University of Colorado **Boulder**

Fundamentals of Data Communications

Linux Overview

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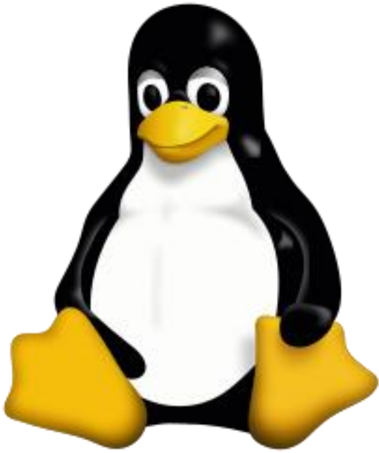
What is Linux?

- **Family of Free and Open-source software (FOSS) – Operation System**

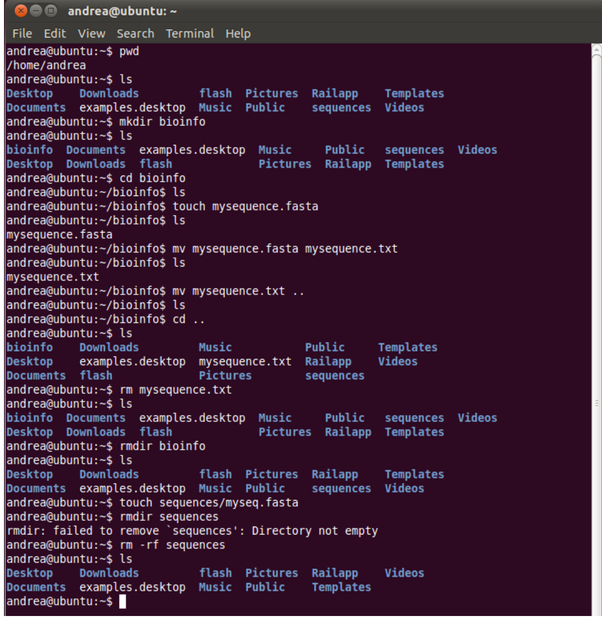
- **Largest installed base in the world**
  - Android, servers

- **Linux Distributions (distro)**
  - Fedora
    - ***Red Hat (commercial)***
  - Ubuntu
    - ***Canonical (commercial)***
  - Debian
  - CentOS
  - Raspbian
  - Kali



Linux Shell “Terminal”

- **Shell / Terminal / CLI**
  - Some machines don’t have GUI
    - ***Bash: borne again shell***
    - ***sh: borne shell***
    - ***ksh: korn shell***
    - ***csh: C shell***



```
andrea@ubuntu:~$ pwd
/home/andrea
andrea@ubuntu:~$ ls
Desktop    Downloads         flash  Pictures  Railapp    Templates
Documents  examples.desktop  Music  Public    sequences  Videos
andrea@ubuntu:~$ mkdir bioinfo
andrea@ubuntu:~$ ls
bioinfo  Documents  examples.desktop  Music     Public   sequences  Videos
Desktop  Downloads  flash             Pictures  Railapp  Templates
andrea@ubuntu:~$ cd bioinfo
andrea@ubuntu:~/bioinfo$ ls
andrea@ubuntu:~/bioinfo$ touch mysequence.fasta
andrea@ubuntu:~/bioinfo$ ls
mysequence.fasta
andrea@ubuntu:~/bioinfo$ mv mysequence.fasta mysequence.txt
andrea@ubuntu:~/bioinfo$ ls
mysequence.txt
andrea@ubuntu:~/bioinfo$ mv mysequence.txt ..
andrea@ubuntu:~/bioinfo$ ls
andrea@ubuntu:~/bioinfo$ cd ..
andrea@ubuntu:~$ ls
bioinfo    Downloads         Music           Public     Templates
Desktop    examples.desktop  mysequence.txt  Railapp    Videos
Documents  flash             Pictures        sequences
andrea@ubuntu:~$ rm mysequence.txt
andrea@ubuntu:~$ ls
bioinfo  Documents  examples.desktop  Music     Public   sequences  Videos
Desktop  Downloads  flash             Pictures  Railapp  Templates
andrea@ubuntu:~$ rmdir bioinfo
andrea@ubuntu:~$ ls
Desktop    Downloads         flash  Pictures  Railapp    Templates
Documents  examples.desktop  Music  Public    sequences  Videos
andrea@ubuntu:~$ touch sequences/myseq.fasta
andrea@ubuntu:~$ rmdir sequences
rmdir: failed to remove `sequences': Directory not empty
andrea@ubuntu:~$ rm -rf sequences
andrea@ubuntu:~$ ls
Desktop    Downloads         flash  Pictures  Railapp    Videos
Documents  examples.desktop  Music  Public    Templates
andrea@ubuntu:~$ 
```

