CSC101
Introduction to ICT

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Lecture - 10

Operating System

Operating System

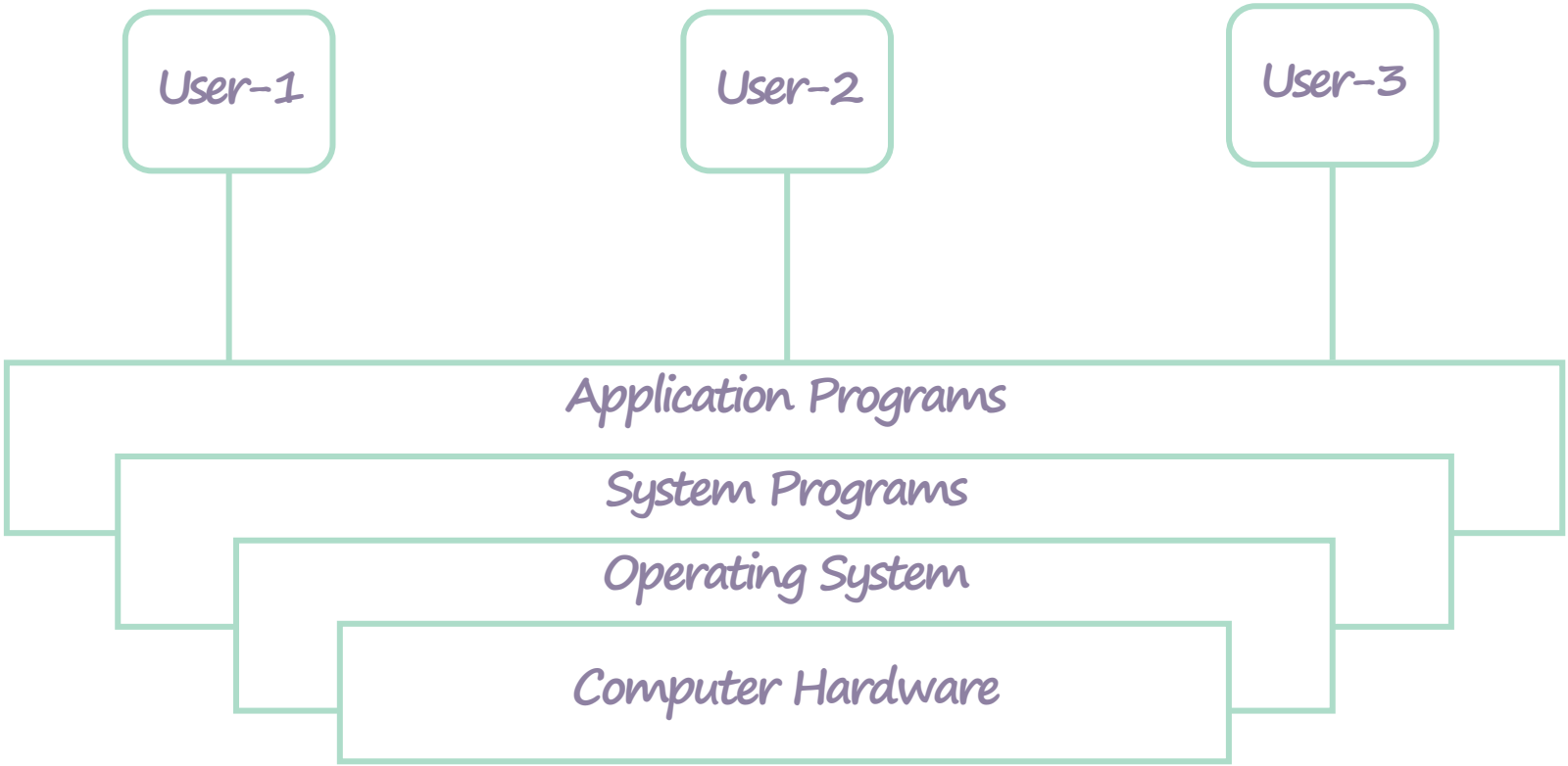
- Operating system (or OS) is a program (in fact, an integrated set of programs) that maintains operations of a computer
- It controls and coordinates all activities among computer hardware resources (the CPU, memory, I/O devices, etc.)
- It provides users with an interface or virtual machine that is more convenient to use than the bare machine

