Computer Fundamentals
And
Operating System Concepts

❑Module introduction

- CCAT point of view:
  - Operating Systems: 9 Questions
  - Computer Fundamentals + Networking: 10 Questions

- Reference Book:
  - Operating System Concepts - Galvin

➢ Introduction: -

- Why there is need of an OS?
- What is an OS?
- Booting process in brief
- Functions of an OS

➢Computer Fundamentals:

- Major Components : Processor, Memory Devices & IO Devices.
- Memory Technologies and its characteristics
- IO Techniques

Operating Systems and Computer Fundamentals

➢UNIX System Architecture Design

- Major subsystem of an UNIX system: File subsystem & Process Control subsystem.
- System Calls & its categories
- Dual Mode Operation

➢Process Management

- What is Process & PCB?
- States of the process
- CPU scheduling & CPU scheduling algorithms
- Inter Process Communication: Shared Memory Model & Message Passing Model
- Processor architecture (CF)

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➢Process Management

- Process Synchronization/Co-ordination
- Deadlocks & deadlock handling methods

➢Memory Management

- Memory types (CF)
- Swapping
- Memory Allocation Methods
- Internal Fragmentation & External Fragmentation Segmentation
- Paging
- Virtual Memory Management

➢File Management

- What is file?
- What is file system & file system structure?
- Disk structure (CF)
- Disk space allocation methods
- Disk scheduling algorithms
- Computer structure (CF)
- Interrupts (CF)
- Direct Memory Access (CF)
- Input-Output (CF)
- System calls

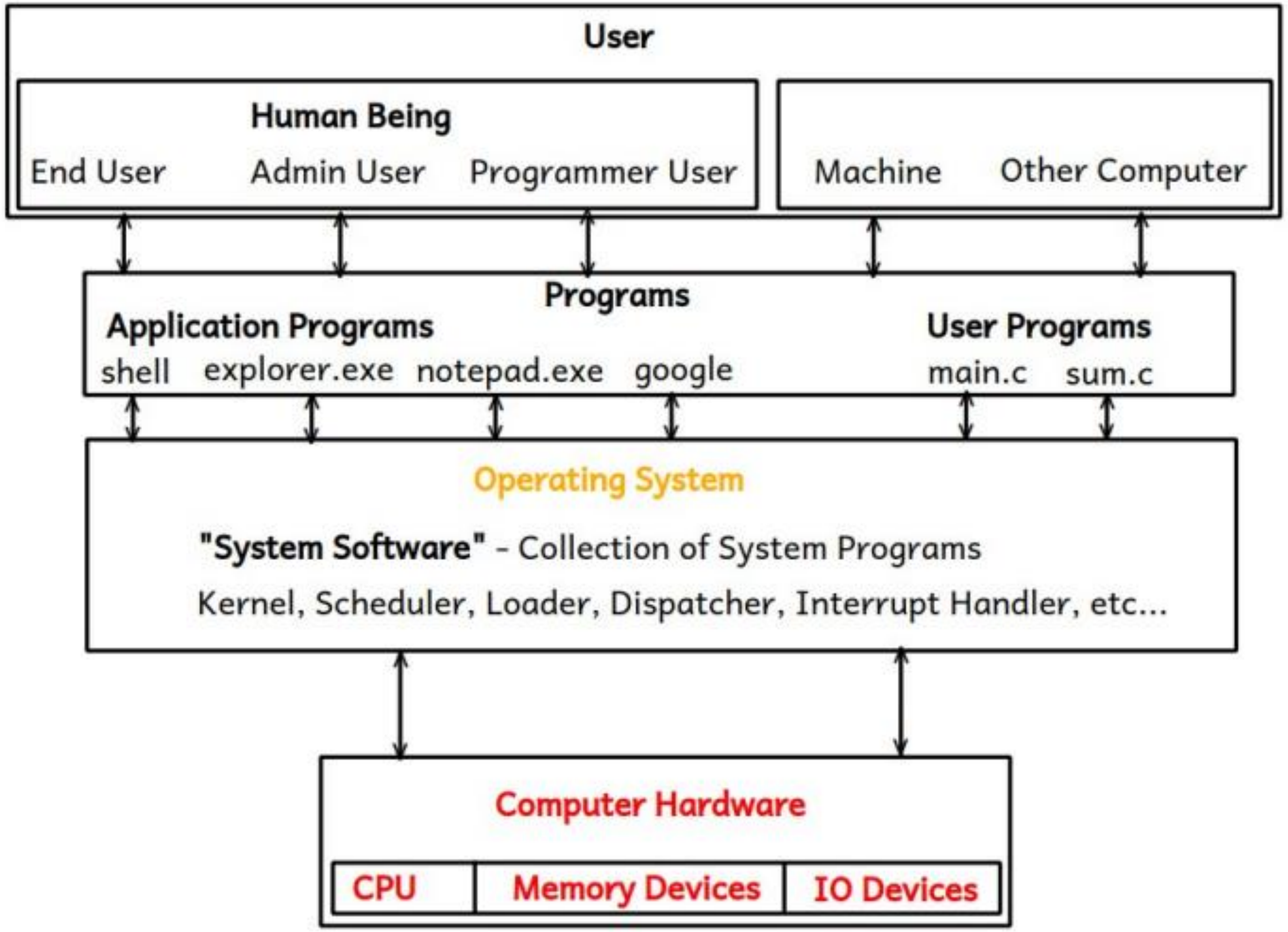
➢Why there is a need of an OS?

