

#1 What happens when we start our computer :- Booting :-

Reboot of OS (OS Boot Process)

(S) The process, when we first start our computer using 'power on' button, that process is called booting.

~~whatever process that has been done after pressing the on button and before loading the full operating system is called booting.~~

(S) So what are the steps it goes when booting.

→ So firstly, there is a program named BIOS (Basic Input Output Service).

→ BIOS → It is a program,

→ It is installed in ROM or EEPROM (Read only Memory) → ROM

(Electrical ~~as~~ Erasable Read Only Memory) → EEPROM

→ These ~~is~~ firmwares are installed by computer manufacturer only.

→ So when we do booting, BIOS programs are started first.

⑤ Now what does this BIOS programs do?

- These BIOS programs locate all peripheral devices (like Processor, keyboard, Memory,) which are attached with our system.
- So once once it is able to locate all those devices, it will start them or say activates them.
- Now once they are all activated, there comes a program called 'Bootstrap Loader'. Now this comes into play. This is also activated by BIOS only.

⑥ Now what does 'Bootstrap Loader' program does?

- This is a program, which is also activated by BIOS.
- Bootstraploader locates the computer 'Hard Disk' or 'Secondary Memory'.
- After locating it, it checks or looks for Operating System on the hard disk.

(S) Now once it finds the OS, it will load this OS in Main Memory (RAM).

→ Now our OS is starting.

→ But this OS has its own main program called 'kernel,' which performs all the functions of operating system.

→ So this 'kernel' program of OS is only loaded in the Main Memory and performs all the functionality of operating system.

→ Note :-
 Size of OS → 6, 10 GB After Installation
 Size of RAM → 2, 4, 6, 8 GB.

→ So not all OS is loaded in Main Memory (RAM), but only Kernel is loaded which is main program of OS and it performs all functionalities of OS.

⑤ so this is how 'Booting' happens in our computer system.

- # First operating system: -
- General Motor Research (GM-R), made IBM 704 (Colain frame) computer.
 - The first operating system used for real work was GM-NAA I/O, produced in 1956 by General Motors' Research division for its IBM 704. Most other early operating systems for IBM mainframes were also produced by customers.
 - Made by Robert L. Patrick.
 - BOSS → Bharat OIS Solutions (Indian Made os.)

#2 Booting Process - More detailed

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- (S) Whenever the user press the on (power) button,
the operating system will be loaded and
the user will start working on the computer.

→ So whatever process has been done after pressing the power (on) button and before loading the operating system is called the booting.

- (B) So now we will see what are the steps that happens during this process.

→ ① First step :- Power ON.

→ ② Second step :- CPU will move to BIOS in ROM

→ ③ Third step :- BIOS will be executed.

(So what exactly will be executed in this BIOS, It is actually POST. POST will be done)

④ Fourth Step :- POST will be done.

→ POST means 'Power On Self Test', so this process will be executed by the BIOS.

→ Here all the hardwares will be checked or tested. Whether Hardware related to this CPU is in working condition or not.

→ If the hardware is not in working condition then automatically this booting process will stop.

→ So if this POST is successful means hardwares are in working condition.

⇒ CPU has access to all the hardwares here. BIOS tests all hardware.

→ Once the test is done successfully, then immediately,

← 5th step

⑤ Fifth Step :- BIOS will load MBR to RAM.

→ MBR means Master Boot Record.

→ So previously we were checking only hardware, so after hardware is in working condition then only we need to load the software into the RAM.

→ BIOS will identify the hard disk & USB.

→ BIOS will transfer control of compiler to some other code stored in the boot drive. Bootdrive can be USB or hard disk. The boot drive is called an MBR. First 512 will be loaded in CPU.

⑥ Sixth Step :- MBR will load bootloader to RAM.

→ Bootloader is the program which loads the operating system to the RAM.

→ There are different stages of bootloader.
Bootloader 1, Bootloader 2.

→ MBR contains a bootstrap code which is very small code.