- Two primary objectives of an OS are;
  - Making a computer system convenient to use
  - Managing the resources of a computer system

- Operating systems (also called the platform) are found on almost any computing device, from smart phones and video game consoles to supercomputers and web servers

Operating System

- The OS layer hides the details of the hardware from the user and provides the user with convenient interface for using the system



Operating System

- Some of the functions of an OS are;
  - Start/stop the computer
  - provide a user interface
  - manage programs
  - manage memory
  - schedule jobs and configure devices
  - establish an Internet connection
  - monitor performance
  - provide file management and other utilities
  - control a network
  - administer security

Operating System

- An OS can be **device-dependent** which means it can run only on specific type of computer hardware, or **device-independent** which means it can run on many types of computer hardware

- Similarly, a **single-platform application** can only run on a specific OS whereas a **cross-platform application** is the one which runs identically on multiple OSs

Types of Operating Systems

- Five major types of Operating systems;
  - Desktop OS
  - Embedded OS
  - Mobile OS
  - Network OS
  - Distributed OS

Types of Operating Systems

- Desktop OS
  - A desktop OS is the one that is intended for a desktop computer
  - It usually comes with all the software that one would probably use at a desk
  - Examples: Windows 10, macOS
- Embedded OS
  - Embedded OS is designed to be compact, efficient at resource usage and created to cover specific tasks
  - Do not have many functions that a desktop OS provides
  - Examples: Windows CE (Embedded Compact), Symbian, NetBSD
- Mobile OS
  - Mobile OS operates a smartphone, tablet, PDA, or other digital mobile devices
  - It has the features such as handling touchscreen, cellular, Bluetooth, Wi-Fi, GPS mobile navigation, camera, speech recognition, voice recorder, music player etc.
  - Examples: iOS, Android

Types of Operating Systems

- Network OS
  - Network OS runs on a server computer and enables the server to manage data, users, groups, security, applications, and other networking functions
  - Allows users to share printer, files, and programs on a network
  - Administers security by establishing username and password for each user
  - Examples: Windows Server 2013, Oracle Solaris, Cumulus Linux

- Distributed OS
  - A distributed OS is an extension of the network OS that supports higher levels of communication and integration of the computers on the network
  - It runs on multiple, independent CPUs and the processing jobs are distributed among these processors
  - It supports multiple real-time applications, multiple users and wide sharing of resources like computational capacity, I/O, files etc.
  - Examples: Amoeba, Inferno

Process Management

- A program is a static set of instructions
- A process (also called task or job) is a program in execution state
- Process management in OS, manages the processes submitted to a system in a manner to minimize idle time of processors (CPUs, I/O processors, etc.) of the system

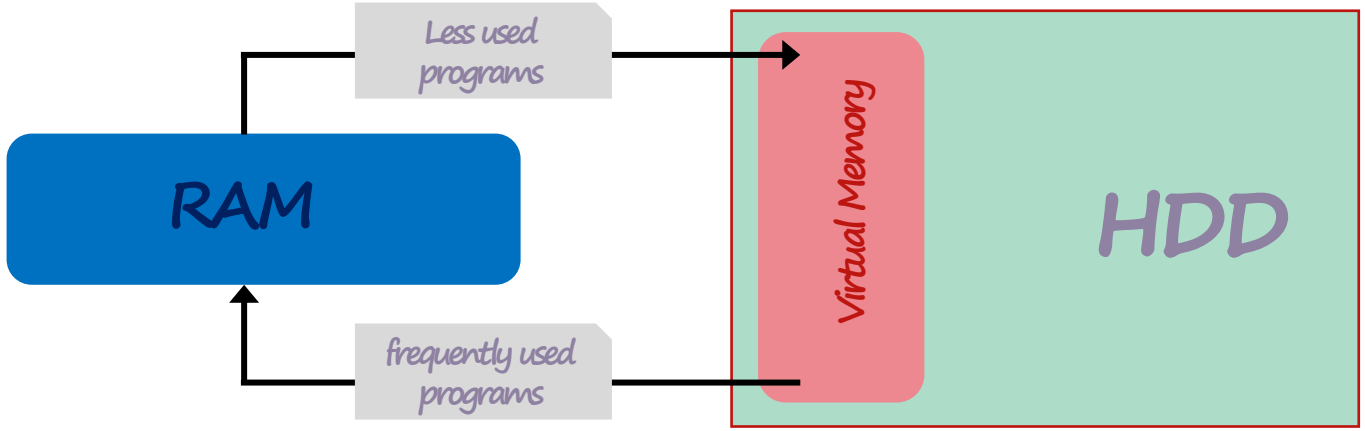
- Multitasking
  - Interleaved execution of multiple jobs (often referred to as tasks of same user) in a single-user system
  - Multiple tasks are executed concurrently instead of sequentially
  - Tasks share common processing resources, such as a CPU and main memory
  - Computer systems used for multitasking are uniprocessor systems (having only one CPU)
- Multiprocessing
  - Parallel execution of multiple processes using more than one processor
  - System with two or more CPUs, having ability to execute multiple processes concurrently
  - Multiple CPUs are used to process either instructions from different and independent programs or different instructions from the same program simultaneously