- **Command completion:**
  - Begin typing a file name and hit TAB to autocomplete commands
  - If ambiguous hit TAB twice for a list.

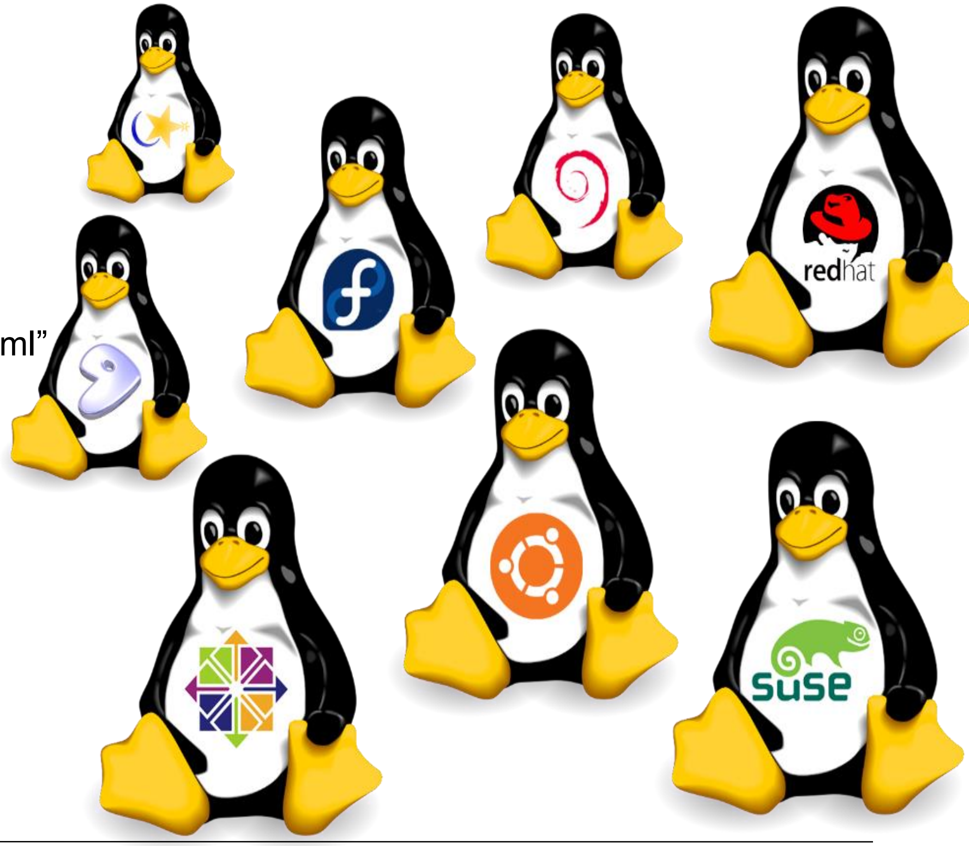
Super User Do “sudo”

- **“sudo”**
  - Run programs with security privileges of another user (i.e. super user)

- **“sudo –s”**
  - Login as super user so you don’t have to type “sudo” in front of every command

