

Computer Fundamentals And Operating System Concepts



❑ Module introduction

➤ CCAT point of view:

- Operating Systems: 6 Questions
- Computer Fundamentals / Concepts of Programming :

➤ Reference Book:

- Operating System Concepts - Galvin

Operating Systems and Computer Fundamentals

➤ Practice Exam :

- Quiz : 4 quiz exam **OS** (**10** Question)
- Quiz : 1 quiz exam **Computer Fundamentals** (**10** Question)
- Module End Quiz Exam (**20** Question)

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➤ 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

➤ 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
- Process life cycle
- CPU scheduling & CPU scheduling algorithms
- Inter Process Communication: Shared Memory Model & Message Passing Model
- Processor architecture (CF)

➤ 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

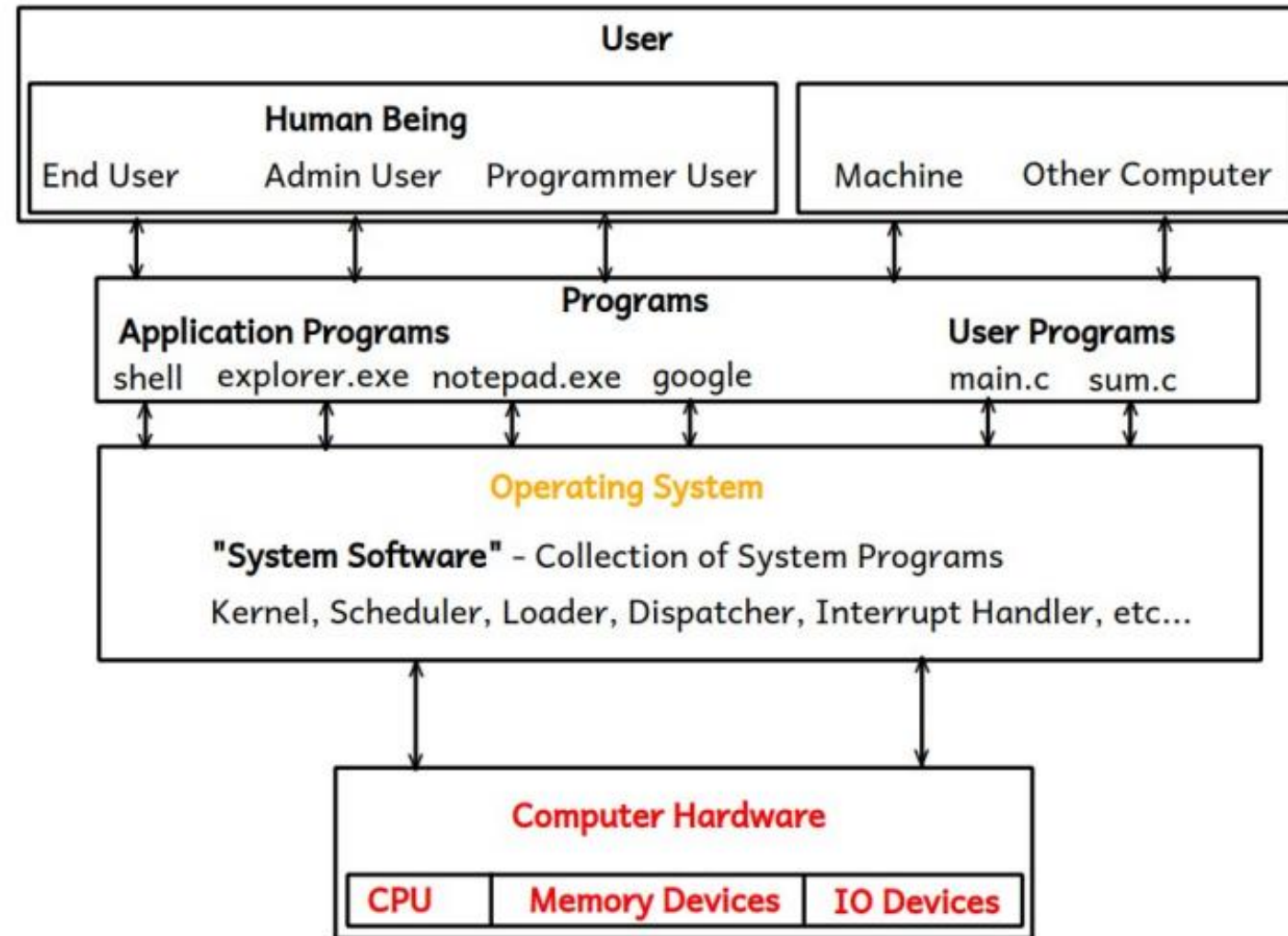
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Q. Why there is a need of an OS?

