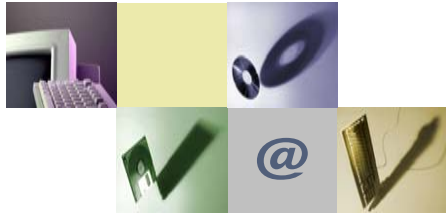


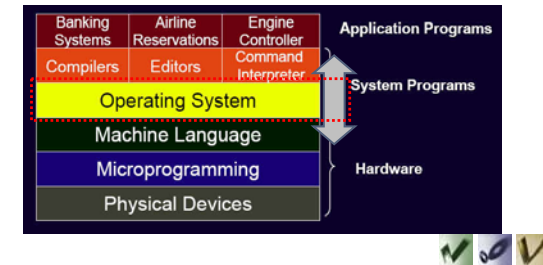
## Operating System



Digital Computer Concept and Practice

## Operating System (OS)

- System software that manages computer resources and provides as an interface between an application program and the computer hardware.



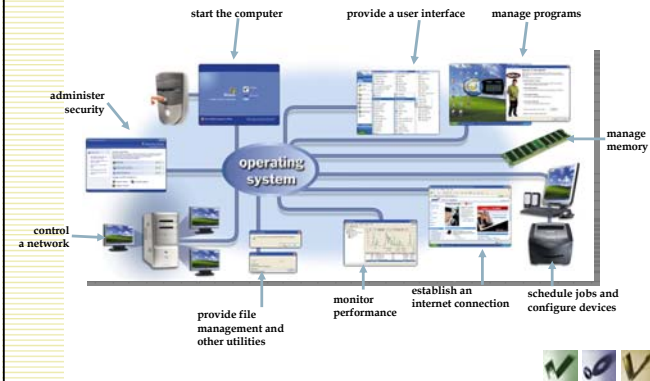
## Computer Software (revisited)

- System software: manages and controls computer hardware so that application software can perform a task
  - Operating systems
  - Device drivers
  - Programming tools, etc.
- Application software
  - Word processors: used to create and print documents.
  - Spreadsheets: allow users to perform various calculations on rows and columns of numbers.
  - Graphics, etc.

## Operating System

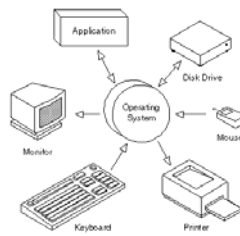
- Goals
  - Execute user programs
  - Use the computer hardware in an efficient manner
  - Make the computer system convenient to use

## OS Tasks



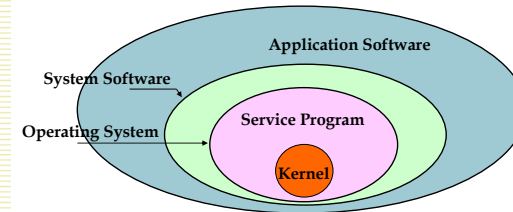
## OS Tasks

- e.g. recognizing input from the keyboard, sending output to the display screen, keeping track of files and directories on the disk, and controlling peripheral devices such as disk drives and printers.



## OS Architecture

- OS = Kernel + Service Program



## Operating System Architecture

- Kernel
  - Core component (OS of a narrow sense)
  - When the OS boots, a kernel loads first and remains in main memory.
  - Providing all the essential services
    - CPU scheduling, managing system resources, I/O functions, etc.
- Service
  - Providing convenience services
    - Notepad, calculator, disk defragmenter, etc.

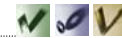
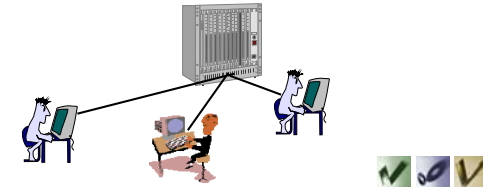
## Types of Operating System

- **Job Processes** → Single Tasking, Multitasking
- **User** → Single User, Multi-user
- **System Processes** → Batch Processing, Time-Sharing



## User

- **Single user**
  - MS-DOS, Windows 95
- **Multi-user**
  - Allows two or more users to run programs at one time
  - UNIX (LINUX), Windows XP, Windows Vista



