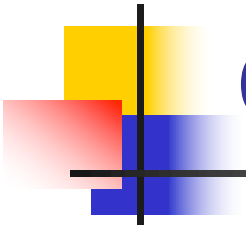
# Introduction to Computer Operating System



# Objectives

- What an operating system is.
- A brief history of operating systems.
- Goals of operating systems.
- Operating system functions.
- Type of operating systems

# What is Hardware?

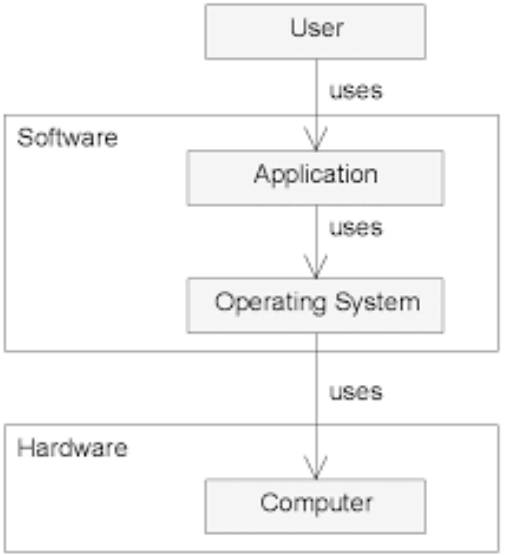
- Hardware refers to the physical components of a computer system that can be touched and seen.

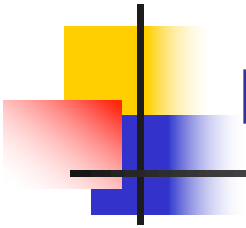
- Examples:
  - **CPU** (Central Processing Unit) – The brain of the computer.
  - **RAM** (Random Access Memory) – Stores data temporarily for quick access.
  - **Storage Devices** – Hard drives, SSDs.
  - **Input/Output Devices** – Keyboards, monitors, printers.

# What is Software?

Software consists of the **programs and applications** that run on a computer and tell the hardware what to do.

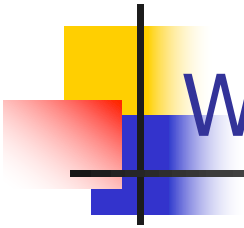
- **Types of Software:**
  1. **System Software** – Manages hardware and provides basic functions (e.g., OS).
  2. **Application Software** – Helps users perform tasks (e.g., MS Office, games).
  3. **Programming Software** – Tools to create other software (e.g., compilers, IDEs).
- **Example:**
  An antivirus program, a word processor, or a mobile app.





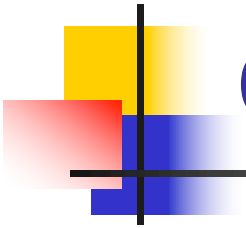
# Relationship Between Software and Hardware

- **Software relies on hardware** to perform tasks; without hardware, software cannot operate.
- **Hardware requires software** to be useful; without software, hardware is just an inert collection of parts.



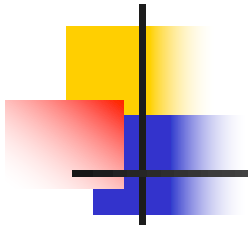
# What is an Operating System (OS)?

- A program that acts as an intermediary between a user of a computer and the computer hardware.
- A set of programs that coordinates all activities among computer hardware resources.
- Operating system goals:
  - Execute user programs and make solving user problems easier.
  - Make the computer system convenient to use.
  - Use the computer hardware in an efficient manner.

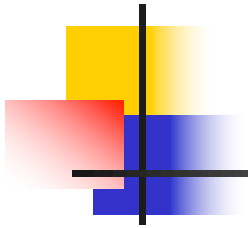


# Operating System history

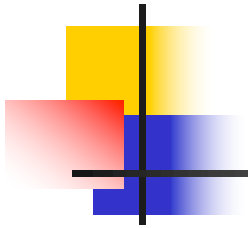
- Early History: The 1940s and 1950s
- Operating systems evolved through several phases
  - 1940s
    - Early computers did not include operating systems
  - 1950s
    - Executed one job at a time
    - Included technologies to smooth job-to-job transitions
    - Single-stream batch-processing systems
    - Programs and data submitted consecutively on tape



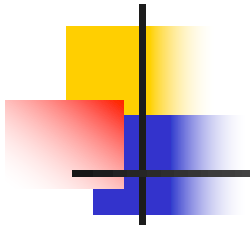
- 1960s
  - Still batch-processing systems
  - Process multiple jobs at once
    - Multiprogramming
  - One job could use processor while other jobs used peripheral devices
  - Advanced operating systems developed to service multiple interactive users
- 1964
  - IBM announced System/360 family of computers



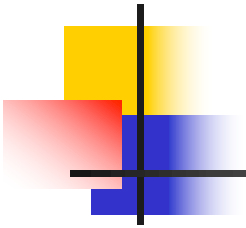
- The 1970s
- Primarily multimode timesharing systems
  - Supported batch processing, timesharing and real-time applications
- US Department of Defense develops TCP/IP
  - Standard communications protocol
  - Widely used in military and university settings
  - Security problems
    - Growing volumes of information passed over vulnerable communications lines.



