Linux Driver
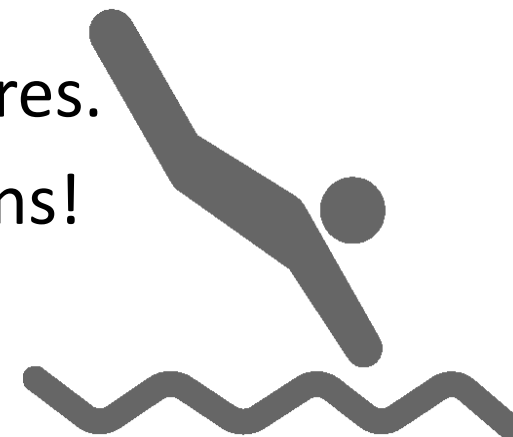
Mohamad Abbasi

Who Am I & What Do I Do Here?

- I am Mohamad Abbasi

- A software developer & technology enthusiast

- Talk about Linux's philosophy, functionalities and features.

- Only for developers & data scientists. Not for Sys Admins!

- I am here to make you the **LINUX DRIVER**!

- We will dive in the Linux world!
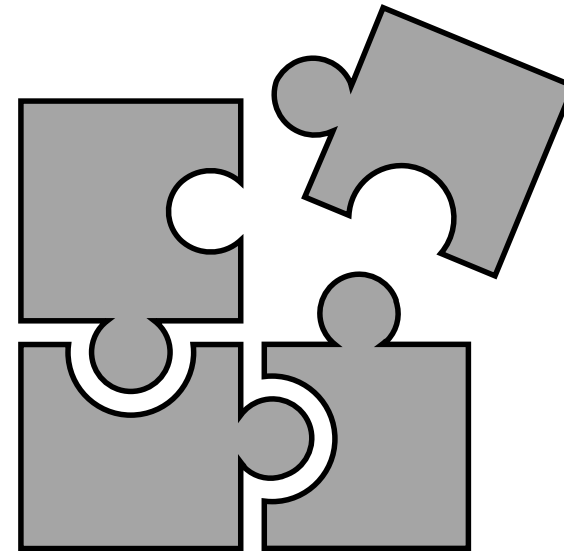
Linux! What is It?!

- An **operating system**
- Initially made by **Linus Torvalds**
- A package of components:
  - The **bootloader**
  - The **kernel**
  - **Daemons**
  - The **shell**
  - The **graphical server**
  - The **desktop environment**
  - **Applications**

Linux! What is Not?

- Linux is not **Unix** & Vice Versa!
- Linux is not **GNU** & Vice Versa!
- Linux is not **Android** & Vice Versa!
- GNU/Linux vs. Linux!

Why Use Linux?!

- High Security
- High Stability
- Ease of Maintenance
- Runs on Any Hardware
- Free as Freedom
- Open Source
- Ease of Use
- Customization
- Education
- Support
- Professional Tools
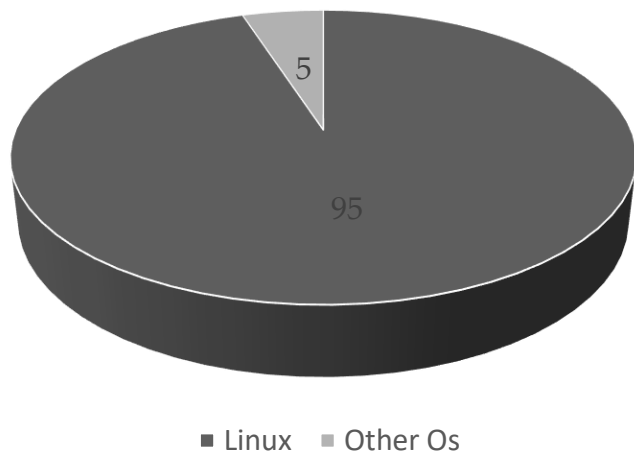- Job

تولیدکننده محتوا: محمد عباسی

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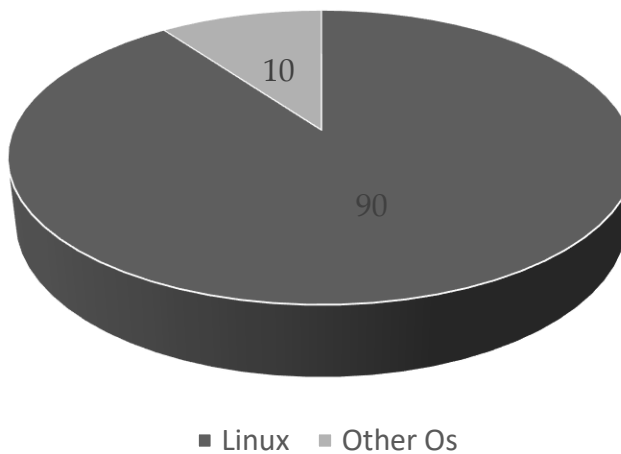daychegroup
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Some Stats in 2019

World's top 1 million **domains**

5

95

■ Linux ■ Other Os

public **cloud**

10

90

■ Linux ■ Other Os

World's 500 **supercomputers**

0

100

■ Linux ■ Windows

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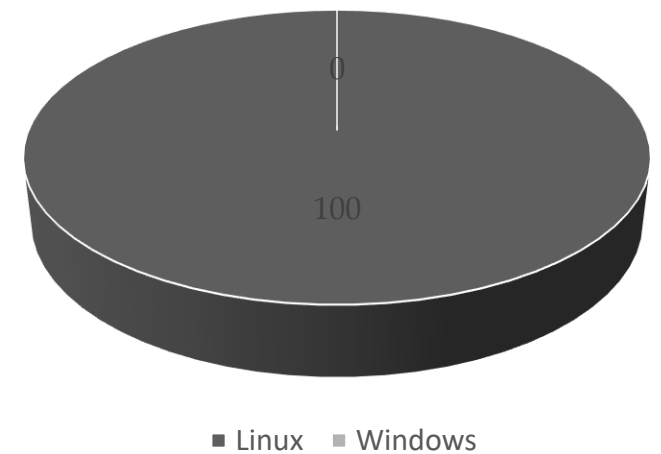
Source & More Statistics: https://hostingtribunal.com/blog/linux-statistics/

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Which Distribution?

- How much your **skill level** is?

- **Performance** or **beauty**? Or both?

- Server or **desktop**?

- **Community** is important!

- What is your **goals**?

- Its depends on your **taste**!

- We work on **Ubuntu**!

Ubuntu

- It means humanity
- Support by Canonical
- It forked from Debian
- It releases in certain period
- It has code name
- LTS versions
- Most used distro!

