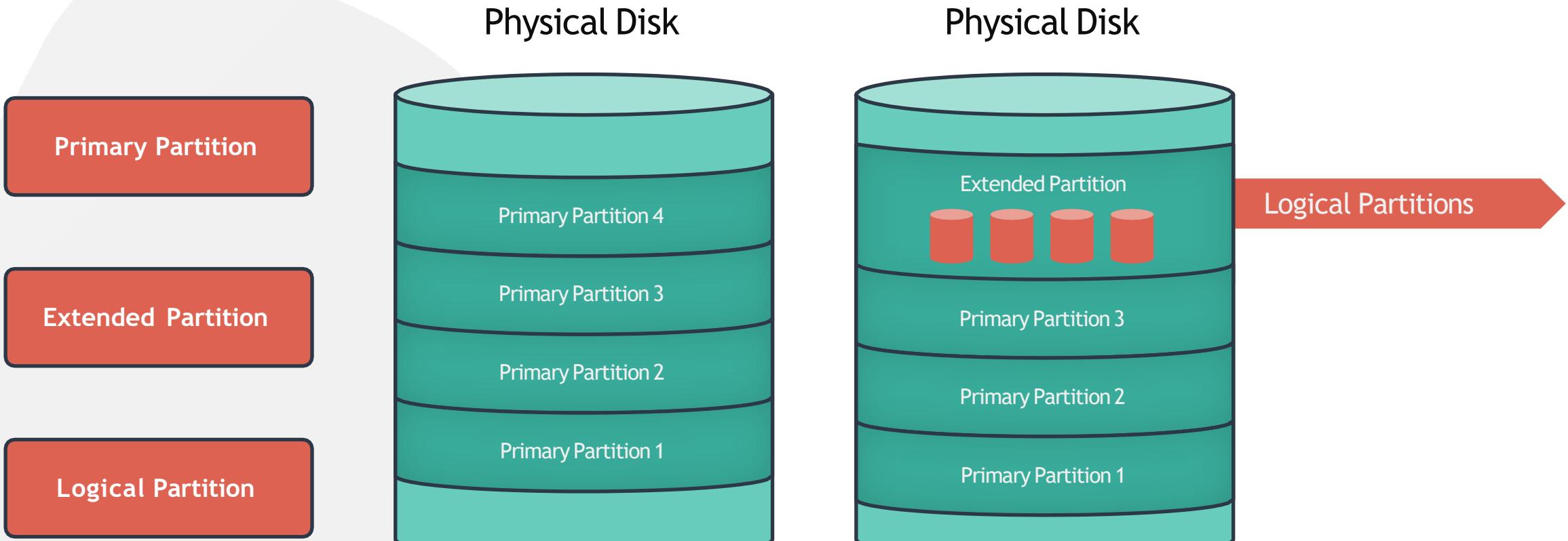
```
[~]$ sudo fdisk -l /dev/sda
```

Disk /dev/sda: 119.2 GiB, 128035676160 bytes, 250069680 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: gpt
Disk identifier: 26E-9EAD-4486-E6A1-C8B2B5270A23

	2048	206847	204800	100M	EFI System
/dev/sda1	2048	206847	204800	100M	EFI System
/dev/sda2	239616	150194175	149954560	71.5G	Linux filesystem
/dev/sda3	150194176	247955455	97761280	46.6G	Linux filesystem