## Job Processes

- **Single tasking**
  - One task at one time
  - MS-DOS (Microsoft Disk Operating System)
    - Developed in early 1980s for personal computers
    - Used command-line interface when first developed
    - Hardly used today because it does not offer GUI
- **Multitasking**
  - More than one task at one time
  - Allows more than one program to run concurrently
    - Foreground contains a program you are using
    - Background contains programs that are running but are not in use



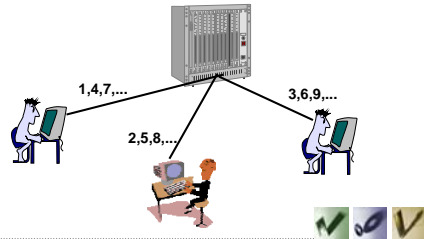
## System Processes

- **Batch processing**
  - It is execution of a series of programs ("jobs") on a computer
  - Data or programs are collected grouped and processed at a later date.
  - Early operating systems



## System Processes

- Time-sharing
  - Refers to sharing a computing resource among many users by multitasking.
  - Faster responses than batch processing
  - UNIX



## (1) Main Memory Management

- Memory management involves providing ways to allocate portions of memory to programs at their request and freeing it for reuse when no longer needed.
- Program execution methods
  - Monoprogramming (single programming)
  - Multiprogramming
- Program allocation methods
  - Fixed partition (static partition)
  - Variable partition (dynamic partition)
- Virtual memory



## Operating System Functions

- Main Memory Management
- Process Management
- I/O Management
- User Interface
- Protection for Program and User

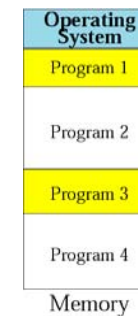


## Program Execution Methods

Monoprogramming

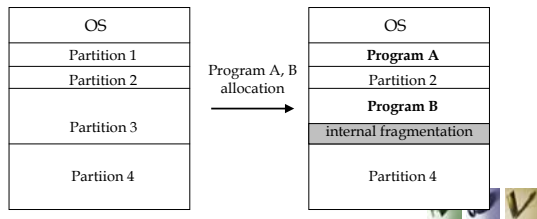


Multiprogramming



## Fixed Partition Allocation

- Program allocation methods: 'fixed' or 'variable'
- Divide memory into fixed-size partitions
- Each partition contains exactly one process
- When a process terminates, the partition becomes available for other processes
- Easy to implement, but..



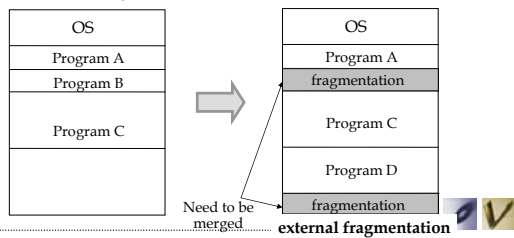
## Virtual Memory

- Not a physical device but an abstract concept.
- System creates illusion of large contiguous memory spaces for each process.
  - Keep only the active the process in main memory
  - Inactive processes are kept in the secondary memory, i.e. hard disk.
- The main memory can execute a process bigger than its own capacity.

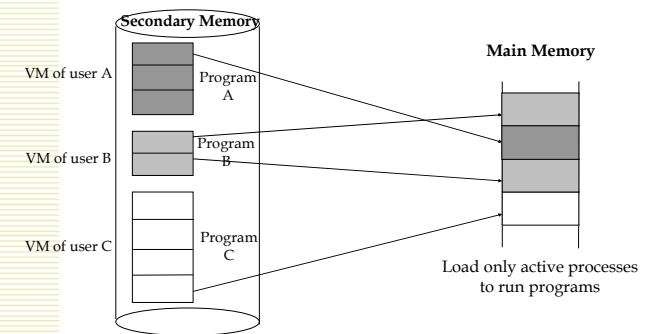


## Variable Partition Allocation

- When a process arrives, search for a memory large enough for this process
- Allocate only as much memory as needed
- When a process terminates, the space becomes available for loading a new process
- Hard to manage, but..



