Computer Science

Year 1

SECTION

2

INTRODUCTION TO COMPUTER HARDWARE AND SOFTWARE

COMPUTER ARCHITECTURE AND ORGANISATION

Computer Hardware and Software

INTRODUCTION

Understanding computer hardware is crucial because it forms the foundation of all computing processes. It helps improve system performance, troubleshoot technical issues, and make cost-effective decisions when purchasing or upgrading hardware. Key components such as input devices (like keyboards and sensors), output devices (like monitors and printers), and storage devices (like hard drives and SSDs) play essential roles in how computers interact with users and the world. Additionally, hardware knowledge connects the digital and physical worlds, enabling the creation and optimisation of real-world applications in areas like robotics, healthcare, and automation. An understanding of how hardware components, including input, output, and storage devices function, allows students to better understand how software interacts with these physical systems, enhancing their overall understanding of computing.

Consider how computer hardware technologies—such as input devices (like keyboards, touchscreens, and microphones), output devices (like monitors, speakers, and printers), and storage devices (like hard drives and cloud services)—are integral parts of your everyday life. Think about how you use these components daily when you text on your smartphone, listen to music, watch videos, or save files for school projects. By reflecting on how these technologies are embedded in your routine, you can appreciate the importance of understanding hardware and its role in connecting the digital and physical aspects of your world.

Hardware components of a computer are various physical parts or devices that work together to provide the necessary functionality for computing tasks.

Hardware devices are categorised into the following:

- Input devices
- Output devices
- Processing devices
- Storage devices
- Communication devices

We will now look at each of these in more detail, covering examples of each category.

At the end of this section, you should be able to:

- Explain the features of the hardware components of a computer (input hardware, processing hardware, output hardware, storage hardware and communication hardware).
- Describe the categories of Computer Software

Key Ideas

- Hardware is the physical part of the computer.
- Input hardware is devices used to enter data and instructions into the computer.
- Output hardware displays the data/information.
- Storage hardware keeps the data for future use.
- Communication hardware sends and receives data and signals.
- Network refers to a collection of interconnected devices that communicate with each other to share resources, data, and services.
- Network storage is a type of hardware that allows access to storage on a network.
- Cloud storage is a type of storage that allows access to storage in remote servers in data centres through the Internet.
- Communication hardware facilitates data transfer between systems or devices in a network.
- The motherboard is a circuit board of the computer. RAM slots, expansion slots, and CPU sockets are some of the components of the CPU.
- A software is a set of instructions that tells a computer what to do. It includes a broad range of applications or programs, tools, and systems that enable the hardware to perform specific tasks.
- A computer program is a specific set of instructions that a computer executes to perform a particular task. A program is a subset of software, usually focused on achieving a single function.

INPUT DEVICES

Input devices are hardware components that allow users to give data and instructions to a computer system. They enable users to interact with the computer and provide the necessary input for executing tasks. Here are some examples of input devices:

1. Keyboards

A keyboard is a common input device, consisting of a set of keys that allow users to input alphanumeric characters, symbols, and commands. They facilitate the typing text and providing commands to the computer.

Figure 2.1 Keyboard.

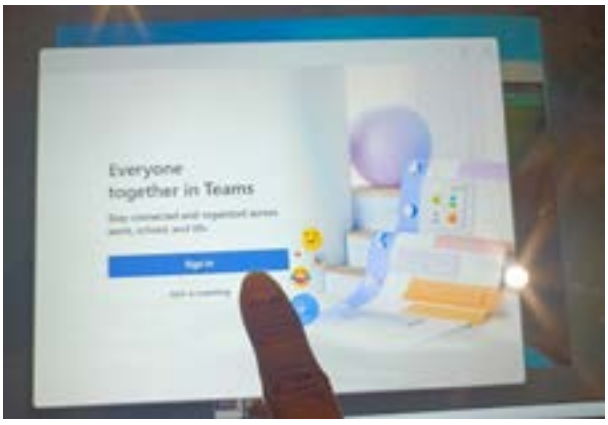
2. Mouse

The mouse is a pointing device that allows users to control the cursor on the screen. They typically have buttons and a scroll wheel, enabling users to select objects, navigate interfaces, and perform actions through mouse movements and clicks. It is important to know that the plural form of mouse is "mice".

Figure 2.2 Mouse.

3. Touchscreens

Touchscreens enable users to directly interact with the computer by touching the display. They can detect and respond to finger gestures, allowing for intuitive input methods such as tapping, swiping, or pinching. Playing a similar role to the mouse, they are particularly popular for portable deceives where a mouse would be impractical.



4. Scanners

Scanners are used to convert physical documents, images, or objects into digital formats. They capture the data optically and transfer it to the computer for storage, editing, or further processing.

Figure 2.3 Scanners.

Activity 2.1

1. A computer lab of Mpeasem SHS located at Kojokrom in the Western Region of Ghana needs to accommodate students with diverse needs, including those with disabilities and different backgrounds. As a computing student studying input devices, suggest a plan to equip the lab with a variety of input devices, ensuring accessibility for all students in groups. You might want to research more input devices, perhaps those with accessibility in mind. Discuss your group reports with your teacher.
2. Individually move around the computer room and write down the names of input devices you can see.

OUTPUT DEVICES

The output device displays the result of the processed data that is entered into the computer through an input device. There are a few output devices that display output in different ways such as text, images, hard copies, and audio or video.

They bridge the gap between digital data and human perception, letting users engage with computer-generated information.

There are many types of output devices for processed data as text, images, or video.

Monitors and projectors allow users to view computer output on screens or project it onto larger surfaces.

1. Monitors

Monitors allow users to view computer output on screens. There are different types of monitors, three of which as shown in Figure 2.4.

Figure 2.4 Monitors.

Some computers, such as laptops, have built-in monitors.

Monitors can be found where computers are being used. For example, they are used in educational institutions, such as schools and universities, to facilitate learning. They display educational content, multimedia presentations, interactive learning materials, etc.

2. Projectors

A projector is an output device that enables the user to project the output onto a big screen or wall. It can be connected to a computer and similar devices to project their output onto a screen. It uses light and lenses to produce magnified texts, images, and videos. So, it is an ideal output device to give presentations or to teach a large number of people.

Modern projects (digital projectors) come with multiple input sources such as Display Port (DP) and High-Definition Multimedia Interface (HDMI) ports for newer equipment and Video Graphics Array (VGA) ports that support older devices. Some projectors are designed to support

Wi-Fi and Bluetooth as well. They can be fixed onto the ceiling, placed on a stand, and more and are frequently used for classroom teaching, giving presentations, home cinemas, etc.

Figure 2.5 A projector.

3. Plotters

A plotter is a specialised output device used to generate high-quality, accurate, and detailed graphics. It's popular in fields like engineering, architecture, and

graphic design. Unlike printers, which use ink or toner to create pictures or text on paper, plotters can utilise a pen or marker to draw continuous lines on diverse media such as paper, vinyl, or film.

Examples of Plotters

Pen Plotters: Pen plotters are the most classic sort of plotter, drawing continuous lines on paper or other media using a pen or marker.

Figure 2.6 Pen Plotter.

Electrostatic Plotters: Electrostatic plotters use an electrostatic charge to attract toner or ink onto paper. They operate by selectively charging areas of the paper and then applying toner or ink to those charged areas, resulting in the formation of graphical output.

Figure 2.7 Electrostatic Plotter.

4. Printers

A printer produces hard copies/physical copies of the processed data. It enables the user to print images, text or any other information onto the paper. Users can pick from various printer types, such as inkjet and laser, to meet their printing demands. Printers enable the generation of tangible copies for record-keeping, presentations, marketing materials, and other purposes, from household to professional settings. Printers are essential for personal and commercial use due to their simplicity and adaptability.

Figure 2.8 Small Laser Printer.

Printers vary in type. size, speed, and cost. Some printers can output in A3. Some printers have photocopy and scan functions. Popular types of printers are laser printers and inkjet printers.

3D printers (as shown in Figure 2.9) create three-dimensional objects by depositing layers of material (plastic, metal, or composite) based on a digital model. They are used in various industries, including manufacturing, prototyping, and healthcare.

Figure 2.9 3D printing.

5. Sound Output devices

These devices deliver audio output for listening or communication purposes. Speakers and headphones/earphones enable users to hear the sound - music, and speech.

Figure 2.10 Examples of Sound Output Devices.

Activity 2.2

1. Abdulai Joanna Fati hailed from the Northern Region of Ghana and works as an Internet Café Manageress of DM ICT Centre at Ho. She wants to change the old printers of the café. As a hardware specialist who studied output devices, recommend describing to her at least three (3) things that she should consider when buying a new printer.
2. Individually move around the computer room and write down the name of the devices there and their categories (input or output).

3. Upon your admission, describe how the admission officer used the various input and output devices to help you get the hard copy of your admission letter, prospectus and code of conduct online.

STORAGE DEVICES

These devices are essential components of a computer system that store and retrieve data, programs, and files. They provide long-term data storage and enable users to save, access, and manage their digital information.

When looking at storage devices, there are three considerations: capacity, speed, and cost (how much to purchase per MB).