- Computer is a machine/hardware does different tasks efficiently & accurately.
- Basic functions of computer :

  1. Data Storage : Memory Devices
  2. Data Processing : CPU/Processor
  3. Data Movement
  4. Control

- As any user cannot communicates/interacts directly with computer hardware to do different tasks, and hence there is need of some interface between user and hardware.

Diagram :OS



User

Human Being

End User Admin User Programmer User

Machine Other Computer

Programs

Application Programs

shell explorer.exe notepad.exe google

User Programs

main.c sum.c

Operating System

"System Software" - Collection of System Programs

Kernel, Scheduler, Loader, Dispatcher, Interrupt Handler, etc...

Computer Hardware

CPU | Memory Devices | IO Devices

Q. What is a Software?

- Software is a collection of programs.

Q. What is a Program?

- **Program is a finite set of instructions written in any programming language** (either low level or high level programming language) given to the machine to do specific task.

❖ 3 types of programs are there:

1. **"user programs":** programs defined by the programmer user/developers e.g. etc.... main.c, hello.java, addition.cpp
2. **"application programs":** programs which comes with an OS/can be installed later e.g. MS Office, Notepad, Compiler, IDE's, Google Chrome, Mozilla Firefox, Calculator, Games etc....
3. **"System Programs":** programs which are inbuilt in an OS/part of an OS. e.g. Kernel, Loader, Scheduler, Memory Manager etc...

➢What is an IDE (Integrated Software Development) ?

- It is **an application software i.e. collection of tools/application programs like source code editor, pre-processor, compiler, linker, debugger etc... required for faster software development**.

e.g. VS code editor, MS Visual Studio, Net beans, Android Studio, Turbo C etc.... Source Code – Program written in any programming language.

1. **"Editor":** it is an application program **used to write a source code.**

   e.g. notepad, vi editor, gedit etc...

2. **"Pre-processor":** it is an application program gets executes before compilation and does two jobs **- it executes all pre-processor directives and removes all comments from the source code.**

   e.g. cpp

3. **"Compiler":** it is an application program which converts high level programming language code into low level programming language **code i.e. human understandable language code into the machine understandable language code.**

   e.g. gcc, tc, visual c etc...

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4. **"Assembler":** it is an application program which converts assembly language code into machine language code/object code. e.g. masm, tasm etc...
5. **"Linker":** it is system program which links object file/s of a program with precompiled object modules of library functions exists in a lib folder and creates final single executable file.
   e.g. **ld** : link editor in Linux.

- **Loader :** It is a system program (i.e. inbuilt program of an OS**) which loads an executable file from HDD into the main memory.**

- **Dispatcher :** It is a system program (i.e. inbuilt program of an OS) **which loads data & instructions of a program which is in the main memory onto the CPU** (i.e. into the CPU registers).