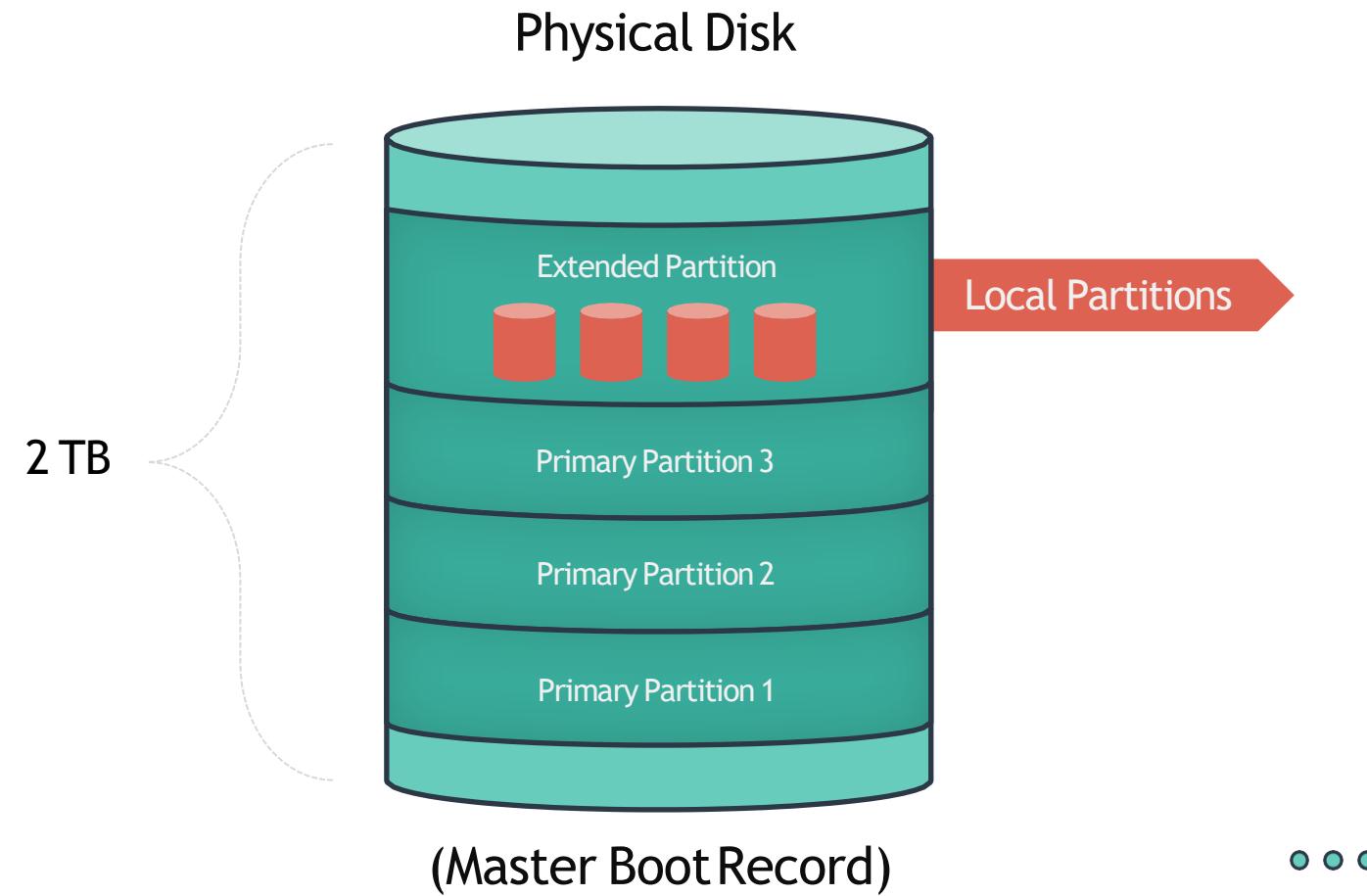


PARTITION TYPES - PRIMARY, EXTENDED AND LOGICAL

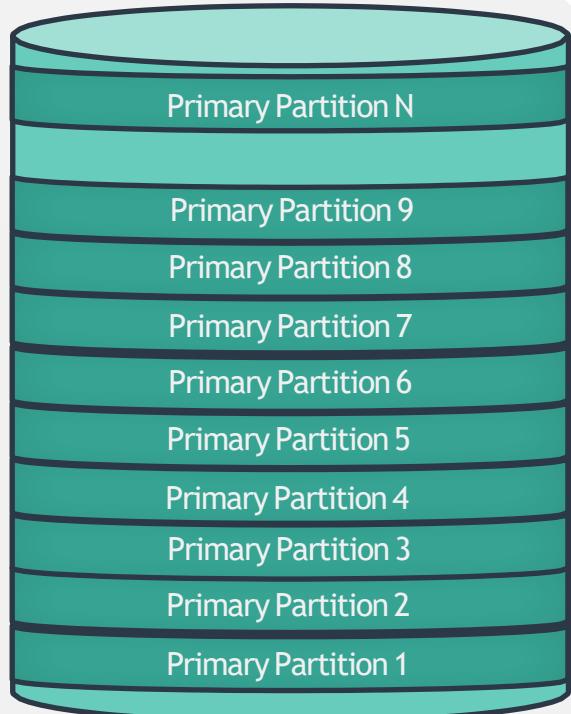




PARTITION SCHEME - MBR



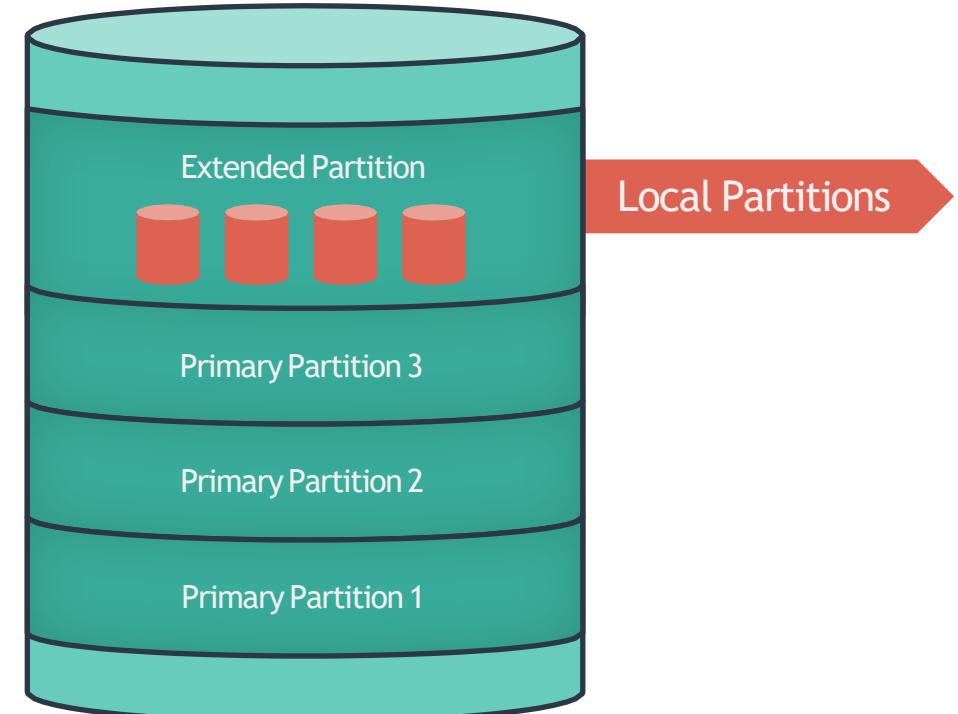
PARTITION SCHEME - GPT



(GUID Partition Table)

No max Size per partition
Unlimited partitions

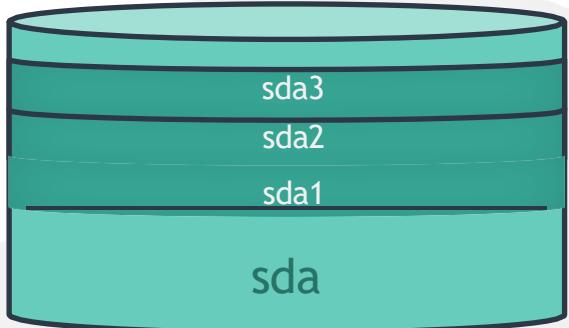
2 TB



(Master Boot Record)

• • •

CREATING PARTITIONS



```
[~]$ lsblk
```

Device	Major:Minor	Mount Point	File System	Block Size	Number of Blocks	Disk Type
fd0	2:0			4K	0	disk
sr0	11:0			1024M	0	rom
sda	8:0			97.7G	0	disk
-sda1	8:1	/	ext4	93.7G	0	part
-sda2	8:2			1K	0	part
-sda5	8:5			3.9G	0	part
sdb	88:155			200G	0	disk

```
[~]$ gdisk /dev/sdb
```

GPT fdisk (gdisk) version 1.0.1

Partition table scan:
MBR: protective
BSD: not present
APM: not present
GPT: present

Found valid GPT with protective MBR; using
GPT. Command (? for help):

CREATING PARTITIONS



```
[~]$ gdisk /dev/sdb
GPT fdisk (gdisk) version 1.0.1

Partition table scan:
  MBR: protective
  BSD: not present
  APM: not present
  GPT: present

Found valid GPT with protective MBR; using
GPT.

b      back up GPT data to a file
c      change a partition's name
d      delete a partition
i      show detailed information on a partition
l      list known partition types
n      add a new partition
o      create a new empty GUID partition table (GPT)
p      print the partition table
q      quit without saving changes
r      recovery and transformation options (experts only)
s      sort partitions
t      change a partition's type code
v      verify disk
w      write table to disk and exit
x      extra functionality (experts only)

Command (? for help):
```

CREATING PARTITIONS



Command (? for help): ?

```
b      back up GPT data to a file
c      change a partition's name
d      delete a partition
i      show detailed information on a partition
l      list known partition types
n      add a new partition
o      create a new empty GUID partition table (GPT)
p      print the partition table
q      quit without saving changes
r      recovery and transformation options (experts only)
s      sort partitions
t      change a partition's type code
v      verify disk
w      write table to disk and exit
x      extra functionality (experts only)
?      print this menu
```

Command (? for help): **n**

Partition number (1-128, default 1): **1**

First sector (34-41943006, default = 2048) or {+-}size{KMGTP}: **2048**

Information: Moved requested sector from 34 to 2048 in
order to align on 2048-sector boundaries.

Use 'l' on the experts' menu to adjust alignment

Last sector (2048-41943006, default = 41943006) or {+-}size{KMGTP}: **41943006**

Current type is 'Linux filesystem'

Hex code or GUID (L to show codes, Enter = 8300):

Changed type of partition to 'Linux filesystem'

Command (? for help): **w**

Final checks complete. About to write GPT data. THIS WILL OVERWRITE EXISTING
PARTITIONS!!

Do you want to proceed? (Y/N): **Y**

OK; writing new GUID partition table (GPT) to /dev/vdb.

The operation has completed successfully.

CREATING PARTITIONS



```
Command (? for help):
Partition number (1-128, default 1): 1
First sector (34-41943006, default = 2048) or {+-}size{KMGTP}: 2048
Information: Moved requested sector from 34 to 2048 in
order to align on 2048-sector boundaries.
Use 'l' on the experts' menu to adjust alignment
Last sector (2048-41943006, default = 41943006) or {+-}size{KMGTP}: 41943006
Current type is 'Linux filesystem'
Hex code or GUID (L to show codes, Enter = 8300):
Changed type of partition to 'Linux filesystem'

Command (? for help): W

Final checks complete. About to write GPT data. THIS WILL OVERWRITE EXISTING
PARTITIONS!!

Do you want to proceed? (Y/N): Y
OK; writing new GUID partition table (GPT) to /dev/vdb.
The operation has completed successfully.
```

```
[~]$ sudo fdisk -l /dev/sdb

Disk /dev/sdb: 20 GiB, 128035676160 bytes, 250069680
sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512
bytes I/O size (minimum/optimal): 512 bytes / 512
bytes
Disklabel type: gpt
Disk identifier: 5ABF26E-9723-4406-75A1-C8B2B6D70A23
          Device      Start    End  Sectors  Size Type
/dev/sdb1        2048 41943006 41940959 20GB Linux filesystem
```

HANDS-ON LABS





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...