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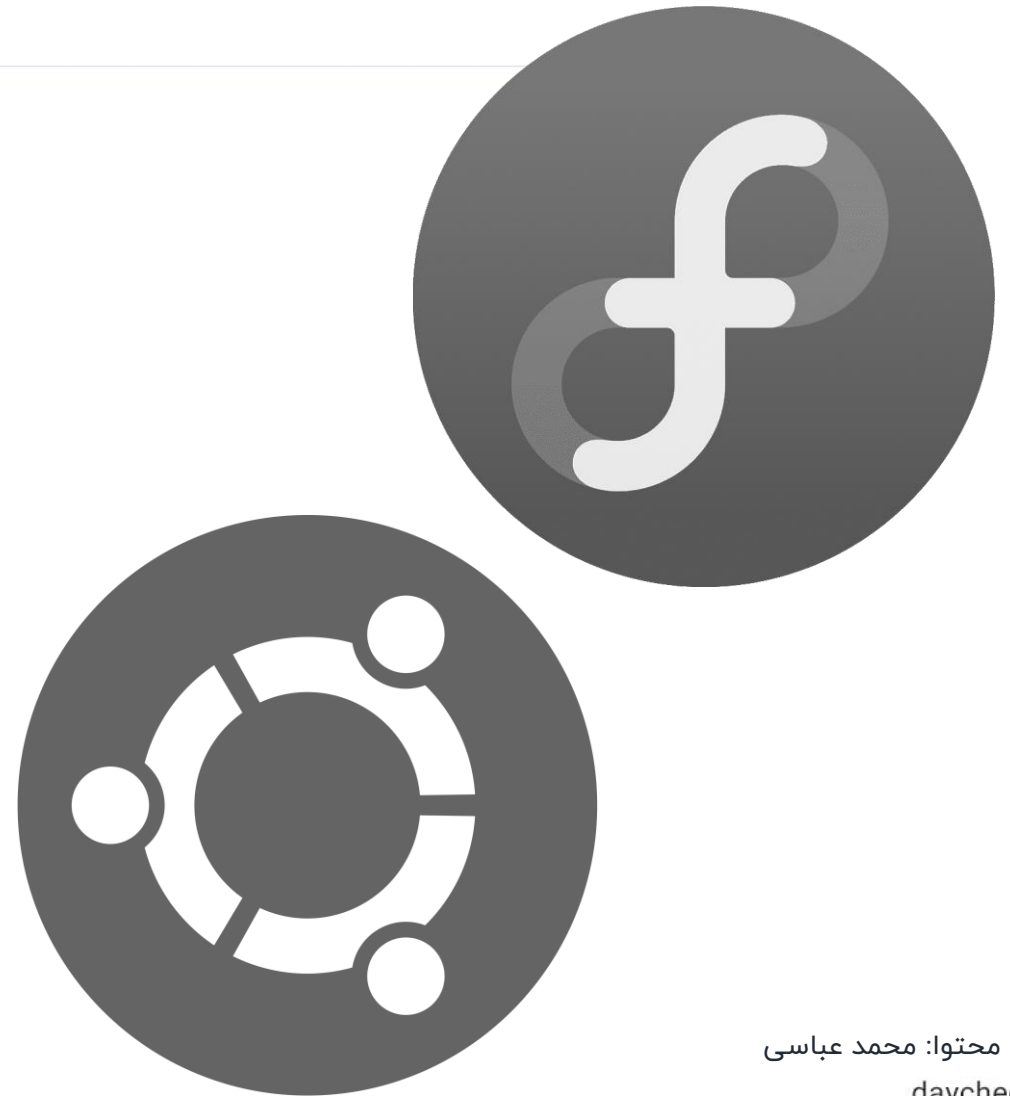
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Linux in Iran

- Open Source Foundation in Iran
- Linux User Groups (**LUG**)
- https://lugs.ir/
- https://ubuntu.ir/
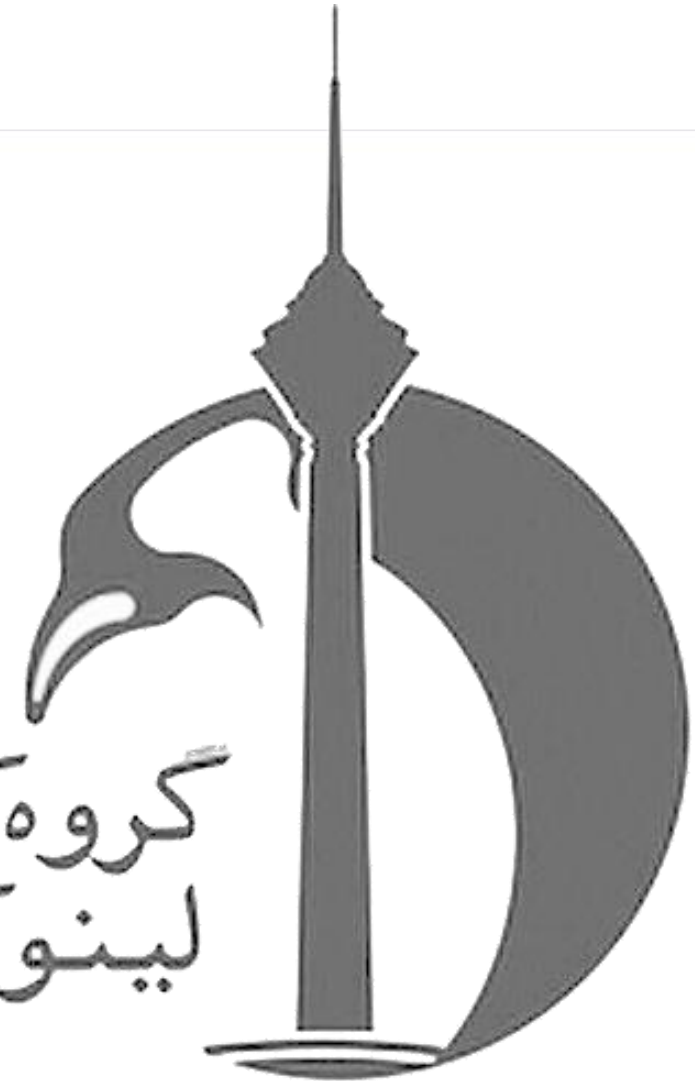
گروه کاربـران
لینـوکس تهـران