- 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 : I/O Devices
 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.

Operating Systems Concepts

Diagram :OS



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**.

Operating Systems Concepts

- 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...



Operating Systems Concepts

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. main.c, hello.java, addition.cpp etc....
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...



➤ 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

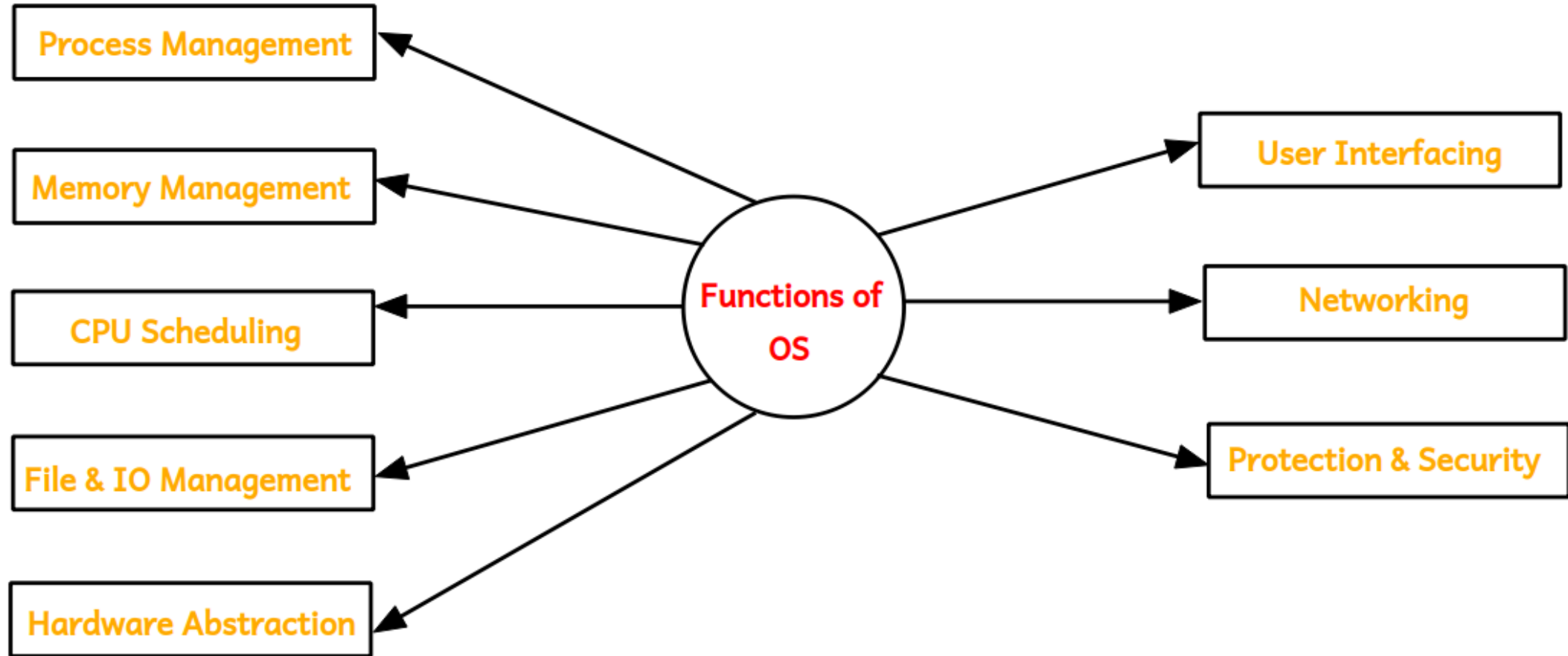
Extra utility functionalities/optional:

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

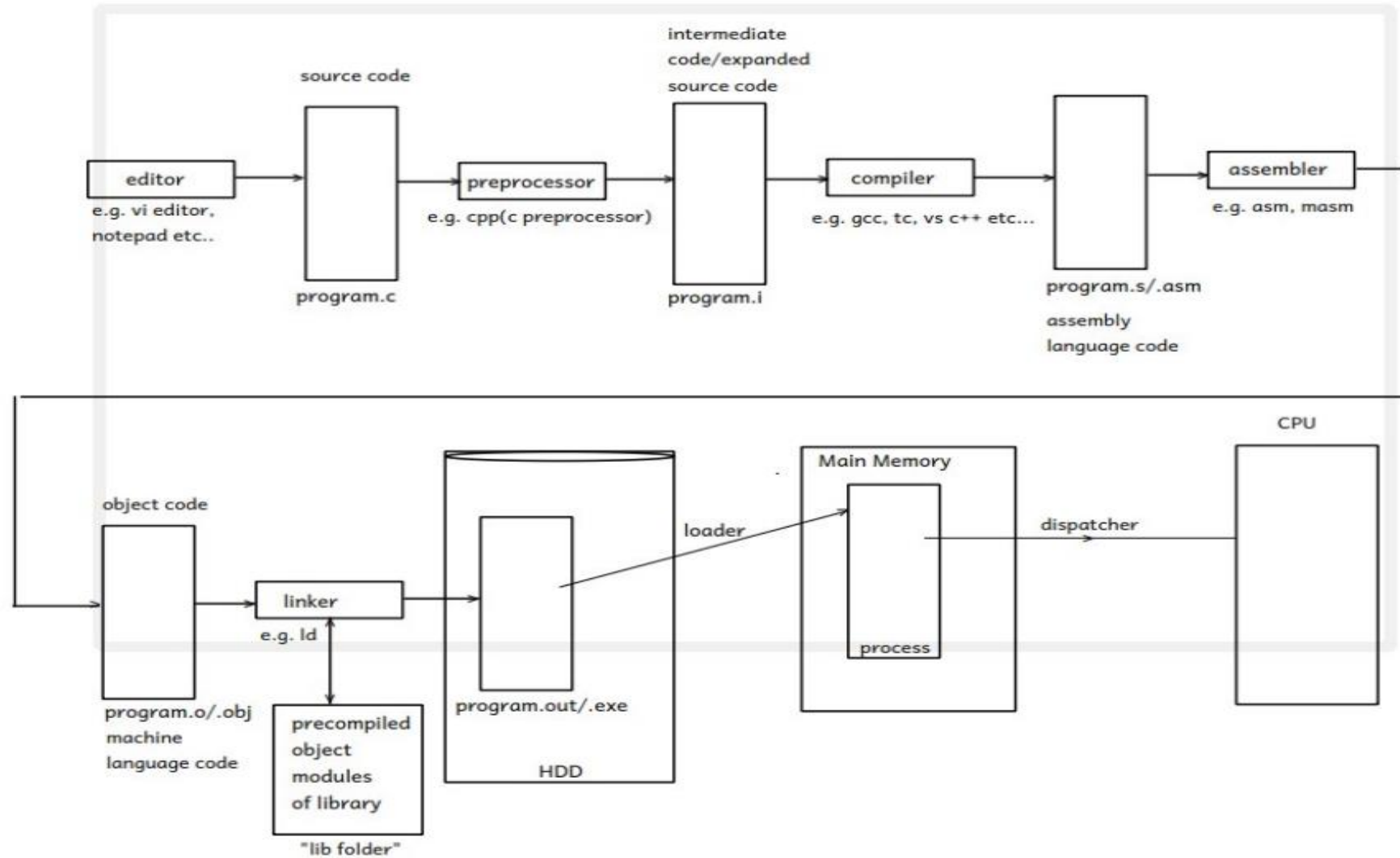
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Basic Minimal Functionalities/Core
Functionalities => "Kernel"