Linux Filesystems



The Linux Basics Course



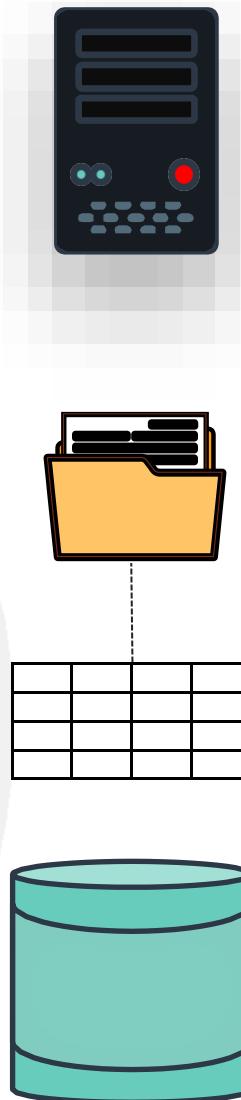


/my-disk

Mount Filesystem

Create Filesystem

Partition Disk



...

Linux Filesystem

EXT2

2 TB File size

4 TB volume size

Supports Compression

Supports Linux Permissions

Long Crash Recovery

EXT3

2 TB File size

4 TB volume size

Uses Journal

Backwards Compatible

EXT4

16 TB File size

Uses Journal

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
Mountpoint	Directory to be mounted on
Options	Such as RW = Read-write, RO = Read Only
Dump	0 = Ignore, 1 = take backup



HANDS-ON LABS





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...

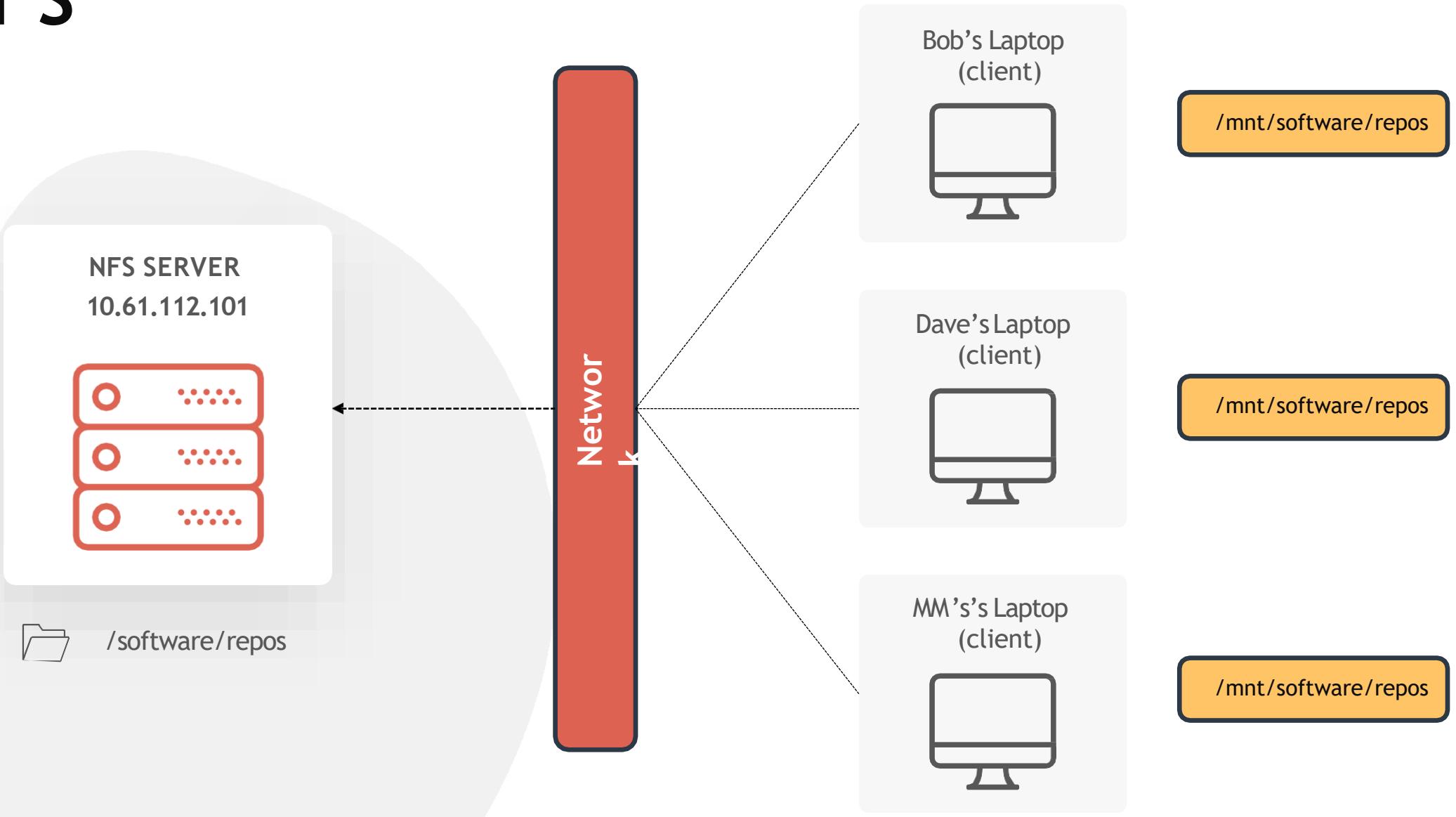
Network **Filesystem**



The Linux Basics Course



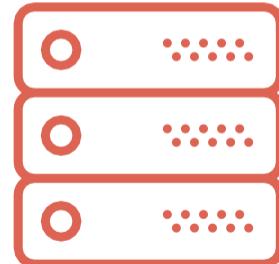
NFS



NFS

```
[~]$ /etc/exports  
/software/repos 10.61.35.201 10.61.35.202  
10.61.35.203
```

NFS SERVER
10.61.112.101



/software/repos



Bob's Laptop (client)

10.61.35.201



Dave's Laptop (client)

10.61.35.202



Mohan's Laptop (client)

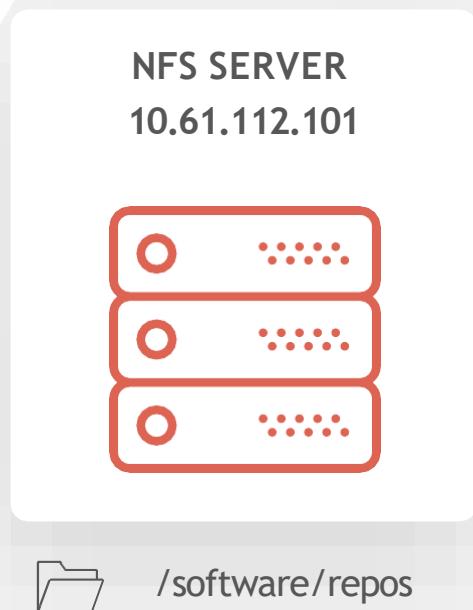
10.61.35.203



...