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Installation Prerequisite

- Boot process
- File system hierarchy
- Disk layout
- Partitioning

Boot Process

- Bios
- GRUB
- Kernel
- Init
- Run Levels

Basic Input/Output System
executes MBR

Master Boot Record
executes GRUB

Grand Unified Bootloader
executes Kernel

Kernel
executes /sbin/init

Init
executes runlevel program

Runlevel
executes from /etc/rc.d/rc*.d/

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BIOS

- Basic Input/Output System
- A power-on self-test (POST)
  - Beep codes
- Determine which devices are bootable
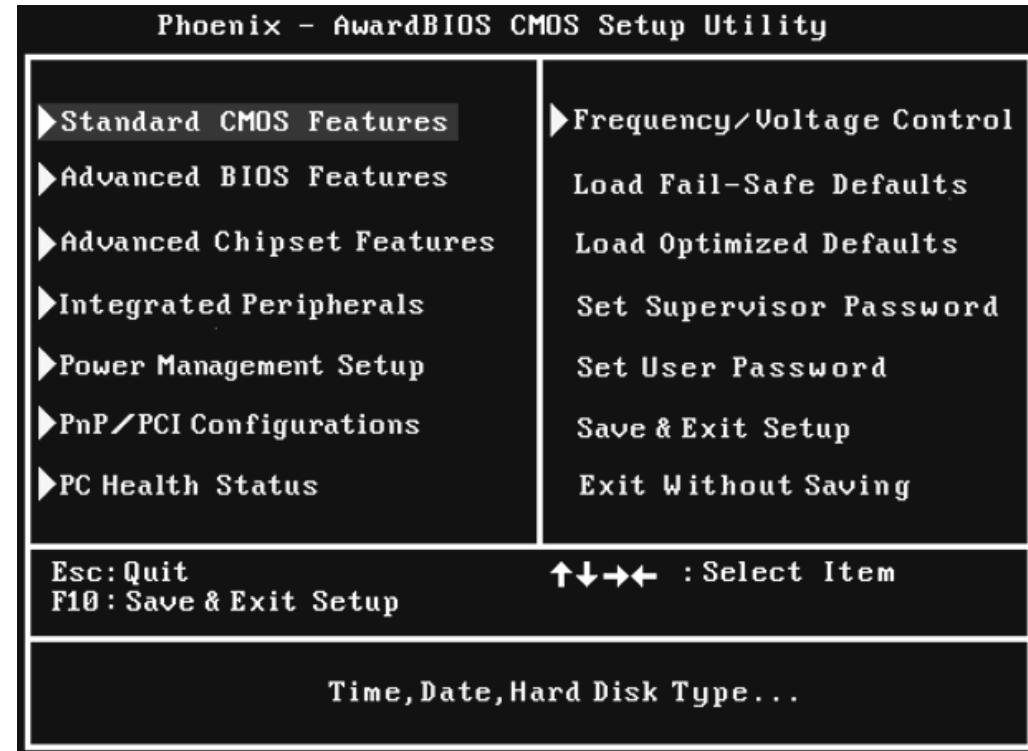- Store clock and manage things like
keyboard, …

```
Phoenix - AwardBIOS CMOS Setup Utility

▶Standard CMOS Features          ▶Frequency/Voltage Control
▶Advanced BIOS Features          Load Fail-Safe Defaults
▶Advanced Chipset Features       Load Optimized Defaults
▶Integrated Peripherals          Set Supervisor Password
▶Power Management Setup           Set User Password
▶PnP/PCI Configurations          Save & Exit Setup
▶PC Health Status                Exit Without Saving

Esc:Quit                         ↑↓→← :Select Item
F10:Save & Exit Setup

Time,Date,Hard Disk Type...
```

Bootloader

- GNU GRUB (Grand Unified Bootloader)
- A boot loader package from the GNU Project.
- The reference implementation of the FSF's Multiboot Specification.
- The bootloader transfers the control to the operating system kernel.
- Alternative: LILO
- Basic errors:
  - **grub>**: GRUB has found everything except the configuration file. This file probably will be *grub.conf*.
  - **grub rescue>**: GRUB 2 is unable to find the GRUB folder or its contents are missing/corrupted.

Kernel

- Core of operating system
- Manage resources such as CPU, memory and …
- Functionality:
  - Store data
  - Networking
  - Security
  - Scheduling
  - …

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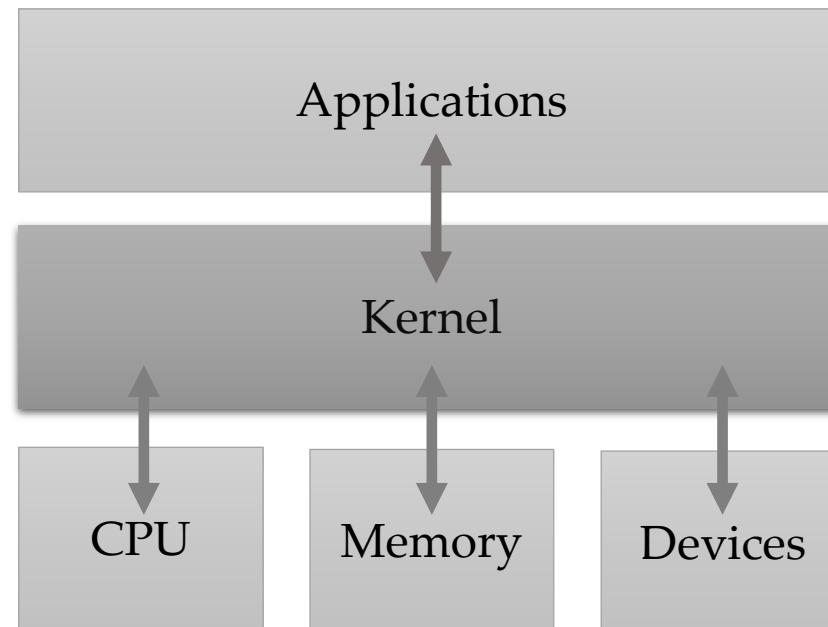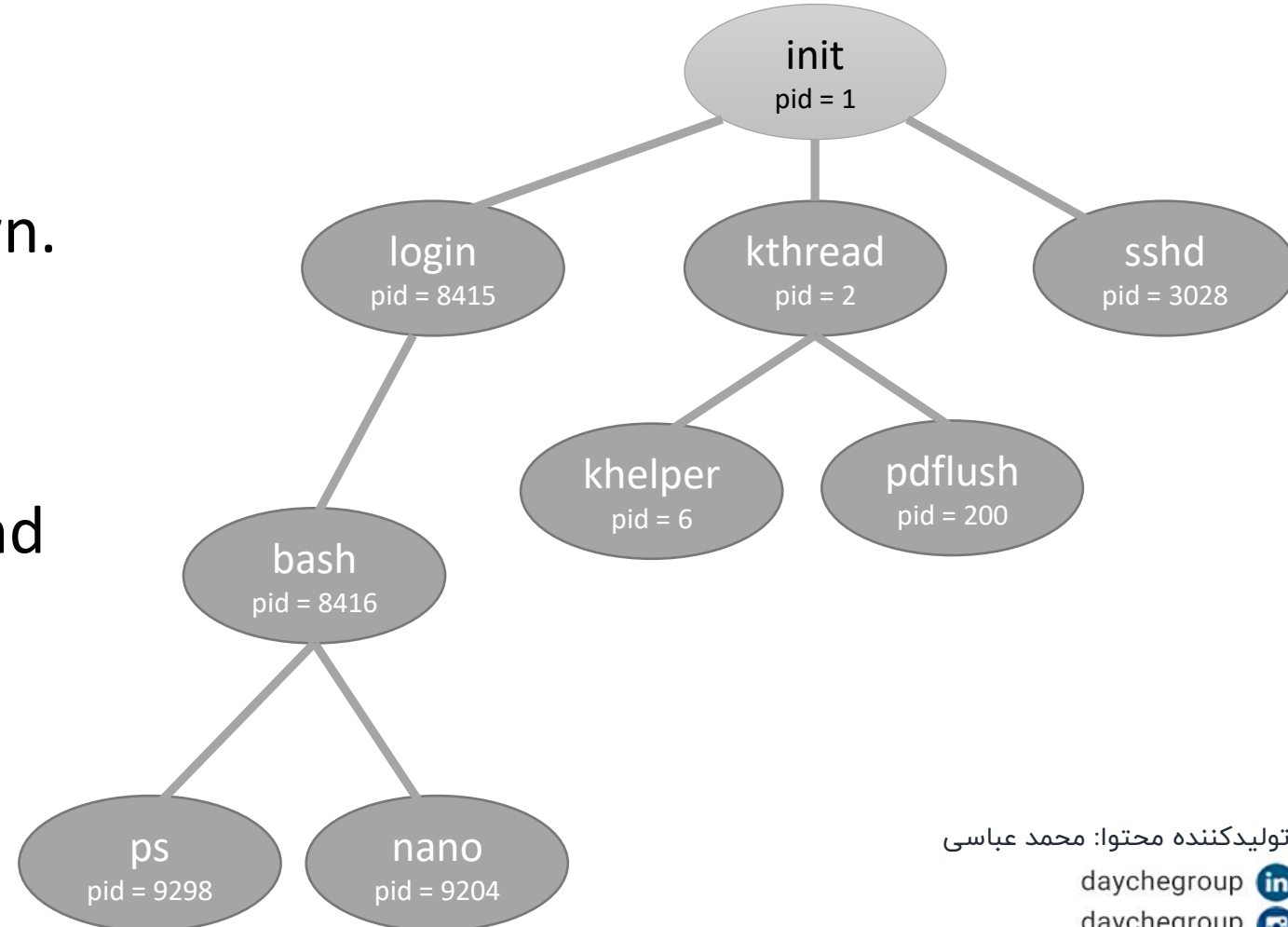
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Init