→ For windows bootloader is BootMGR
for Linux its GRUB

(S)

→ 7) seventh step :- Bootloader will load OS to RAM.

→ and it will start executing the operating system.

→ So whatever be the operating

system, either Windows or Linux, it will load OS in RAM and automatically the control will move to the operating system.

→ initilaisation process at end

of boot process control will move to OS

(B) So this is all what happens in the booting process.

→ all these happens after powering on and finally control moves to the OS at the end.

at end of boot process control moves to OS

→ so this overall process is called booting.

boot process starts from power on

boot process is directed by BIOS

BIOS works from AI

RAM is rebooted again not

③ Types of Booting :-

① Hard Booting → (Power ON the system)

② Soft Booting → (Restart the system)

or (Ctrl+Alt+Del twice)

→ system restarts.

④ So this is all about the booting process.

CPU moves to BIOS in ROM → BIOS initialized

→ BIOS runs POST → BIOS loads MBR to RAM → MBR loads bootloader to RAM → bootloader loads OS to RAM

Bootloader-1

Bootloader-2

→ sub bootloader & OS loader in RAM

boot loader errors like at is unidentified etc

check boot at end in boot loader file

multiple partitions exist no single disk

either no boot loader in partition or bad

boot loader exist in partition

S MBR step and bootloader stages :-

- Once BIOS identifies all hardware, it is also responsible for identifying hard disk & USB.
- After this:- software part now
 - BIOS will transfer control of Computer to some other code stored in the bootdrive.
 - Bootdrive can be USB or a hard disk.
 - The boot drive is called an MBR.
 - BIOS will load the first 512 bytes of MBR & CPU starts executing them.
- MBR contains a partition table.
 - Partition table contains information about all the partitions and where they are stored.
 - MBR also contains a bootstrap code which is very very small code.
- It is called a stage 1 bootloader.
 - Its responsibility is to call some other code.
 - So, where does it have to find the code?
 - That depends on the operating system.
 - But in windows it searches for an active partition in the partition table.

→ And it will load first 512 bytes of that partition

→ Partition contains → jmp (first 3 bytes),

→ file system, then bootstrap code.

→ we will reach bootstrap code after executing the jmp statement and it will also send us to some other code. (in the next sector of partition).

Then comes the second stage bootloader.

→ It looks up a file in the partition itself (a normal file) and asks the CPU to execute its content.

→ There is no restriction on this file. This file can be large.

Now the actual process begins, which operating system to load, where to load it from, etc.