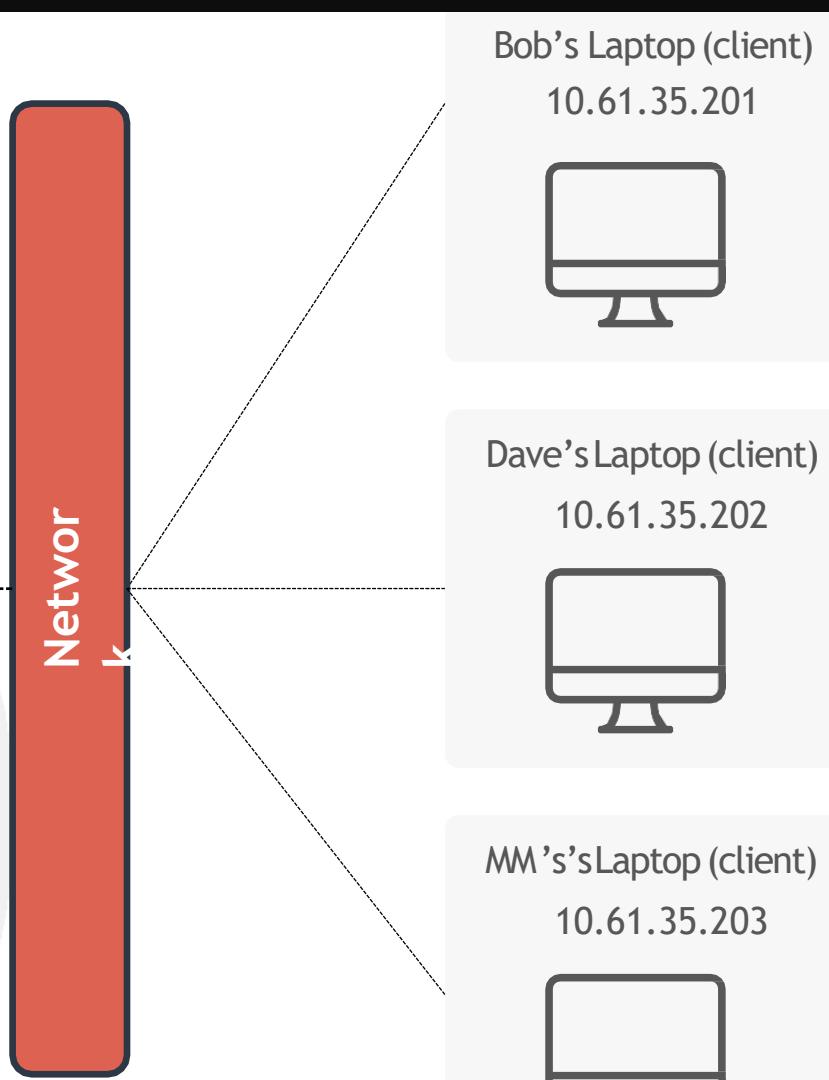
NFS

```
[~]$ mount 10.61.112.101:/software/repos /mnt/software/repos
```



```
[~]$ exportfs -a
```

```
[~]$ exportfs -o  
10.61.35.201:/software/repos
```



/mnt/software/repos



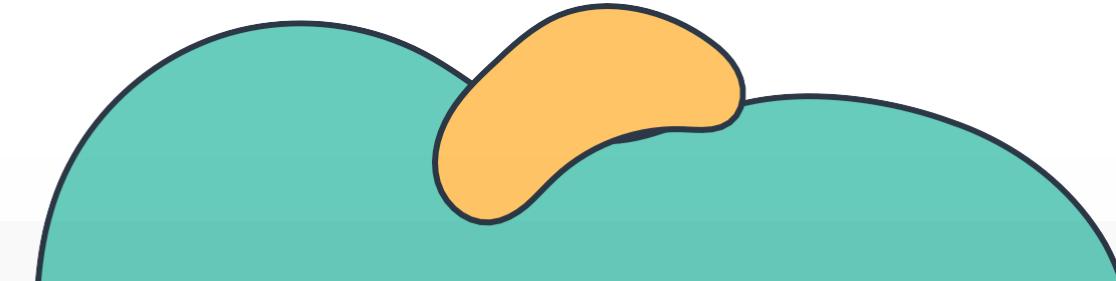
HANDS-ON LABS





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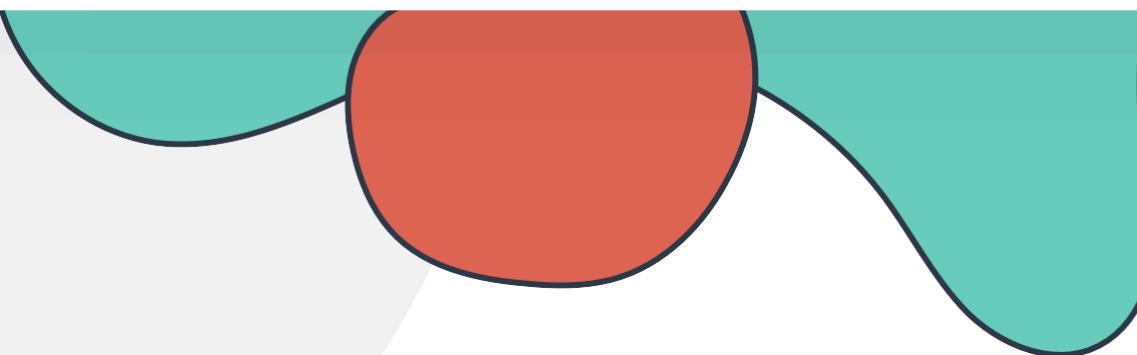
...