- init, short for initialization
- Kernel panic
- runs until the system shuts down.
- System V init
- starts serially
- Replaced by Upstart and systemd

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daychegroup (O)
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Runlevel

- 0 = halted
- 1 = single user
- 2 = multi-user mode
- 3-4 = same as 2
- 5 = graphical mode
- 6 = reboot
- 7-9 = undocumented
- telinit

Filesystem hierarchy

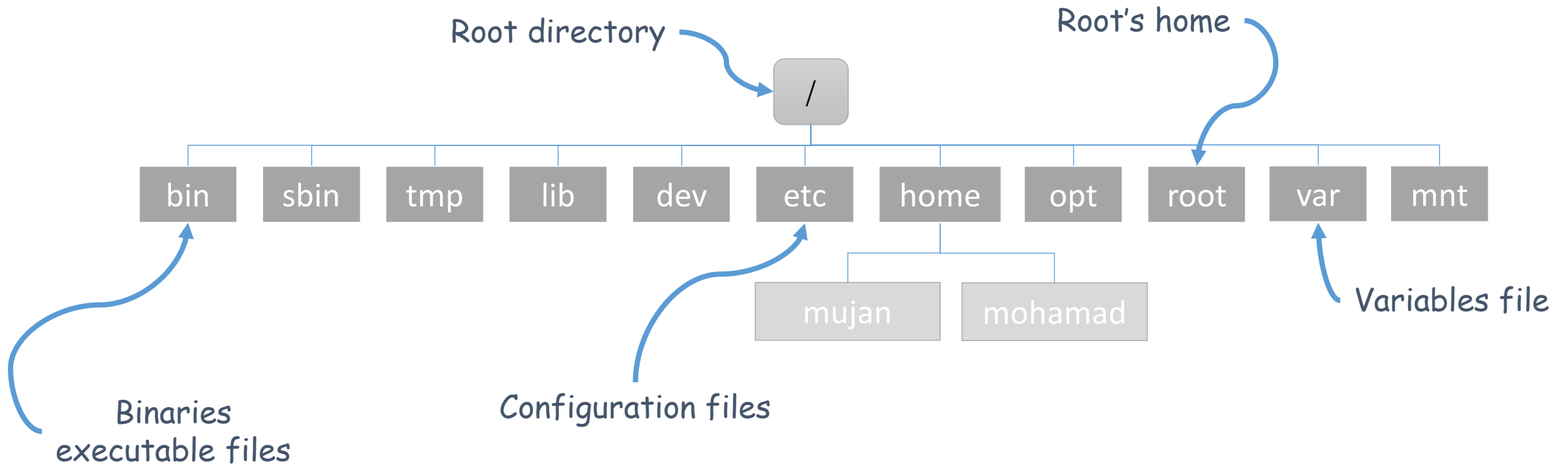Root directory

Root's home

/

bin | sbin | tmp | lib | dev | etc | home | opt | root | var | mnt

mujan | mohamad

Variables file

Binaries
executable files

Configuration files

Disk Layout

- Devices defined in /dev
  - /dev/sda
- MBR & GPT
- Boot partition
- Swap

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Filesystems

- ext2
- ext3
- ext4
- ReiserFS
- XFS
- swap
- vfat
- NTFS

Swap

- RAM vs. Hard
- Twice of RAM up to 8 G
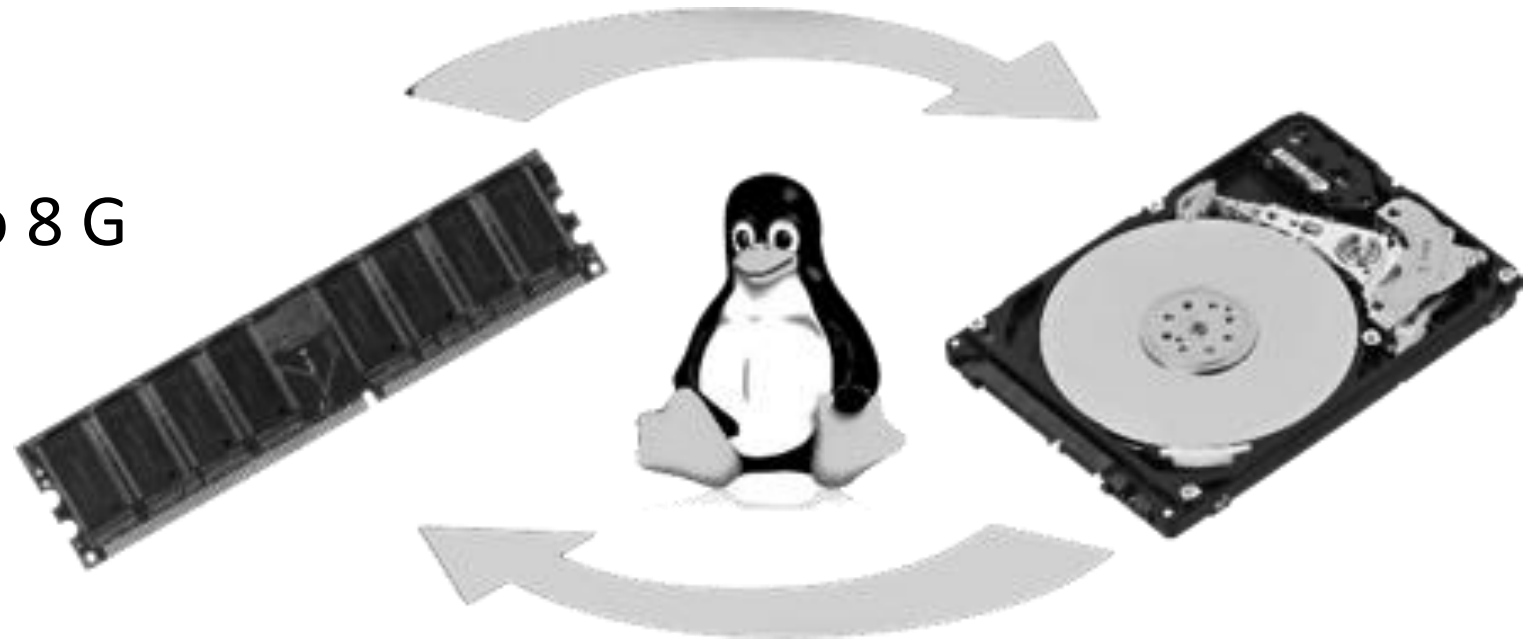
Partitioning for Desktop

Partitioning for Server

Format Partition

- fdisk & mkfs (linux)
- parted & gparted (linux)
- Paragon Partition Manager (windows)
- Windows disk management (windows)

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Any Questions?

Install Ubuntu

- Congratulation, you're ready!
- Download the ubuntu's iso
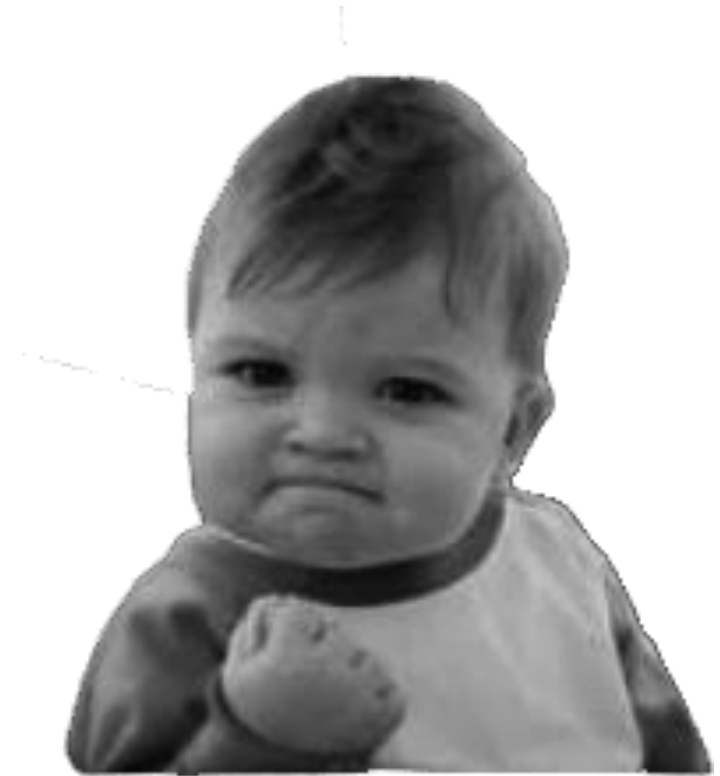
Installing!

- **Step 1: Prepare Install Media**
  - Rufus for USB
  - Free ISO Burner for DVD
  - UEFI or Bios?!

- **Step 2: Setting Install Config**

- **Step 2: Setting Install Config**

Just a Note!

Linux is Case Sensitive

LINUX IS CASE SENSITIVE

linuX iS casE sensitive

LiNuX iS cAsE sEnSiTiVe

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After Installation

- Disable fast boot feature

- Add Persian language

- Disable IPv6

- Install graphic drivers

- Install TLP

- Install vide codecs

Basic Commands

```
mujan@ubuntu-pc:~$ pwd
mujan@ubuntu-pc:~$ ls