Storage Capacity & Performance

a. One characteristic of storage devices is their capacity, which is the amount of data they can store, typically measured in Kilobytes (KB), Megabytes (MB), Gigabytes (GB), or Terabytes (TB).

b. Performance factors include read/write speeds, access times and data transfer rates.

Types of storage devices

Storage devices fall into three categories: magnetic, optical and flash.

1. Magnetic

Magnetic storage uses a magnetisable material. Patterns of magnetisation are then used to represent binary sequences. Magnetic storage tends to have a high capacity at low cost. One particular downside to Magnetic storage is the lower read speeds, typically they are relatively slow. Examples include magnetic tape and hard disk drives.

Magnetic tape is sometimes used for backup of server computers.

Hard Disk Drives (HDDs) are the most common form of magnetic storage devices used in computers. They use magnetic storage to store data on spinning disks (platters) and read/write heads to access and modify data. HDD capacities typically range from several hundred gigabytes (GB) to several terabytes (TB).

Figure 2 .11 Internal HDDs.

2. Optical

Optical storage works by using laser technology to read and write data a laser. Examining the reflection from the laser will determine whether there are pits on the surface of the disk representing 1s, or lands representing 0s. Examples of optical disks are CDs, DVDs. They can be used for data storage, software installation, media playback and creating backups.

Optical disk drives are gradually being phased out in favour of faster and more versatile storage options.

Figure 2.12 Optical Disks (DVDs).

3. Flash

Flash memory is a type of non-volatile solid-state memory that stores data by trapping electrons in tiny cells to represent ones and zeros. It retains information even when the power is off, allowing data to be stored long-term without needing electricity. Because it has no moving parts and can be quickly read and written, flash memory is used in devices like USB flash drives, SSDs, and memory cards.

Solid State Drives (SSDs)

SDDs offer faster data access and transfer speeds compared to HDDs due to the absence of moving parts. SSDs are more resistant to physical shocks and consume less power compared to HDDs. They come in various form factors and can be internal or external/portable.

Figure 2.13 Internal Solid-State Drive (SSD).

USB Flash Drives

USB flash drives, also known as thumb drives, pen drives or USB sticks, are portable storage devices that use flash memory. They connect to computers via USB ports and offer a convenient way to transfer and store data. They come in various storage capacities and are widely used for data ***backup, file transfer, and portable storage.***

Figure 2.14 Flash Drives. *Source:* Google images

Memory Cards

Memory cards are small, portable storage media commonly used in cameras, smartphones, tablets, and other portable devices. The data can usually be read by connecting the device with the card to the computer or removing the card from the device and inserting it into a memory card reader connected to the computer.

They provide removable and expandable storage options and use flash memory technology.

Popular memory card formats include Secure Digital (SD) cards, microSD cards, Compact Flash (CF) cards, and Memory Stick.

Figure 2.15 SD Cards

Activity 2.3

1. Use the internet to find out about the following pair of devices/ media: HDDs vs SDDs, HDDs vs Magnetic Tape Drives, CDs vs DVDs, USB flash drive vs memory card. Compare these devices/media and use a table in Word to present your work.
2. Complete the following table template (column headings: device name, typical use(s), main features, average cost, image) and then populate as much as possible with no online assistance. Report your result to your teacher.

S/N	Device Name	Typical Use(S)	Main Features	Average Cost	Image
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

3. In groups, observe the picture of hardware devices in Figure 2.16 and answer the questions that follow:

Figure 2.16 Hardware Devices.

a. Write down the name of the devices and the category (input, output, or storage) each falls in.

b. Match these devices with the tasks they can perform.

c. Discuss devices that can be used to perform the same tasks.

Storage Hardware And Communication Hardware

Sarah is a new student at Senior High School (SHS), she wants to check her admission status at an internet café. Behind the scenes, her admission data is stored on a centralised storage device, while communication hardware facilitates data exchange between her computer and the central storage. Sarah's request travels through the café's network, guided by communication hardware, to retrieve her admission status from the storage device. Once retrieved, Sarah sees her admission status displayed on the computer monitor and prints out her admission letter.

This illustrates how network storage and communication hardware collaborate to enable convenient data access and retrieval in real-life scenarios.

Now let us look at the types and features of both storage hardware and communication hardware.

Computer Storage Devices

Network storage is a type of hardware that allows access to storage on a Local Area Network (LAN). Cloud storage is a type of storage which can be accessed remotely over the internet. Cloud storage is like renting storage space from a provider. So multiple network storage makes up cloud storage.

After getting an understanding, let us look at them one after the other.

Cloud Storage

Cloud storage refers to storing data on remote servers in data centres that are accessed through the Internet. It offers flexible and scalable storage solutions with the convenience of accessing data from anywhere with an internet connection. The business running the cloud storage service manages backups and security. Nowadays, cloud storage is used by individuals, businesses and organisations throughout the world. Cloud storage is regularly used by users of both stand-alone and networked computers even though they will have local storage such as a hard disk and file server respectively.

Popular cloud storage services include Dropbox, Google Drive, Microsoft OneDrive and Amazon S3.

Figure 2.17 Picture showing some cloud storage providers.

We are going to look at the two types of data centre storage systems

1. File Storage Devices

Network-Attached Storage (NAS)

NAS devices are specialised storage devices connected to a network and used for centralised data storage and file sharing. Apart from their use in data centres, NAS devices are often used in homes and in small to medium-sized businesses. They provide data access to multiple users or devices over a network. NAS drives are in operation 24/7, meaning the data and files can be accessed by authorised users at any time, unlike desktop hard drives, which are only in operation when their computer is on.

NAS devices typically contain a minimum of two hard or solid-state drives which gives them high-volume storage capacity. They offer capacities ranging from a few terabytes to multiple petabytes (1 petabyte (PB) is 1024 TB). NAS increases performance and reliability with features like RAID.

NAS devices have a processor that provides computing intelligence and power to manage the file system. The processor reads and writes data to process and serve files, manage multiple users, and integrate with the cloud if desired.

Figure 2.18 Western Digital NAS Device for Home and Small Businesses.

Features of NAS

a. **Centralised Storage:** NAS provides a centralised location for storing and accessing data on a network. This allows multiple users or devices to access files, documents, and media from a single storage repository, promoting efficiency and collaboration.

b. **Easy Setup and Management:** NAS systems are typically designed for easy setup and configuration, making them accessible even to users with minimal technical expertise. They often come with intuitive web-based interfaces or dedicated software for managing storage, users, and permissions.

c. **File Sharing and Collaboration:** NAS enables seamless file sharing and collaboration among users within a network.

d. **Data Protection and Redundancy:** Many NAS systems offer built-in data protection features such as RAID (Redundant Array of Independent Disks), which helps safeguard against data loss due to disk failures. RAID configurations distribute data across multiple hard drives, providing redundancy and fault tolerance.

e. **Remote Access and Cloud Integration:** NAS devices often support remote access functionality, allowing users to access their files and data from anywhere with an internet connection. Additionally, some NAS systems offer seamless integration with cloud storage services, enabling backup, synchronisation, and hybrid cloud deployment options.

f. **Scalability:** NAS systems are highly scalable, allowing users to expand storage capacity as needed by adding additional hard drives or expanding existing storage pools. This scalability ensures that NAS can adapt to changing storage requirements over time, whether in a home environment or a growing business.

g. **Media Streaming and Multimedia Capabilities:** Many NAS devices include built-in media server capabilities, allowing users to stream multimedia

content such as movies, music, and photos to compatible devices within the network. This feature is particularly popular for home entertainment systems and multimedia sharing among family members.

h. **Data Security:** NAS devices typically offer robust security features to protect stored data from unauthorised access and ensure data integrity. This includes support for user authentication, access controls, encryption, and integration with existing network security measures.

2. Block Storage Devices

Block storage devices store data in blocks and provide many terabytes of data capacity. Storage area networks (SANs) are storage units that contain several internal drives (hard drives or solid-state drives) and act as large block storage systems.

Storage Area Networks (SANs)

SANs are specialised high-speed networks that connect storage devices to the computer.

Figure 2.19 HP Storage Area Network System SAN, For Networking, 220V

Apart from their use in data centres, SANs are commonly used in enterprise environments that require large-scale storage solutions and high-performance data access. SAN uses Fibre Channels and can use Ethernet.

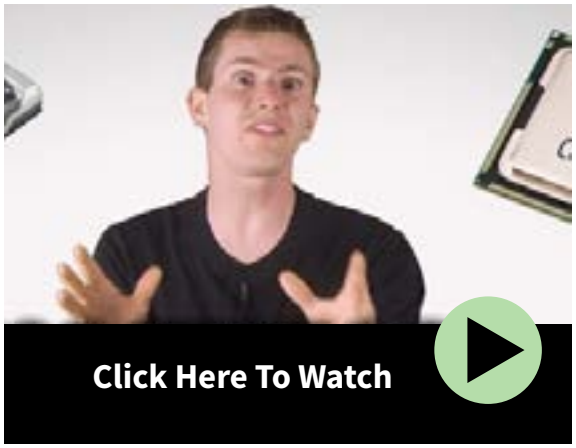
Network-attached storage devices and Storage Area Network devices share the same features but the key differences are shown below.