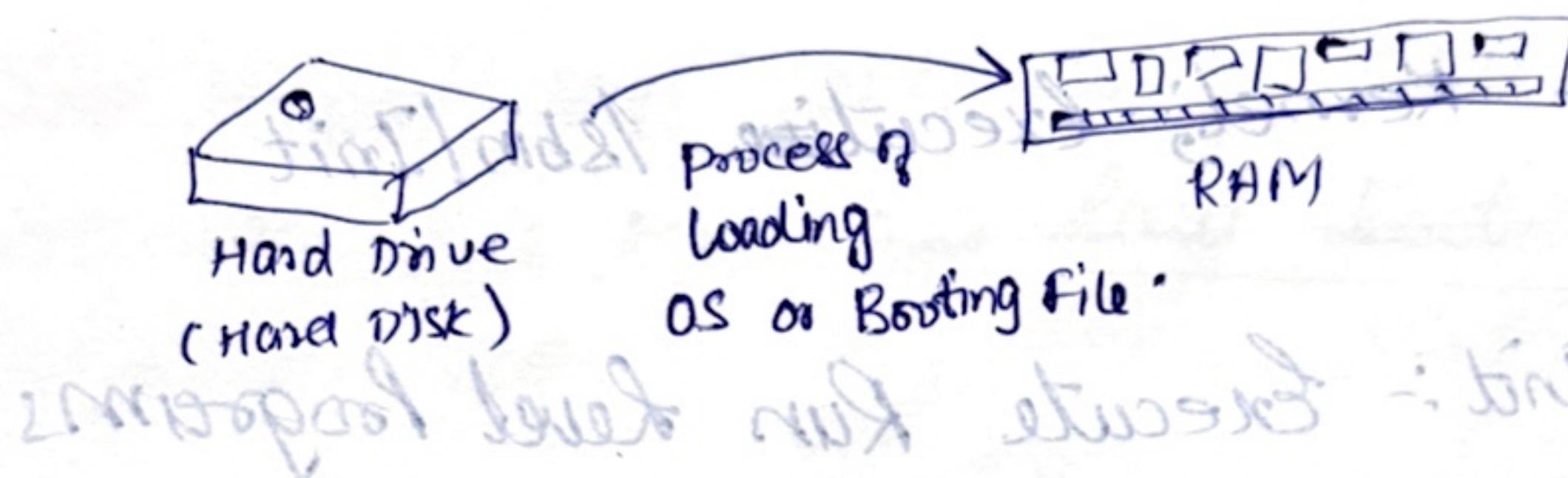
Extras:-

- Boot configuration files, which contains information about the operating systems. Hard coding is not done.
- For windows → bootloader is BOOTMGR,
 - the list of os is read from the Boot file in Boot.
- For Linux → bootloader is GRUB,
 - and the list of os is read from grub.config file.

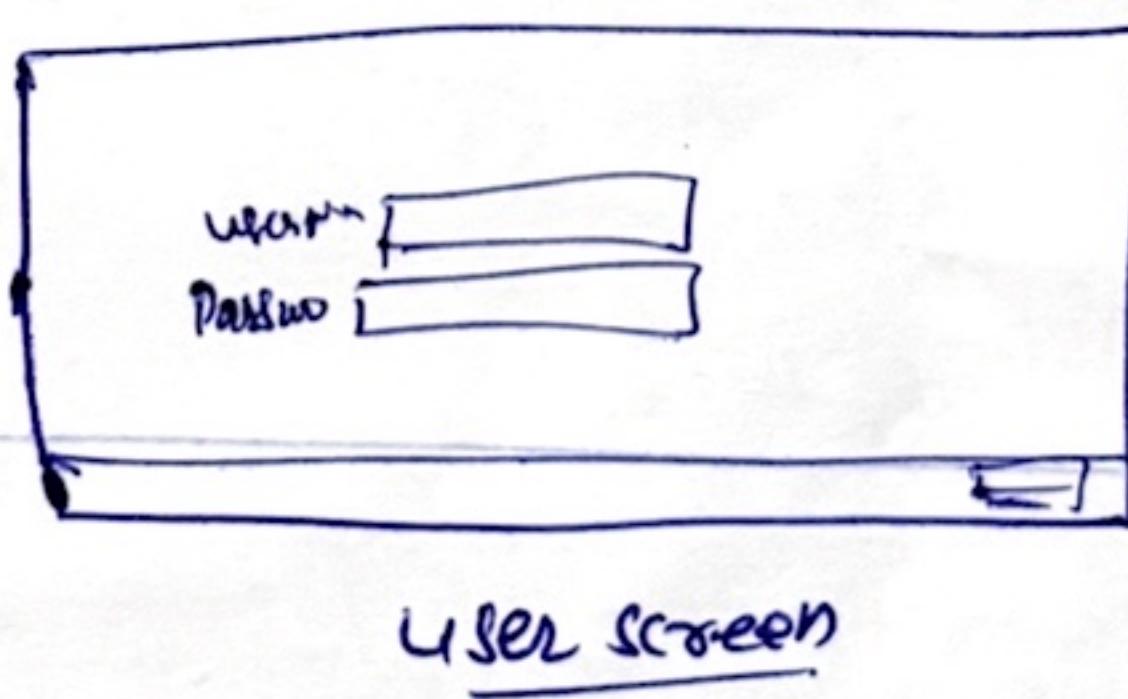
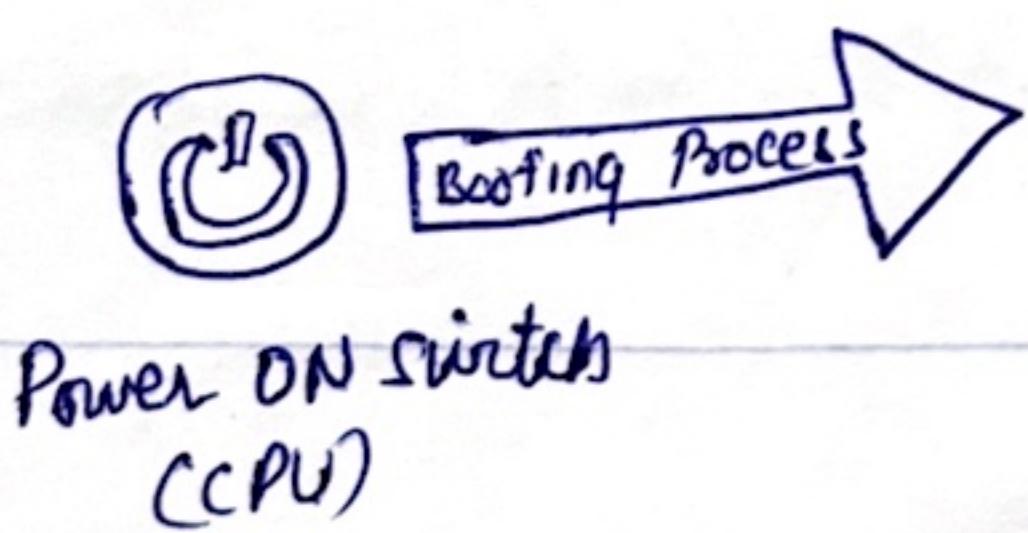
⑦ ⑧ Booting Process in Linux :-