mujan@ubuntu-pc:~$ cd
mujan@ubuntu-pc:~$ mkdir
mujan@ubuntu-pc:~$ rmdir
mujan@ubuntu-pc:~$ rm
mujan@ubuntu-pc:~$ touch
mujan@ubuntu-pc:~$ man # --help
mujan@ubuntu-pc:~$ cp
mujan@ubuntu-pc:~$ mv
mujan@ubuntu-pc:~$ cat
mujan@ubuntu-pc:~$ htop # top
mujan@ubuntu-pc:~$ alias
mujan@ubuntu-pc:~$ unreachable
```

Package Manager

- Advanced Package Tool
- Dependencies
- <package-name>.deb package
- /etc/apt/sources.list
- /etc/apt/sources.list.d/
- Concepts of repositories
- Lock file
- Use `apt` instead `apt-get`

Sources List

- Main: Officially Supported, Open-Source Software

- Restricted: Officially Supported, Closed-Source Software

- Universe: Community-Maintained, Open-Source Software

- Multiverse: Unsupported, Closed-Source and Patent-Encumbered Software

```
deb http://us.archive.ubuntu.com/ubuntu/ bionic multiverse
# deb-src http://us.archive.ubuntu.com/ubuntu/ bionic multiverse
deb http://us.archive.ubuntu.com/ubuntu/ bionic-updates multiverse
# deb-src http://us.archive.ubuntu.com/ubuntu/ bionic-updates multiverse
deb http://us.archive.ubuntu.com/ubuntu/ bionic-backports main restricted universe multiverse
# deb-src http://us.archive.ubuntu.com/ubuntu/ bionic-backports main restricted universe multiverse
deb http://security.ubuntu.com/ubuntu bionic-security main restricted
# deb-src http://security.ubuntu.com/ubuntu bionic-security main restricted
deb http://security.ubuntu.com/ubuntu bionic-security universe
# deb-src http://security.ubuntu.com/ubuntu bionic-security universe
deb http://security.ubuntu.com/ubuntu bionic-security multiverse
```

Update the System

```
mujan@ubuntu-pc:~$ sudo apt update   #update local repository list
mujan@ubuntu-pc:~$ sudo apt upgrade   #update packages

mujan@ubuntu-pc:~$

mujan@ubuntu-pc:~$ sudo apt install package   #update the package

mujan@ubuntu-pc:~$

mujan@ubuntu-pc:~$ sudo apt dist-upgrade   #upgrade distribution
```