Optional Functionalities/Extra utility
Functionalities => "Utility Softwares"



Operating Systems Concepts



➤ 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....

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

Source Code – Program written in any programming language.

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 an application program which links object file/s in a program with precompiled object modules of library functions exists in a lib folder and creates final single executable file.

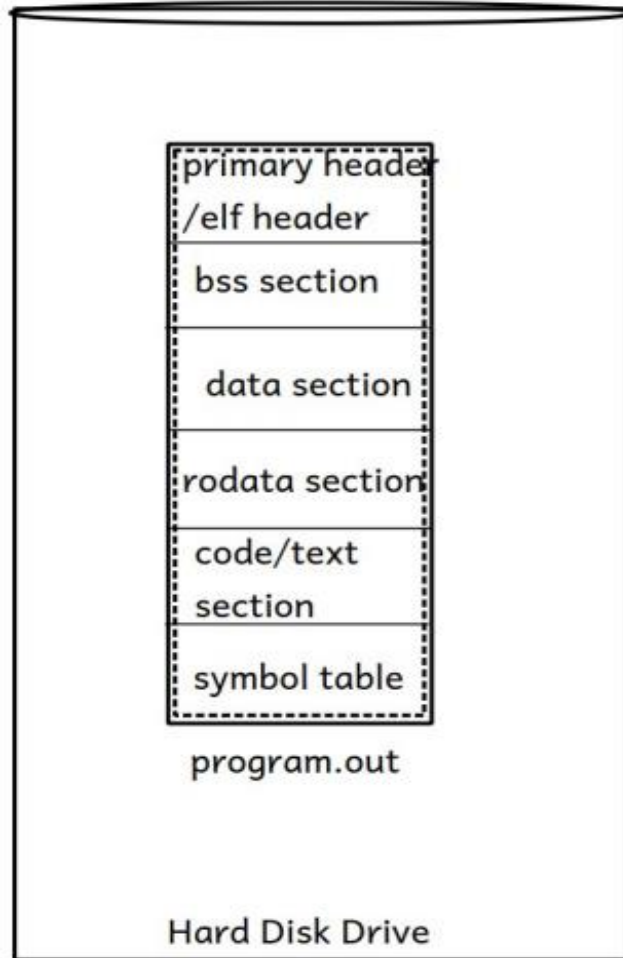
e.g. ld: link editor in Linux.

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Operating Systems Concepts

Structure of an executable file
ELF file format in Linux



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

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

- **magic number:** it is a 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 executable instructions

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



➤ Booting Process

■ Terminologies :

• Bootstrap Program

- It loads OS kernel into main memory
- Each OS has Its own Bootstrap program.
- Located in first sector of bootable storage device.

• Bootable Device

- Storage device whose first sector (512 bytes) contains a special program “Bootstap Program “.
- Usually it is device that stores OS installation setup;
- E.g. Bootable CD/DVD ,Bootable Pendrive.

• Bootloader

- When multiple OS are installed on single computer, at the beginning one program asks end user about which OS boot.
- This task perform by bootloader program.
- Bootloader program bootstrap program of selected OS.
- Located in second sector of bootable storage device.