⑤ Booting process :-

→ The booting process loads the operating system from bootable device like (Harddisk) into main memory (RAM) installed on your computer.



⑥ Press the power button on your system, and after few moments you see the linux login prompt.



⑥

6 steps of Linux Boot process (Startup sequence)

① BIOS :- Basic Input output system. Execute NBR

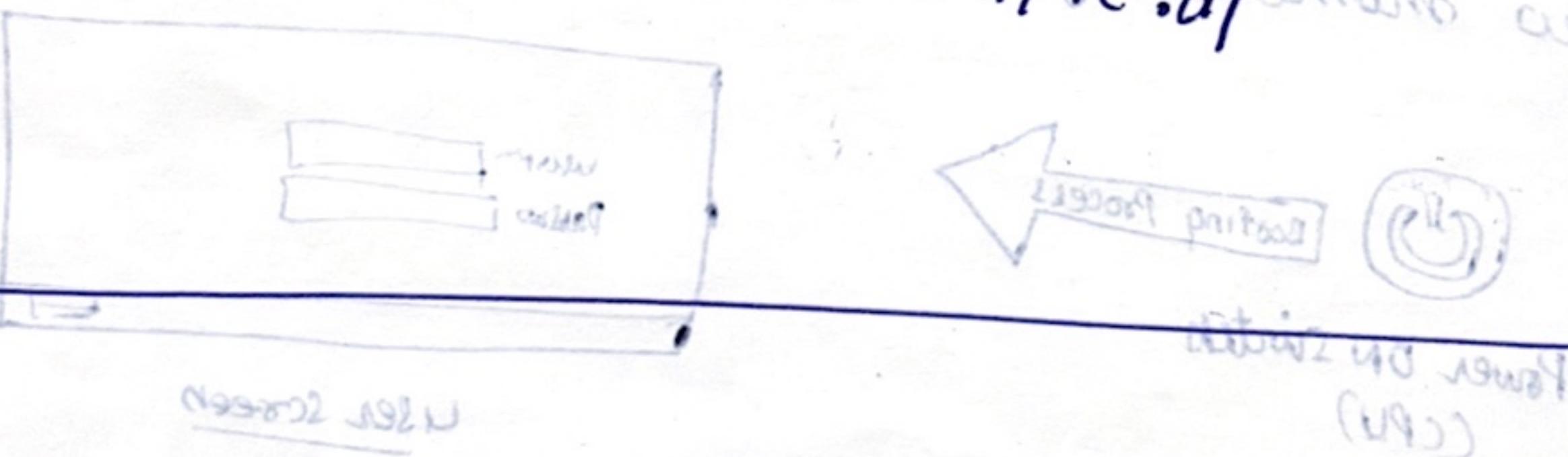
→ ② NBR :- Master Boot Record. Execute GRUB

