

Chapter two

Hardware and software

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Learning objective

- Define hardware
- Evaluate internal and external hardware devices
- Explain the purpose of and evaluate storage devices
- Explain the purpose of input and output devices
- Evaluate input, storage and output devices for a given task
- Define software
- Evaluate different types of software
- Explain the purpose of system software
- Evaluate application software
- Evaluate user interfaces
- Describe utility software
- Compare custom-written and off-the-shelf software
- Describe and evaluate a compiler and interpreter

Key Terms



KEY TERMS

Hardware: a physical component of a computer system

Device: a hardware component of a computer system consisting of electronic components

Output device: a device used to communicate data or information from a computer system

Storage device: a device used to store data onto a storage medium

Input device: a device that allows data to be entered into a computer system

Storage medium: the medium on which data is stored

Volatile: data is lost when there is no power

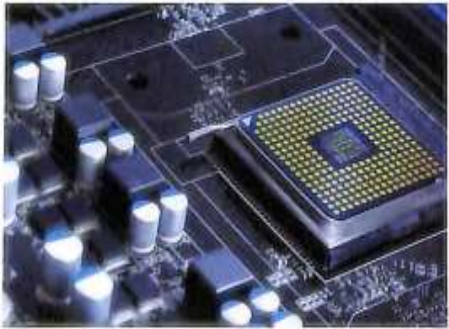
Non-volatile: data remains when there is no power

Hardware Device

- An item of hardware is a physical component that forms part of a computer system. Items of hardware are often known as devices because they comprise electronic components . Hardware devices can be internal to the computer system (such as the central processing unit, memory or motherboard) or they can be external to the computer system (such as the monitor, keyboard or mouse).
- Hardware is categorised into input, output and storage devices. Input devices allow data to be sent to a computer (e.g. keyboard). Output devices allow the communication of data/information from a computer (e.g. monitor). Storage devices store data onto a storage medium so that it can be used at a later time .

Internal Hardware Devices

Central processing unit



Motherboard

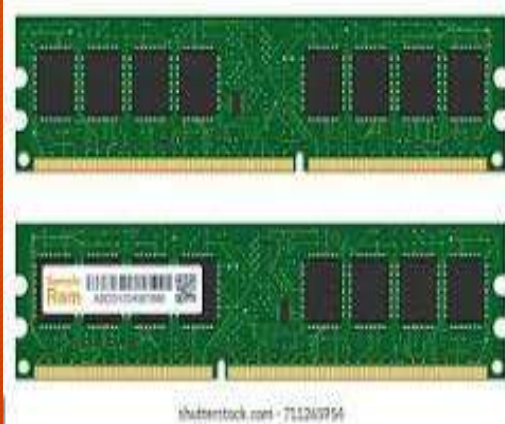


Figure 2.03 - A graphics card.



Figure 2.04 - A hard disk.

CPU

- The central processing unit (CPU) is the brain of a computer. It is the part of the computer that carries out calculations, executes instructions and processes data. It includes the arithmetic logic unit (ALU) and control unit (CU).
- The ALU performs calculations and logical operations. The CU runs the fetch-execute cycle which fetches instructions from memory and executes them. Input data is taken from input devices (such as a keyboard) or storage and processed by the CPU, which produces output data that can be stored or sent to an output device (such as a monitor). CPUs usually consist of multiple cores . Each core is a separate processor, so a quad-core CPU has four processors. Processors are measured by the number of instructions they can process per second (hertz). A 3GHz (gigahertz) processor can process up to 3 billion instructions per second .

RAM (Random Access Memory)

- Random access memory (RAM) is memory that is used to store currently active programs and data. The more RAM that is available to the computer, the more data and programs can be used at the same time.
- This is particularly important in multi tasking environments, when several programs may be open at the same time. When the RAM becomes full, programs or data that are no longer active will be removed to make space for new programs or data. If the RAM becomes full and there are no inactive programs or data to remove, then an area of secondary storage (e.g. hard disc drive (HDD) or solid state drive (SSD)) known as virtual memory is used to expand the amount of memory available to the CPU.

