

Computer Basics - Hardware and Software

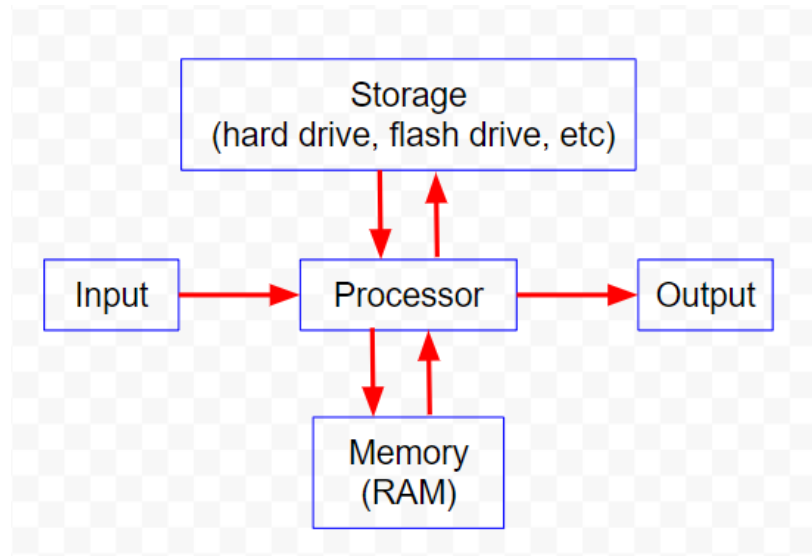
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This document explains some of the basics of computer systems.

- **What is a computer?** Many of the devices we use today are computers. Our mobile phones, tablets, desktops and laptops, and many other electronic devices are computers. Computers consist of hardware and software components
- **Hardware and Software**
 - **Hardware** refers to the physical components of a computer system that can be touched and seen. This includes devices such as the central processing unit (CPU), memory modules, storage drives, input/output devices (keyboard, mouse, monitor), and various interconnected circuits on the motherboard. Hardware is essential for the functioning of a computer and provides the tangible infrastructure that allows software to operate. The performance and capabilities of a computer are largely determined by the quality and specifications of its hardware components.
 - **Software** is like a set of instructions for a computer, telling it what to do. It includes programs and algorithms that guide the computer's operations, from managing resources to running specific tasks. This set of instructions allows users to interact with the computer, run applications, and process data, essentially serving as the brain of the system.

- **Hardware**

The following illustration shows how the hardware interacts on our computing devices



1. **Processor (CPU)** this is the hardware component of the computer that runs the programs and processes the data. The CPU is an integrated circuit (IC) chip. Major manufacturers of processors include Intel and AMD.
2. **Output Devices** send data and information from the computing device to the user. Examples include printer, computer monitor, screen on phone
3. **Input Devices** allow us to get data and programs into the computer. Examples include keyboard, mouse, touch screens on a phone, camera on a phone.
4. **Memory and Storage**
 - a. **Memory** data and programs are stored in **memory** when the processor is working with them. **RAM (Random Access Memory)** is a type of memory.
 - b. **Storage** is more permanent storage than memory. Examples: hard disk drive

(hdd), CD, DVD, flash drive.

About RAM (Memory) and Storage The terms “memory” and “storage” are sometimes used interchangeably, but, traditionally, they refer to two different types of technology.

RAM (Random Access Memory) and “storage” are two distinct components in a computer and serve different purposes.

RAM (Random Access Memory): RAM is a type of computer memory that is used for temporary data storage during the execution of programs or tasks. It provides fast and temporary access to data that the processor needs to perform calculations and operations. RAM is volatile memory, meaning its contents are lost when the power is turned off or the system restarts.

Key characteristics of RAM:

- Speed: RAM is much faster than storage devices, allowing quick access to data.
- Volatility: RAM is volatile, and its contents are temporary.
- Capacity: RAM capacity is typically smaller than storage capacity due to cost considerations.
- Usage: RAM is primarily used for active program execution and data manipulation.

When you run applications or programs on your computer, they get loaded into RAM for faster access by the processor. When you “open” a Word document, for example, you are copying it from longer-term storage (for example, your flash drive or hard drive) and loading it into RAM so that the document can be edited or viewed. When you “save” a document, you are copying the document from the computer’s memory and storing it to longer-term storage device (such as flash drive, CD or hard disk drive). When you open an app on your phone, you are loading it from longer-term storage into RAM.

The more RAM your system has, the better it can handle multiple tasks simultaneously without slowing down. Insufficient RAM can lead to performance issues, such as slow response times or frequent freezing.

Storage: Storage traditionally refers to long-term data storage in a computer system. It stores files, documents, operating system files, applications, and other data persistently even when the power is turned off. Storage devices retain data until it is intentionally modified, deleted, or the device fails.

There are different types of storage devices, including hard disk drives (HDDs), solid-state drives (SSDs), and external storage devices. Each storage type has its own characteristics and performance metrics, but they all serve the purpose of retaining data for long-term use.

Key characteristics of storage:

- Persistence: Storage devices retain data even when the power is turned

off.



