Two Major Parts of a Computer System

- A computer system consists of two major parts:
  - Hardware
  - Software

- Hardware refers to all visible components. They perform the actual data processing work.
- Software refers to programs which are instructions that describe how to do the processing work.

Computer Hardware Components

- A computer consists of the following main hardware components:
  1. Central Processing Unit (CPU)
  2. Main Memory
  3. Secondary Memory / Storage
  4. Input Devices
  5. Output Devices

Central Processing Unit (CPU)

- The brain of the computer
- A complex integrated circuit consisting of millions of electronic parts and is primarily responsible for converting input (data) into meaningful output (information)
Central Processing Unit (CPU)

- Data travels in and out of the CPU through a **bus** – a communication system that transfers data between components inside the computer system.

- CPU processes the data by repeatedly following the machine cycle.

Main Memory

- Responsible for holding data and programs as they are being processed by the CPU.

  - Random access memory (RAM)
    - OS files
    - Running programs
    - Fast but volatile

  - Read-only memory (ROM)
    - BIOS
    - Power-on self test (POST)
    - Firmware
    - Holds built-in system data, not for running programs, non-volatile

Common Types of RAM

<table>
<thead>
<tr>
<th>Type of RAM</th>
<th>Description</th>
<th>Volatile or nonvolatile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic RAM (DRAM)</td>
<td>Memory needs to be constantly recharged or contents will be erased</td>
<td>Volatile</td>
</tr>
<tr>
<td>Static RAM (SRAM)</td>
<td>Memory can be recharged less frequently than DRAM, but can be more expensive than DRAM</td>
<td>Volatile</td>
</tr>
<tr>
<td>Magnetoresistive RAM (MRAM)</td>
<td>Memory uses magnetic charges to store contents, and can retain its contents in the absence of power</td>
<td>Nonvolatile</td>
</tr>
<tr>
<td>Flash memory</td>
<td>Fast type of memory that typically is less expensive than some other types of RAM, and can retain its contents in the absence of power</td>
<td>Nonvolatile</td>
</tr>
</tbody>
</table>

Secondary Storage Devices

- Non-volatile and relatively cheaper than main memory.
- Designed to store data for extended periods of time.
- The type and amount of data helps to determine the most appropriate storage device to use.

Figure 3-5: Storage devices
Storage Solutions (1 of 2)

Hard Drives
- Internal hard drives
  - Magnetic hard disk drives (HDDs)
  - Solid State Drive (SDD)
- External hard drives
  - Magnetic hard disk drives
  - Solid State Drive (SDD)
  - USB flash drive
  - Optical media

Storage Solutions (2 of 2)

Cloud Storage
- Storing electronic files on the Internet instead of a local computer
  - Google Drive
  - Microsoft OneDrive
  - Dropbox

Input and Output Devices
- **Input device**: communicates instructions and commands to a computer
  - Examples: keyboard, mouse
- **Output device**: conveys information from the computer to the user
  - Examples: speakers, printers

Computer hardware Components Summary
How Computers Represent Data

A computer is a Binary System
• All data are represented as binary numbers (a sequence of 1s and 0s).
• Bit: smallest piece of data. Has value 0 (off) or 1 (on).
• Byte: 8 consecutive bits.
• Other units for measuring data sizes:
  o Kilobyte (KB) = 1024 bytes
  o Megabyte (MB) = 1024 KB
  o Gigabyte (GB) = 1024 MB
  o Terabyte (TB) = 1024 GB

How Computers Represent Data

• Integer numbers are stored as binary

<table>
<thead>
<tr>
<th>decimal</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>binary</td>
<td>0</td>
<td>1</td>
<td>10</td>
<td>11</td>
<td>100</td>
<td>101</td>
<td>110</td>
<td>111</td>
</tr>
</tbody>
</table>

• Text coding scheme
  o ASCII (8 bits) A -> 01000001
  o Unicode (16 bits) A -> 0000000001000001

• Other data
  o Images
  o Video
  o Audio

Pros and Cons of Different Types of Computers (1 of 3)