File Navigation

- **pwd**
  - Print working directory (“what is the path for this file”)
- **ls**
  - lists your current directory
- **cd**
  - Change Directory
    - ***“cd /etc/netplan”***
  - “cd . .” (back one directory)
- **cat**
  - displays a file
  - “cat /etc/netplan/ 01-network-manager-all.yaml”
- **more**
  - pages through a file
- **less**
  - like more but allows you to go back up
- **Logs**
  - stored in /var/log/
  - Eg. cat /var/log/messages



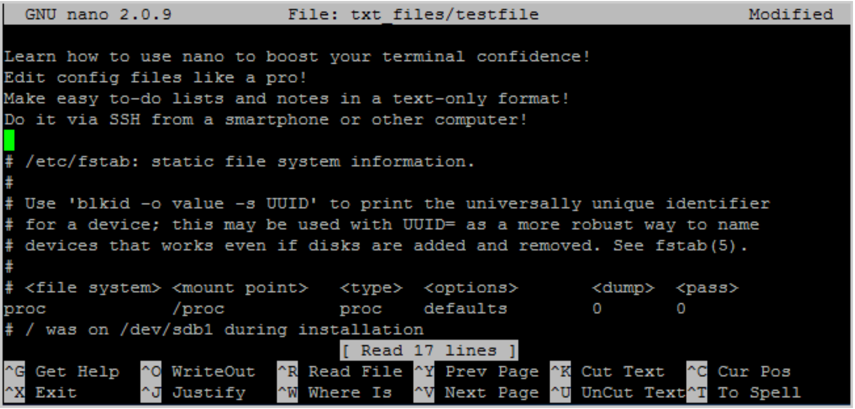
Package Installer

- **To install software you can use yum or dnf or apt**
  - yum (Fedora/Red Hat)
  - dnf (CentOS)
  - apt (Ubuntu)
    - ***"apt update"***
      - Updates all packages
    - ***"apt install wireshark"***
    - ***"apt upgrade wireshark"***
      - Updates the application to the newest version

File Editors (nano & vim)

- **nano <filename>**
  - easy menu driven (yum install nano / apt install nano)
  - “nano helloworld.py”
    - ***Creates a file in the current directory***
    - ***If file is already created, you could use this to make changes to that file***

- **vim <filename>**
  - ESC :wq
    - ***write changes and quite***
  - “i”
    - ***insert mode and make changes to the file***
  - ESC :q!
    - ***(Exit without saving)***



```
  GNU nano 2.0.9            File: txt_files/testfile                   Modified

Learn how to use nano to boost your terminal confidence!
Edit config files like a pro!
Make easy to-do lists and notes in a text-only format!
Do it via SSH from a smartphone or other computer!

# /etc/fstab: static file system information.
#
# Use 'blkid -o value -s UUID' 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>
proc            /proc           proc    defaults        0       0
# / was on /dev/sdb1 during installation
                                [ Read 17 lines ]
^G Get Help   ^O WriteOut   ^R Read File  ^Y Prev Page  ^K Cut Text   ^C Cur Pos
^X Exit       ^J Justify    ^W Where Is   ^V Next Page  ^U UnCut Text^T To Spell
```

Scripting

- **#!/usr/bin/python3**
  - this is the "shabang" line; it makes Python exe work from any directory

- **nano helloworld.py**
  - creates new file (in that directory)

- **chmod +x helloworld.py**
  - makes that file an exe

- **./helloworld.py**
  - runs the file from that directory

Additional Commands

- **<filename> &**
  - – Run the application
  - – “wireshark &”
- **apt-cache policy <application name>**
  - – Shows if the app is installed
  - – “apt-cache policy wireshark”
- **“cat /etc/os-release”**
  - – Check the OS version
- **“shutdown –r now”**
  - – Software reboot the system
- **mkdir <name>**
  - – Create a new directory
  - – “mkdir levi”
    - ***“rmdir levi” – remove***
- **man <name>**
  - – Show the manual
  - – “man wireshark”
- **Find a specific file**
  - – “find / -type f –iname “filename*””

