



CHAPTER 1

TYPES AND COMPONENTS OF COMPUTER SYSTEMS

Chapter 1 Types and components of computer systems

What is hardware?

In basic terms, hardware is the physical components of a computer system. The stuff you can touch, basically. Things like a mouse, a keyboard, a monitor; these are all examples of hardware

What is software?

Software is the programs that control the computer. Things like Microsoft Word and Google Chrome are examples of software (Although you should NEVER use brand names like this when answering exam questions)

Types of software

There are two main categories that software falls into. These are application and system. Application software is programs that allow the user to perform tasks. These tasks can be anything from editing a document in word-processing software to streaming video on a web browser. System software is programs that allow the computer hardware to run properly and programs that allow the user to communicate with the computer. This kind of software can include the operating system (which is the software that basically allows the user to interact with the computer, and, without it, using a computer would be basically impossible), utilities (which manage and control the computer. Stuff like antivirus and file-backup software), and drivers (which allow hardware to communicate with the computer's operating system).

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The CPU (Central Processing Unit)

The CPU deals with commands. It is what is in charge of interpreting and executing the commands. It is often referred to as the “brain” of the computer as it’s really what controls everything. Without it, the computer would not be able to function. Similarly, we would not be able to function without a brain. Known also by the name “**microprocessor**”, the CPU tends to be a single circuit board found at the heart of the computer (sorry about all the body organ comparisons here...) as well as in common household appliances such as washing machines.

HDD (Hard Disk Drive)

Also known as SSD (Solid State Drive), the internal HDD is the main piece of hardware where files are saved to and stored. The good things about HDD are that it’s fast at transferring and accessing data and that it has a lot of memory space to save lots of files.

RAM (Random Access Memory)

RAM is different to HDD as it doesn’t save files permanently. RAM is used to store data for applications that are running on the PC and can be saved to as well as read from. The data saved to the RAM is deleted once the PC is turned off which is what is called **volatile** memory.

ROM (Read Only Memory)

ROM is the opposite of RAM as it saves data that **has** to be permanent like the computer’s configuration data. ROM also cannot be read to, only read from. ROM also saves data even when the PC is turned off. The ROM also contains the BIOS (Basic Input / Output System), which is the code that the computer uses while starting up. The BIOS checks to make sure all of the hardware is there and working when starting up the computer.

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CLI (Command Line Interface)

Command Line Interfaces are the ones you stereotypically see in movies when a person is “hacking” something. Unlike a GUI (which we’ll get to in a sec), a CLI allows the user to perform actions by typing in commands instead of clicking on icons. You can see why CLIs are not the preferred choice of operating system as you have to learn all of the complicated commands to be able to do anything

Task: If you have a Windows PC, go to search and look for “Command prompt”. This is an example of a CLI

GUI (Graphical User Interface)

A graphical user interface is the most common type of operating system. The two biggest operating systems, Windows and macOS, are both examples of a GUI. The main difference between a GUI and a CLI is that you control a GUI by clicking icons using a pointer (also known as the mouse arrow) instead of having to learn complicated codes and type them in. The easiest way to memorise the basic features of a GUI is to remember the acronym **WIMP** which stands for **W**indows **I**cons **M**enu **P**ointer

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Advantages and disadvantages

Command Line Interface:

Advantages:

- The user directly communicates with the computer instead of through a operating system
- The user is restricted to only the predetermined options of the operating system that the computer uses
- The user can change the computer's configuration settings if they want to

Disadvantages:

- The user needs to learn long and complex commands in order to be able to have any interaction with the computer
- All the commands need to be typed in which can take a long time and it is also likely that the user will make mistakes when typing in the command

Graphical User Interface:

Advantages:

- The user does not need to learn long and complicated commands to be able to use the computer
- It is much more user-friendly as the method of using a pointer to click on icons is far easier to learn than typing in complex codes

Disadvantages:

- The interface takes up a lot more memory space than a CLI interface
- The user can only perform actions that are predetermined by the operating system that they are using
- It requires an operating system to work which can cost both money and memory space on the computer

PCs (Desktop computer)

A PC (Personal Computer) is a computer that is made up of four main components: a mouse, a keyboard, a monitor and a processor unit (the main part of the PC or the "tower" as some call it).

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Laptops

Laptops (sometimes called notebooks) are computers which combine the four main components of a PC into one singular device. This makes it a lot easier to carry around. They also have an internal battery so that it does not have to be plugged in constantly

Tablets

Tablets do virtually the same thing as a laptop, but even more efficiently. Tablets combine the screen and keyboard into a singular touchscreen which makes the whole device smaller and more portable than a laptop. Tablets also can have 3G/4G/5G capabilities which allow the user to access the Internet without a need for WiFi. There are also devices that are cleverly named **phablets**. These devices have all of the features of a smartphone and some of the features of a tablet (i.e. larger storage space), while being smaller than a tablet, but bigger than a smartphone.