## Virtual Memory



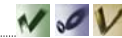
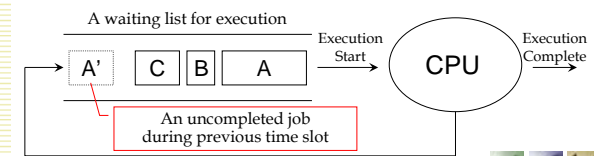
## (2) Process Management

- Process: a running program
- CPU executes only one instruction at a time, one after the other → needs CPU scheduling
- CPU scheduling
  - FIFO
  - Round robin
  - Priority scheduling



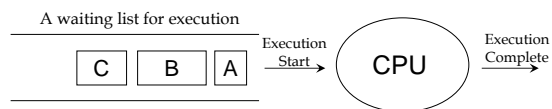
## Round Robin

- Assigns time slices to each process in equal portions and in order, handling all processes without priority
  - A job is resumed next time a time slot is assigned to that process.
- Keeping current process states
- Appropriate for interactive system.



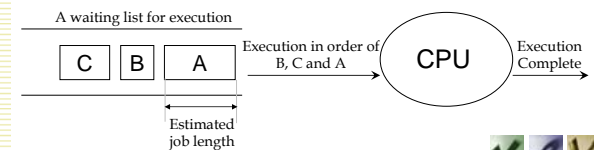
## FIFO (First In First Out)

- FIFO executes a process in the requested order
  - It gives every process CPU time in the order they come.
- Though a process needs a short time, it can wait a long time.
- Inappropriate for interactive system.



## Priority Scheduling

- Each process is assigned a priority, and the process with the highest priority is performed
- How to give a priority?
  - 'Shortest job first' scheduling
    - Scheduler runs the shortest job first.
    - The length of a job estimates based on previous runs.
  - UNIX : Round Robin + Priority



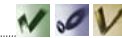
### (3) I/O Management

- "Interrupt"
  - It gives OS a signal that an event has occurred.
  - An interrupt is a signal which tells the OS to suspend execution of its present instructions (A) and to transfer to another instructions (B).
  - And, the OS resumes the original instruction (A) when finished with (B).
- Interrupt signals can come from a variety of sources.
  - e.g. every keystroke generates an interrupt signal

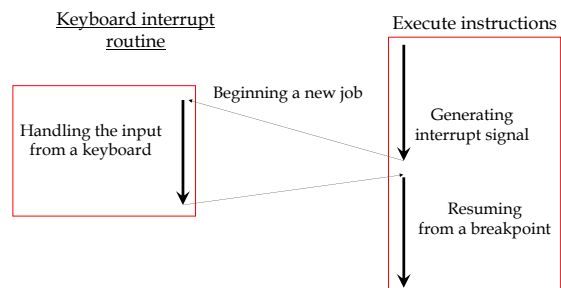


### File Management

- Files
  - Collection of information (stored on hard disk)
  - Disks need to be formatted to allow them to store information
- OS manages location of files on disk.
  - Performs I/O to disk
  - Checks and corrects errors on disk I/O
- Performs copying, renaming, deleting, and moving files



### Keyboard Interrupt



### (4) User Interface

- Command line interface
  - MS DOS, UNIX
  - Interacting with a computer by typing commands to conduct the system.
- GUI (Graphical User Interface) interface
  - MS Windows, Mac OS
  - GUI presents graphical icons and visual indicators.
  - Using mouse and keyboard



## (5) Protection for Program and User

- Control system resources of each user
  - Authentication and authorization
- Detect and protect a personal computer from unauthorized intrusions

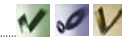


## MS Windows

### ■ MS Windows versions

- Windows 3.x
  - Not O/S
  - Offering multitasking and GUI
- Windows 95
  - Plug and Play
  - OLE (Object Linking and Embedding)

Windows Version	Year Released
Windows 3.x	1990
Windows NT 3.1	1993
Windows 95	1995
Windows NT Workstation 4.0	1996
Windows 98	1998
Windows Millennium Edition	2000
Windows 2000 Professional	2000
Windows XP	2001
Windows XP SP2	2004
Windows Vista	2006



## Examples of Operating System

- MS Windows
- UNIX (LINUX)
- Mac OS



## MS Windows

- Windows XP
  - Fast, reliable(?) Windows operating system
  - Available in five editions: Home Edition, Professional Edition, Tablet PC Edition, Media Center Edition, and 64-bit Edition



## MS Windows

- Windows Vista
  - Successor to Windows XP, containing a new interface and new/enhanced features



## Mac OS

- Mac OS X
  - Available only for Apple computers
  - GUI environments



## UNIX

- UNIX (1969, Bell Lab.)
  - Portability, small size kernel, and open source codes (by C language)
  - Currently offers GUI
  - Many versions
    - System V
    - SunOS
    - Solaris
    - Linux (for PC)