Operating Systems Concepts

- **BIOS/Firmwaer**

- Firmware is a program/set of a program loaded into base ROM of motherboard.
- It is developed by Manufacturer of motherboard.
- The firmware developed for PC (by IBM) is named as BIOS : Basic Input Output System
- BIOS Contain
 - POST/BIST
 - Bootstrap loader
 - Information utility
 - Bootable Device preference/settings
 - Basic/Minimal device driver.

- **POST/BIST**

- **POST** - Power ON Self Test
- **BIST** - Built In Self Test
- Send signal to all peripheral(e.g. keyboard , mouse, monitor...)and test if they are functioning well.
- Located in Base ROM(Part of Firmware)



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- **Bootstrap Loader :**

- Finds the bootable device in the computer and start it's Bootloader.
- It check all devices in a order given in BIOS and start the first found bootable device.
- Located in Base ROM (Part of Firmware).



Operating Systems Concepts

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



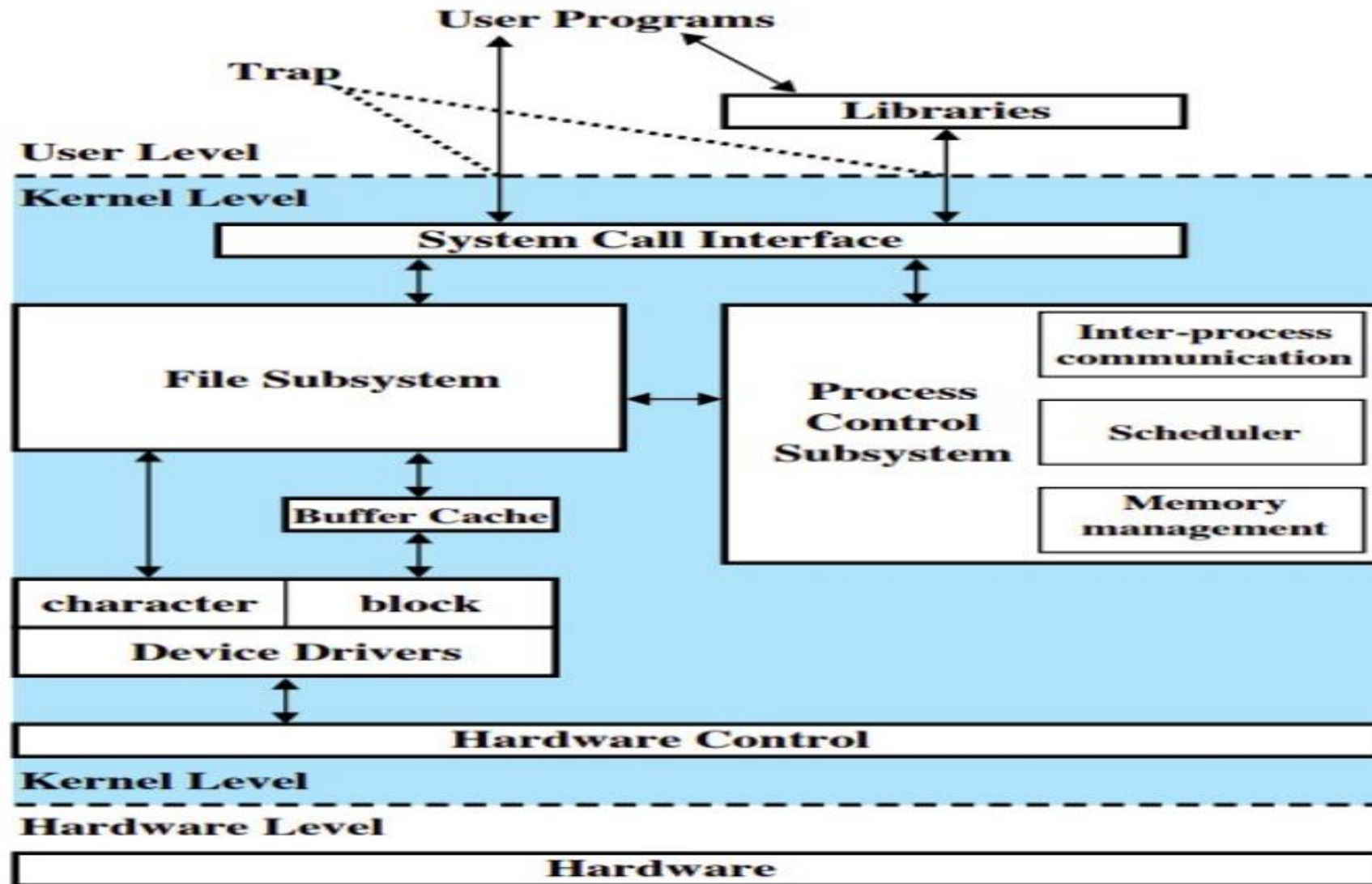
Operating Systems Concepts

○ **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.**



Operating Systems Concepts



Operating Systems Concepts

- Kernel acts as an interface between programs and hardware.
- Operating System has subsystems like **System Call Interface Block, File Subsystem Block, Process Control Subsystem Block (which contains IPC, Memory Management & CPU Scheduling), Device Driver, Hardware Control/Hardware Abstraction Layer.**
- **There are two major subsystems:**
 1. Process Control Subsystem
 2. File Subsystem
- In UNIX, **whatever is that can be stored is considered as a file and whatever is active is referred as a process.**
- **File has space & Process has life.**



Operating Systems Concepts

- From **UNIX point of view all devices are considered as a file**
- In UNIX, devices are categorized into two categories:
 - 1. Character Devices:** Devices from which data gets transferred character by character
→ character special device file
e.g. keyboard, mouse, printer, monitor etc...
 - 2. Block Devices:** Devices from which data gets transferred block by block
→ block special device file
e.g. all storage devices.
- **Device Driver** : It is a program/set of programs enable one or more hardware devices to communicate with the computer's operating system.