	NAS	SAN
Fabric	Uses TCP/IP[1] networks, most commonly Ethernet	Runs on high-speed Fibre Channel networks.
Data processing	Processes file-based data	Processes block data
Protocols	Connects directly to an Ethernet network; can use several protocols to connect with servers including NFS[2], SMB[3]/CIFS[4], and HTTP[5]	Uses SCSI[6] protocol to communicate with servers
Performance	Generally, has lower throughput and higher latency because of its slower file system layer	A higher performer for environments that need high-speed traffic.
Scalability	Entry levels and NAS devices not highly scalable, High-end NAS systems scale to petabytes using clusters or scale-out nodes.	Scalability is a major driver: its network architecture enables admins to scale performance and capability in scale-up or scale-out configurations.
Ease of management	Easier to manage: device easily plugs into the LAN and offers a simplified management interface.	Requires more administration time than NAS.
Price	In general NAS is less expensive to purchase and maintain, although a high-end NAS will cost more than an entry-level SAN	SANs are more complex to manage with FC[6] SANs on top of the complexity heap.

Table 2.1 Comparison table showing key differences between NAS & SAN.

1. TCP/IP: Transmission Control Protocol/Internet Protocol is a suite of communication protocols used to interconnect network devices on the Internet.
2. NFS: Network File System was designed in 1984 by Sun Microsystems. This distributed file system protocol allows a user on a client computer to access files over a network in the same way they would access a local storage file.
3. SMB: Server Message Block is a network file-sharing protocol that allows applications on a computer to read and write to files and to request services from server programs in a computer network
4. CIFS: Common Internet File System is a dialect of SMB. That is, CIFS is a particular implementation of the Server Message Block protocol, created by Microsoft.
5. HTTP: Hypertext Transfer Protocol is the foundation of the World Wide Web, and is used to load webpages using hypertext links.
6. FC: Fibre Channel is a high-speed data transfer protocol providing in-order, lossless delivery of raw block data.

Let us watch these videos to understand the difference between NAS and SAN



Data Redundancy and RAID

Redundant Array of Independent Disks (RAID) is a storage technology that combines multiple drives to improve performance, reliability and data redundancy. Data redundancy is when multiple copies of the same information are stored in more than one place at a time. This redundancy provides fault tolerance which is the ability of a system to continue operating properly in the event of the failure of one or more components (in this case a disk failure).

Figure 2.20 SAN showing HDD in RAID to prevent data loss.

RAID configurations provide fault tolerance and data protection by distributing data across multiple drives.

Let us watch this video to understand why RAID is important in Network Storage.

Activity 2.4

Complete the concept map of computer storage

Hint:

a. Place "Computer Storage" as the central node.
b. Write the two main types of computer storage from the central node.
c. List the specific types of storage under the two main branches listed in (b)
d. Compare your concept map with your peer's for accuracy.

Hint: remember to respect each other's review

Activity 2.5

Worldwide Tech Solutions is seeking a network storage solution to support its daily operations, store business transaction records, and facilitate file sharing among on-site and off-site staff. Collaborate with a colleague to recommend the most suitable network storage solution for Worldwide Tech Solutions. Consider factors such as cost, efficiency, scalability, and ease of management.

Hint:

a. Discuss with your group members.
b. Compare and contrast cloud storage and NAS based on the company's needs.
c. Analyse how each solution meets with the company's requirements for storing transaction records and facilitating file sharing among staff.

Communication Hardware Devices

Communication hardware devices enable the transmission and reception of data and signals between computers, devices, and networks. They facilitate communication and data transfer across various media.

For example, in the café, communication hardware facilitates the exchange of data between Sarah's computer and the central storage device. Ethernet cables connect the café's computers to a router, which manages the network traffic. This router acts as a traffic director, ensuring that Sarah's request to check her admission status reaches the central storage device and that the response is sent back to her computer.

Below are the types of Communication devices.

1. Network Interface Cards (NICs)

Network Interface Cards, also known as network adapters or network cards, enable computers to connect to networks. NICs provide the necessary hardware interface for transmitting and receiving data over wired networks. WNICs (Wireless Network Interface Cards) provide the same functionality for wireless networks. They support various networking technologies such as Ethernet, Wi-Fi, Bluetooth and cellular connectivity.

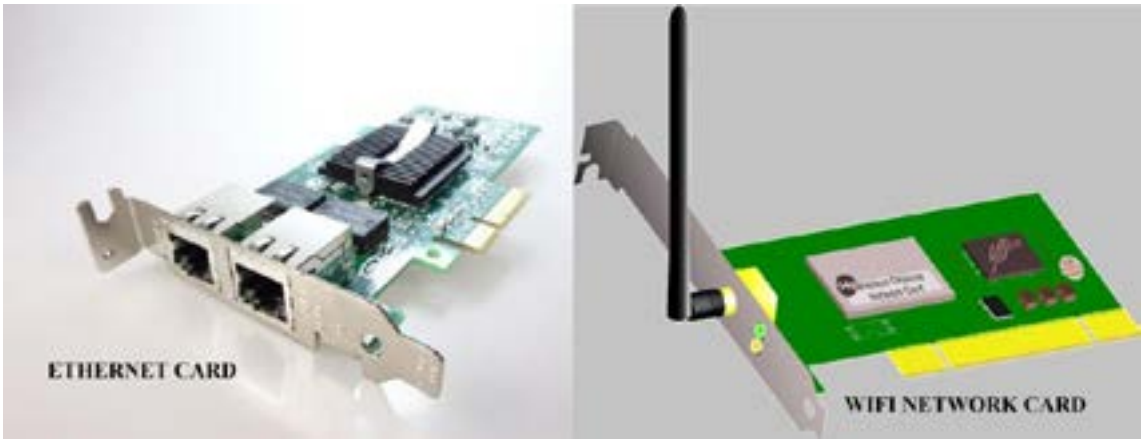


Figure 2.21 Ethernet and Wi-Fi Network Interface Cards.

2. Modems

Modems are devices used to modulate and demodulate digital signals into analogue signals and vice versa. Modems allow computers to communicate over analogue networks such as telephone lines. A modem is essential for internet access because it receives an analogue signal from the Internet Service Provider (ISP) and then converts it into a digital signal that work, school or home devices can understand and vice versa.

Many modems nowadays are "all-in-one" devices that also include a router. This integrated device is sometimes called a gateway.

Figure 2.22 Vodafone Pocket Modem.

3. Routers

Routers are networking devices that connect different networks (such as the Internet and a school network) and direct data packets between them. Data packets are fundamental units of data transmitted over a network. They contain both the information being transmitted and the metadata necessary for the network to deliver them to their intended destination.

Routers analyse network addresses, determine the most efficient path for data transmission, and forward packets accordingly.

You will need the features of both a modem and a router, integrated or not, to have an internet connection for all of the devices in a local network (for example, your home network).

Figure 2.23 Modem and Router.

4. Switches

Switches are devices that enable the interconnection of multiple devices within a local network. They receive and forward data packets to their intended destination based on their MAC (Media Access Control) addresses. A MAC address is a string of characters that identify a device on a network. Switches provide a dedicated connection for each device leading to enhancing network performance.

Figure 2.24 Different types of Switches based on their number of ports.

5. Hubs

Hubs are networking devices that serve as central connection points for multiple devices within a network. They receive incoming data and broadcast it to all connected devices, making them less efficient than switches as bandwidth is shared. Only the intended network device will accept the data. These are typically not used in a modern network as they have a negative impact on the traffic on the network.

Figure 2.25 NETGEAR Ethernet Hub EN104 TP model.

6. Wireless Access Points (WAPs)

Wireless Access Points, also known as WAPs enable wireless connectivity in local networks. They create wireless network signals that devices can connect to, allowing wireless communication and internet access.

Figure 2.26 Wireless Access Point fixed on a ceiling.

7. Repeaters and Extenders

Repeaters and extenders are devices used to extend the coverage area of a Wi-Fi network. They receive and amplify signals to increase coverage and overcome signal degradation or distance limitations. however, they do it in different ways.

Figure 2.27 NETGEAR Wi-Fi Extender plugged to a wall socket.

Activity 2.6

1. Create three tables, one for each of the following comparisons of communication hardware, and discuss them with your classmates.
   a. NIC and WNIC
   b. Modem and Router
   c. Switch and Hub
2. Lead: If you have access to a computer, you can use Microsoft Word to create the tables. Otherwise, you can draw the tables in your exercise book.

Motherboard Components

Previously we looked into the world of hardware devices, exploring the important components that make up our computers. You saw the various categories of hardware devices. However, there is one important hardware component inside the system unit that we did not talk about.

So, today, we are going to focus on this very important component, the *motherboard*. Think of the motherboard as the heart of our computers. It's like a central component that helps all the different parts talk to each other and work together smoothly. It "talks" to the other components and ensures that the each of them is working together.

Motherboard

A motherboard is an essential piece of hardware that is often referred to as the "heart" of a computer. It is a large circuit board that holds and connects all the essential components of a computer, allowing them to work together.