→ ③ GRUB :- Grand Unified Bootloader. Execute Kernel

→ ④ KERNEL :- Kernel, execute /sbin/init

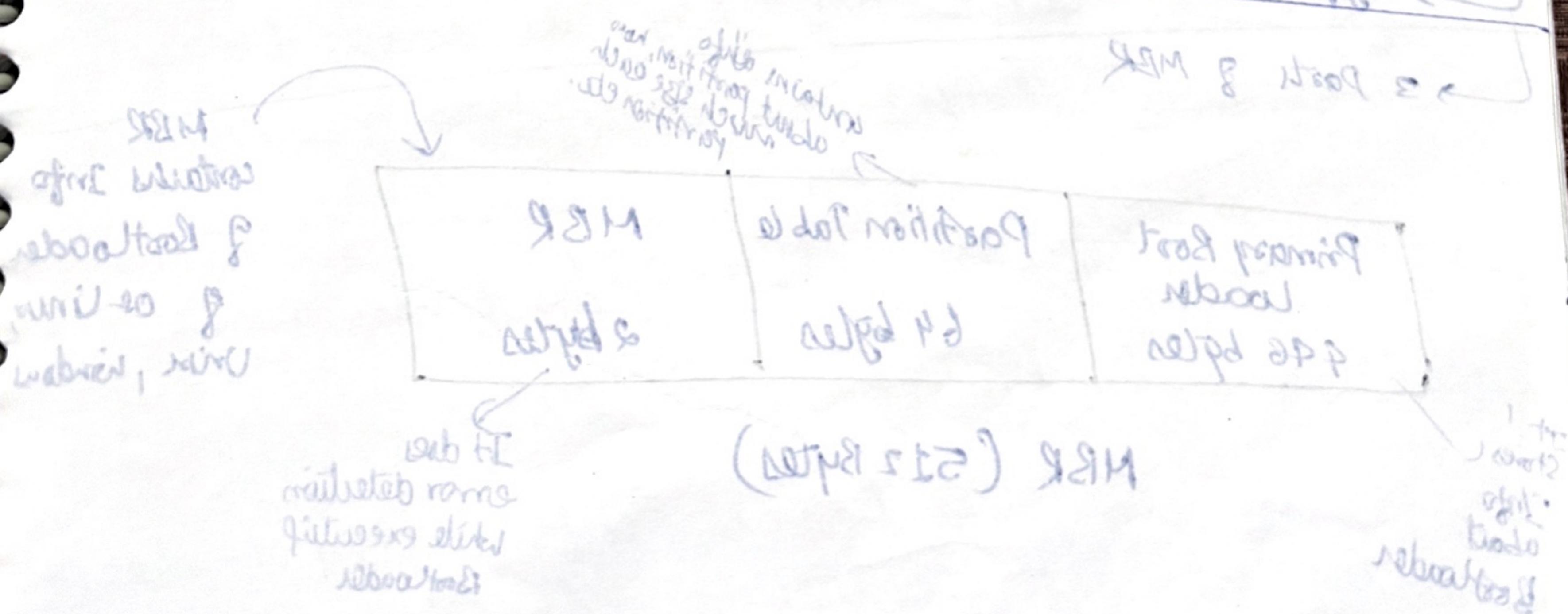
→ ⑤ Init :- Ind :- Execute Run Level Programs