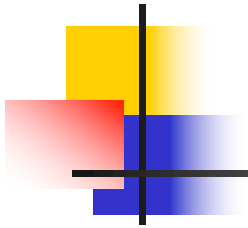
- 1980s
  - Decade of personal computers and workstations
  - Computing distributed to sites at which it was needed
  - Personal computers proved relatively easy to learn and use
    - Graphical user interfaces (GUI)
  - Transferring information between computers via networks became more economical and practical



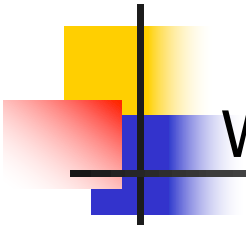
- The 1980s (con’t)
- Client/server computing model became widespread
  - Clients request various services
  - Servers perform requested services



- The 1990s
- Operating systems became increasingly user friendly
  - GUI features pioneered by Apple widely used and improved
  - "Plug-and-play" capabilities built into operating systems
    - Enable users to add and remove hardware components dynamically
    - No need to manually reconfigure operating system

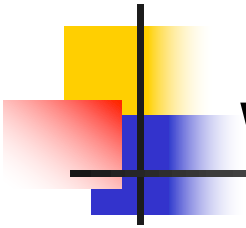


- 2000 and Beyond
- Middleware
  - Links two separate applications
    - Often over a network and between incompatible machines
  - Particularly important for Web services
    - Simplifies communication across multiple architectures
- Web services
  - Encompass set of related standards
  - Ready-to-use pieces of software on the Internet
- Cloud Computing



# What are the main functions of an operating system?

- Start up the computer
- Administrator security
- Control network
- Access the web
- Monitor performance and provide housekeeping services
- Schedule jobs and configure devices
- Manage memory
- manage programs
- Provide user interface



# Where is the operating system located?

- Operating System resides on ROM chip in handhelds devices like PDA, Mobile Phone.
- Operating System resides on hard disk in most computer cases.

# Operating System Functions

- What is booting?
  - a process of starting or restarting a computer.

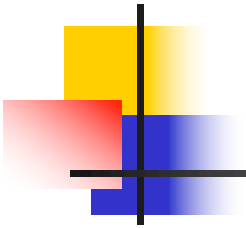
**Cold Boot**

Process of turning on a computer after it has been powered off completely.

**Warm boot**

Process of restarting a computer
that is already powered on.

Key Differences



# Booting

| Aspect | Cold Boot | Warm Boot |
|---|---|---|
| **Power State** | Fully powers off, then back on | Remains powered on |
| **System Reset** | Complete hardware reset | Partial reset (software level) |
| **Speed** | Slower (full initialization) | Faster (partial initialization) |
| **Common Usage** | First start of the day, hardware issues | Software updates, minor resets |
| **Example** | Turning on a powered-off computer | Clicking “Restart” in the OS |