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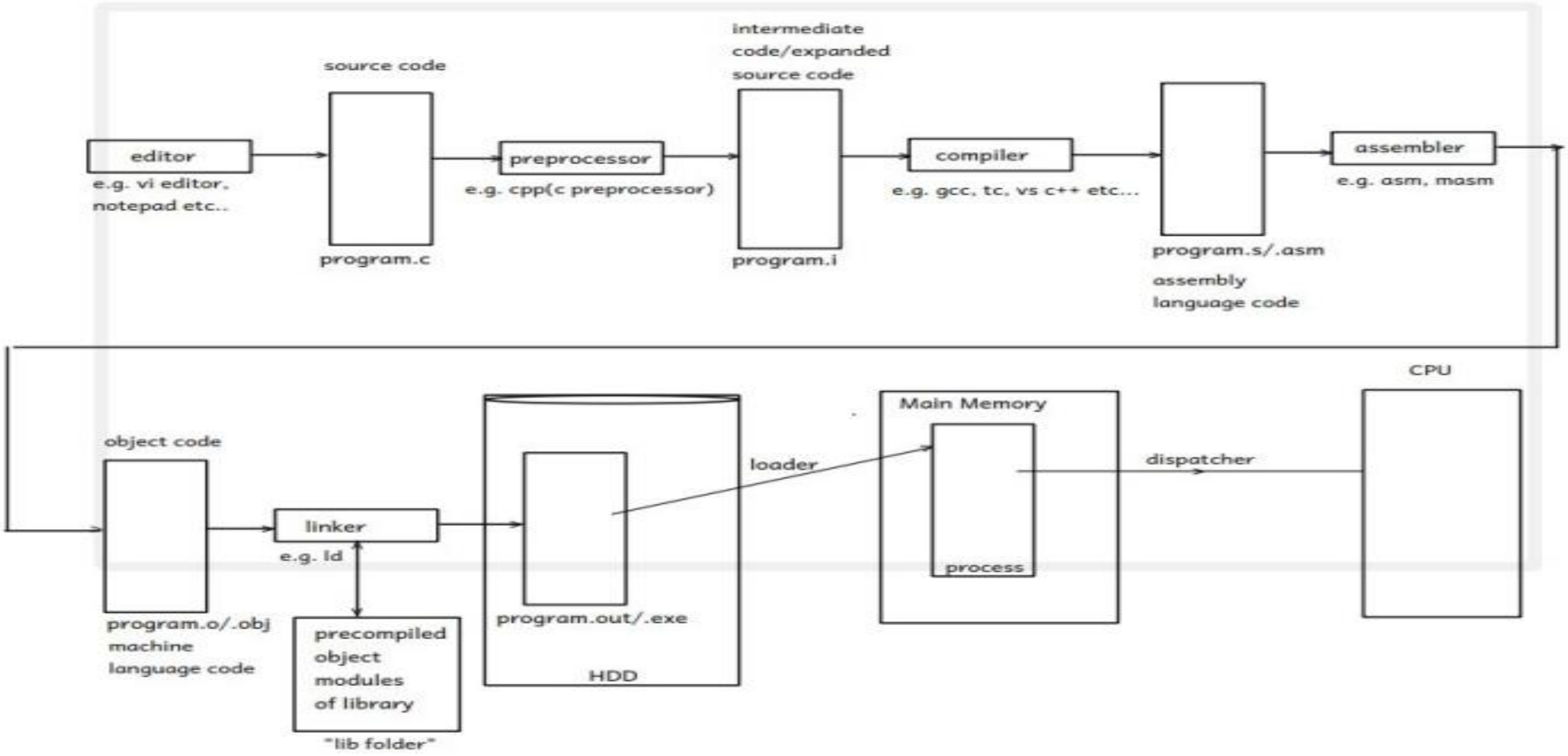