PPA

- Personal Package Archive
- Hosted in Launchpad

```
mujan@ubuntu-pc:~$ sudo add-apt-repository ppa:<package-info>
mujan@ubuntu-pc:~$ sudo apt update
```

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Searching Package

- Search in local repositories list and man pages
- I recommend to use Google!

```
mujan@ubuntu-pc:~$ apt-cache search <package-name>
```

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Installing Package

```
mujan@ubuntu-pc:~$ sudo apt install package
mujan@ubuntu-pc:~$ sudo apt install --download-only package
mujan@ubuntu-pc:~$ sudo apt install -s package
mujan@ubuntu-pc:~$ sudo apt list package
mujan@ubuntu-pc:~$ sudo apt show package
```

Removing Packages

- ## Dependencies

```
mujan@ubuntu-pc:~$ sudo remove package
mujan@ubuntu-pc:~$ sudo apt autoremove package
```

- ## Remove unused packages

```
mujan@ubuntu-pc:~$ sudo apt autoremove
mujan@ubuntu-pc:~$
```

dpkg

```
mujan@ubuntu-pc:~$ sudo dpkg --contents package.deb
mujan@ubuntu-pc:~$ sudo dpkg -i package.deb
mujan@ubuntu-pc:~$ sudo dpkg -s package.deb
```

Other Tools

- Synaptic (GUI for apt)
- Aptitude
- Snappy 💡
- AppImages
- Flatpaks

We have a problem!

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Graphical Installation

Install from Source Code

- Its not recommend

- Read README first

- Download source code

```
mujan@ubuntu-pc:~$ ./configure  #check dependencies
mujan@ubuntu-pc:~$ make     #compile
mujan@ubuntu-pc:~$ sudo make install     #copy executable files
```

We're Done

Dose anyone have any questions for my answers?!

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Bash

- What is Bash?
- Bash's configs
- Bash operations
- Exiting from bash
- Bash search
- Streams in bash
- Stream redirection

Groups

- Linux use groups to manage users

- A group per user

- sudo

- su

- passwd

```
mujan@ubuntu-pc:~$ groups
mujan@ubuntu-pc:~$ groups username
mujan@ubuntu-pc:~$ id
```

Users

- /etc/passwd
- etc/shadow
- /etc/skel

```
mujan@ubuntu-pc:~$ sudo adduser newuser
mujan@ubuntu-pc:~$ sudo usermod -aG sudo newuser
mujan@ubuntu-pc:~$ sudo deluser newuser
mujan@ubuntu-pc:~$ sudo deluser --remove-home newuser
mujan@ubuntu-pc:~$ sudo groupadd mygroup
mujan@ubuntu-pc:~$ sudo groupadd -g 1010 mygroup
mujan@ubuntu-pc:~$
```

Permissions

```
mujan@ubuntu-pc:~$ ls -l

Total 44
drwxr-xr-x 3 mujan mujan 4096 Mar 20 13:43 Desktop
drwxr-xr-x 2 mujan mujan 4096 Oct 29 01:32 Documents
drwxr-xr-x 2 mujan mujan 4096 Oct 29 01:32 Downloads
-rw-r--r-- 1 mujan mujan 8980 Oct 29 01:09 examples.desktop
drwxr-xr-x 2 mujan mujan 4096 Oct 29 01:32 Music
drwxr-xr-x 2 mujan mujan 4096 Mar 20 04:14 Pictures
drwxr-xr-x 2 mujan mujan 4096 Oct 29 01:32 Public
drwxr-xr-x 2 mujan mujan 4096 Oct 29 01:32 Templates
drwxr-xr-x 2 mujan mujan 4096 Oct 29 01:32 Videos
```
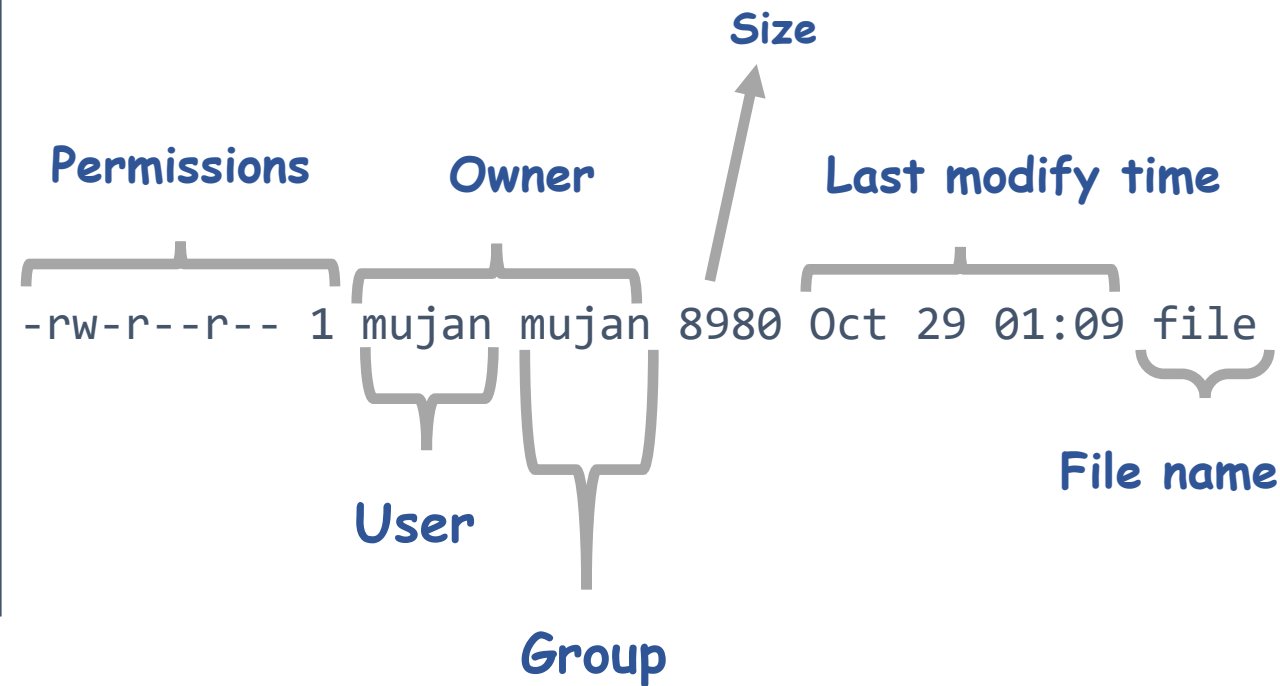
Permissions **Owner** **Size** **Last modify time**

```
-rw-r--r-- 1 mujan mujan 8980 Oct 29 01:09 file
```