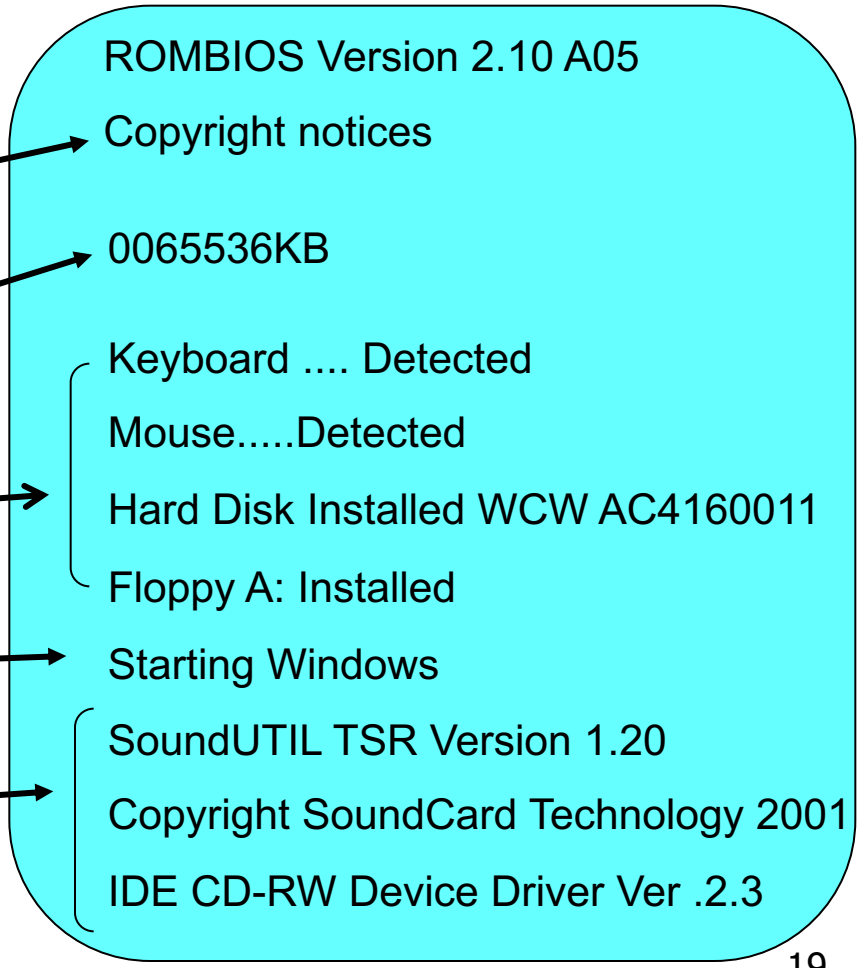
# Operating System Functions

- How does a personal computer booting up?
- Step 1
  1. Power supply sends signal to components in system unit
  2. The processor accessed BIOS to start computer

# Operating System Functions

What messages display when you boot the computer?

- BIOS version and copyright notice
- total amount of memory
- devices detected and tested
- Windows message
- Sound card and CD-ROM drivers loaded



# Operating System Functions

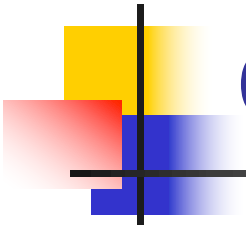
- Step 3
  - BIOS checks components such as mouse, keyboard connectors and expansion cards

# Operating System Functions

- Step 4
  - Results of Power-On Self-Test (POST) are compared to data in the CMOS chip

# Operating System Functions

- Step 5
  - BIOS looks for system files in different drives (A, C, D,…) and then...
  - Drive that contains operating system is called boot drive.



# Operating System Functions

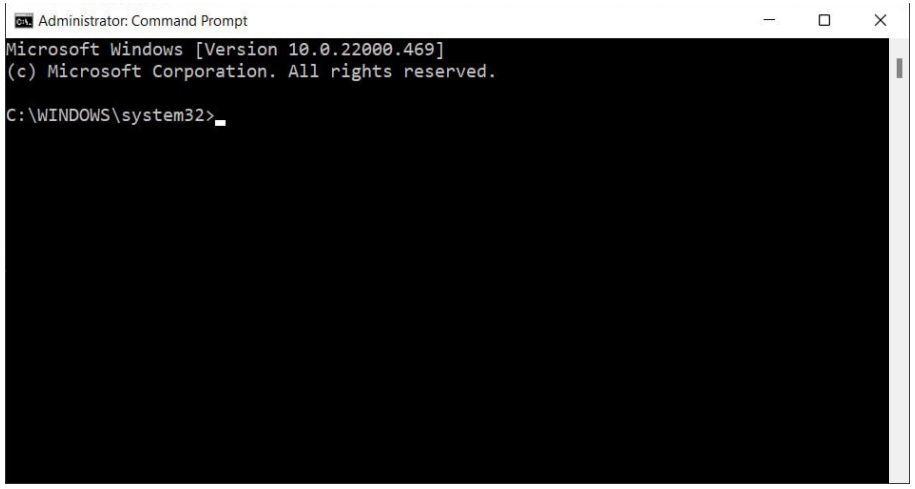
- Step 6
  - Boot program loads kernel of operating system into RAM from boot drive
  - Operating system in memory takes control of computer