Virtual Memory

- Virtual memory is an operating system technique that creates the illusion of a large, contiguous memory space for applications by combining physical RAM with secondary storage (like a hard drive or SSD). When RAM is full, inactive data is moved (swapped) to the virtual memory on the disk, freeing up RAM for actively used data. This allows the computer to run more applications and larger programs than its physical RAM would otherwise allow, though it slows down performance due to the slower access speed of hard drive or SSD virtual memory compared to RAM.

RAM cont...

- RAM is volatile , which means the content of the memory is lost if there is no power to the RAM. When you are using a computer and experience a power cut, this is why the data you are currently using is lost unless it has recently been saved to secondary storage. Read only memory Read only memory (ROM) is memory that, once it has been written to, can no longer be changed .
- It is permanent and it is non-volatile , which means that when there is no power to the computer, the contents of the ROM will be retained. This is because it is powered by a small long-life battery

ROM (Read Only Memory)

Read only memory (ROM) is memory that, once it has been written to, the contents are difficult to be changed . It is a permanent memory and it is non-volatile, which means that when there is no power to the computer, the contents of the ROM will be still retained.

The ROM contains a small computer program called BIOS (basic input/output system) which a computer's microprocessor uses to start up the computer system after it is powered on.

ROMs are also used to store the firmware for digital devices like mobile phones, game consoles and home appliances like ACs, washing machines, microwave ovens, etc.

Types of ROM

There are four main types of ROM:

- Masked Read Only Memory (MROM),
- Programmable Read Only Memory (PROM),
- Erasable Programmable Read Only Memory (EPROM),
- Electrically Erasable Programmable Read Only Memory (EEPROM).

Types of ROM

- Mask ROM is a read-only memory whose contents are programmed by the integrated circuit manufacturer (rather than by the user). The desired memory contents are furnished by the customer to the device manufacturer.
- PROM full form is programmable read-only memory. It is a type of non-volatile computer memory. This means that once data has been written to PROM, it cannot be erased. PROM is used to store programs or firmware for microcontrollers and other digital devices.

Types of ROM cont..

- EPROM, form of computer memory that does not lose its content when the power supply is cut off and that can be erased and reused. EPROMs are generally employed for programs designed for repeated use but that can be upgraded with a later version of a program.
- EEPROM (electrically erasable programmable read-only memory) is a user-modifiable ROM. It can be erased and reprogrammed (written to) repeatedly by applying an electrical voltage that is higher than normal. However, EEPROM is a type of non-volatile ROM that enables individual bytes of data to be erased and reprogrammed. That is why EEPROM chips are known as byte

Class Activity one

- Let us have four group(1,2,3,4)
- Group 1,2 we tell us two purpose of PROM
- Group 3,4 we tell us two purpose of EPROM