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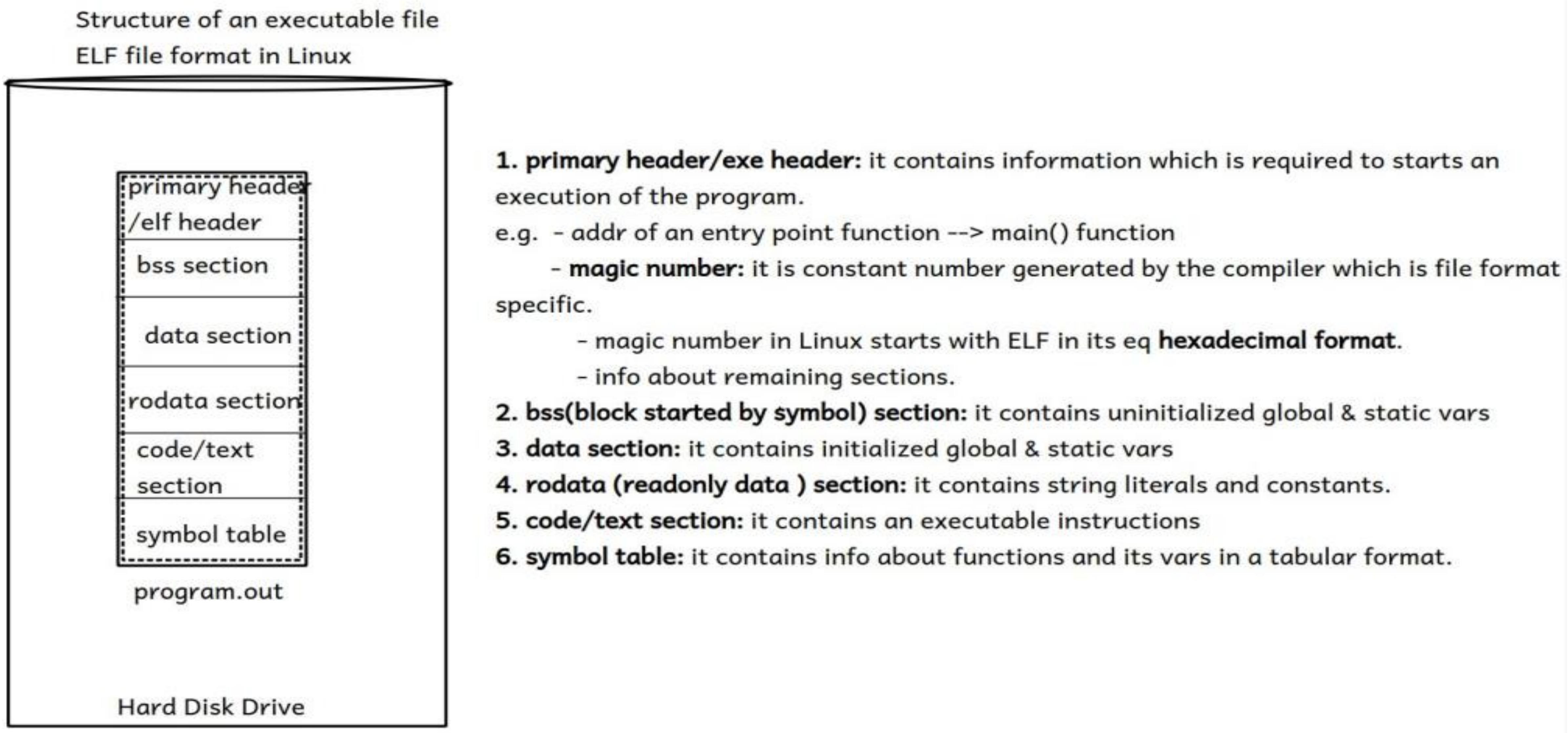

1. primary header/exe header: it contains information which is required to starts an execution of the program.

e.g. - addr of an entry point function --> main() function

- **magic number:** it is constant number generated by the compiler which is file format specific.
  - magic number in Linux starts with ELF in its eq **hexadecimal format**.
  - info about remaining sections.

2. bss(block started by symbol) section: it contains uninitialized global & static vars

3. data section: it contains initialized global & static vars

4. rodata (readonly data) section: it contains string literals and constants.

5. code/text section: it contains an executable instructions

6. symbol table: it contains info about functions and its vars in a tabular format.

Q. What is an Operating System?

- An OS is a **system software** (i.e. collection of system programs) which acts as an interface between user and hardware.
- An OS also acts as an **interface between programs and hardware**.
- An OS allocates resources like main memory, CPU time, i/o devices access etc... to all running programs, hence it is also called as **a resource allocator.**
- An OS controls an execution of all programs and it also controls hardware devices which are connected to the computer system and hence it is also called as **a control program.**

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- An **OS** manages limited available resources among all running programs, hence it is also called as a **resource manager**.

- **From End User:** An OS is a software (i.e. collection of programs) comes either in CD/DVD, has following main components:

1. **Kernel**: It is a core program/part of an OS which runs continuously into the main memory does basic minimal functionalities of it. e.g. Linux: vmlinuz, Windows: ntoskrnl.exe
2. **Utility Software's:** e.g. disk manager, windows firewall, anti-virus software etc...
3. **Application Software's**: e.g. Google chrome, shell, notepad, MS office etc...

➢Functions of an OS:

Basic minimal functionalities/Kernel functionalities:

1. Process Management
2. Memory Management
3. Hardware Abstraction
4. CPU Scheduling
5. File & IO Management

Extra utility functionalities/optional:

6. Protection & Security
7. User Interfacing
8. Networking

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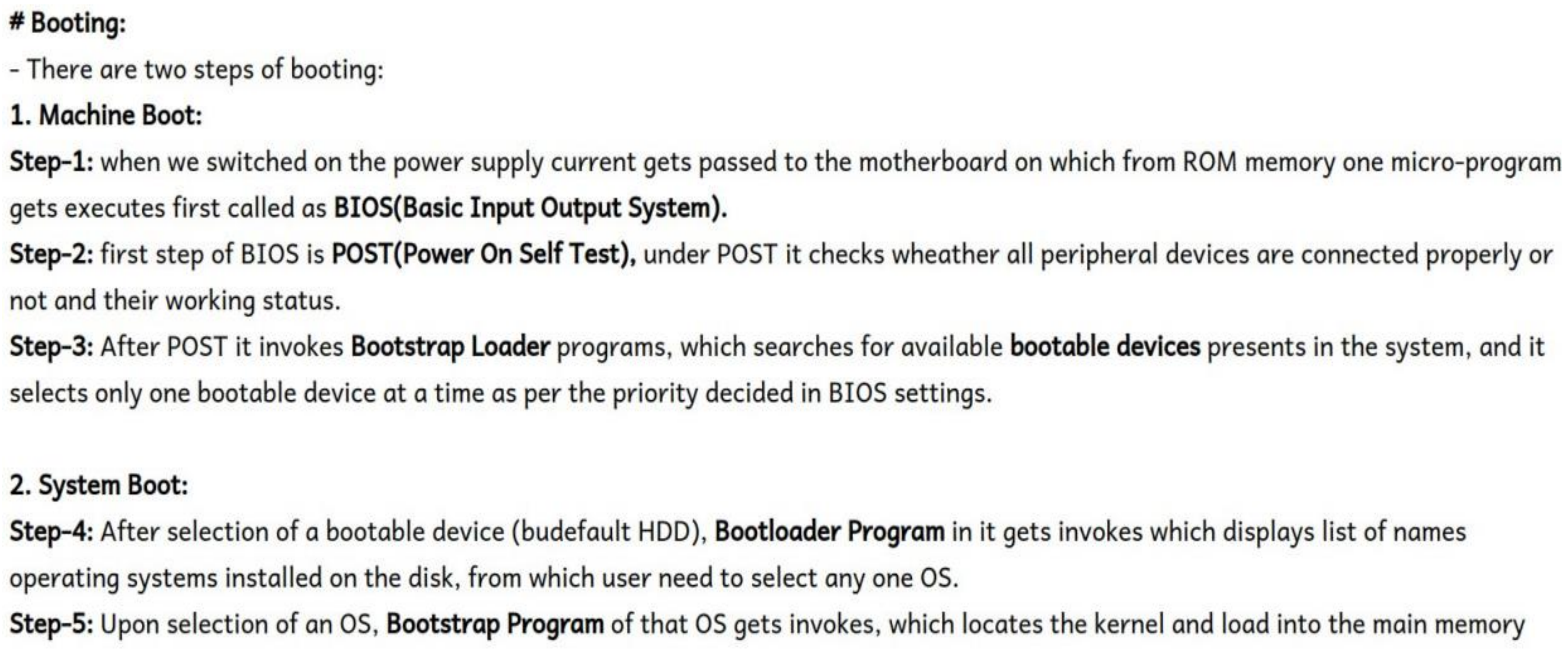

# Booting:

- There are two steps of booting:

1. Machine Boot:

Step-1: when we switched on the power supply current gets passed to the motherboard on which from ROM memory one micro-program gets executes first called as **BIOS(Basic Input Output System).**

Step-2: first step of BIOS is **POST(Power On Self Test),** under POST it checks wheather all peripheral devices are connected properly or not and their working status.

Step-3: After POST it invokes **Bootstrap Loader** programs, which searches for available **bootable devices** presents in the system, and it selects only one bootable device at a time as per the priority decided in BIOS settings.

2. System Boot:

Step-4: After selection of a bootable device (budefault HDD), **Bootloader Program** in it gets invokes which displays list of names operating systems installed on the disk, from which user need to select any one OS.

Step-5: Upon selection of an OS, **Bootstrap Program** of that OS gets invokes, which locates the kernel and load into the main memory

UNIX Operating System:

- ○ **UNIX** : UNICS – Uniplexed Information & Computing Services/System.
- ○ **UNIX** was developed **at AT&T Bell Labs** in US, in the decade of 1970's by **Ken Thompson, Denies Ritchie and team.**

- It was first run on a machine **DEC-PDP-7** (Digital Equipment Corporation Programmable Data Processing-7).
- UNIX is **the first multi-user, multi-programming & multi-tasking operating system.**
- **UNIX was specially designed for developers by developers**
- System architecture design of UNIX is followed by all modern OS's like Windows, Linux, MAC OS X, Android etc**..., and hence UNIX is referred as mother of all modern operating systems.**

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Thank you!

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