Process Management

- Operating systems can be classified as follows:
- **Multi-user**: Allows two or more users to run programs at the same time
- **Multitasking**: Allows more than one program to run concurrently
- **Multithreading**: Allows different parts of a single program to run concurrently
- **Multiprocessing**: Supports running a program on more than one CPU

Memory Management

- Virtual Memory
  - Memory management scheme that allows execution of processes that might not be completely loaded in the main memory
  - Virtual memory (VM) is an optimize use of RAM in which a portion of the hard disk is allocated to function as RAM
  - When required, OS transfers the least recently used data and program instructions to secondary memory because RAM is needed for other functions
  - The data and program instructions from secondary memory are transferred back to RAM when they are needed



Memory Management

- Advantages of VM
  - Provides a large virtual memory on a system having smaller physical memory
  - Enables execution of a process on a system whose main memory size is less than the total memory required by the process
  - Enables a process's execution to be started even when sufficient free memory for loading the entire process is not available
  - Often leads to less I/O activity resulting in an efficient system

- Disadvantages of VM
  - Difficult to implement because it requires algorithms to support demand paging
  - If used carelessly, it may substantially decrease performance due to high page fault rate

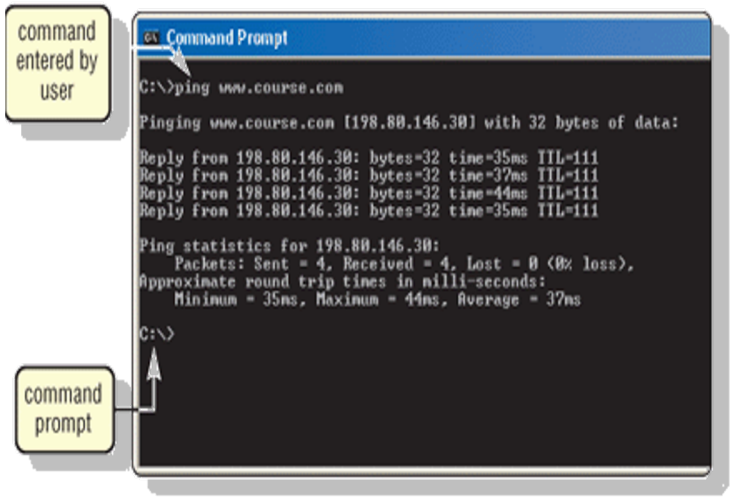
Memory Management

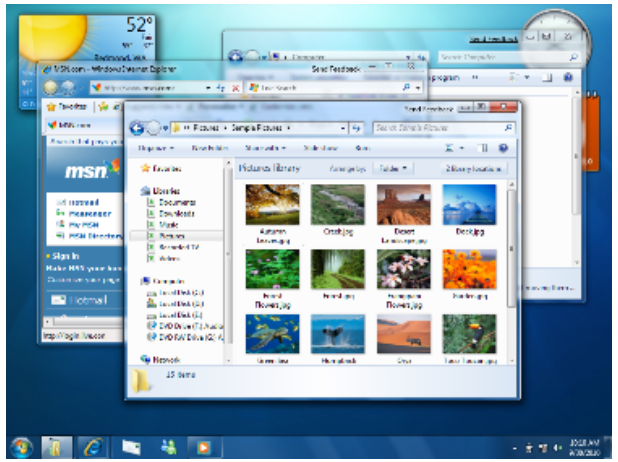
- Cache Memory
  - Cache memory stores data (in a hardware or software component) so that future requests for that data can be served faster
  - Data stored in a cache might be the result of an earlier computation or a copy of data stored elsewhere
  - It is faster than recomputing a result or reading from a slower data store, thus, increases the system performance