- **Hardware Control Layer/Block** does communication with control logic block i.e. controller of a hardware.



➤ Dual Mode Operation:

System runs in two modes:

1. System Mode
2. User Mode

1. System Mode:

- When the CPU executes system defined code instructions, system runs in a system mode.
- System mode is also referred as **kernel mode/monitor mode/supervisor mode / privileged mode.**

2. User Mode:

- When the CPU executes user defined code instructions, system runs in a user mode.
- User mode is also referred as **non - privileged mode.**
- Throughout execution, the CPU keeps switch between kernel mode and user mode

Dual Mode Operation:

- Throughout an execution of any program, the CPU keeps switches in between **kernel mode and user mode** and hence system runs in two modes, it is referred as **dual mode operation**.
- To differentiate **between user mode and kernel mode** one bit is there onto the CPU which is maintained by an OS, called as **mode bit**, by which the CPU identifies whether currently executing instruction is of either **system defined code instruction/s** or **user defined code instruction/s**.
- In **Kernel mode** value of mode bit = 0, whereas
- In **User mode** value of mode bit = 1.



Operating Systems and Computer Fundamentals

1. CUI/CLI : Command User Interface/Command Line Interface

- By using this kind of interface user can interact with an OS by means entering commands onto the terminal/command line in a text format.
- e.g. In Windows name of the program which provides CUI => cmd.exe
- command prompt In Linux name of an application program which provides CUI => shell/terminal
- In MSDOS name of the program which provides CUI => command.com (Microsoft Disk Operating System).

2. GUI : Graphical User Interface

- by using this kind of interface user can interact with an OS by means making an event like click on buttons, left click/right click/double click, menu bar, menu list etc.....
- - Windows = User friendly GUI.
- e.g. In Windows name of an application program which provides GUI => explorer.exe
- In Linux name of an application program which provides GUI => GNOME/KDE (GNU Network Object Model Environment / Common Desktop Environment).





Thank you!

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