User **Group** **File name**

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Permissions

File type

Permissions

-rwxr-xr--

User

Group

Other
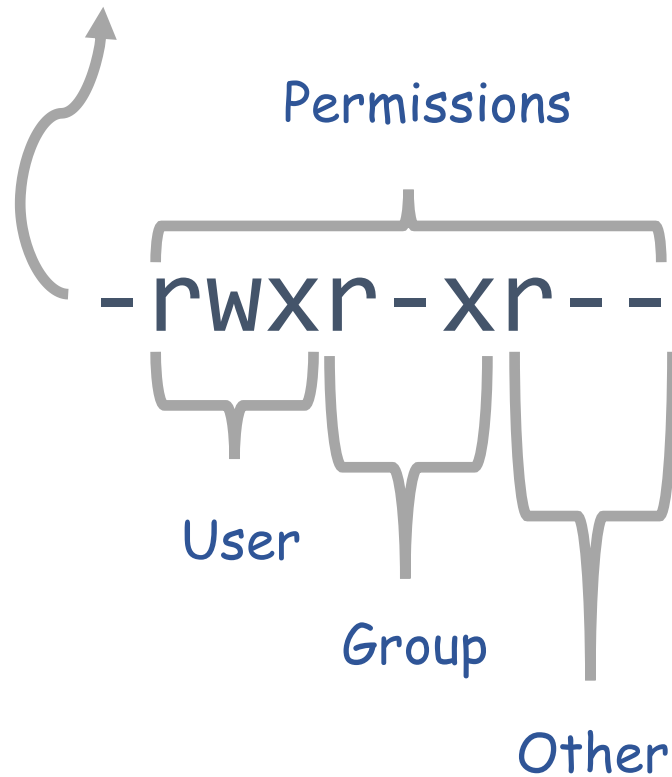
SYMBOLIC	BINARIES	OCTAL
rwx	111	7
rw-	110	6
r-x	101	5
r--	100	4
-wx	011	3
-w-	010	2
--x	001	1
---	000	0

Permissions

```
mujan@ubuntu-pc:~$ sudo chmod u=x file
mujan@ubuntu-pc:~$ sudo chmod u+x file
mujan@ubuntu-pc:~$ sudo chmod u+x,o+x,g+x file
mujan@ubuntu-pc:~$ sudo chmod 751 file
mujan@ubuntu-pc:~$ sudo chmod -R u+x /tmp
mujan@ubuntu-pc:~$ sudo chown newuser:newgroup file
mujan@ubuntu-pc:~$
```

Hard & Soft Link

- inode
- Everything in the Linux is a file!
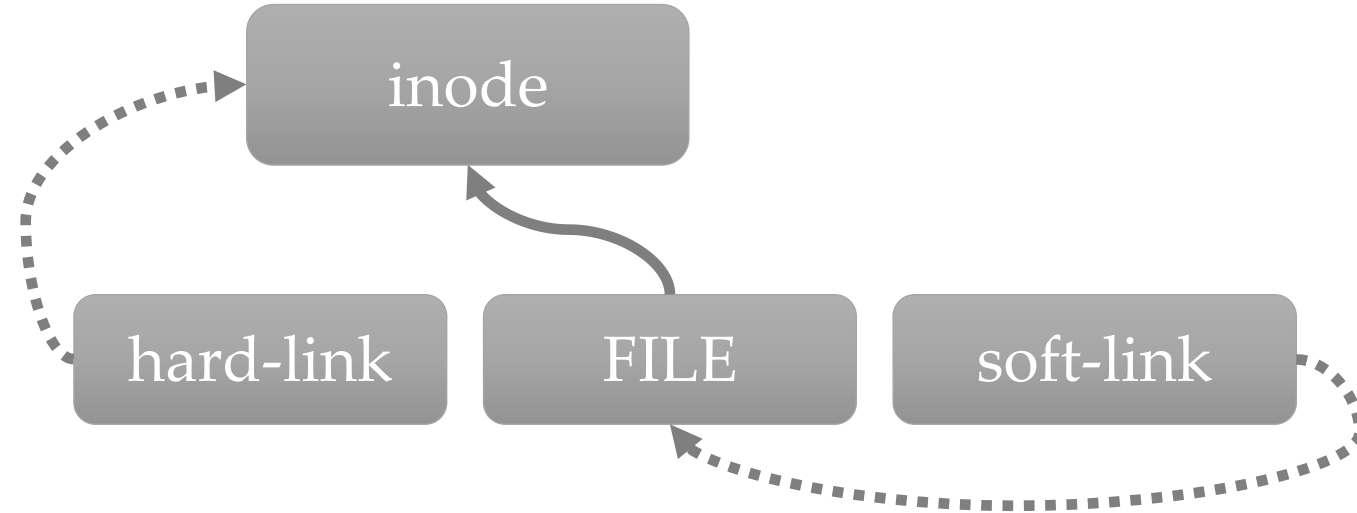

```
mujan@ubuntu-pc:~$ df -i
mujan@ubuntu-pc:~$ ln sourcefile targetfile
mujan@ubuntu-pc:~$ ln -s sourcefile targetfile
```

Environment Variables

- Just a variable!

- Path

- locale (dpkg-reconfigure locales)

```
mujan@ubuntu-pc:~$ env
mujan@ubuntu-pc:~$ MYVAR=VALUE
mujan@ubuntu-pc:~$ export MYVAR # child process
```

Archiving & Compressing

- TapeARchive or tar

- Zip
  - gzip
  - gunzip

- Bzip
  - bzip2
  - bunzip2

SWITCH	MEANING
-v	verbose
-z	gzip
-b	bzip2
-cf	create file
-xf	extract file

```
mujan@ubuntu-pc:~$ tar cfvz myfile.tar.gz ~/Desktop/mydir/
mujan@ubuntu-pc:~$ tar xvfz myfile.tar.gz
mujan@ubuntu-pc:~$ gunzip myfile.tar.gz
mujan@ubuntu-pc:~$ tar xf myfile.tar
```

Data Preprocessing

- grep
- sed
- join
- head & tail
- paste
- AWK

grep

```
mujan@ubuntu-pc:~$ grep 'word' file
mujan@ubuntu-pc:~$ grep -n 'word' file
mujan@ubuntu-pc:~$ grep -i 'word' file
mujan@ubuntu-pc:~$ grep ^word file
mujan@ubuntu-pc:~$ grep $word file
mujan@ubuntu-pc:~$ grep .word file
mujan@ubuntu-pc:~$ egrep '^(a|b)' file # grep -E
mujan@ubuntu-pc:~$ egrep '^[a|b]' file
mujan@ubuntu-pc:~$ grep -Ff "$file" "$datafile"
mujan@ubuntu-pc:~$ systemctl reload-or-restart application.service
mujan@ubuntu-pc:~$ systemctl enable application.service
mujan@ubuntu-pc:~$ systemctl disable application.service
mujan@ubuntu-pc:~$ systemctl cat application.service
mujan@ubuntu-pc:~$ systemctl list-dependencies application.service
```

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awk

Services

- System V init

- Upstart – A init replacement daemon implemented in Ubuntu GNU/Linux and designed to start process asynchronously.