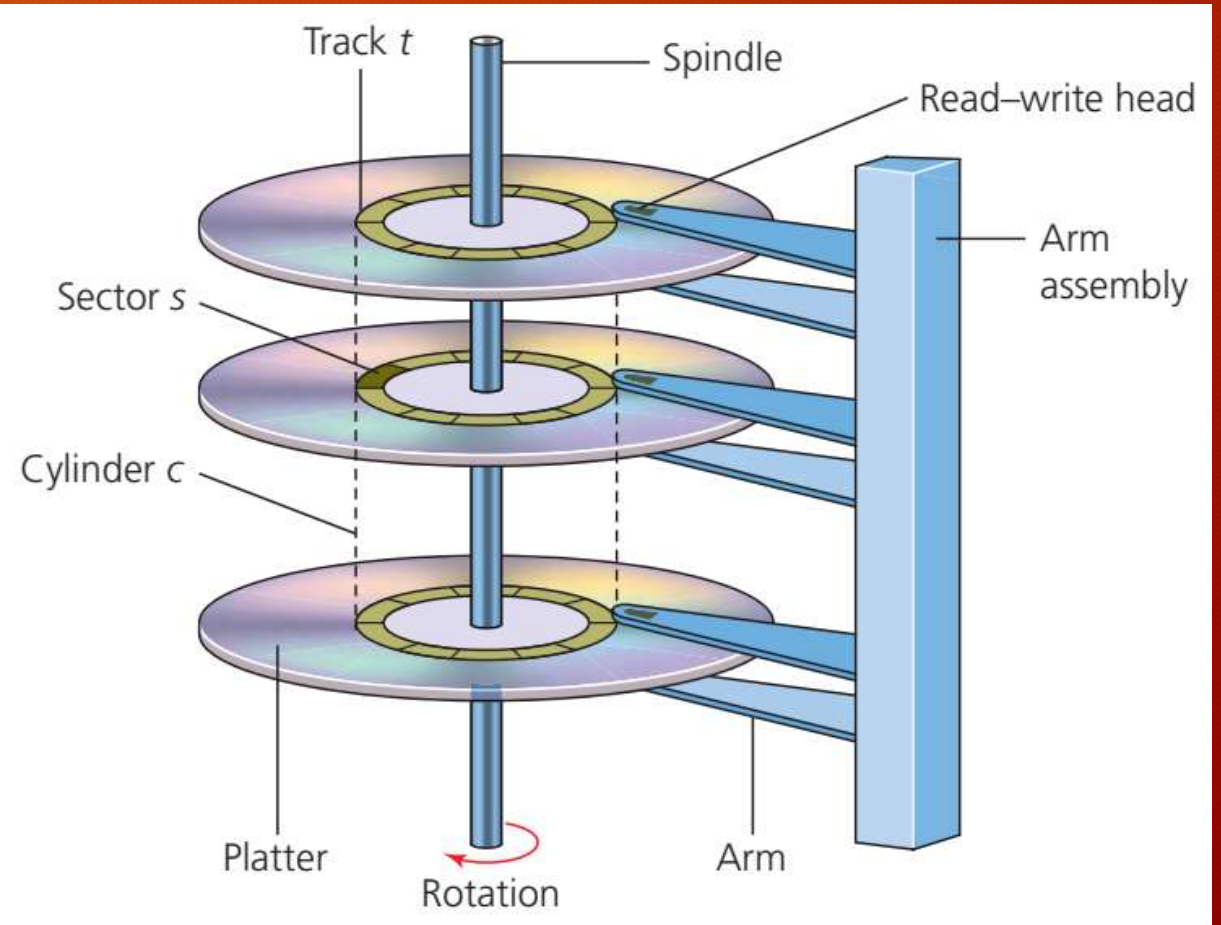
ROM in our mobile phone is what_____ then, state the reason from your own point of view (group 1,2)

BIOS stand form what_____the the type of ROM that host BIOS is what_____ state the reason from your own point of view

Hard disk drive

- A hard disk drive (HDD) is a type of computer secondary storage device that uses spinning magnetic disks called platters to store data.

Hardisk



Hard disk cont...

- A hard disk is made up of disks (platters), the read and writes heads which are held in place by an arm (actuator), and the spindle which holds platters together. The platters are coated with magnetic materials on both sides for data storage. The actuator makes sure that the read and write head moves to the disk location where data need to be read or written to.
- The platters are divided into tracks and sectors which are used to define locations where data is stored . The more tracks and sectors the higher the disk capacity.

SSD(Solid State Drive)