Linux Networking

- **Interface configuration “ifconfig”**
  - – Displays current network configuration information: IP addresses, interfaces, netmask
  - – Display active/inactive info
    - ***“ifconfig –a”***
  - – Display specific interface
    - ***“ifconfig enp3s0”***

- **Enable/Disable interface**
  - – “ip link set eth0 up”
  - – “ip link set eth1 down”

Network Interfaces (IP Addresses)

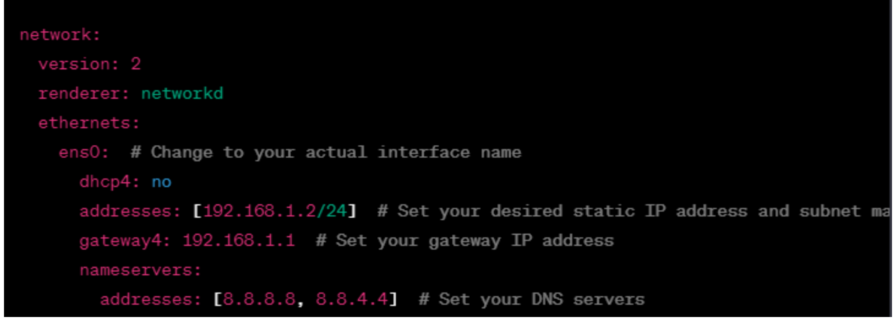
- **Configure “one time” address (doesn’t persist after reboot)**
  - “ip addr add 10.1.1.1/24 dev eth0”

- **Add default-gateway**
  - “ip route add default via 10.1.1.254”
  - Or “gateway4 10.1.1.254” in the “/etc/netplan” config.
    - ***After making changes, apply the Netplan config (“netplan apply”)***

- **Restart the networking service**
  - “systemctl restart system-networkd”

- **View the routing table**
  - “route –n”

Network Interfaces (continued)



```
network:
  version: 2
  renderer: networkd
  ethernets:
    ens0:  # Change to your actual interface name
      dhcp4: no
      addresses: [192.168.1.2/24]  # Set your desired static IP address and subnet ma
      gateway4: 192.168.1.1  # Set your gateway IP address
      nameservers:
        addresses: [8.8.8.8, 8.8.4.4]  # Set your DNS servers
```

- **View the network interfaces startup configuration file**
  - “cat /etc/netplan/01-network-manager-all.yaml”
- **Modify the file (use editor of choice)**
  - “nano /etc/netplan/01-network-manager-all.yaml”
- **Save the file and apply the changes**
  - “netplan apply”
- **Restart Networking**
  - “systemctl restart system-networkd”