DAS, NAS & SAN



The Linux Basics Course

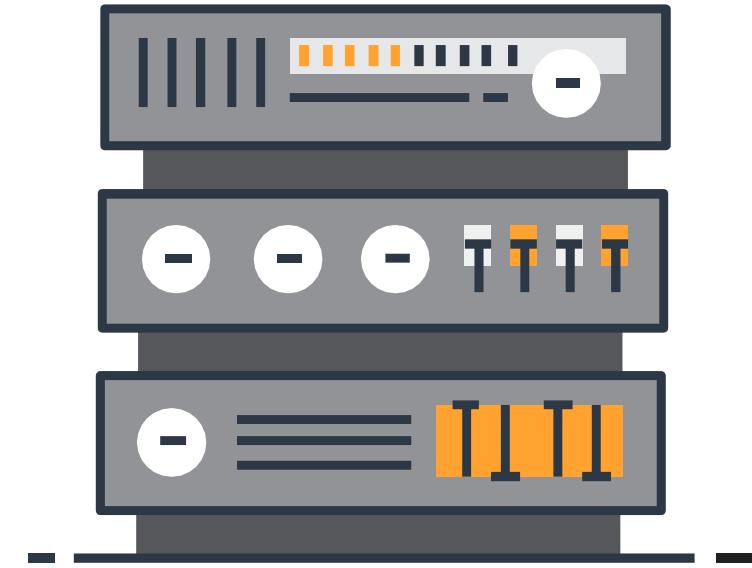


DAS, NAS and SAN

DAS = DirectAttached Storage

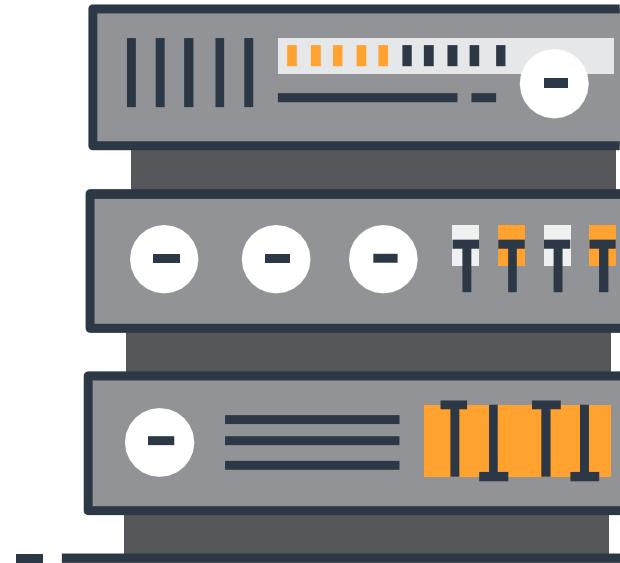
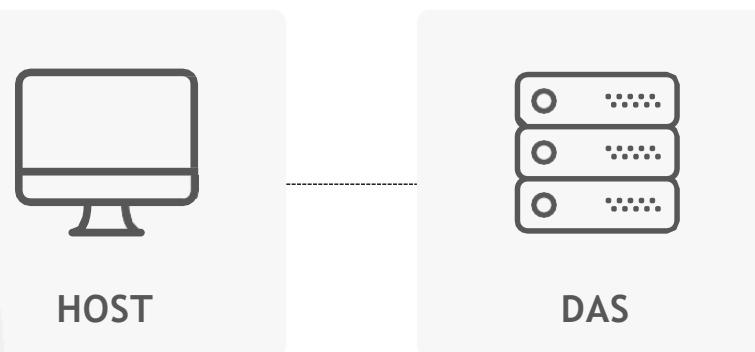
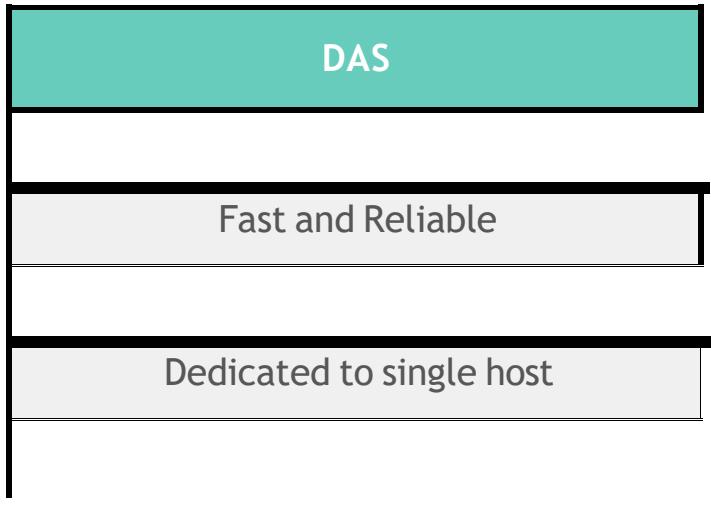
NAS = Network Attached Storage

SAN = Storage Area Network



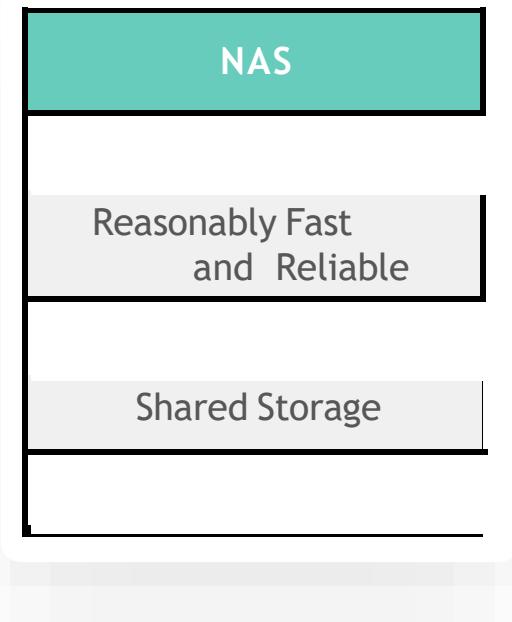
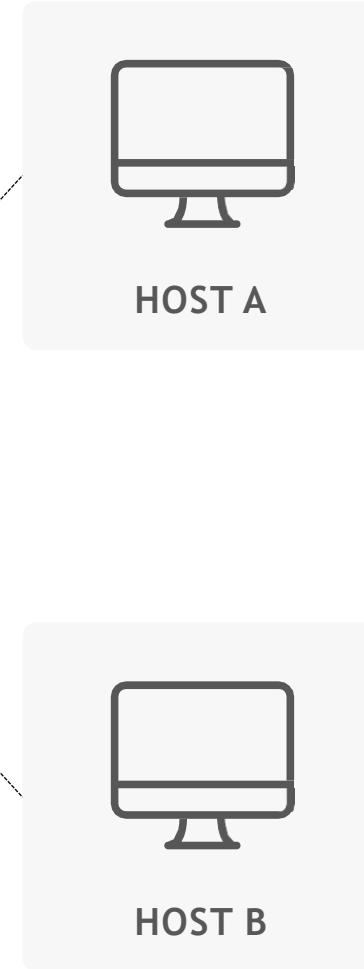
DAS

DAS = DirectAttached Storage

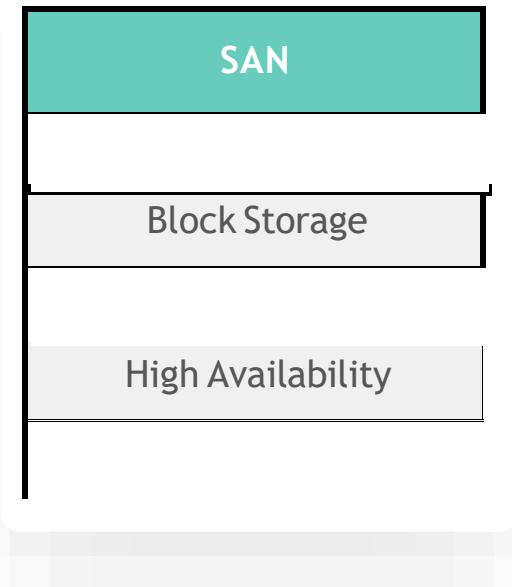
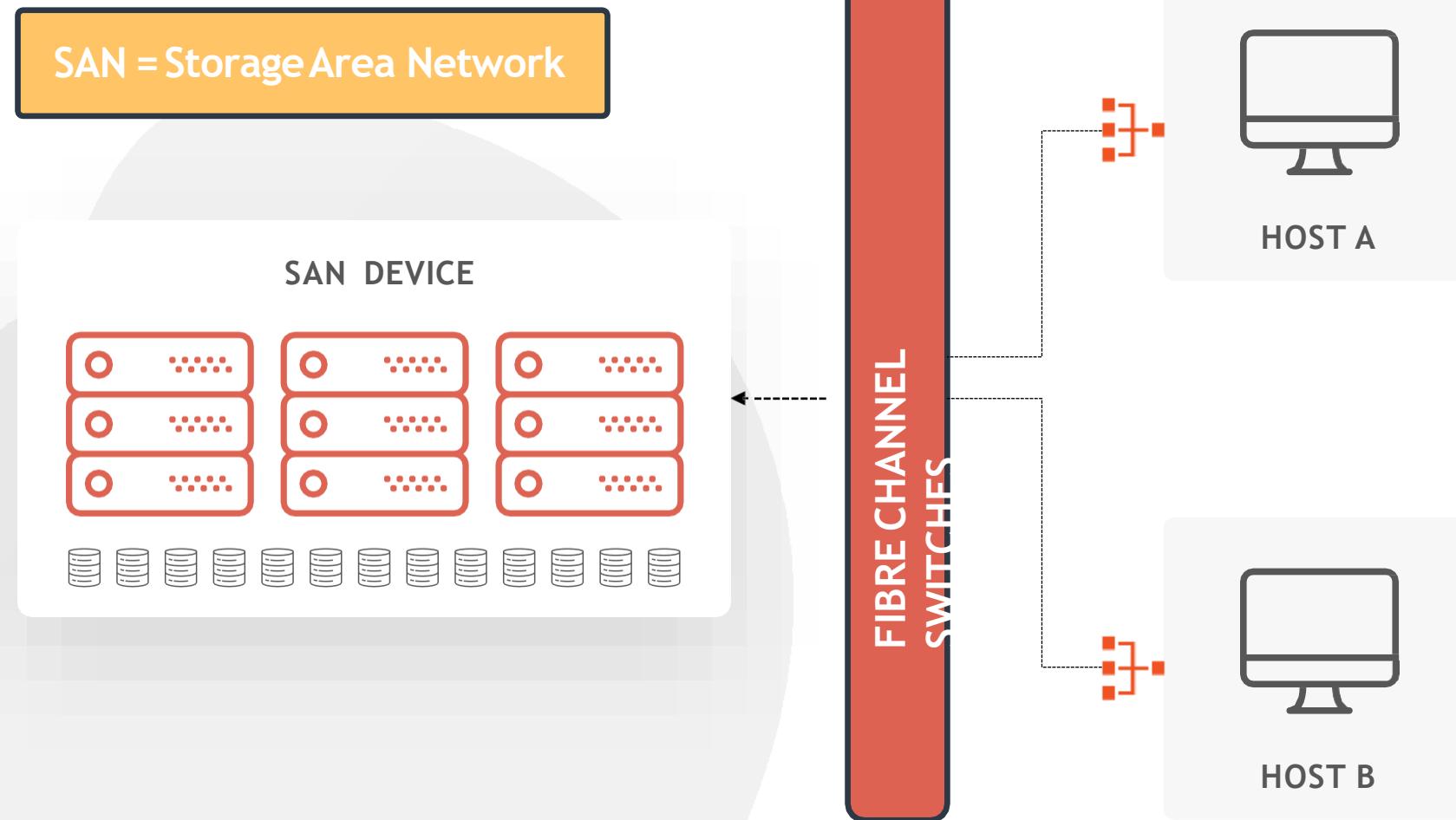