→ ⑥ Run Level :- Run Level Programs:- Execute from /etc/rc.d/rc*.d/



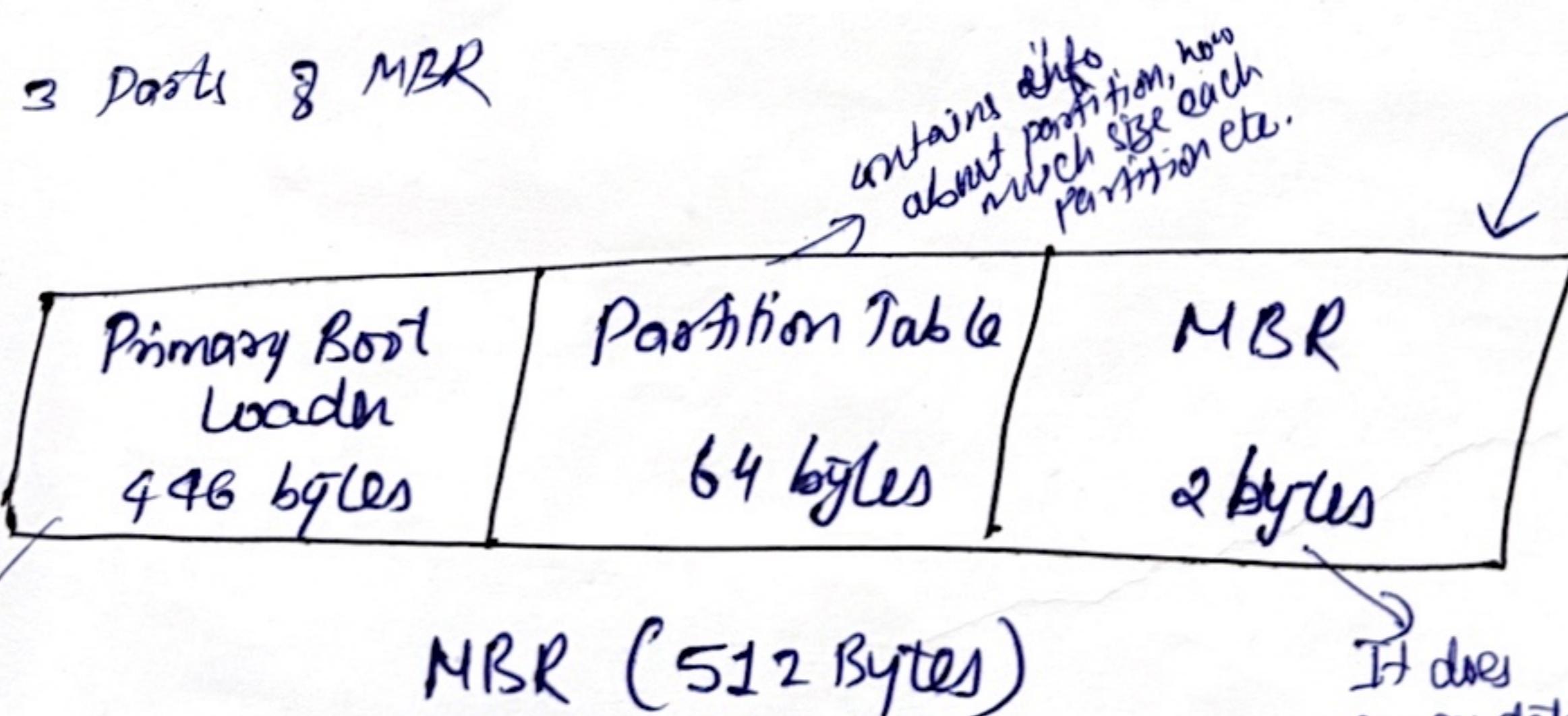
BIOS (Basic Input/Output System)

- Perform Integrity check (POST Process).
 - This POST process is BIOS first task.
 - POST → Power on self test.
 - Here it detects all devices like Keyboard, mouse, Harddrive, ~~etc~~. They must all work fine.
 - The second task BIOS does after POST is Execute MBR and Load boot Loader Program called NBR.
 - It will try to read first sector of your bootable device (Hard Disk or USB). That first sector contains info about MBR, (Master Boot Record.)