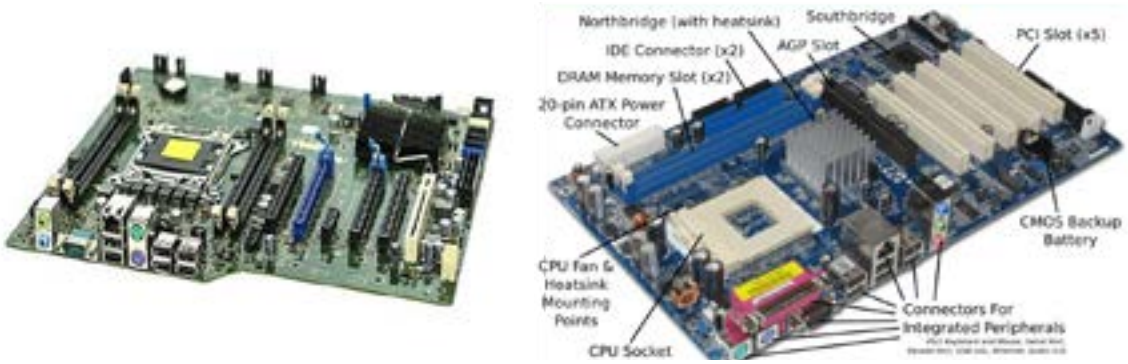


Figure 2.28 Motherboards – empty and with components.

The motherboard's form factor is the specification of a motherboard, such as the dimensions, power supply type, location of mounting holes, and number of ports on the back panel. Different sizes of motherboards fit into different computer cases, so if building a computer, it is essential to choose a form factor that fits your chosen case.

Components of the Motherboard

Dear learner, do you remember some of the components you saw in the image of the motherboard in Figure 7.1? Now stay with me as we look at these components and what they do to help the computer function effectively.

1. CPU Socket

The CPU is installed through the CPU socket onto the motherboard. A cooling system is mounted directly on top of the CPU, dissipating heat generated by the processor's operation.

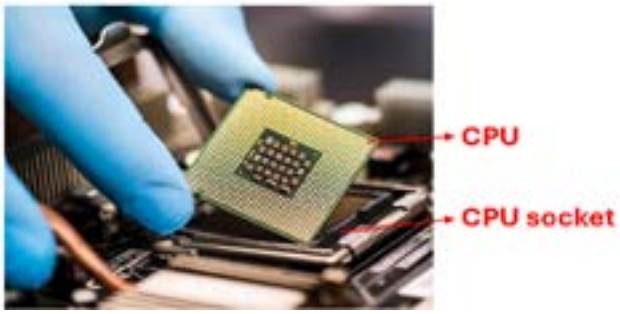


Figure 2.29 CPU installation.

The CPU (the "central" or "main" processor), often referred to as the "brain" of the computer is a complex set of electronic circuitries that runs the computer's programs.

Specifications of a processor (CPU) include:

a. **Clock Speed:** Measured in GHz, it determines how fast the CPU can execute instructions.
b. **Number of Cores:** Multicore processors can handle multiple tasks simultaneously.
c. **Cache Memory:** Provides faster access to frequently used data for the CPU.

The two types of CPU sockets in use today are **Pin Grid Array (PGA)** and **Land Grid Array (LGA)**. In a PGA socket, the pins are located on the CPU, which fit into corresponding holes in the socket on the motherboard—this type is commonly used by AMD for their older desktop processors. In contrast, an LGA socket has pins on the motherboard socket itself, and the CPU has flat contact points that align with these pins—this design is typically used by Intel for their processors and AMD for their newer processors. Both socket types serve the same purpose of securely connecting the CPU to the motherboard while allowing for efficient electrical communication between them.

2. RAM Slots

RAM slots are where memory modules (RAM sticks) are inserted on the motherboard. RAM stores the program and data that the computer is currently using, and more RAM means the computer can handle more tasks at once.

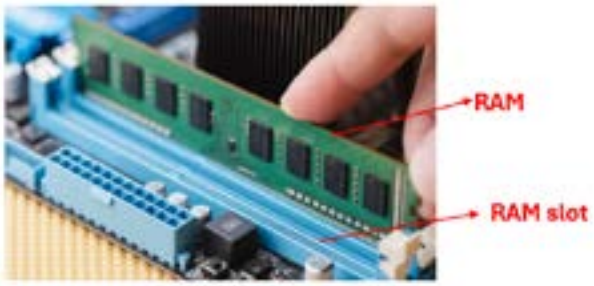


Figure 2.30 RAM slot.

RAM is a computer's short-term memory where the data and programs that the processor is currently using are stored.

Specifications of RAM include:

a. **Capacity:** Measured in gigabytes (GB) for desktops, laptops and smartphones,
b. **Speed:** Measured in MHz or MT/s (MegaTransfers per second), it affects how fast data can be read and written to the RAM
c. **Type:** here are a few different types commonly in use today: Static RAM (SRAM), Dynamic RAM (DRAM), Synchronous Dynamic RAM (SDRAM) and more recently Double Data Rate SDRAM (DDR SDRAM). The type used can affect the speed and power consumption.

3. Expansion Slots

Expansion slots are the connection points on the motherboard where you can add extra components like graphics cards, sound cards and WNICs (Wireless Network Interface Controllers) to enhance the computer's capabilities. There are several possible options that you may come across – PCI (Peripheral Component Interconnect) or AGP (Accelerated Graphics Port), however in modern PCs, these have been exclusively replaced by PCIe (Peripheral Component Interconnect Express) slots.

4. Chipset

The chipset is often referred to as the "glue" of the motherboard. It is basically the electronics on the motherboard that communicate with all the connected components. It is like a traffic police officer on the motherboard. It manages data flow between the different parts, making sure everything works together smoothly.

5. BIOS

The BIOS (or Basic Input Output System) is software stored on a small memory chip on the motherboard that tells the computer how to start up, perform self-checks, and load the operating system. UEFI (Unified Extensible Firmware Interface) is a more modern solution doing the same job as a BIOS but works a bit differently, UEFI is required to run latest operating systems such as Windows 11.

Figure 2.31 Photo of BIOS.

6. Power Connectors

Power connectors on the motherboard provide electricity to all the components. Just like a power outlet in a wall, these connectors make sure all the parts get the power they need.

Figure 2.32 Power connectors.

7. Storage Connectors

These connectors let you attach Hard Disk Drives (HDD) and Solid-State Drives (SSD) to store all your files and programs. These are a form of SATA (Serial Advanced Technology Attachment).

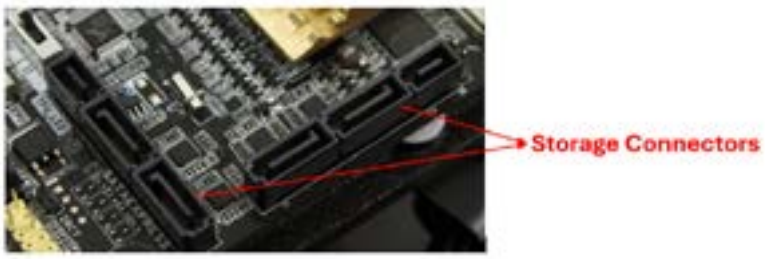


Figure 2.33 Storage Connectors.

8. I/O Ports

I/O ports are like the computer's "communication points." They include USB ports, audio ports, Ethernet ports, and more, allowing you to connect various devices and peripherals. Peripherals are the electronic devices (e.g. a scanner) connected to the system unit. They expand the capabilities of the computer.

Figure 2.34 Types of ports. *Source: Google Images*

9. Sound card

A sound card is a hardware that connects to the motherboard (via a PCIe slot) and is responsible for handling sound received via a microphone and for producing sound on a computer that can be heard through speakers or headphones. Many sound cards have their own processor, a DSP (Digital Signal Processor) which handles audio-related tasks such as the calculations for analogue-to-digital and digital-to-analogue conversions, relieving the load on the main processor (CPU). Alternative to a sound card, computer sound can be handled by a designated sound chip that is integrated into the majority of modern motherboards.

Figure 2.35 PCIe sound card.

10. Graphics Card

A graphics card or video card is an add-in circuit board to the motherboard. One of the main components of this expansion board is the Graphics Processing Unit (GPU) which is responsible for 3D graphics rendering and displaying images, videos, and animations on the computer monitor.

Figure 2.36 NVIDIA Graphics card.

Whilst the majority of the time the GPU is a separate card, sometimes GPUs are integrated, they are embedded in the motherboard. Some GPUs have their own memory to store graphical data separately. Integrated GPUs are often much less capable and are designed for allowing you to interact with the Operating System, but are not as able to handle more complex tasks such as gaming, or 3D rendering as well as a dedicated GPU.

11. Onboard (or integrated) Components

Built-in components, like a sound chip, GPU or Wi-Fi chip, save the computer user from having to add separate cards for these functions.

12. Cooling System

Motherboards need to cool the chips that would otherwise get too hot and degrade. There are two main options to safely mitigate heat from motherboard components such as the CPU. These two main options are fans and heatsinks, and liquid cooling.

a. **Fans/Heatsinks:** a cooling method using circulated air.