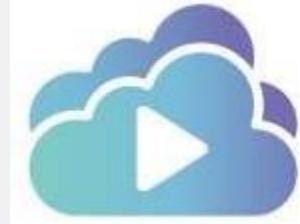
NAS

NAS = NetworkAttached Storage



SAN





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...

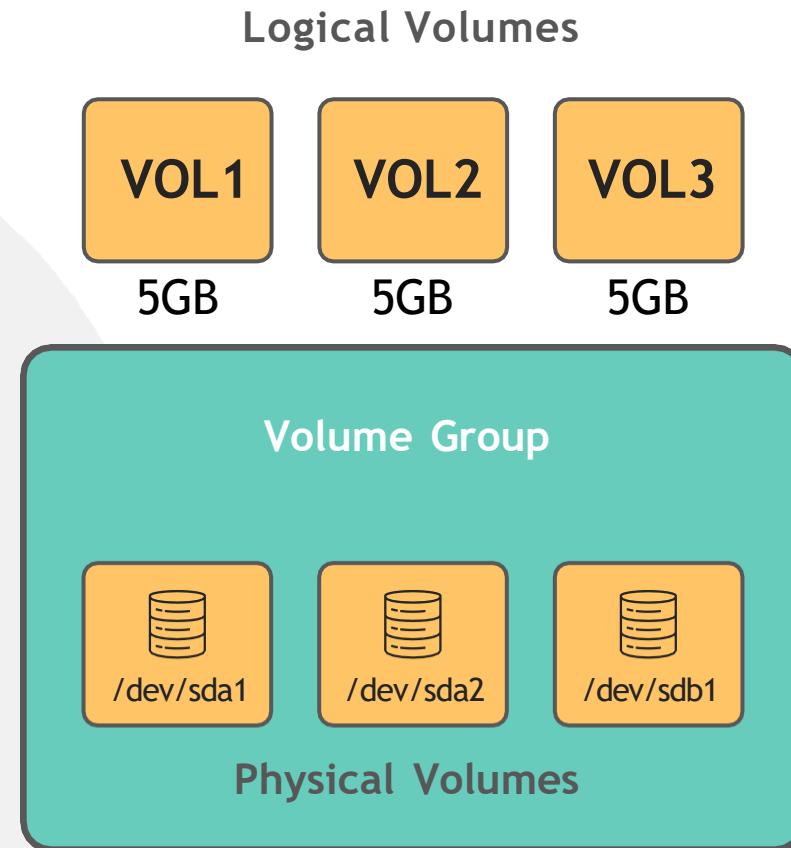
Logical Volume Manager



The Linux Basics Course

...

LVM



LVM

Logical Volumes

VOL1
/home

10GB

VOL2
/var

10GB

VOL3
/tmp

10GB

Volume Group



/dev/sda1



/dev/sda2



/dev/sdb1

Physical Volumes

LVM

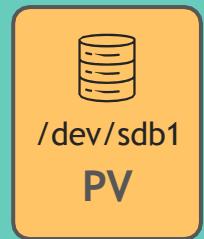
```
[~]$ apt-get install lvm2
```

```
[~]$ pvcreate /dev/sdb  
Physical volume "/dev/sdb" successfully created
```

```
[~]$ vgcreate caleston_vg /dev/sdb  
Volume group "caleston_vg" successfully created
```

```
[~]$ pvdisplay  
--- Physical volume ---  
PV Name /dev/sdb  
VG Name caleston_vg  
PV Size 20.00 GiB / not usable 3.00 MiB  
Allocatable yes  
PE Size 4.00 MiB  
Total PE 5119  
Free PE 5119  
Allocated PE 0  
PV UUID iDCXIN-En2h-5ilJ-Yjqv-GcsR-gDfV-zaf66E
```

Volume Group

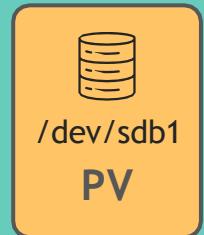




```
[~]$ vgdisplay
```

```
--- Volume group ---
VG Name          caleston_vg
System ID
Format           lvm2
Metadata Areas   1
Metadata Sequence No 1
VG Access        read/write
VG Status         resizable
MAX LV
Cur LV
Open LV
Max PV
Cur PV
Act PV
VG Size          20.00 GiB
PE Size           4.00 MiB
Total PE          5119
Alloc PE / Size  0 / 0
Free  PE / Size  5119 / 20.00 GiB
VG UUID          VzmIAn-9cEl5bA-1Vtm-wHKX-KQaObR
```

Volume Group



caleston_vg



LVM

Logical Volumes

VOL1

1GB

Volume Group



caleston_vg

```
[~]$ lvcreate -L 1G -n vol1 caleston_vg
```

```
Logical volume "vol1" created.
```

```
[~]$ lvdisplay
```

```
-- Logical volume --
LV Path          /dev/caleston_vg/vol1
LV Name          vol1
VG Name          caleston_vg
LV UUID          LueYC3-VWpE31-UaYk-wjIR-FjAOyL
LV Write Access  read/write
LV Creation host, time master, 2020-03-31 06:26:14
LV Status        available
# open          0
LV Size          1.00 GiB
Current LE       256
Segments         1
Allocation       inherit
Read ahead sectors
 - currently set to 256
Block device     252:0
```



```
[~]$ lvs
```