- Epoch – A init replacement daemon built around simplicity and service management, designed to start process single-threaded.

- Mudar – A init replacement daemon written in Python, implemented on Pardus GNU/Linux and designed to start process asynchronously.

- systemd – A init replacement daemon designed to start process in parallel, implemented in a number of standard distribution – Fedora, OpenSuSE, Arch, RHEL, CentOS, etc.

What is systemd?

- System Management Daemon
- Concurrent and parallel processing at boot.
- Event Logging with journald.
- Better API.
- Simple Unit Syntax.
- Job Scheduling using systemd Calendar Timers.

Service Management in systemd

- Systemctl is a systemd utility which is responsible for Controlling the systemd system and service manager.

- The fundamental purpose of an init system is to initialize the components that must be started after the Linux kernel is booted (traditionally known as "userland" components).

- Units are the objects that systemd knows how to manage.

```
mujan@ubuntu-pc:~$ systemd --version    #check if systemd is installed on your system or not
mujan@ubuntu-pc:~$ systemd-analyze    #analyze systemd boot process.
mujan@ubuntu-pc:~$ systemd-analyze blame    #analyze time taken by each process at boot.
mujan@ubuntu-pc:~$ systemctl list-units --type=service --state=inactive
```

systemctl

```
mujan@ubuntu-pc:~$ systemctl status application.service
mujan@ubuntu-pc:~$ systemctl is-active application.service
mujan@ubuntu-pc:~$ systemctl is-enabled application.service
mujan@ubuntu-pc:~$ systemctl is-failed application.service
mujan@ubuntu-pc:~$
mujan@ubuntu-pc:~$ sudo systemctl start application.service
mujan@ubuntu-pc:~$ sudo systemctl stop application.service
mujan@ubuntu-pc:~$ sudo systemctl restart application.service
mujan@ubuntu-pc:~$ sudo systemctl reload application.service
mujan@ubuntu-pc:~$ sudo systemctl reload-or-restart application.service
mujan@ubuntu-pc:~$ sudo systemctl enable application.service
mujan@ubuntu-pc:~$ sudo systemctl disable application.service
mujan@ubuntu-pc:~$ sudo systemctl cat application.service
mujan@ubuntu-pc:~$ sudo systemctl list-dependencies application.service
```

ps

```
mujan@ubuntu-pc:~$ ps -aux
mujan@ubuntu-pc:~$ command &
mujan@ubuntu-pc:~$ jobs
mujan@ubuntu-pc:~$ fg # bg
```

Scheduling Task

```
mujan@ubuntu-pc:~$ crontab -l
mujan@ubuntu-pc:~$ crontab -e
mujan@ubuntu-pc:~$ sudo nano /etc/crontab #system wide
mujan@ubuntu-pc:~$ at now + 1min
mujan@ubuntu-pc:~$
mujan@ubuntu-pc:~$ sudo systemctl start application.service
mujan@ubuntu-pc:~$ sudo systemctl stop application.service
mujan@ubuntu-pc:~$ sudo systemctl restart application.service
mujan@ubuntu-pc:~$ sudo systemctl reload application.service
mujan@ubuntu-pc:~$ sudo systemctl reload-or-restart application.service
mujan@ubuntu-pc:~$ sudo systemctl enable application.service
mujan@ubuntu-pc:~$ sudo systemctl disable application.service
mujan@ubuntu-pc:~$ sudo systemctl cat application.service
mujan@ubuntu-pc:~$ sudo systemctl list-dependencies application.service
```
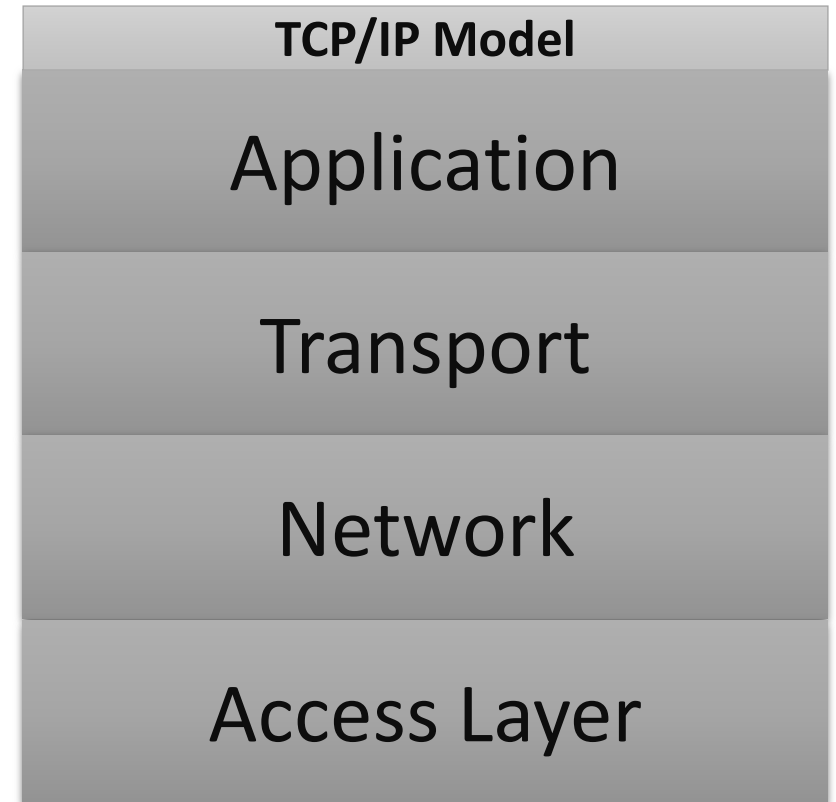
Basic Network

- TCP/IP
- IP
- TCP & UDP
- Netmask & Subnetting (CIDR)
- IPv6
- Port
- NAT
- Gateway

IP ADDRESS	COUNT
192.168.a.b	65K
172.16-31.a.b	1M
10.a.b.c	16M

TCP/IP Model

Application

Transport

Network

Access Layer

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Configurations

```
mujan@ubuntu-pc:~$ ifconfig    #active interfaces
mujan@ubuntu-pc:~$ ifconfig -a    #all interfaces
mujan@ubuntu-pc:~$ ifconfig <interface> <ip> netmask <netmask>
mujan@ubuntu-pc:~$ ifconfig <interface> down
mujan@ubuntu-pc:~$ dhclient <interface> -v
mujan@ubuntu-pc:~$ cat /etc/resolve.conf    #set nameserver
mujan@ubuntu-pc:~$
mujan@ubuntu-pc:~$ route # show routing table (netstat -nr)
mujan@ubuntu-pc:~$ route add default gw <ip>
mujan@ubuntu-pc:~$ netstat -na
mujan@ubuntu-pc:~$
mujan@ubuntu-pc:~$ ping
mujan@ubuntu-pc:~$ traceroute
mujan@ubuntu-pc:~$
```

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