Figure 2.37 Fan attached to a heat to cool a CPU.

b. **Liquid Cooling:** an alternative cooling method that uses liquid to dissipate heat, this can be done one of two ways, either by an All-In-One (AIO) system which is a self-contained liquid cooler, or a custom liquid loop which contains reservoirs, tubes, pumps and radiators (as shown in Figure 7.11).

Figure 2.38 Gaming desktop having a custom liquid cooling system on the CPU.

Activity 2.7

Do the following with the help of the teacher.

1. Closely examine (observe) the motherboard the teacher will show you.
2. Identify its components.
3. Explain the features of the components identified.
4. Explain the function(s) of the components in a computer system.
5. Share the responses with peers and the teacher.

Activity 2.8

Click on the link below and watch the online video on the various components and features of the motherboard in the computer and answer the questions that follow.

Major parts & components of the Motherboard identified and explained (OLD MOTHERBOARD)

From your observation,

a. List at least ten (10) components of the motherboard.

b. In your own words, explain the features of the components you listed above.

c. Classify the components identified into input, output, storage, communication, and network storage hardware categories.

d. Share your answers with your peers and the teacher in class.

Activity 2.9

In groups, do the following:

Observe the labelled diagram of the motherboard below carefully.

Go online and find the features and importance of the components such as CPU sockets, RAM slots, expansion slots, chipsets and I/O ports as shown in the labelled diagram.

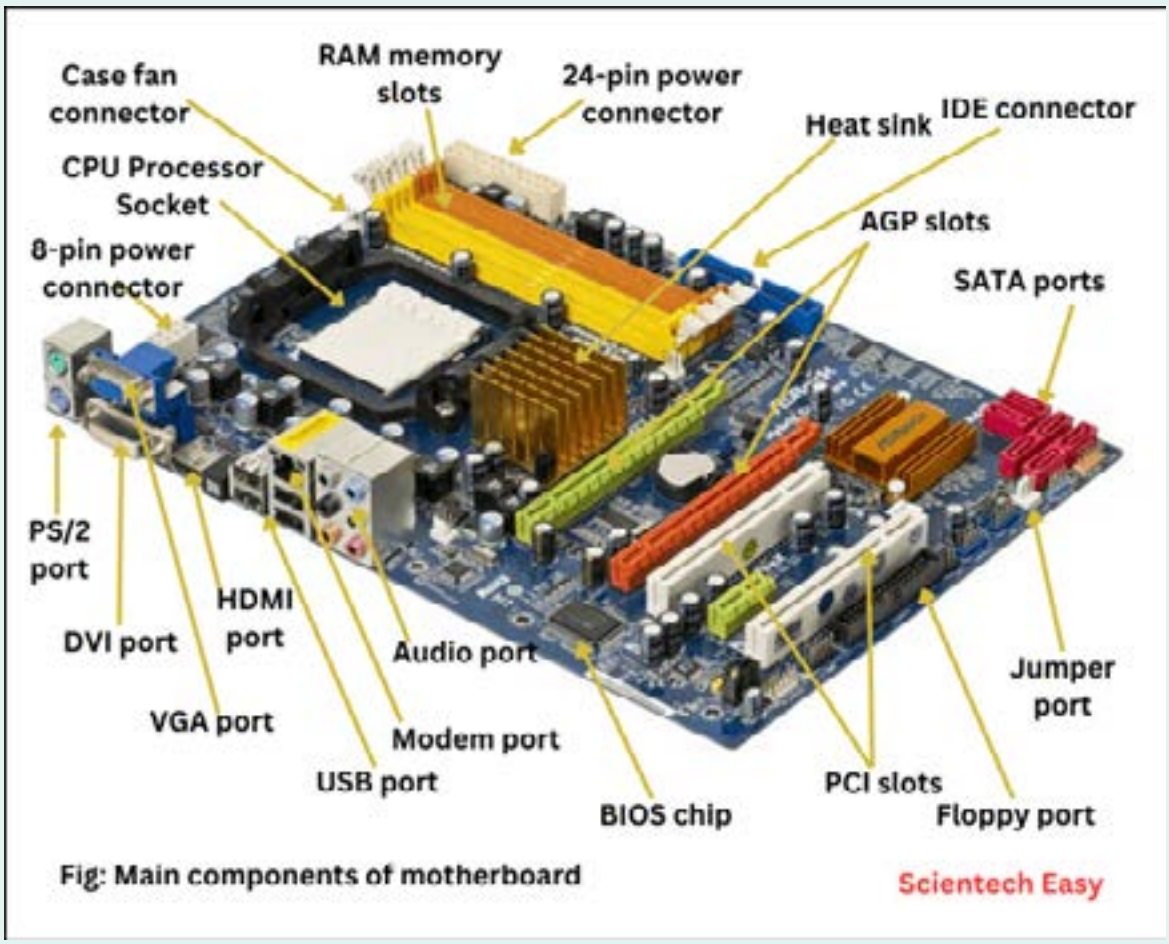
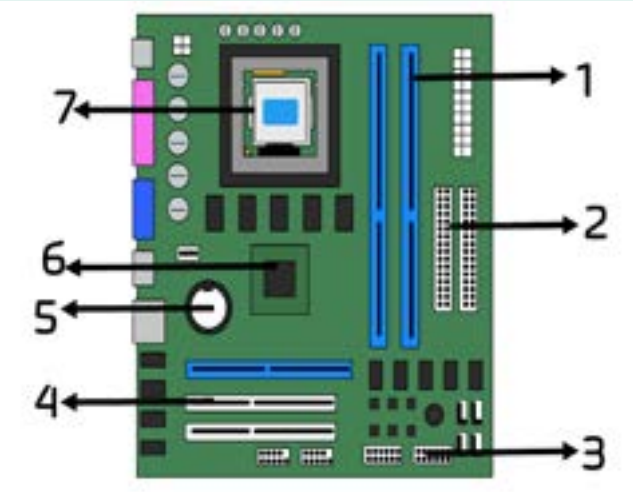


Fig: Main components of motherboard

Activity 2.10

In your groups, observe the image of the motherboard below and identify the components labelled 1 – 7.



Activity 2.11

With the permission of your teacher, work with your classmates to disassemble a non-functional computer, pointing out each component's location and purpose as you remove them.

Hint:

- Start by removing the side panel of the system unit.
- Identify and disconnect all cables and connectors attached to the motherboard, drives, and other components.
- Remove any expansion cards such as graphics cards or sound cards.
- Unscrew and remove the power supply unit.
- Carefully detach the CPU cooler and remove the CPU from its socket.
- Remove the RAM sticks.
- Finally, remove the motherboard from the case.

Activity 2.12

Work with your classmates to assemble a working computer explaining each step's significance.

Hint:

- Start by placing the motherboard back into the case, and aligning it with the standoffs (small metal or plastic spacers used to elevate and secure a motherboard inside a computer case). NOTE – Ensure that there is the correct number of standoffs, otherwise damage can be done to the motherboard.
- Install the CPU into the CPU socket, applying thermal paste if necessary, and attach the CPU cooler.
- Insert the RAM sticks into the appropriate slots on the motherboard.
- Install any expansion cards into their respective slots.
- Connect all cables and connectors to the motherboard, ensuring they are securely attached.
- Install the power supply unit and secure it with screws.
- Connect all appropriate power cables to the various components.
- Close the side panel of the system unit.

NOTE: You can purchase the components from any computer hardware shop and build your own system unit at home.

Alternative: If you do not have access to a system unit, try the following:

i. Click on the link How to Disassemble/Assemble a Computer System Unit? - Basic Parts and Function (youtube.com)

ii. Watch the video on how to assemble and disassemble the desktop computer.

iii. In groups, write a set of instructions based on the assembly process you saw in the video.

CATEGORIES OF COMPUTER SOFTWARE

See your computer as a human body. The hardware we discussed earlier is like the body's physical structure – the head, legs, hands, mouth and many more. Software is the soul that gives life to the hardware of the computer system to work. Without the hardware, the software cannot function and vice versa.

In today's lesson, we will discover the different types of software and see how they are seamlessly integrated into various aspects of our lives. From enhancing education and streamlining our work to enriching our personal lives, software is the invisible force that makes everything run smoothly in the computer.

So, get ready to explore the soul of your computer and see how it brings the hardware to life in ways that make our daily lives easier, more efficient, and more connected.

Categories of Computer Software

Now let's take a look at the two main categories of computer software as shown in **Figure 2.39 –** Applications and System.

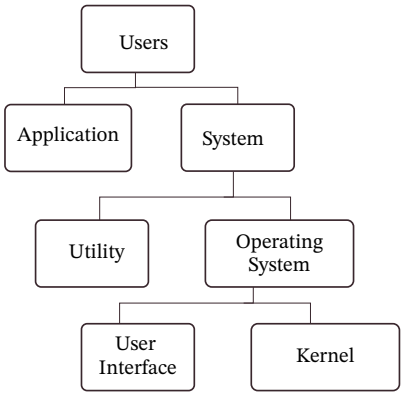


Figure 2.39 Categories of Computer Software.