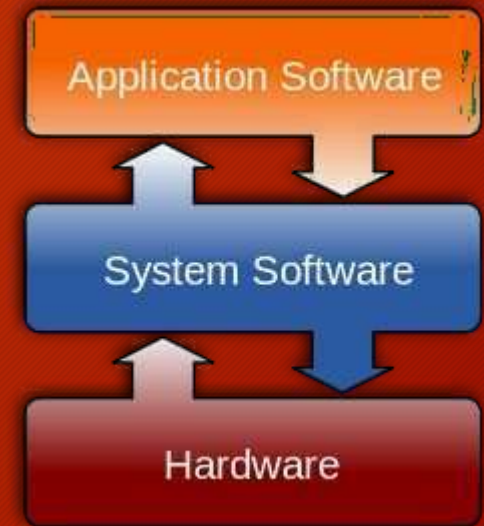
- Solid state drive A solid state drive (SSD) is another secondary storage device that is non-volatile. However, there are no moving parts and the data is stored onto flash memory. It is also not necessary to store data in the same cylinder in order to maximise access speed as the data can be stored anywhere on the flash memory and access speeds will not be affected. SSDs are also non-magnetic and so are not susceptible to damage from close, strong magnetic fields. In 2015, SSDs could store up to 8TB, but due to the newer technology were far more expensive than HDDs and were more common in capacities of 128, 256 or 512 GB.
- SSDs have access speeds of around 400 -600 MBps (two to three times faster than a HDD). This means they are used in higher performance computers. A frequent compromise between speed, capacity and price is to have a smaller SSD to store the operating system and software (for speed of access) and use a larger HDD to store data.
- SSDs also require a lot less power than HDDs and so are preferred in laptop and tablet computers.

APPLICATION SOFTWARE

- An application software is any software designed to perform specific user-defined tasks on a computer system. Examples include: MS Office programs like MS Word, MS Excel, MS PowerPoint, etc as well web browsers, media players, etc.

SYSTEM SOFTWARE

- **System software** refers to the programs that manage and control a computer's hardware and application software. Examples of system software are **compilers, interpreters, linkers, anti-virus software, device drivers, operating systems and utilities (aka utility programs).**



COMPILERS

- A compiler is software (a program) that processes statements written in a high level programming language and converts them into machine language or code that a computer's processor understands and can execute. In other words, it translates a high-level language program called source code into an executable file called object code. The compiled program is then run directly without the need for the compiler to be present.
- When a program is compiled, the whole source code is translated into the executable file at once which can then be distributed to customers and individual computers for installation. The whole program is translated in one go before it is executed.
- As it is in an executable format, it can only run on operating systems for which the compiler has translated it.
- For example, programs that have been compiled for Windows will not work on Linux unless they are compiled again for Linux. The same situation exists with mobile phone and tablet operating systems.

A program written in Python

```
total = 0
count = 0

while count < 10:
    num = int(input("Enter a number: \n"))
    if num >= 1 and num <= 10:
        total = total + num
        count = count + 1
    else:
        print("Invalid number. Re-enter a number.")

print("The total is:" + str(total))
```


COMPILERS

- Most software that runs on computers is in machine code, which is stored in binary form within the computer. Machine code consists of the instructions that computers understand and each instruction is actually a number written in binary. Unfortunately, programmers who write the software for computer users find it difficult to use machine code for programming purposes. So programmers write programs using high level language like Python, Java, JavaScript, C++, etc.

INTERPRETERS

- An interpreter translates the high-level language program one statement, or line, at a time into an intermediate form, which it then executes. It continues translating the program until the first error is met, at which point it stops. This means that errors are located by the programmer, exactly where they occur. Unlike a compiled program, an interpreted program can be transferred between computers with different operating systems because it remains in the form of source code, but it needs to be translated in each computer it is moved to. This takes more time than with a compiler, but it means that the program can be distributed regardless of the processor or operating system (OS) of the computer.

COMPILER AND INTERPRETER DIFFERENCES

| Compiler | Interpreter |
|---|--|
| Translates source code into object code all at once in advance of execution. | Translates source code into Intermediate code one line at a time. |
| Compiled object code will only work on the operating system it has been compiled for. | Source code can be translated into object code for more than one operating system. |
| Object code is ready to be executed without delay. | Object code has to be generated, so additional time is added to the execution time. |
| Compiling can take a long time, which is not appropriate for on-the-fly testing. | Only the required code needs to be interpreted, so this is efficient for on-the-fly testing. |

LINKERS

- A **linker** also known as **link editor** is a system program that combines object files or modules that have been created using a compiler into one single executable file. Most programs are written in modular form. That is to say, a number of programmers, write separate pieces of code, or modules that form the required program when combined, which has the advantage of saving time than if one person wrote the whole code although it is still possible for one person to write all the modules. If there is an error only that module has to be corrected. A linker is used to combine different modules of object code into one single executable code program or software.