LV	VG	Attr	LSize	Pool
vol1	caleston_vg	-wi-a----	1.00g	

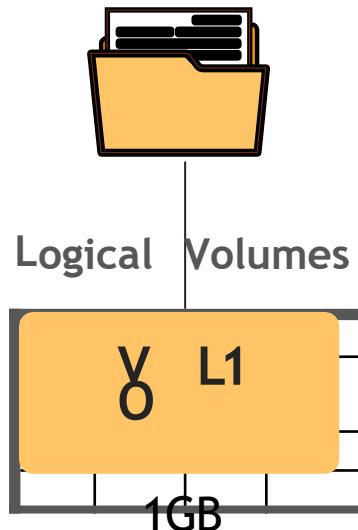
```
[~]$ mkfs.ext4 /dev/caleston_vg/vol1
```

```
mke2fs 1.42.13 (17-May-2015)
Creating filesystem with 262144 4k blocks and 65536 inodes
Filesystem UUID: 3ba95aaa-5f1a-417e-8baf-91b1233999b5
Superblock backups stored on blocks:
      32768, 98304, 163840, 229376
```

```
Allocating group tables: done
Writing inode tables: done
Creating journal (8192 blocks): done
Writing superblocks and filesystem accounting information:
done
```

```
[~]$ mount -t ext4 /dev/caleston_vg/vol1 /mnt/vol1
```

/mnt/vol1



Volume Group



caleston_vg





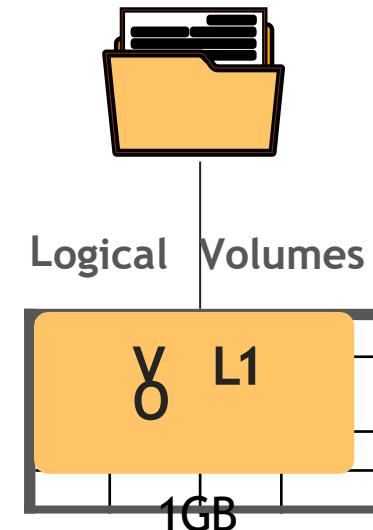
LVM

```
[~]$ vgs
VG          #PV #LV #SN Attr   VSize   VFree
caleston_vg    1   1   0 wz--n- 20.00g 19.00g
```

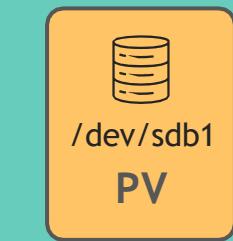
```
[~]$ lvresize -L +1G -n /dev/caleston_vg/vol1
Logical volume vol1 successfully resized.
```

```
[~]$ df -hP /mnt/vol1
Filesystem      Size  Used Avail Use% Mounted on
/dev/mapper/caleston_vg-vol1  976M  1.3M  908M   1% /mnt/vol1
```

/mnt/vol1

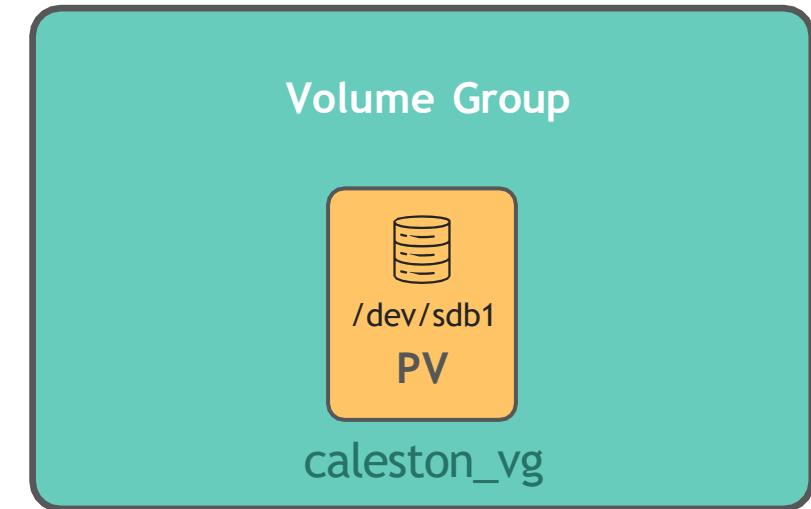
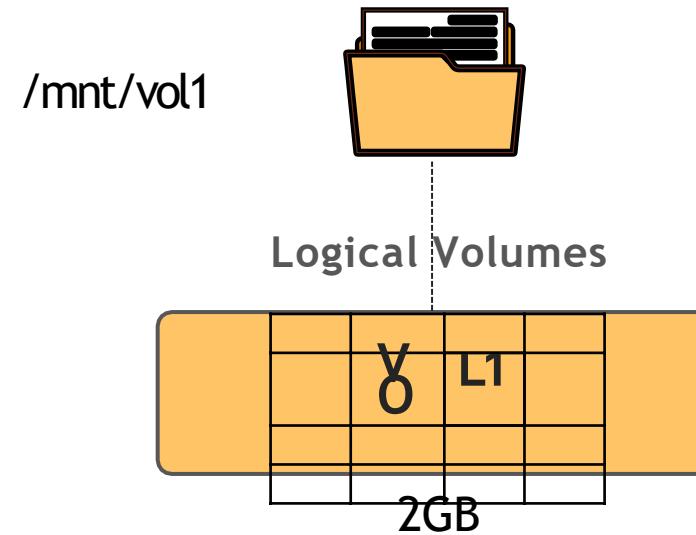


Volume Group





```
[~]$ resize2fs /dev/caleston_vg/vol1
resize2fs 1.42.13 (17-May-2015)
Filesystem at /dev/mapper/caleston_vg-vol1 is mounted on
/mnt/vol1; on-line resizing required
old_desc_blocks = 1, new_desc_blocks = 1
The filesystem on /dev/mapper/caleston_vg-vol1 is now 524288
(4k) blocks long.
```





```
[~]$ resize2fs /dev/caleston_vg/vol1
resize2fs 1.42.13 (17-May-2015)
Filesystem at /dev/mapper/caleston_vg-vol1 is mounted on
/mnt/vol1; on-line resizing required
old_desc_blocks = 1, new_desc_blocks = 1
The filesystem on /dev/mapper/caleston_vg-vol1 is now 524288
(4k) blocks long.
```

```
[~]$ df -hP /mnt/vol1
Filesystem              Size  Used Avail Use% Mounted on
/dev/mapper/caleston_vg-vol1  2.0G  1.6M  1.9G   1% /mnt/vol1
```

Logical Volume

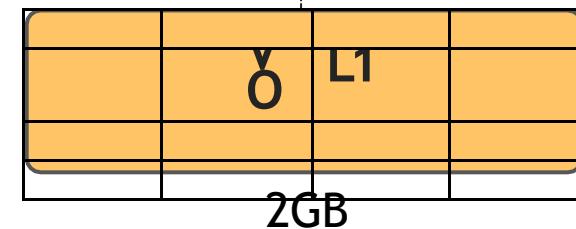
Filesystem Path

vol1

/dev/caleston_vg/vol1

/mnt/vol1

Logical Volumes



Volume Group



/dev/sdb1

PV

caleston_vg



HANDS-ON LABS





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SYSTEMD and Service Management



The Linux Basics Course

...