Smartphones

Smartphones allow users to have a computer experience that they can fit in their pocket. They allow users to make phone calls and use applications while on the go. Smartphones also run an operating system, usually either Android, iOS, or Windows (with Windows being far less popular than the other two). Smartphones have 3G/4G/5G functionality that allow them to access the Internet without need for a WiFi connection as long as they have a connected account with a mobile network provider. 3G/4G/5G are **mobile networks** which we will get into later on.

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Smartwatches

Smartwatches allow the user to have a computer experience on something even smaller than a smartphone; something that can fit on your wrist even. They usually consist of a small touchscreen on a strap that you wear like a watch. The watch is usually connected to your smartphone via Bluetooth allowing the wearer to do things read messages, see notifications, control music and calls, check the weather, and, of course, check the time, without having to use their phone. Quite often smartwatches will also have health-monitoring (i.e. measuring the user's heart rate), fitness, and GPS capabilities as well.

Mainframe computers

These are the big boys. These computers are extremely powerful as they are the ones that control applications and services like online banking. They have to be powerful because they have to process massive amounts of data every day. They will have multiple CPUs (Central Processing Units) which allow data to be processed much faster. They will also have massive amounts of storage space and internal memory (i.e. some will have hundreds of gigabytes of RAM).

Advantages and disadvantages:

PCs (Desktop computers)

Advantages:

- Best specifications (i.e. faster processing, more powerful, more storage space)
- Do not have to worry about battery capacity as it remains plugged into an outlet
- Best heat dissipation – They are the largest so heat does not get trapped as easily
- Since they are not moved often, there is less risk of them being damaged
- Since they are not moved often, they have to most consistent Internet connection

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Disadvantages:

- Obviously, they are not portable. You cannot take a desktop PC to work or school with you
- Whenever you want to use files from your PC while away from it, you will have to save them to somewhere else (i.e. a memory stick or a cloud storage service)
- They tend to take up a lot more space with wires and a separate monitor, keyboard and mouse

Laptops:

Advantages:

- Obviously, they are much more portable than PCs and you can easily put them in a bag and take them with you
- There are no wires that clutter up space (except for the power cable when it needs to charge)
- Can take full advantage of WiFi since the computer does not have to stay in just one place
- Their portability allows them to be able to connect to multimedia systems

Disadvantages:

- The fact that they are much smaller makes it easier for them to be stolen
- Since they are not constantly plugged in like a PC, battery life becomes a problem since you have to constantly carry around a heavy charger cable to be able to charge it
- Sometimes the keyboard is too small and awkward for some people to use. The trackpad can also be awkward to use

Tablets:

Advantages:

- Tablets are much faster to turn on than a PC or a laptop
- They are more portable than both a PC and a laptop
- The touchscreen is easier to use and means that other input devices aren't needed
- Comes with built-in apps like a camera and music player app
- The solid-state tech means that it does not heat up as much as a PC or a laptop, so overheating becomes less of a problem
- The battery life of a tablet is greater than that of a laptop
- It does not completely turn off when you press the power button, meaning it stays connected to the Internet and can still get alerts

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Disadvantages:

- They have a lot less storage and memory than PCs and laptops
- If 3G/4G/5G is used frequently, it can become expensive
- Typing on a touchscreen is typically much slower than typing on a physical keyboard and you are more likely to make spelling mistakes
- Transferring files between devices is a lot less efficient than on a PC or laptop
- Tablets tend to support less file types than a PC or laptop

Smartphones:

Advantages:

- Much smaller than all 3 previously mentioned devices, so it much easier to carry with you at all times
- You can make calls and connect to the Internet while away from home or work or anywhere with an Internet connection
- The Internet can be accessed from anywhere (even without WiFi) as long as the phone has a SIM card with a mobile network provider
- There are countless apps available that make doing certain tasks much more efficient than doing them on a PC or laptop
- They have a relatively good battery life compared to laptops

Disadvantages:

- The smaller screen makes things quite difficult to read sometimes and makes tasks like typing more difficult
- Taking pictures and browsing the Internet drains the battery life quite drastically
- The amount of memory space is a lot smaller than that of a PC or laptop, and usually about half the size of a tablet
- There are certain things that a smartphone operating system can't do that a PC/laptop operating system can
- The small size makes it easier to lose a smartphone or to have it stolen
- Using a mobile network can tend to be much slower than WiFi which can be irritating at times, especially when trying to stream video or music

Tip: When answering exam questions that ask you to compare the advantages and disadvantages of certain devices, always mention what it is you are comparing the device to (i.e. "is smaller **than a laptop**")

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Artificial intelligence (AI) biometrics:

You probably all know about fingerprint scanners. Quite a lot of you probably have them on your phones. The biggest problem with them is that, occasionally, the fingerprint will be denied because it is not in the same exact position that the original was scanned. This is where AI will be able to help. With the help of AI, the user's fingerprint will be saved every time the scanner is used and the fingerprint is accepted, increasing the amount of samples in the scanner's database. This way the system learns about the user's fingerprint and, with the larger amount of samples, the scanner will make far fewer mistakes when scanning the fingerprint. Similar methods can be used for other biometric devices such as facial recognition (as people age, their face changes. AI will help with problems such as glasses or facial hair too).