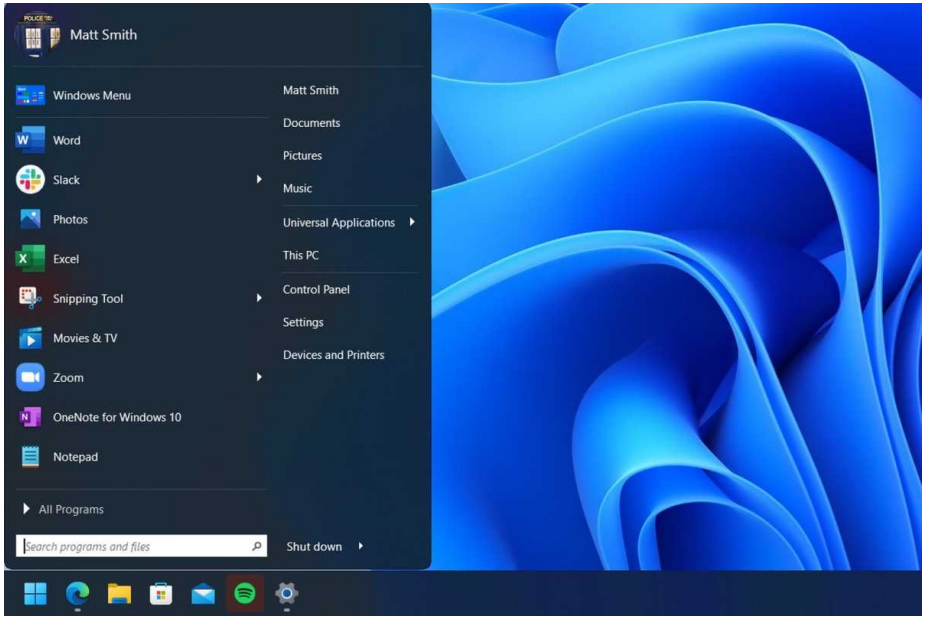
# Operating System Functions

- Step 7
  - operating system loads configuration information and displays desktop on screen
  - operating system executes programs in startup folder

# Operating System Functions

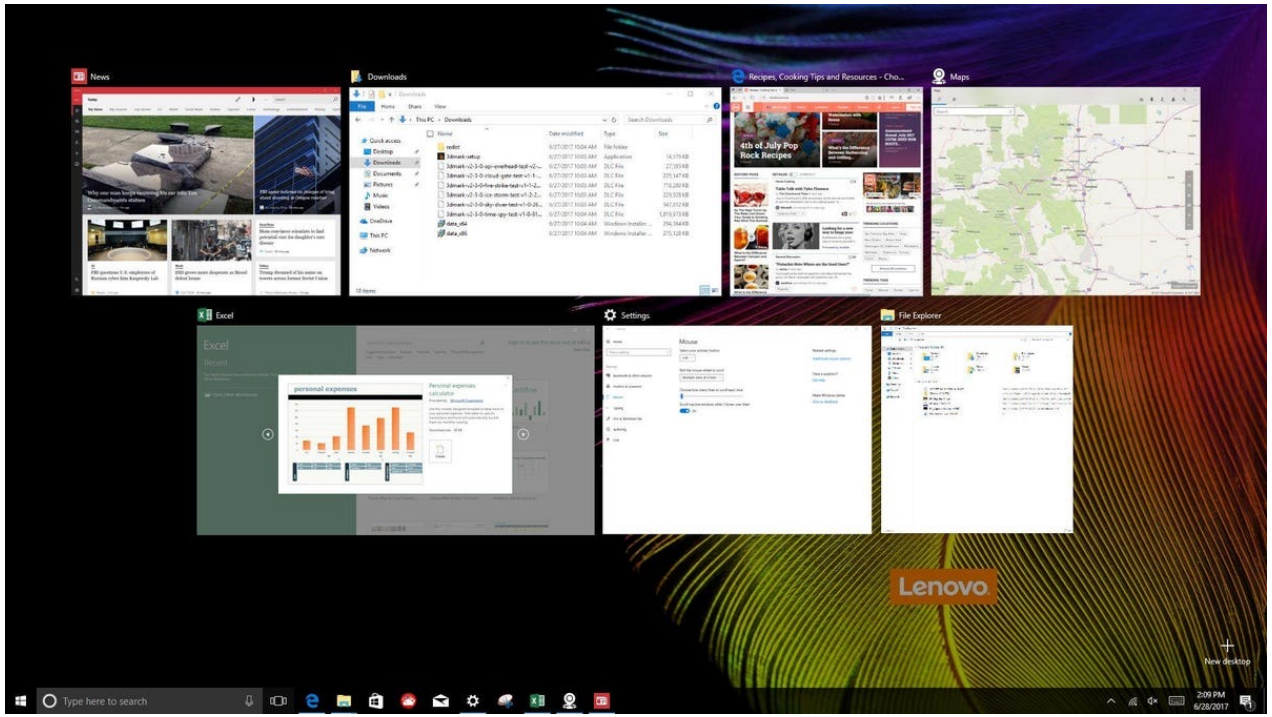
- What is a user interface?
- controls how you enter data and instructions and how information displays on screen.



# Operating System Functions

- What is Multitasking?
  - allows a single user to work on two or more applications that reside in memory at same time.



# Operating System Functions

- What are other program management features of OS?