- Hardware based cache memory, also called CPU memory, is high-speed Static Random-Access Memory (SRAM) that a computer microprocessor can access more quickly than it can access regular Random-Access Memory (RAM)

User Interface

- User Interface (or UI) controls how you enter data and instructions and how information displays on screen
- Two types of user interfaces supported by various OSs are:
- Command-line User Interface (CLI): User gives instructions to the computer by typing the commands
- Graphical User Interface (GUI): User gives commands to the system by selecting icon or menu item displayed on the screen with the use of a point-and-draw device





Survey of Modern Operating Systems

- Unix
- Microsoft DOS
- Microsoft Windows
- Linux
- macOS
- iOS
- Android

Survey of Modern Operating Systems

- Unix
  - Developed in the early 1970s at Bell Laboratories by Ken Thompson and Dennis Ritchie
  - Written in C language and is highly portable
  - Multi-user, multitasking, time-sharing OS
  - Used on a wide variety of computers ranging from notebook computers to super computers
  - Especially prevalent on workstations such as those from Sun Microsystems, HP and IBM
  - Structured in three layers – kernel, shell, and utilities

Survey of Modern Operating Systems

- Microsoft DOS
  - Stands for Microsoft Disk Operating System
  - Single-user OS for IBM and IBM-compatible personal computers (PC)
  - Used command-line interface when first developed, later included menus
  - Very popular in the 1980s, now not in much use and development, with the launch of Microsoft Windows OS in the 1990s
  - Structured in three layers – BIOS (Basic Input Output System), kernel, and shell

Survey of Modern Operating Systems

- Microsoft Windows
  - Developed by Microsoft to overcome limitations of MS-DOS operating system
  - Microsoft proprietary, single-user, multitasking OS
  - Native interface is a GUI
  - Designed to be not just an OS but also a complete operating environment
  - OS of choice for most PCs after 1990
  - Latest version is Windows 10 for the desktop

Survey of Modern Operating Systems

- Microsoft Windows (Server)
  - Multi-user, time-sharing OS developed by Microsoft
  - Supports multiprogramming and is designed to take advantage of multiprocessing on systems having multiple processors
  - Native interface is a GUI
  - Designed to have UNIX-like features so that it can be used for powerful workstations, network, and database servers
  - Built-in networking and communications features, provides strict system security
  - Rich set of tools for software development

Survey of Modern Operating Systems

- Linux
  - Name "Linux" is derived from its inventor Linus Torvalds
  - Open-source OS enhanced and backed by thousands of programmers world-wide
  - Multi-tasking, multiprocessing OS, originally designed to be used in PCs
  - Several Linux distributions available (Ubuntu, Red Hat, Debain)
  - Difference in distribution is mostly set of tools, number and quality of applications, documentation, support, and service

Survey of Modern Operating Systems

- macOS
  - Available only for computers manufactured by Apple, comes bundled with hardware
  - It's the first OS that offered GUI and has been model for most GUIs
  - Has not been very popular because of the Microsoft monopoly in the market, secondly its not as user friendly as compared to its competitors
  - Latest version is 10.14 (Mojave)

Survey of Modern Operating Systems

- iOS
  - Closed platform, closed source mobile OS developed by Apple
  - Can only be installed on Apple hardware (mobile devices)
  - Strong user growth and data-hungry user base
  - Backed by a vibrant application store and but strict Apple's ecosystem
  - Latest version is 13

Survey of Modern Operating Systems

- Android
  - Open source and platform independent mobile OS developed by Google
  - Runs on top of Linux
  - World's most commonly used smartphone platform (about 80% market share)
  - Support to install third party applications but with security risk
  - Latest version is 9 (Pie)

THANK YOU