Application Software

Think of application software like different tools in a toolbox, each tool performing a unique task.

In the same way, **Application software** are programs designed to carry out a specific task other than one relating to the operation of the computer/device itself. Application software is tailored to fulfil particular user needs, such as productivity, communication, entertainment, education, and more. Examples of application software include internet

browser, a spreadsheet program, database management systems, a word processor, and games software. A computer used to manage inventory for a manufacturing company will have different applications compared to one used by an electrical engineer.

Application software runs on top of the systems software, an operating system and utilises system resources to execute tasks according to user instructions.

Here are examples of some categories of application software.

1. Productivity Software

Productivity software helps users create, edit, manage, and share various types of digital content, including documents, spreadsheets, presentations, and databases. Examples include Microsoft Office Suite (Word, Excel, PowerPoint), Google Workspace (Docs, Sheets, Slides), and Adobe Acrobat.

2. Multimedia Software

Multimedia software enables users to create, edit, organise, and playback multimedia content such as audio, video, and images. Examples include media players (VLC Media Player, Windows Media Player), photo editing software (Adobe Photoshop, GIMP), and video editing tools (Adobe Premiere Pro, iMovie).

3. Educational Software:

Educational software is designed to support teaching and learning activities by providing interactive tutorials, simulations, quizzes, and educational games. Examples include learning management systems (Moodle, Canvas), educational apps (Khan Academy, Duolingo), and digital textbooks.

Systems Software

System software serves as the foundational framework of a computer system, much like the foundation of a building upon which bricks are laid. These bricks represent the programs that perform specific tasks within the structured support of the system software. System software ensures computers run smoothly by overseeing hardware functions and serving as a foundation for running additional programs.

Systems software is the program that governs the computer system. Allowing the computer to:

1. control the hardware, including any peripherals
2. allow application software to run
3. provide an interface for the user to interact with the computer
4. maintain the system

In essence, system software acts as an intermediary between the hardware and the end-user applications, enabling the efficient execution of tasks and providing essential services for the computer system to function properly.

Now let's take a look at Examples some of important systems software.

1. Operating Systems (OS)

An Operating System (OS) provides the user interface, manages hardware resources, and manages the running of applications.

In order to perform the actions requested by the computer's users, an operating system must be able to communicate with those users. The portion of an operating system that handles this communication is often called the *user interface.* Older user interfaces, called shells, communicated with users through textual messages using a keyboard and monitor screen.

Nowadays, computer systems usually perform this task by means of a *Graphical User Interface* (GUI—pronounced "GOO–ee"). In GUI systems, applications run in Windows, and all objects (apps, hardware and files) are represented by icons. Application features are accessible through the use of menus. Users interact with the interface by using a mouse and on-screen pointer.

An example of a hardware resource managed by the OS is RAM. When a program is run, it is loaded into RAM. The operating system determines how much memory the program requires and allocates enough space to hold it and its data. When the program is closed, the allocated space is freed up for use by other programs.

Multitasking means being able to run two or more programs simultaneously. An example would be a user streaming music while entering text into a word processor. All modern operating systems have multitasking capabilities. The OS allocates system resources such as CPU time, input/output devices, and computer memory among the programs currently running.

Examples of operating systems include Microsoft Windows, macOS, Linux, Android, and iOS.

Figure 2.40 Some OS examples.

2. Device Drivers

A device driver is a program that controls a specific hardware device attached to a computer. Device drivers control and facilitate communication between hardware devices and the operating system. They relay requests for device access and actions from the operating system and its active applications to their respective hardware

devices. They also deliver outputs or status/messages from the hardware devices to the operating system and thus to applications.

Devices such as keyboards modems, routers, speakers, and printers require device drivers to operate.

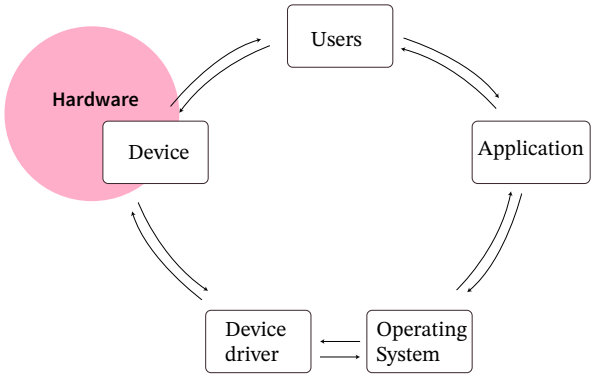


Figure 2.41 A device driver acts as a translator between a hardware device and the applications or operating systems that use it.

3. Utility Software

Utility Software is system software that helps to maintain the proper and smooth functioning of a computer system. These programs assist the operating system to manage, organise, maintain, and optimise the functioning of the computer system.

A file compression program is an example of utility software. Other examples are shown in Figure 2.42.

Figure 2.42 Examples of utility software.

Comparison between utility software and operating systems

a. An **OS is a must-have software to operate a computer, while utility software is optional and can be added as per user convenience.**

b. Utility software assists the operating system but never replaces it.

c. Both are system software, but their functions do not overlap.

Activity 2.13

In pairs, explain the differences between the Android operating system and the WhatsApp application on your mobile phone?

Activity 2.14

Match the following task to their respective software and give 2 examples of software used in each task.

A. playing music
B. word processing
C. protecting computer against viruses and malware.
D. managing the use of the computer's memory.
E. monitors and optimises the performance and health of the hard drive
F. providing a user interface

System software	Application software	Device drivers	Utility

Activity 2.15

Create a presentation explaining how the operating system on your computer or smartphone helps you manage your files and applications?

Activity 2.16

Working with a partner, discuss when was the last time you updated your operating system, and what improvements or changes did you notice? What is the purpose of these updates?

Activity 2.17

Research using the internet to come up with the purpose of an operating system that our mobile phones operate on. Present your findings to the group.

Review Questions 2.1

1. Analyse how the introduction of SSDs has changed the performance of computers compared to HDDs. Consider factors such as speed, durability, and energy consumption.
2. Working in pairs, compare certain pairs of devices/media with related uses such as HDDs vs SDDs, CDs vs DVDs, Keyboards vs Mouse, and present your comparisons in a suitable easy-to-read format.
3. Korkuvi Musah from the Upper East has been using mobiles for games. Her auntie, Maame Esi Appam who lived in East Legon, Accra wants to gift him a computer for excelling well in an inter-school computing competition. With your knowledge of computer hardware, what recommended computer specifications will you give Korkuvi Mensah in terms of performance, display quality, and portability to give to his auntie in purchasing a better computer to aid in his programming and graphics design learning tasks?
4. As a student who uses smartphones, computers or any digital device to chat on WhatsApp, Telegram or any chatting applications. Evaluate your experience of using voice input versus a keyboard for composing a message. Consider factors such as speed, accuracy, ease of use, and any potential challenges.
5. Daboya Community Day SHS in the North Gonja District of Savannah Region replaced traditional computer labs with tablets using touch screens. As a hardware expert, discuss the reasons for this change and the impact on students' learning and interaction in the school.

Answers To Review Questions 2.1

1. The introduction of Solid-State Drives (SSDs) has significantly transformed computer performance compared to traditional Hard Disk Drives (HDDs) in several key areas:

Speed

- Data Transfer Rates:
  - SSDs: Provide much faster read and write speeds. Typical SATA SSDs offer speeds of around 500 MB/s, while NVMe SSDs can reach speeds of up to 14,000 MB/s.
  - HDDs: Traditional spinning HDDs usually have read and write speeds around 100-150 MB/s.
- Boot Times:
  - SSDs: Significantly reduce boot times for operating systems. A computer with an SSD can boot in 10-20 seconds, compared to a minute or more with an HDD.
  - HDDs: Generally, much slower due to mechanical parts and lower data transfer rates.
- Application Loading:
  - SSDs: Applications and files load much quicker, resulting in a more responsive system.
  - HDDs: Slower application load times due to slower data access speeds.

Durability

- Mechanical Reliability:
  - SSDs: Have no moving parts, making them less susceptible to physical shock and wear and tear. This enhances their durability and reliability, especially in mobile devices.
  - HDDs: Contain spinning disks and moving read/write heads, making them prone to mechanical failures and damage from drops or bumps.
- Lifespan:
  - SSDs: Lifespan is generally defined by the number of write cycles (typically measured in TBW - Terabytes Written). Modern SSDs can handle hundreds of terabytes of data writes, making them very durable for regular use.
  - HDDs: Lifespan can be affected by the physical wear of moving parts. However, they can last many years with moderate use.

Energy Consumption

Power Efficiency:

- SSDs: Typically consume less power than HDDs because they don't need to spin disks or move read/write heads. This makes them more energy-efficient, which is particularly beneficial for laptops and portable devices.
- HDDs: Higher power consumption due to the need to power the motor that spins the disks and the actuator that moves the read/write heads.

In summary, SSDs offer substantial improvements in performance, reliability, and energy efficiency, making them the preferred choice for modern computing applications.