**Multiuser**

Operating System enables two or more users to run a program simultaneously

**Multiprocessing**

Operating System can support two or more processors running programs at same time

**Fault-Tolerant**

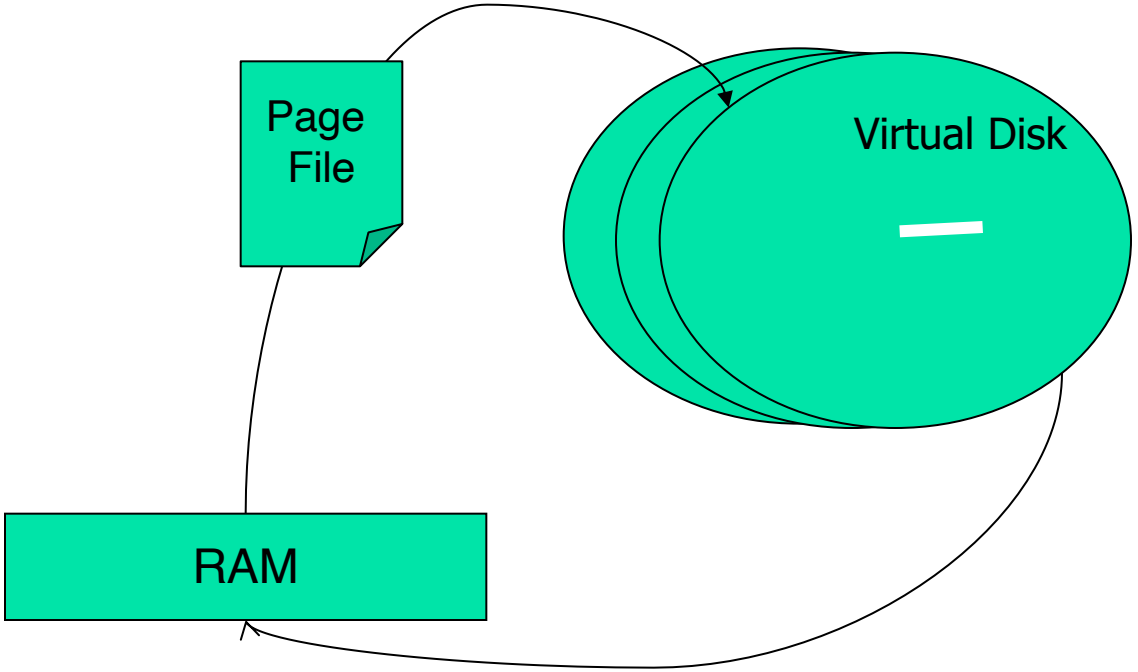
Continues to operate even if one of its components fails

# Operating System Functions

- What is Memory management?
  - Optimizes the use of random access memory (RAM)
  - allocates or resigns, data and instructions to area of memory while they are being processed
  - monitors contents of memory
  - clears items from memory when processor no longer requires them