Q2 MBR (Master Boot Record) :-

- It is located in the 1st sector of the bootable disk.
- Its total size is 512 bytes.
- MBR contains information of Bootloader.
- Bootloader → is that file where the information of your operating system is present, like where your operating system is installed, that is in which drive your OS is installed.
- So the first sector of your bootable device is called MBR.
- Typically /dev/hda, or /dev/sda
- 3 parts of MBR



It stores info about Bootloader

It does error detection while executing Bootloader.

MBR contains info of Bootloader of Linux, Unix, Windows

cont'

(S)

In Linux there are two types of Bootloader

① LILO (old) and GRUB.

→ LILO → Linux Loader

→ GRUB → Grand Unified Bootloader.

→ These days we use GRUB Bootloader only.

(S) So now MBR searches for bootloader information,

so whenever the bootloader information is

read, we will see GRUB display screen

more details and screens and more, we will see

it works at next page see

shows we of need itself a separate disk

through boot it, yet who need time of

the work in briefcase so (from 20) need

from -dmg [dmg] tool) mi betwol ite

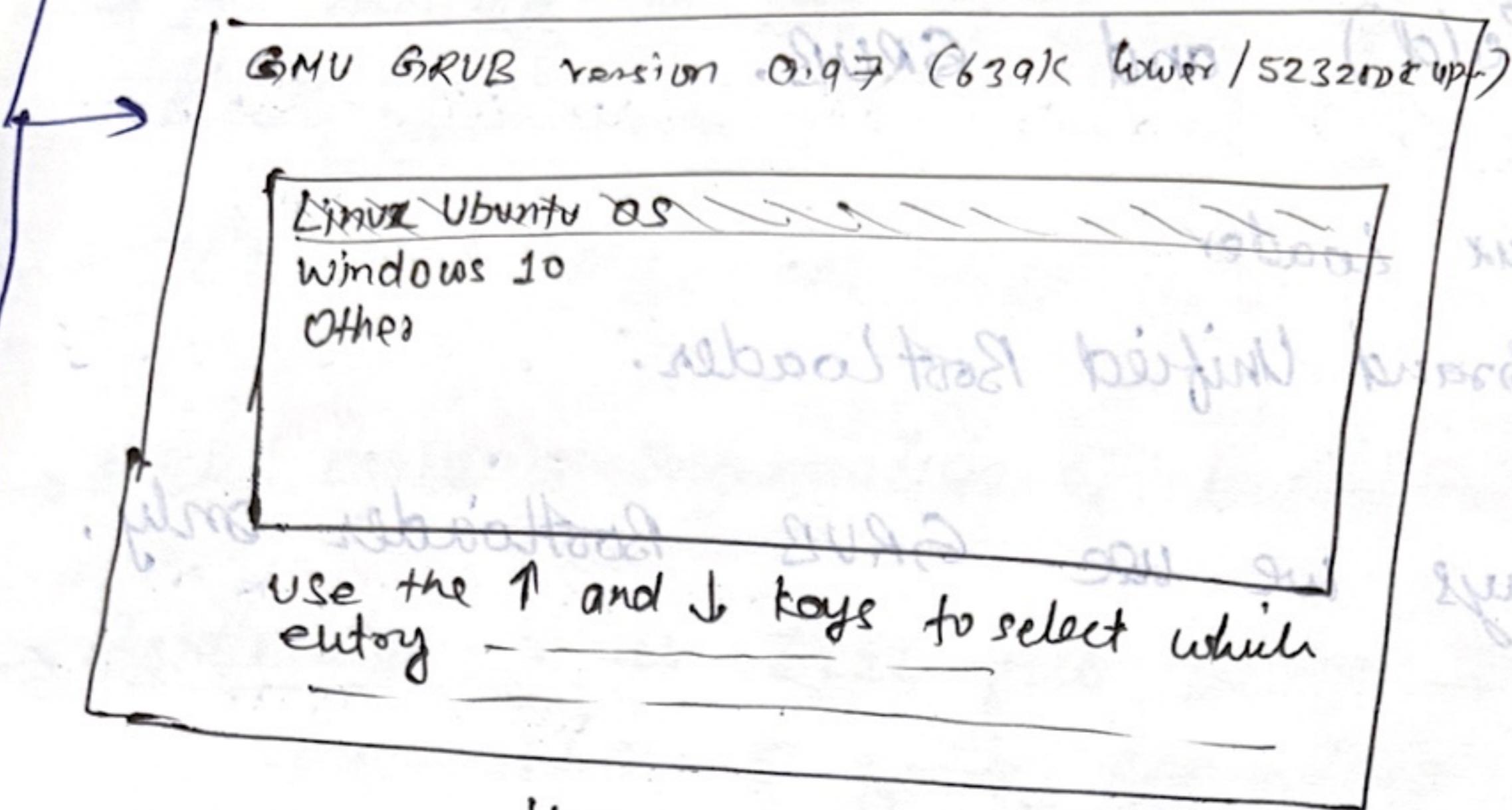
open file and need to do the

work from . so file need situation see it

part next . so the printout is not with

. boot fail know - see

GRUB (Grand Unified Bootloader) :-



→ If multiple kernel Images (OS) are installed on your system, you can choose one which you want to execute.

→ Grub displays a flash screen for few seconds. If don't enter any key, it load default kernel (OS Image) as specified in GRUB file.

→ It's located in /boot/grub/grub.conf

→ It contact kernel and initrd image. like you are contacting its OS. Kernel means are present just load.

(S) Kernel