2. Comparison of the specified pairs of devices/media presented in a clear and easy-to-read format:

HDDs vs. SSDs

Feature	HDDs	SSDs
Speed	100-150 MB/s	500-14,000 MB/s (SATA vs. NVMe)
Boot Times	Slow (1+ minutes)	Fast (10-20 seconds)
Durability	Prone to mechanical failure due to moving parts	No moving parts, more shock resistant
Lifespan	Long, but can wear out with physical use	Finite write cycles, but generally durable
Energy Consumption	Higher due to spinning disks and moving heads	Lower, more energy-efficient
Cost	Cheaper per GB	More expensive per GB
Use Cases	Bulk storage, archival purposes	System drives, gaming, applications

CDs vs. DVDs

Feature	CDs	DVDs
Storage Capacity	Up to 700 MB	4.7 GB (single-layer), 8.5 GB (dual-layer)
Data Transfer Rate	Up to 1.4 MB/s	Up to 11 MB/s
Video Quality	Suitable for standard definition video	Suitable for standard definition and some high-definition video
Common Uses	Audio, software distribution	Movies, software distribution, data backup

Feature	CDs	DVDs
Physical Size	120 mm diameter	120 mm diameter
Cost	Generally cheaper	Slightly more expensive

Keyboards vs. Mice

Feature	Keyboards	Mice
Primary Function	Text input, shortcuts, commands	Cursor control, clicking, scrolling
Types	Mechanical, membrane, wireless, ergonomic	Optical, laser, wireless, ergonomic
Precision	High for typing and command input	High for pointer precision, gaming
Input Style	Key presses	Movements and clicks
Ergonomics	Can be optimised with layout and design	Can be optimised with design and grip
Use Cases	Writing, programming, shortcuts	Navigation, gaming, graphic design
Dependence	Often used in combination with a mouse	Often used in combination with a keyboard
Cost	Varies widely from budget to high-end	Varies widely from budget to high-end

3. For Korkuvi Mensah's needs in programming and graphics design, the computer should balance performance, display quality, and portability. The following are the recommended specifications:

- **Performance**
  - **Processor (CPU):**

    Recommendation: Intel Core i7 or AMD Ryzen 7 (latest generation)

    Reason: These CPUs offer strong multi-core performance suitable for programming and graphics design tasks.

  - **Memory (RAM):**

    Recommendation: 16GB or 32GB DDR4

    Reason: 16GB is sufficient for most tasks, but 32GB is beneficial for handling large files and multitasking.

  - **Storage:**

    Recommendation: 512GB or 1TB SSD (NVMe preferred)

Reason: SSDs provide fast boot times and quick access to files and applications. NVMe SSDs are faster than SATA SSDs.

- **Graphics Card (GPU)**:

  Recommendation: NVIDIA GeForce RTX 3060 or AMD Radeon RX 6600 (or higher)

  Reason: A dedicated GPU is important for graphics design, rendering, and potentially for using machine learning libraries.

- **Display Quality**
  - **Screen Size:**

    Recommendation: 15.6-inch or 17-inch display

    Reason: Larger screens provide more real estate for design work and coding.

  - **Resolution:**

    Recommendation: Full HD (1920x1080) or 4K (3840x2160)

    Reason: Full HD is the minimum for clarity, while 4K offers superior detail, which is beneficial for graphics design.

  - **Colour Accuracy:**

    Recommendation: IPS panel with at least 100% sRGB coverage

    Reason: IPS panels offer better colour accuracy and viewing angles, essential for design work.

- **Portability**
  - **Weight:**

    Recommendation: 4-5 pounds (1.8-2.3 kg)

    Reason: Balances performance and portability, making it easier to carry without sacrificing too much power.

  - **Battery Life:**

    Recommendation: At least 8-10 hours of battery life

    Reason: Ensures productivity on the go without frequent recharging.

  - **Build Quality:**

    Recommendation: Durable chassis (metal or high-quality plastic) with good thermal management.

    Reason: Ensures the laptop can withstand daily use and maintain performance without overheating.

- **Additional Considerations**
  - **Operating System:**

    Recommendation: Windows 11 or macOS (depending on preference and software compatibility)

Reason: Both operating systems have strong support for programming and graphics design tools.

- **Ports:**

  Recommendation: USB-C, USB-A, DP, HDMI, and SD card reader

  Reason: Ensures compatibility with various peripherals and external displays.

- **Keyboard and Trackpad:**

  Recommendation: Comfortable keyboard with good travel and a responsive trackpad

  Reason: Enhances typing and navigation experience, crucial for long hours of work.

Recommended Models

- **Dell XPS 15:** Known for its performance, excellent display, and build quality.
- **MacBook Pro 16-inch:** Offers great performance, display quality, and is popular among designers.
- **HP Spectre x360 15:** Versatile with strong performance, good display, and 2-in-1 functionality.
- **ASUS ROG Zephyrus G15:** High performance with gaming-grade hardware suitable for intensive graphics tasks.

4.

Voice Input:

- Speed: Generally, faster for short messages.
- Accuracy: Depends on the clarity of speech and background noise; may require corrections.
- Ease of Use: Intuitive and hands-free but requires quiet environments.
- Challenges: Misinterpretation of words, punctuation issues, privacy concerns.

Keyboard:

- Speed: Can be fast for experienced typists, and slower for beginners.
- Accuracy: High accuracy with practice, easier to correct mistakes.
- Ease of Use: Familiar to most users, can be tiring over long periods.
- Challenges: Requires physical interaction, potential for repetitive strain injuries.

5.

Reasons for Change:

- The portability of tablets allows for flexible learning environments.
- Intuitive touch interfaces can engage younger students.

- Reduced maintenance compared to traditional computer setups.

Impact on Learning and Interaction:

- Positive: Increased engagement and interactivity, more collaborative learning opportunities, and access to a wide range of educational apps.
- Negative: Potential for distraction, difficulties in typing long documents, screen time concerns.

Review Questions 2.2

1. Apart from a transmission medium, either wired or wireless, identify two other hardware components that are required to connect a computer to a LAN.
2. Evaluate the benefits of using a SAN over a direct-attached storage for a large enterprise. Consider aspects such as scalability and performance.
3. You have been sent to the headmaster's office. You realise there is a router in his office network. Identify the primary function of the router. How does it differ from the role of a switch?
4. One advantage of RAID systems is fault tolerance.
   a. Explain what this means.
   b. State another advantage of a RAID system.
5. Describe the requirements to set up a network in a small office with four workers. Include as many technical specifications as you can. A drawing showing a possible positioning of the hardware items within the office.

   Guidelines:

   i. Get a manila card, your pencil, ruler, eraser

   ii. Represent the office and the various hardware components using shapes, such as circle, rectangle, triangle, square, etc, and label them.

Answers To Review Questions 2.2

1. *Network Interface Card (NIC):* This hardware component allows the computer to connect to the network. It can be integrated into the motherboard or come as an expansion card that you can install. For wired connections, it's typically an Ethernet card, while for wireless connections, it would be a Wi-Fi adapter.

   Router or Switch: A router connects multiple networks together and directs traffic between them, often providing connectivity to the internet. A switch, on the other hand, connects multiple devices within the same network, allowing them to communicate with each other. Both are essential for managing data traffic and ensuring smooth communication between devices on the network.

2. SAN offers better scalability and performance, allowing for centralised storage management and access by multiple servers, which is more efficient for large enterprises with extensive data storage and access requirements.

3. A router directs data packets between different networks (e.g., a home network and the internet), while a switch connects devices within the same network to enable communication.

4.

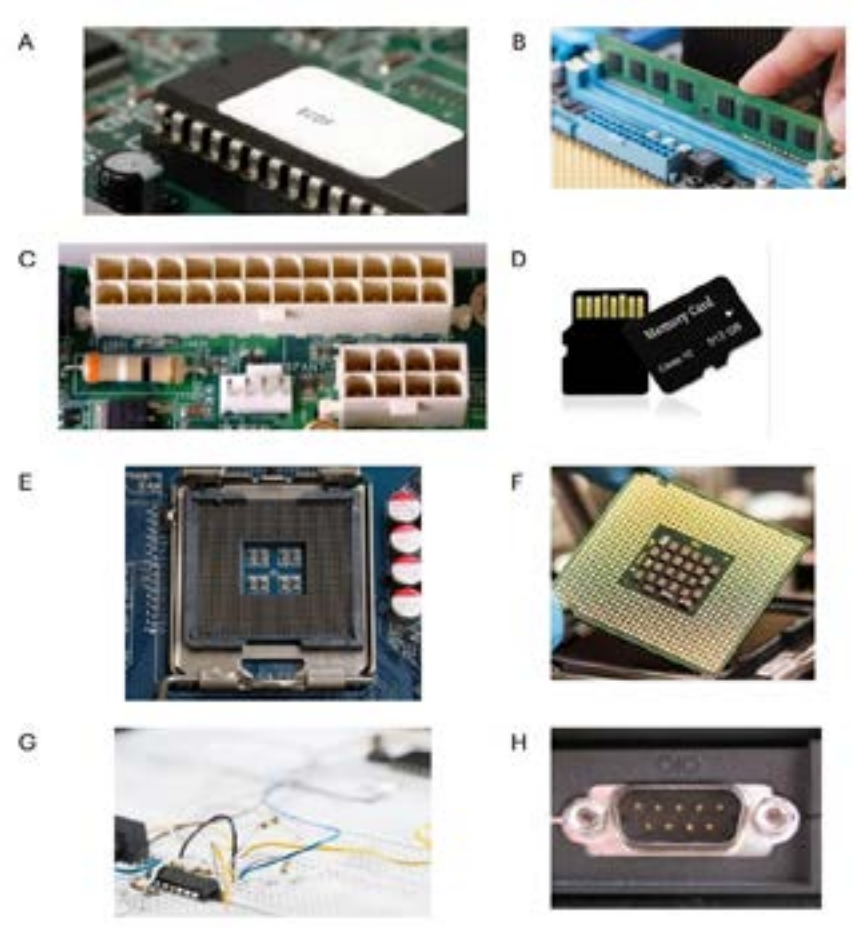
   a. Fault tolerance refers to the capability of a RAID (Redundant Array of Independent Disks) system to continue functioning even when one or more of its disk drives fail. This is achieved through redundancy, where data is duplicated across multiple disks. In case of a drive failure, the system can reconstruct the lost data from the remaining disks, ensuring that the data remains accessible, and the system remains operational without any interruption.