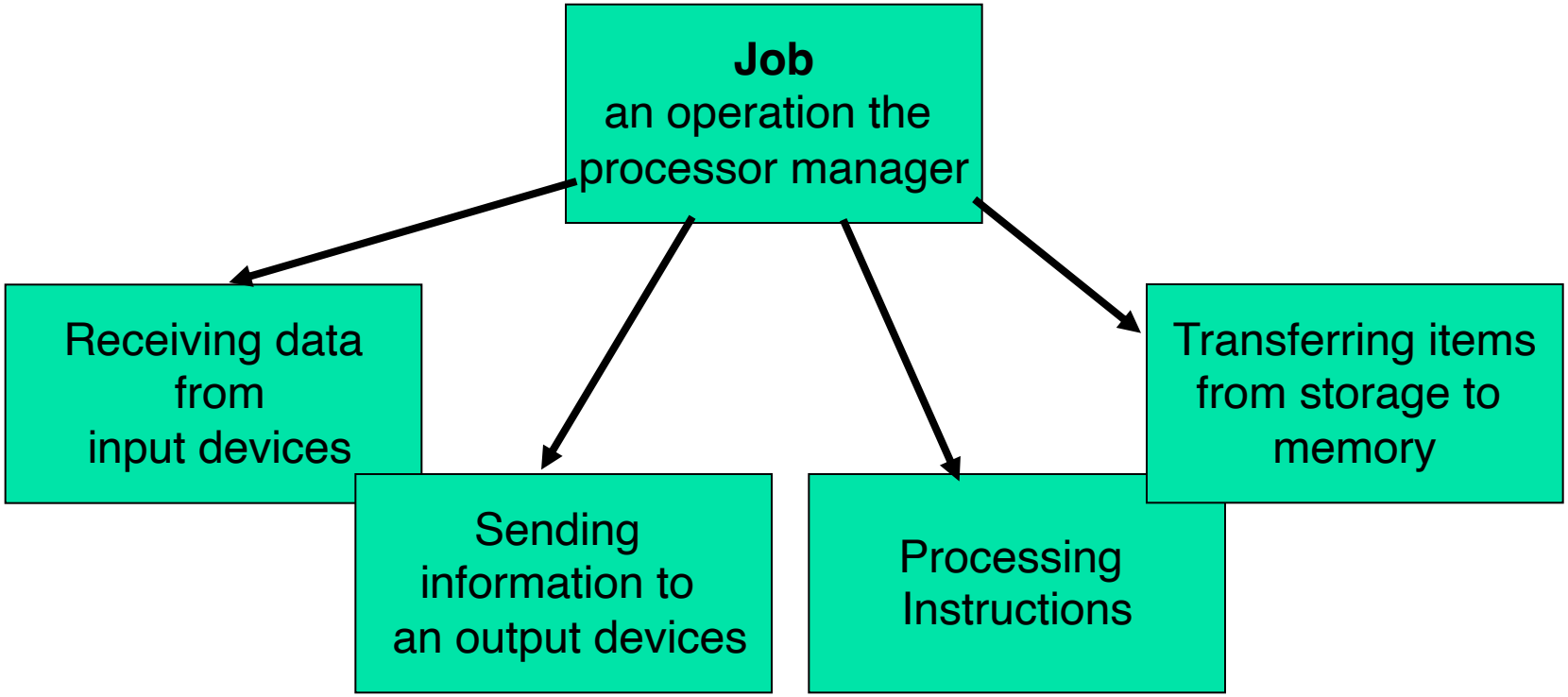
# Operating System Functions

- What is virtual memory (VM) management?
  - Operating system allocates portion of hard disk to function like RAM
  - Paging



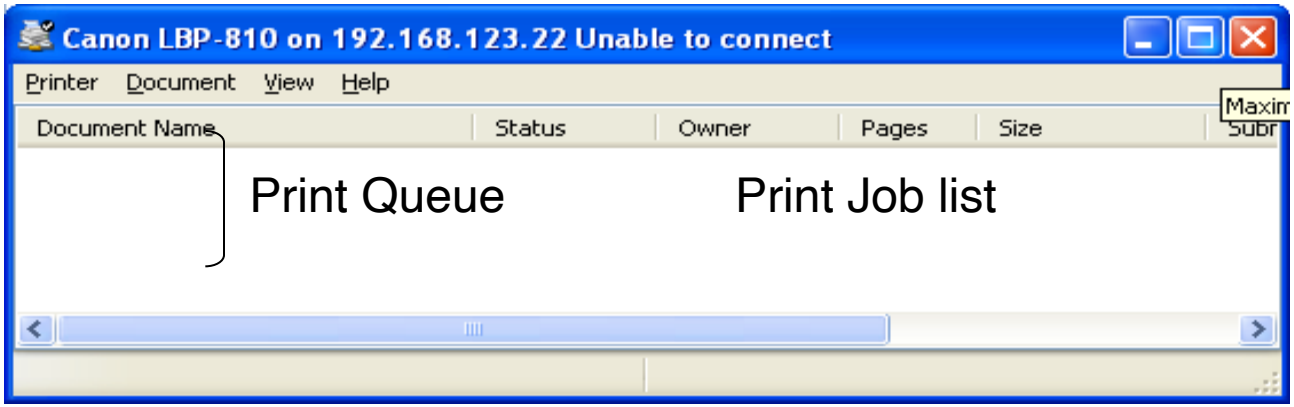
# Operating System Functions

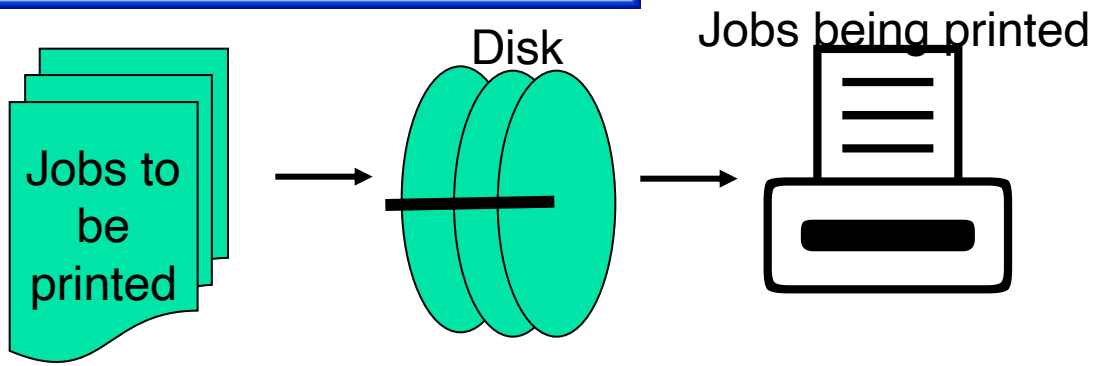
- How does an operating system schedule jobs?