Desktop Computer
• Typically consists of a system unit, monitor, keyboard, and mouse
• More powerful, more storage
• Hardware components can be easily upgraded
• Can’t be moved easily

Laptop Computer
• Very portable due to its compact size
• Less powerful than desktop
• Memory and hard drive are about the only components that can be upgraded
Pros and Cons of Different Types of Computers (2 of 3)

All-in-One Computer
- Monitor and system unit are housed together
- Take up less space and easier to transport
- Typically more difficult to service or upgrade
- More expensive than desktops

Pros and Cons of Different Types of Computers (3 of 3)

Mobile Device
- Smartphone, Tablet, etc.
- Portable or handheld computing device
- Less powerful
- Not upgradeable

Categories of Software

- **System Software**: The software that runs a computer, including the operating system and the utilities
- **Operating System (OS)**: A program that manages the complete operation of your computer or mobile device and lets you interact with it.
  - Windows, MacOS, Unix, Android OS
  - Most operating systems come installed on your computer or device
- **Application Software**: Programs that provide services to the user. They solve specific problems, such as word processing, browsing the web, games, etc.
  - Microsoft Office
  - Google Chrome

Standard Operating System Functions

- Starting and shutting down a computer or device
- Managing programs
- Managing memory
- Coordinating tasks
- Configuring devices
- Establishing an Internet connection
- Monitoring performance
- Providing file management
- Updating operating system software
- Monitoring security
- Controlling network access
Operating System Features

- Graphical user interface (GUI)
- Utilities: software developed to help maintain the computer
- Software as a Service (SaaS): software accessed online via a subscription
  - Google Apps
  - DocuSign
- Open/closed source: software whose original source code is made freely (or not freely) available and may (or may not) be redistributed and modified
  - Android OS (open source)
  - Microsoft Office (closed source)

Desktop Operating Systems

<table>
<thead>
<tr>
<th>OS</th>
<th>Available for</th>
<th>Notable features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows</td>
<td>Desktop computers, laptops, and some tablets</td>
<td>Supports the Cortana virtual assistant, touchscreen input, HoloLens headsets, and built-in apps such as the Microsoft Edge browser</td>
</tr>
<tr>
<td>macOS</td>
<td>Macintosh desktop computers and laptops</td>
<td>Includes the Siri virtual assistant, coordination with Apple mobile devices, and cloud file storage</td>
</tr>
<tr>
<td>UNIX</td>
<td>Mainframes, web servers, workstations</td>
<td>Multitasking operating system with many versions, as the code is licensed to different developers</td>
</tr>
<tr>
<td>LINUX</td>
<td>Desktop computers, laptops, and some tablets</td>
<td>Distributed under the terms of a General Public License (GPL), which allows you to copy the OS for your own use, to give to others, or to sell</td>
</tr>
<tr>
<td>Chrome OS</td>
<td>Chromebook laptops</td>
<td>Based on Linux, uses the Google Chrome browser as its user interface, and primarily runs web apps (an app stored on an Internet server that can be run entirely in a web browser)</td>
</tr>
</tbody>
</table>

Server Operating Systems

<table>
<thead>
<tr>
<th>OS</th>
<th>Notable features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows Server</td>
<td>The server version of Windows. It includes advanced security tools and a set of programs called Internet Information Services that manage web apps and services.</td>
</tr>
<tr>
<td>macOS Server</td>
<td>Supports all sizes of networks and servers. One unique feature is that it lets authorized users access servers their iPhones or other Apple devices.</td>
</tr>
<tr>
<td>UNIX</td>
<td>A multipurpose operating system that can run on a desktop PC or a server. Many web servers, which are Internet computers that store webpages and deliver them to your computer or device, use UNIX because it is a powerful, flexible operating system.</td>
</tr>
</tbody>
</table>

Mobile Operating Systems

<table>
<thead>
<tr>
<th>OS</th>
<th>Notable features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Android</td>
<td>Developed by Google based on LINUX, and designed to be run on many types of smartphones and tablets</td>
</tr>
<tr>
<td>iOS</td>
<td>Runs only on Apple devices, including the iPhone, iPad, and iPod; derived from macOS</td>
</tr>
</tbody>
</table>