SYSTEMD and Services

Create your own SYSTEMD service

SYSTEMD Tools

Labs: SYSTEMD





Introduction to SYSTEMD

Program - /usr/bin/project-mercury.sh

Start Python Application after Postgres DB

Use Service Account project_mercury

Auto Restart on Failure

Restart Interval 10 seconds

Log Service Events

Load when booting into Graphical Mode



Introduction to SYSTEMD

```
[~]$ /usr/bin/project-mercury.sh
```

Program - /usr/bin/project-mercury.sh



Start Python Application after Postgres DB

Use Service Account project_mercury

Auto Restart on Failure

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Load when booting into Graphical Mode

```
/etc/systemd/system/project-mercury.service
```

```
[Service]  
ExecStart=
```

```
[~]$ systemctl start project-mercury.service
```

```
[~]$ systemctl status project-mercury.service
```

- project-mercury.service
 Loaded: loaded (/etc/systemd/system/ report-manager;
static; vendor preset: enabled)
 Active: active (running) Fri 2020-04-10 00:52:16 EDT; 6min
ago Main PID: 25041 (project-mercury.sh)
 Tasks: 2 (limit: 4915)
 CGroup: /system.slice/ project-mercury.service
 └─6494 sleep 60
 ├─25041 /bin/bash /usr/bin/project-mercury.sh

```
[~]$ systemctl stop project-mercury.service
```





Introduction to SYSTEMD

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```
/etc/systemd/system/project-mercury.service
```

```
[Service]
ExecStart=/usr/bin/project-mercury.sh
[Install]
WantedBy=graphical.target
```

...



Introduction to SYSTEMD

Program - /usr/bin/project-mercury.sh



Start Python Application after Postgres DB

Use Service Account project_mercury



Auto Restart on Failure



Restart Interval 10 seconds



Log Service Events



Load when booting into Graphical Mode



```
/etc/systemd/system/project-mercury.service
```

```
[Service]
ExecStart=/usr/bin/project-mercury.sh
User=project_mercury
Restart=on-failure
RestartSec=10
```

```
[Install]
WantedBy=graphical.target
```





Introduction to SYSTEMD

Program - /usr/bin/project-mercury.sh



Start Python Application after Postgres DB



Use Service Account project_mercury



Auto Restart on Failure



Restart Interval 10 seconds



Log Service Events



Load when booting into Graphical Mode



```
/etc/systemd/system/project-mercury.service
```

```
[Unit]
```

```
Description=Python Django for Project Mercury
```

```
Documentation=http://wiki.caleston-dev.ca/mercury
```

```
After=postgresql.service
```

```
[Service]
```

```
ExecStart=/usr/bin/project-mercury.sh
```

```
User=project_mercury
```

```
Restart=on-failure
```

```
RestartSec=10
```

```
[Install]
```

```
WantedBy=graphical.target
```

```
[~]$ systemctl daemon-reload
```

```
[~]$ systemctl start project-mercury.service
```



Introduction to SYSTEMD

- Program - /usr/bin/project-mercury.sh
- Start Python Application after Postgres DB
- Use Service Account project_mercury
- Auto Restart on Failure
- Restart Interval 10 seconds
- Log Service Events
- Load when booting into Graphical Mode

```
/etc/systemd/system/project-mercury.service

[Unit]
Description=Python Django for Project Mercury
Documentation=http://wiki.caleston-dev.ca/reported

After=postgresql.service
[Service]
ExecStart=/usr/bin/project-mercury.sh
User=project_mercury

Restart=on-failure
RestartSec=10

[Install]
WantedBy=graphical.target
```



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SYSTEMD Tools

The Linux Basics Course

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SYSTEMD TOOLS

SYSTEMCTL

MANAGE SYSTEM STATE

START/STOP/RESTART/RELOAD

ENABLE/DISABLE

LIST AND MANAGE UNITS

LIST AND UPDATE TARGETS

JOURNALCTL

QUERY SYSTEMD JOURNAL

...



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="2020-03-21T00:45:21.628602304-04:00" level=warning msg="Your kernel does not
Mar 21 00:45:21 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:21.629107909-04:00" level=info msg="Loading containers: sta
Mar 21 00:45:21 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:21.827189816-04:00" level=info msg="Default bridge (docker0
Mar 21 00:45:22 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:22.032716885-04:00" level=info msg="Loading containers: don
Mar 21 00:45:22 bob-Bionic dockerd[23340]: time="2020-03-21T00:45:22.134167743-04:00" 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





SERVICE MANAGEMENT WITH SYSTEMD

```
[~]$ systemctl daemon-reload
```

```
[~]$ systemctl edit project-mercury.service --full
```





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
```

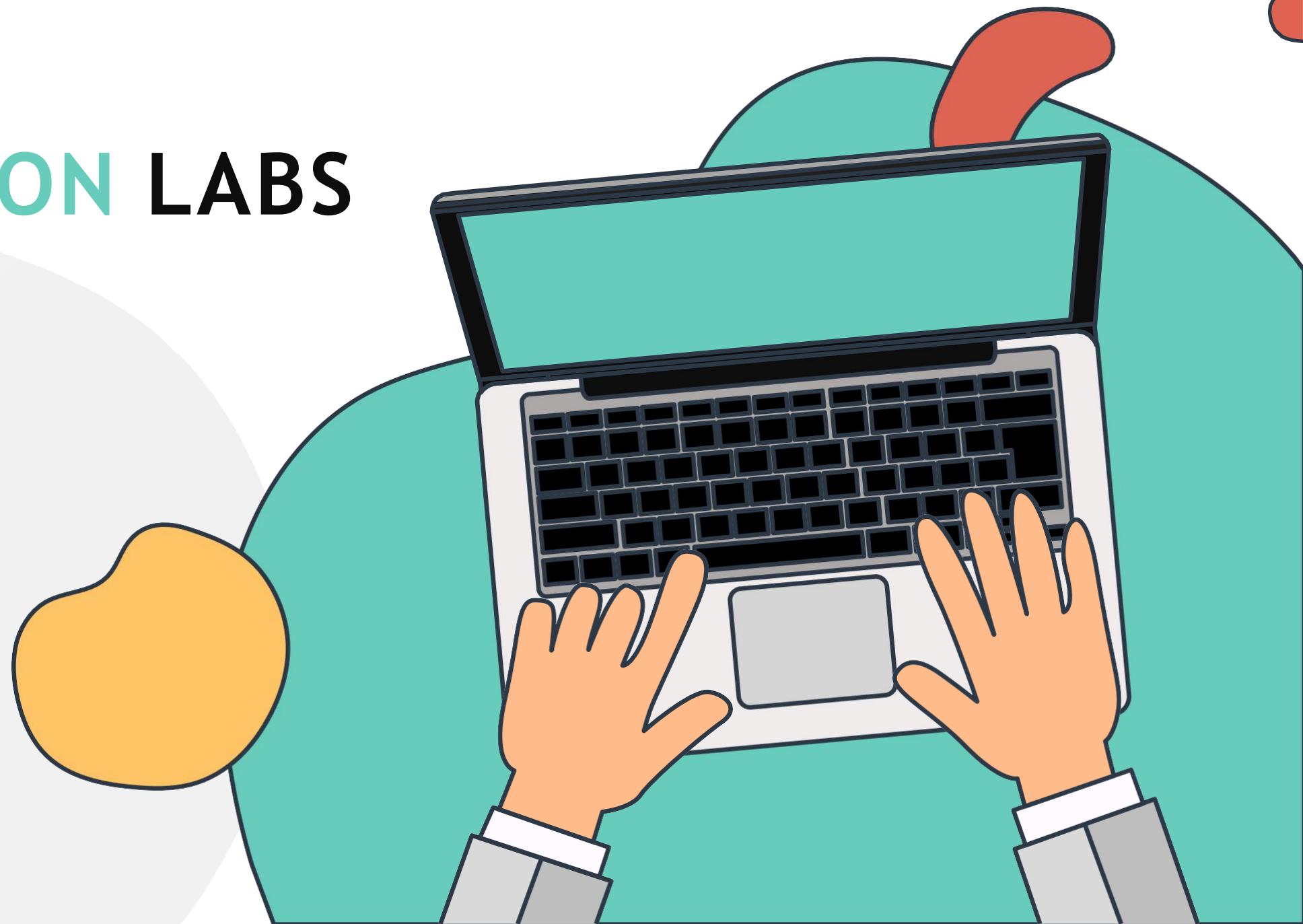
```
[~]$ journalctl -b
```

```
[~]$ 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.
```

HANDS-ON LABS





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