- Capacity: Storage devices typically offer larger capacity compared to RAM.
- Slower access: Accessing data from storage is slower compared to RAM.
- Non-volatile: Storage is non-volatile, meaning it retains data even without power.

Storage devices are used for storing the operating system, software applications, files, multimedia content, and other data that need to be accessed over a longer period. They provide a means for data persistence and act as a repository for all the information you save on your computer.

In summary, RAM is a type of volatile memory used for **temporary** data storage during active program execution, providing fast access to data for the processor. Storage, on the other hand, is non-volatile and serves as **long-term** data storage, retaining information even when the power is turned off.

Example:

The following shows the specifications for a Google Pixel phone. Notice the two types of storage/memory. In this case, the term “memory” to refer to both long-term(permanent) and short-term memory. What is called “internal memory” here, is long-term storage and the “phone memory” is the RAM.

Carrier	Unlocked
Wireless Technology	5G
Operating System ⓘ	Android 12
Internal Memory ⓘ 	128 gigabytes
Screen Size ⓘ	6.1 inches
Water Resistant ⓘ	Yes
Phone Memory (RAM) ⓘ 	6 gigabytes
Front-Facing Camera	8 megapixels
Rear-Facing Camera	12 megapixels
Processor Model ⓘ	Google Tensor

Why RAM (Memory) and Storage matter:

Speed: The more **RAM** you have, then the faster the phone can process things. With more RAM, the device doesn't have to continually swap things out of long-term storage and into RAM. For example, if you open an app on your phone, the phone will first need to load the app from your long-term storage into your RAM. If you open another

app—and if you do not have much RAM—then your device may need to swap another app in memory with the new app you are loading. Switching between apps, then, may be slower. In the Google Pixel example above, the phone has 6 GB of RAM. If your phone is slow, one reason might be insufficient RAM. Note though, there are MANY factors which can impact your phone's speed. The speed of your device will depend on its processor speed, the speed of your Internet connection, the size and types of apps running, etc. **Cynical note #1 from your teacher.** Apple recently settled a court case in which it was accused of purposely slowing down older iPhones in order to get users to believe they needed to buy new phones. See this link for more info <https://www.npr.org/2020/11/18/936268845/apple-agrees-to-pay-113-million-to-settle-batterygate-case-over-iphone-slowdowns>

Storage Capacity: On your computer/phone, your photos, videos, the operating system, and apps all have to be stored in long-term storage to be accessible. So, if you do not have enough storage, you may not be able to install a new app, or take new pictures, videos, etc. **However, most computing devices are now able to access cloud storage.** So your iPhone, for example, by default, will automatically back up photos and videos to the cloud, and swap them back when you need to view them later. This should free up space on your phone. NOTE: Apple users can view photos, videos etc at icloud.com. Google Android users can view photos, videos etc at photos.google.com. Try it!

Cynical note #2 from your teacher: Apple is incentivized to sell new phones and to make you pay extra for phones with larger storage capacity. In my experience, Apple does not always manage phone and cloud storage well. Instead of seamlessly backing up your photos, videos, etc to the cloud—and freeing up space on your phone—it often keeps them on your device. Is this on purpose to make you think you need a new phone? Apple would argue that having videos and pics on your phone allows you to access them more quickly. While that is true, when storage is full, it should back up at least the older ones to the cloud.

Cynical note #3 from your teacher: Most computing devices have few, or zero, moving parts. So computer parts do not “wear out” and get slower over time. For example, if your computer running Microsoft Windows gets slower, it is not usually because the computer is old. It is more likely that Microsoft has installed new updates to Windows. . These updates are larger and require higher memory and processing capability. Microsoft would argue that they have improved Windows, adding better security, more features etc. They cynic would say they do this to make you need a new computer. idk. you decide :) Note: if you have an old PC or Mac that is really slow, consider replacing the OS with **ChromeOS Flex for PC or Mac.** It is a great alternative. (See discussion of the OS below)

- **Software** consists of the programs that run the computer. A **program** is a set of instructions which tells the computer what to do. There are several types of programs.. Application programs (“apps”) and system software
 - **System Software:** the main program that runs the device is called the **operating system (OS)**. This is a very important program. More than any other program, it determines the capabilities and characteristics of the device. The operating system of Apple phones and tablets is called **iOS**. Apple manufactures the phone and Apple also makes the OS which operates the phone. The OS for most other mobile phones is a program from Google called **Android**. Google does make its own phone (the Google Pixel) but it provides the operating system (Android) for other phone manufacturers, for example Samsung phones. On most desktop and laptop computers, the OS is Microsoft’s **Windows**. On Apple Macintosh computers, the OS is called **macOS**. On Google Chromebooks, the OS is called **ChromeOS**. Take a look at this link [Operating System Market Share Worldwide | Statcounter Global Stats](#), to see the current market share of various operating systems.
 - **Application software – aka “apps”:** most other programs on our devices are called “apps” Examples: camera app (which tells the device how to use the camera), Google Docs, social media apps, music apps, Word, Excel, etc