Vision enhancement:

The two main types of vision enhancement are **LVES (Low-Vision Enhancement Systems)** and **NVE (Night-Vision Enhancement)**. LVES are systems that use headsets connected to a computer that allow zoomed-in images to be projected in front of the user's eyes to allow the user to see them better. The much more common NVE system (commonly used by the military) is a system which uses infrared and visible light to produce an image that can be seen in the darkness.

Robotics:

When you think of robots, you probably think of humanoid machines that can walk and talk and act like humans, and while robots like that do exist (ok, maybe not the "act like humans" bit... not yet anyway), the majority of robotics tends to be used in manufacturing things. A popular type of robotics is **drones**. Used by both the military and regular people, drones have a wide range of uses from creating 3D landscapes for GPS systems to search and rescue missions for natural disasters.

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Advantages and disadvantages of robotics:

Advantages:

- Saves people having to waste time and energy doing repetitive and simple jobs
- They can perform tasks that would be risky for people to do (like flying into a hurricane to observe it)
- They can provide entertainment and even help with simple everyday jobs

Disadvantages:

- They take jobs **away** from people so there is more unemployment
- There is the fear that, with AI technology, robots could someday overpower humans
- Robots are incapable of showing emotion
- The potential of a robot is limited only to its programming

Quantum cryptography:

To be able to understand quantum cryptography, we first need to be able to understand what **encryption** is. This will be explained in more detail in a later topic, but for now, encryption is the method of changing a message to make it illegible to a hacker. If the data gets to the intended recipient, a key can be used to decrypt the data. It is important to note that encryption does **not stop hacking from occurring**; it only makes it so that, if it is hacked, the hacker won't be able to understand it (this is a common mistake made when answering exam questions). Since hackers are always developing new ways to decipher encrypted messages, new methods of encryption have to be made too, one of the strongest currently being quantum encryption. While most methods of encryption use maths to create an algorithm that encrypts the data, quantum cryptography uses the power of physics and the properties of photons to create a basically unbreakable encryption.

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CAT (Computer Assisted Translation):

I can imagine almost all of you have used services like Google Translate before. This is an example of a CAT system. When a document or string of text is presented to the translation tool, the system first removes anything that isn't text (like pictures and tables). What is left over is then translated according to the language that was selected by the user.

Advantages and disadvantages:

Advantages:

- When in foreign countries, CAT tools make reading things and communicating with people far easier
- It can be used to translate full websites to allow the website to be read and used by far more people from far more countries

Disadvantages:

- Most services will provide a very literal and exact translation, sometimes making it quite difficult to understand. (For a fun example of this, try putting these Japanese characters into Google Translate: え ぐ. If you add more each time, i.e. え ぐ え ぐ え ぐ, you'll find the results change each time and almost always make no sense)
- Certain things can prevent the system from producing an accurate translation (i.e. words with multiple meanings and words with no actual translation)

3D and holographic imaging:

A hologram is a free-standing 3D image that you can see around created using photographic projections. You've all seen them in movies, but hologram technology is actually advancing relatively quickly (companies like Kino-mo are already using the technology for advertising)

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Holograms can be used for many different things, such as:

- Engineering design (allows them to physically see a 3D version of what they are designing)
- Architecture (creates a 3D image of the building they are designing)
- Medicine (allows 3D images of organs to analyse easier)
- Cinema (special effects)
- Gaming (special effects)
- Advertising (as previously mentioned)
- TVs (a full 3D experience without the need for glasses)
- Computer memory (already in development, can increase the storage of optical devices up to 1TB by using the full volume of the storage medium and not just the surface)
- Optical computers (will be able to work at speeds **trillions** of times faster than what we are working with now)

VR (Virtual Reality):

With devices like the HTC Vive and Oculus Rift, you are probably all familiar with VR devices. How it works is that it uses technology like headsets, sensor suits, data gloves or helmets to simulate situations or environments.

VR is currently being used for many different things, such as:

- Military training (removes the risk that may occur if the situation was real)
- Education (provides a more interactive and engaging form of education, like being able to see into ancient buildings for history for example)
- Health care (aids in diagnostics)
- Entertainment (mostly gaming, creates a more immersive gaming experience)
- Fashion (preparation for fashion shows)
- Real estate (allows people to look around properties without actually having to visit them)
- Engineering (allows engineers to see how their design will look)
- Sport (helps with improving techniques like golf swings for example)
- Media (special effects)
- Science (allows scientists to visualise things like molecular structures)