OPERATING SYSTEMS (OS)

- An OS is system software that manages computer hardware and software resources as well as the interaction with device drivers. The OS also acts as an interface between an application program and the computer hardware, so that an application program can communicate with the hardware. To sum up, an operating system interacts with application software, device drivers and hardware to manage a computer's resources, such as the processor, RAM, storage space, and peripherals.
- Before an operating system (OS) is loaded the computer has to boot up. Booting up a computer is starting it up by loading the BIOS. BIOS is a small program stored in ROM and is the Basic Input/Output System for the computer which executes during boot-up. It checks whether various devices are present before loading the OS.

FUNCTIONS OF THE OPERATING SYSTEMS

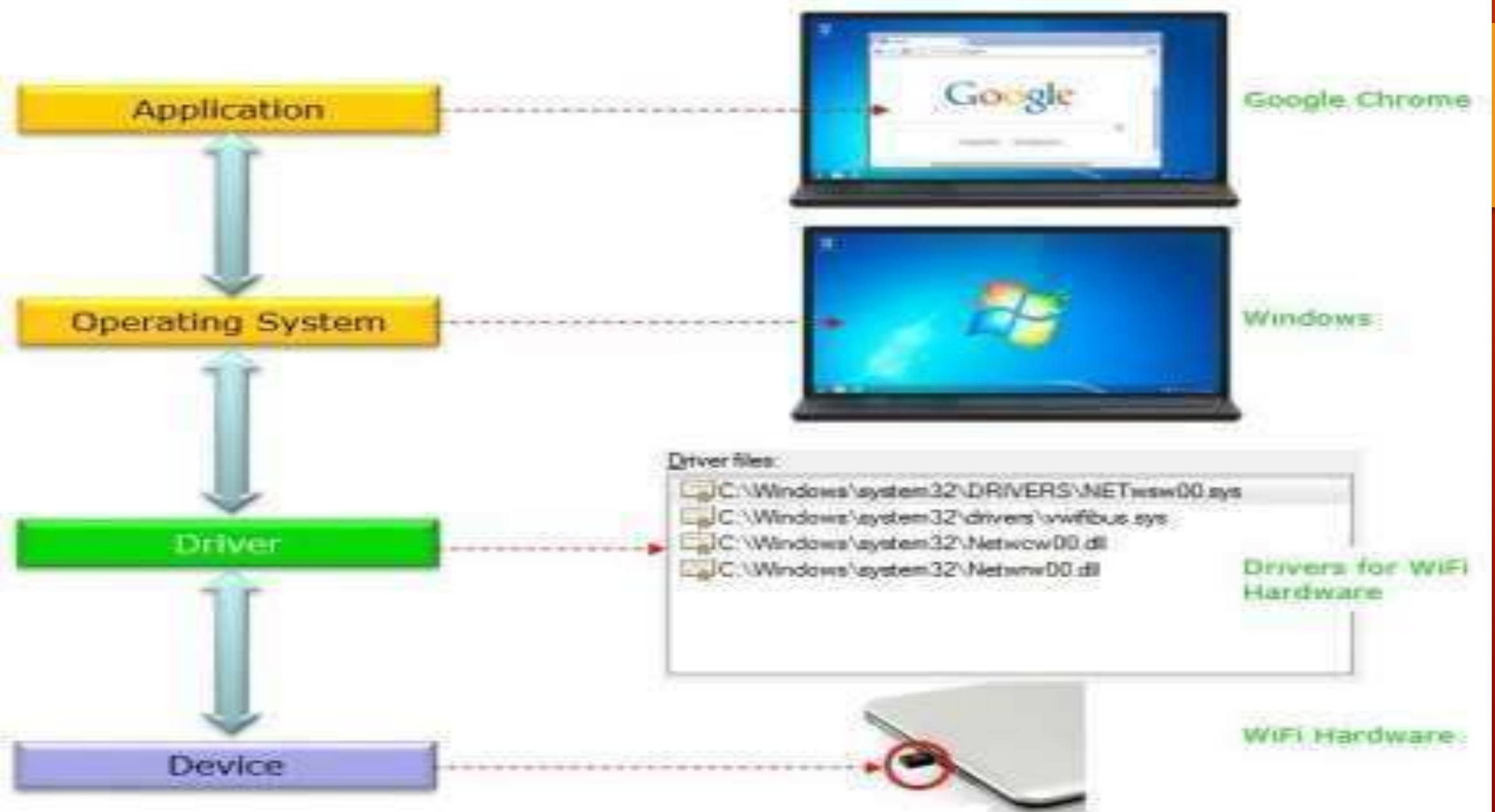
- **Memory management:** One of the major functions of an operating system is to manage the computer's memory. The OS allocates a particular part of RAM for each program, whether it is an application, system software or a utility that is running. It needs to make sure that instructions and data from one program do not spread into another program's memory allocation, otherwise data can get corrupted and the computer could crash.
- **Responding to input devices** such as when a key is pressed on the keyboard. The OS responds to input devices in order to receive and manage data. It does this by communicating with the device driver so that it can receive data from the input device.
- **Sending data and instructions to output devices** such as printer. It also uses device drivers when it sends data or instructions to the printer to print a document.
- **File management:** The OS manages the opening (loading) and closing of files on storage devices such as hard disk drive, SSD, etc. It knows the names of each file and exactly where they are stored on the hard disk. It also keeps a record of any empty spaces on the medium so that it knows where new files can be stored.
- **Processor management:** The OS must allocate processor time to each running task or program fairly, so that all tasks or programs get a reasonable amount of time for processing.
- **User logon and security:** When a user logs in to a system, it is the OS that deals with this. It authenticates the user by comparing the password they entered with the one stored on the system and if it matches it allows log on, otherwise it prevents log on.