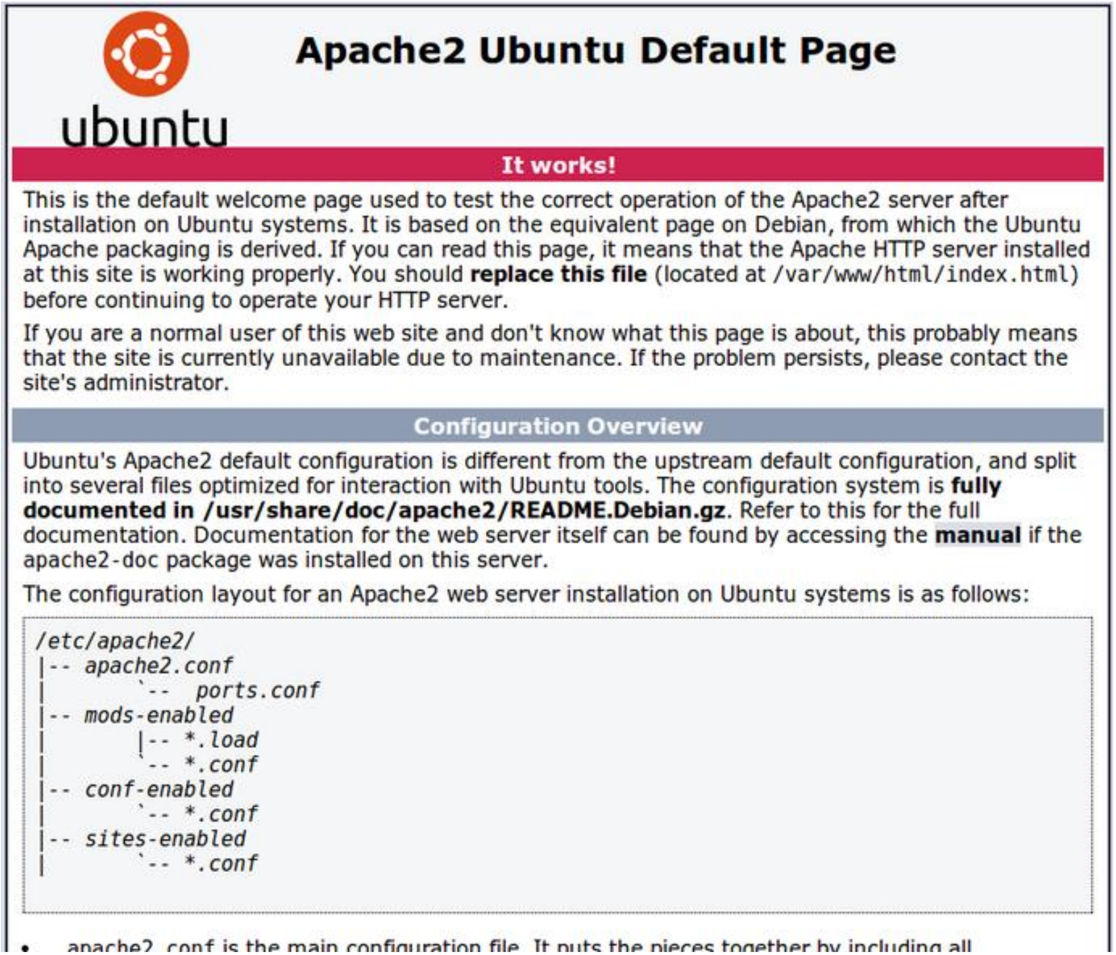
LAMP Stack

- **LAMP**
  - – Linux Operating System
  - – Apache HTTP Server
  - – MySQL database
  - – PHP/Py/Perl programming language

Apache2 – HTTP Server

- **Install apache2**
  - “apt install apache2”
- **Firewall settings (allow outside access)**
  - Typically allow “Apache” (only 80) or “Apache Secure” (443) or “Apache Full” (80 & 443)
  - “ufw allow ‘Apache Full’”
- **Verify if change is active**
  - “ufw status”
- **Reload the UFW if needed**
  - “ufw reload”
- **Content for web server**
  - /var/www/html
    - ***Default “index.html” file located in that directory to test functionality***

Apache2 Default Page



Apache2 Ubuntu Default Page

It works!

This is the default welcome page used to test the correct operation of the Apache2 server after installation on Ubuntu systems. It is based on the equivalent page on Debian, from which the Ubuntu Apache packaging is derived. If you can read this page, it means that the Apache HTTP server installed at this site is working properly. You should **replace this file** (located at `/var/www/html/index.html`) before continuing to operate your HTTP server.

If you are a normal user of this web site and don't know what this page is about, this probably means that the site is currently unavailable due to maintenance. If the problem persists, please contact the site's administrator.

Configuration Overview

Ubuntu's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Ubuntu tools. The configuration system is **fully documented in /usr/share/doc/apache2/README.Debian.gz**. Refer to this for the full documentation. Documentation for the web server itself can be found by accessing the **manual** if the apache2-doc package was installed on this server.

The configuration layout for an Apache2 web server installation on Ubuntu systems is as follows:

```
/etc/apache2/
|-- apache2.conf
|       `--  ports.conf
|-- mods-enabled
|       |-- *.load
|       `-- *.conf
|-- conf-enabled
|       `-- *.conf
|-- sites-enabled
|       `-- *.conf
```

- apache2.conf is the main configuration file. It puts the pieces together by including all

Questions?