# Operating System Functions

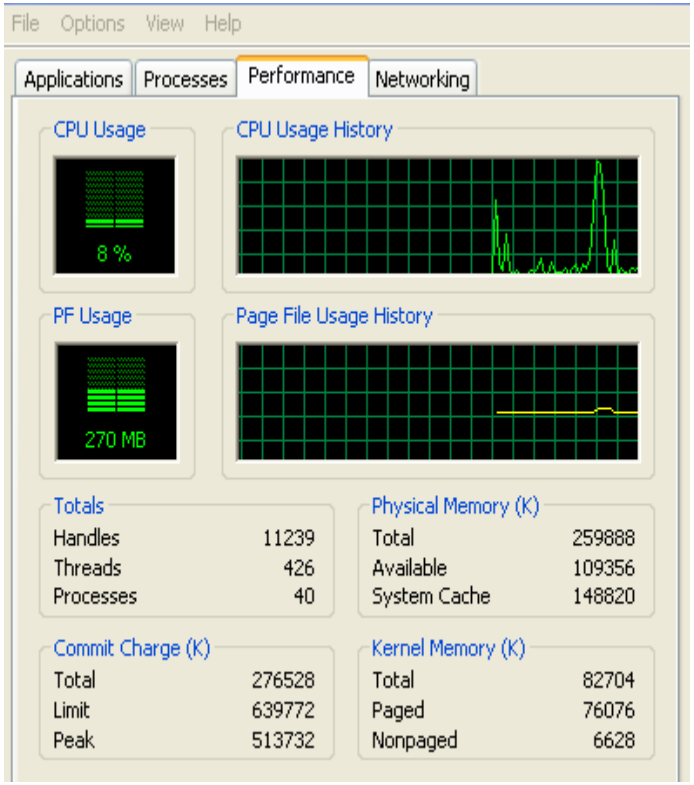
- What is spooling?
- Print jobs sent to buffer instead of directly to printer, where print jobs wait their turn



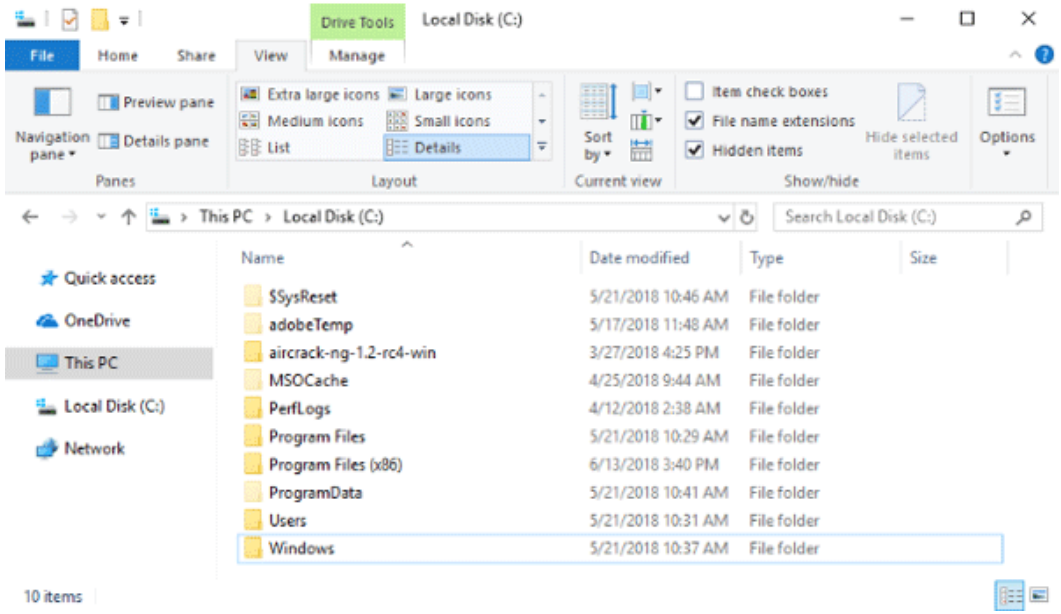
# Operating System Functions

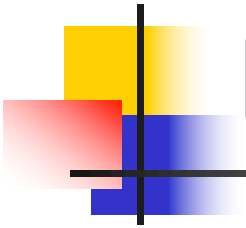
- How does an operating system monitor performance?
  - Provides a program called performance monitor, that assesses and reports information about various system resources and devices.