- Kernel mounts the root file system. (where your OS is installed)
- Once kernel starts, its operation will execute /sbin/init process (Init Process)
- Note:- After RHEL6 new Service Manager used in RHE7. Means upto version 6 only Init was used. Later versions, i.e., 7, 8, ... "Service Manager", ~~#init~~ is being used then.
~~(Systemd)~~
- Initrd is used by kernel as temporary root file system until kernel mounts the root file system....

metals, etc. prints. touch our time root privileged
several parallel set of user threads now

\b.0cr\b.0rl\st0\ \ O Jovian\ \
\b.1cr\b.1rl\st1\ \ M " "
\b.2cr\b.2rl\st2\ " "
\b.3cr\b.3rl\st3\ " "
\b.4cr\b.4rl\st4\ " "
\b.5cr\b.5rl\st5\ " "

(3) INIT / Systemd (Initialization) :-

- Looks at the `/etc/inittab` file to decide the Linux run level.
- Run level decide which initial programs are loaded at startup.
- Run levels are
 - Init 0 → Halt
 - Init 1 → Single User Mode
 - Init 2 → Multiuser Mode, without NFS
 - Init 3 → Full Multiuser mode
 - Init 4 → Unused
 - Init 5 → X11
 - Init 6 → Reboot

(3) Run Level Programs :-

- Depending your init run level setting, the system will execute one of the following directories.
- RunLevel 0 → `/etc/rc.d/rc0.d/`
" 1 → " " `/rc1.d/`
" 2 → " " `/rc2.d/`
" 3 → " " `/rc3.d/`
" 4 → " " `/rc4.d/`
" 5 → " " `/rc5.d/`
" 6 → " " `/rc6.d/`

⑤ After then booting process is completed and your login screen shows up. That's it.

SOFT

Extra knowledge :-

- Master Boot Record (MBR) is a small program that starts when the computer is booting, in order to find the OS.
- This complicated process called the boot Process starts with POST & ends when BIOS search for the MBR on the harddrive, which is generally located in the first sector, first head, first cylinder (cylinder 0, head 0, sector 1).

→ A typical structure looks like:-