   b. Another advantage of the RAID system is improving performance. RAID systems can enhance data read and write speeds by distributing data across multiple disks. This is particularly true for RAID levels like RAID 0 and RAID 5, where data is striped across disks. With multiple disks working in parallel, data can be read from and written to multiple drives simultaneously, significantly improving the overall performance compared to a single disk setup.

5. A suitable setup would include a NAS for centralised file storage and backup. A router for connecting the network to the internet and providing firewall security, and WAPs to offer wireless access throughout the office. This setup ensures data accessibility, internet connectivity, and flexibility for office layout changes.

Review Questions 2.3

1. Kofi Musah is not convinced that the motherboard is necessary in the computer system. As a friend, how would you convince him to understand why it is necessary to have a motherboard in the computer system?
2. Identify at most five components of the motherboard from the photo gallery and write the names in your exercise books.



3. Explain the function of the CPU socket on a motherboard.
4. Differentiate between RAM slots and expansion slots on a motherboard.
5. Compare and contrast the roles of the chipset and the CPU in a computer system.
6. Discuss how the I/O ports on a motherboard affect the connectivity of a computer system.
7. Evaluate the importance of expansion slots on a motherboard for upgrading a computer system
8. Explain the difference between integrated and dedicated graphics cards and describe which type of applications each is most suitable for.

Answers To Review Questions 2.3

1. The motherboard is necessary because it serves as the main circuit board of a computer, providing the electrical connections by which the other components of the system communicate.
2. A- bios, B- ram slot, C- Power Supply, E- CPU socket, H- I\O port
3. The CPU socket is a specialised slot on the motherboard that houses the computer's central processing unit (CPU). It ensures the CPU is securely attached and connected to the motherboard, facilitating communication between the CPU and other components.
4. **RAM Slots:** RAM slots are specific connectors on a motherboard designed exclusively for installing Random Access Memory (RAM) modules.

   Expansion Slots: Expansion slots, on the other hand, are connectors that allow additional cards or peripherals to be installed into the computer system, to enhance the computer's capabilities.
5. The CPU executes instructions from programs and processes data, acting as the brain of the computer. The chipset, on the other hand, manages data flow between the CPU and other components, including memory, graphics cards, and storage devices. While the CPU performs calculations and processes tasks, the chipset organises the communication and data exchange across the system.
6. I/O ports on a motherboard enable external devices to connect and interact with the computer system.
7. Expansion slots (such as PCI, PCI Express, and AGP slots) allow for the addition of expansion cards (like graphics cards, sound cards, and network cards) to enhance or add functionality to a computer system.
8. **Integrated graphics** are built into the motherboard or CPU and share memory with the computer's processor (CPU). They do not have their own dedicated memory or RAM; instead, they utilise a portion of the system's RAM

   Dedicated graphics cards are separate components that plug into the motherboard via an expansion slot. They have their dedicated RAM (VRAM), GPU, and cooling system, independent of the computer's CPU and main RAM.

In terms of performance, dedicated graphics cards generally offer significantly better performance than integrated graphics due to their dedicated resources.

Additionally, Integrated graphics consume less power than dedicated graphics cards, which can draw considerable power.

Review Questions 2.4

1. Identify two types of software that you use for different purposes in your daily life?
2. How does software, like the apps on your phone or the programs on your computer, help you in your daily activities?
3. Which category of software does an operating system belong to, and how does it control your computer's functions?
4. You are tasked with creating a budget for your department. Which type of software would you most likely use
   - **A.** System software
   - **B.** Utility software
   - **C.** Application software
   - **D.** Firmware
5. If you are using a software program to perform a specific task like writing a report or creating a presentation, what type of software are you using?
   - **A.** System software
   - **B.** Utility software
   - **C.** Application software
   - **D.** Driver software
6. Name four examples of software tools that help you manage and optimize your computer's performance.
7. Explain how device drivers facilitate communication between the operating system and hardware devices. Provide an example to support your explanation.

Answers To Review Questions 2.4

1. Messaging apps (e.g., WhatsApp, Messenger) for communication. Productivity software (e.g., Microsoft Office, Google Docs) for work-related tasks and document creation.
2. Software helps in our daily activities by enabling communication, productivity, and entertainment. For example, messaging apps allow you to stay in touch with friends and family, productivity software like word processors and spreadsheets help with work tasks, and entertainment apps provide music, videos, and games for relaxation.
3. An operating system (OS) belongs to **system software**. It controls your computer's functions by managing hardware resources, providing a user interface, and enabling the execution of application software. It acts as an intermediary between hardware and software applications, ensuring that they work together efficiently.
4. C: Application software
5. C:Application software
6. Antivirus software (e.g., McAfee), Disk cleanup tools (e.g., CCleaner), File compression tools (e.g., WinRAR, 7-Zip), Defragmentation tools (e.g., Windows Disk Defragmenter)
7. Device drivers are specialised software that enable the operating system to communicate with hardware devices. They act as translators between the OS and the hardware, providing the necessary instructions for the hardware to perform its functions. For example, a printer driver translates the data from the OS into a format that the printer can understand, allowing you to print documents. Without the correct driver, the OS would not be able to send the proper commands to the printer, resulting in malfunction or inability to use the printer.

EXTENDED READING

1. Thomas Eli Yaw Miheso who hailed from Denu, in the Volta Region was given a task to perform in computing when he was taught hardware. He is to create a report on assistive technology, describing at least three assistive devices and their benefits. (Examples include a screen reader, a braille keyboard and a head mouse). Kindly help him with this assignment and present the result to your facilitator for feedback.
2. Kindly watch this video: https://www.youtube.com/watch?v=PQaWQoWeU30 for more clarification on computer hardware.
3. Joyce Mawusi Sarkpoh is a computing madam for the Academy of Christ the King SHS, Cape Coast and has tasked her students to draw diagrams and write annotations that explain what their gadget does. The annotations should clearly identify all input, output and storage devices/media included in their design. As a student, of your current school, perform the task given by the madam and present the result to your facilitator.
4. Research on emerging input device technologies (e.g., brain-computer interfaces, gesture recognition). Present a report on how these technologies work, their potential applications, and the challenges they face.
5. Click the links below to read more on NAS Storage and its features https://medium.com/@frankd228801/a-complete-guide-nas-storage-its-features-5b937dc358ed

   https://www.westerndigital.com/solutions/network-attached-storage

   https://stonefly.com/blog/network-attached-storage-appliance-practicality-and-usage/
6. Click on the link below to watch a video on NAS and SAN https://www.youtube.com/watch?v=bliqVybiEV4
7. Click on the link below to watch a video on how to build a NAS server https://www.youtube.com/watch?v=6LqFY5yymKQ
8. Investigate the reasons behind the use of heat sinks and thermal paste on a motherboard, particularly around the CPU and chipset.
9. Imagine you are responsible for building the school team, where each player has their unique powers and abilities. Think of the motherboard as the pitch where your team plays, and each component, like RAM, graphics cards, and other devices, as the players. Now, just like how some players work better together than others, the components of your computer need to be compatible to ensure your computer runs smoothly and efficiently.

   For example, if you put different types of RAM into the computer, it's like having players who don't get along well; they might not work together as effectively, causing your team to slow down or encounter problems. Similarly, adding too many players to a team without considering their compatibility is like overcrowding the team with heroes, which can lead to chaos and reduce the overall efficiency of your team.

Your goal is to analyse the impact of motherboard components' incompatibility and mixed specifications on the performance and functionality of a computer system (team).

10. Motherboard basics https://www.youtube.com/watch?v=34Aunc-QXRI
11. How motherboards are produced https://www.youtube.com/watch?v=bR-DOeAm-PQ
12. https://www.youtube.com/watch?v=QdGW1xE6d_k
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