# Operating System Functions

- How does an operating system manage files?
  - Includes a program called file manager, such as Windows Explorer.
  - Commands Copy, Rename, Delete, move ...





# File System

- A **file system** is a method and data structure that the operating system uses to **organize, store, retrieve, and manage files** on storage devices.

- **Purpose:**
  - To provide a structured way to store data.
  - To enable easy access and retrieval of files.
  - To manage the storage efficiently and securely.

- **Examples:** NTFS, FAT32, ext4, APFS.

# File System

- **Basic Components of a File System**

1. **Files:** Units of data storage with a name and extension, containing text, programs, media, etc.
2. **Directories (Folders):** Containers for organizing files, can contain subdirectories.
3. **Partitions:** Segments of a storage device that a file system can use.
4. **Metadata:** Information about files (size, type, permissions, timestamps)

# File System Structure

- **Directory Structure:**
  - Organizes files and folders in a **hierarchical structure** (tree-like).
  - Each folder can contain files and subfolders, starting from a **root directory**.
- **File Allocation Table (FAT):**
  - A table that maps out which parts of the disk hold data for each file.
- **Inodes (Index Nodes):**
  - Used in UNIX/Linux file systems, inodes store metadata and point to data blocks.

# Types of File Systems

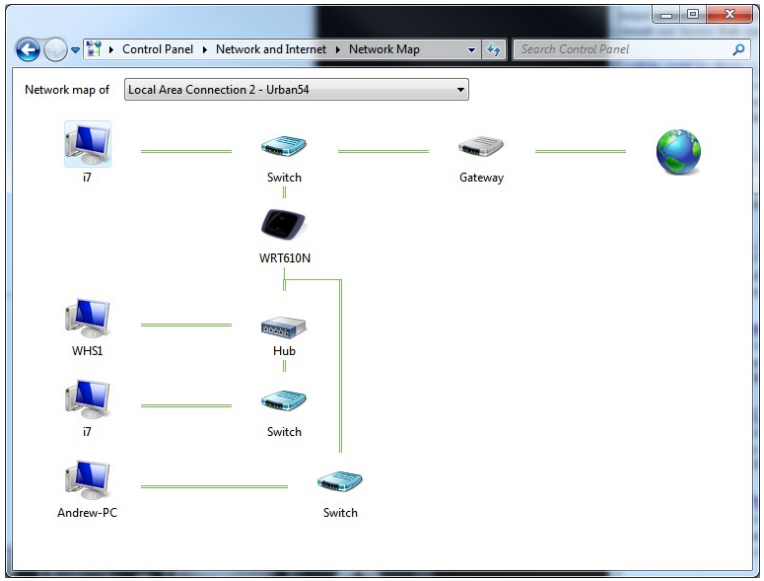
- **Disk-Based File Systems:**
  - Examples: **NTFS**, **FAT32**, **ext4**, **APFS**.
  - Used in traditional hard drives and SSDs.
- **Network File Systems:**
  - Examples: **NFS**, **SMB/CIFS**.
  - Allows files to be accessed over a network.
- **Flash-Based File Systems:**
  - Examples: **exFAT** (for flash drives), **F2FS**.
  - Optimized for flash storage (USB drives, SD cards).

# Key File System Operation

- **Creating and Deleting Files:** Allocating and freeing up space on storage.
- **Reading and Writing:** Accessing file contents, modifying, and saving changes.
- **File Organization:** Moving, renaming, copying files.
- **Permissions Management:** Defining who can read, write, or execute files.
- **Metadata Handling:** Keeping track of file information, such as timestamps and access history.

# Operating System Functions

- What are functions of operating system on network?
  - Establish network connection
  - Controlling network  traffic
  - Closing network connection



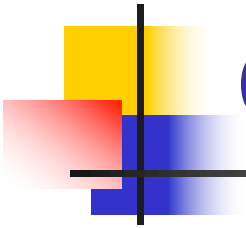
# Type of Operating System

- Desktop Operating System

  a program control activities in standalone computer.

- Network Operating System

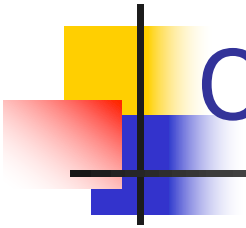
  a program control activities both on local computer and other computer on network.



# Operating System Goals

Users expect certain properties of operating systems

- Efficiency
- Robustness
- Scalability
- Extensibility
- Portability
- Security
- Protection
- Interactivity
- Usability



# Operating System Architectures

- Today's operating systems tend to be complex
  - Provide many services
  - Support variety of hardware and software
  - Operating system architectures help manage this complexity