TASK

Microsoft Windows is an example of an operating system. Find at least two other operating systems used by desktop computers and at least three operating systems used by mobile phones or tablets.

DEVICE DRIVERS

- A device driver is a small program that enables the operating system (OS) and application software to communicate with a hardware device. It is used to send customized instructions to a specific hardware. One example is a printer driver which acts as an interface between the OS (or any application software that is running) and the printer. The user, through the application, might want to print information. The application tells the printer driver and the printer driver tells the printer. This, in effect, allows the user to have control of the device. Other devices which need drivers are sound cards, monitors, mice, SSDs, network cards, keyboards, disk drives and many other items of hardware.



UTILITY PROGRAMS

- **Utility software** is a type of system software that is needed to help maintain a computer system operations and its devices. A basic set of utility programs is often supplied with the OS, most of which help to manage files and their associated storage devices. However, users can sometimes feel the need to get additional utilities which perhaps the OS does not possess such as a printer driver. Much of the work a computer does revolves around the use of files of data so it is no surprise that it needs a number of programs that deal with file handling. Without utility software, the computer would not function properly. Utility software is required to manage the allocation of computer memory in order to improve the computer's performance and so that users can customise the appearance of their desktop.

TYPES OF UTILITY SOFTWARE

- Types of utility program include:
- Antivirus program
- Backup utility
- Disk defragmenter
- Formatting utility
- Delete utility
- Data compression utility
- etc

ANTIVIRUS PROGRAM

- **Anti-virus software** is a program or set of programs whose function is to detect and remove viruses and other malware on a computer.
- It monitors a computer in a bid to prevent attacks from many types of **malware** (malicious software) such as viruses, **worms**, Trojan horses, spyware, ransomware, etc.
- It also scans a computer and if a malware is detected, the infected file is quarantined or deleted.
- It is important to keep anti-virus software up to date because new viruses and other types of malware appear at frequent intervals and older versions of anti-virus will not detect these.

BACKUP UTILITY

- **Back-up software** is a program that is used to keep copies of files from a computer. The back-up is an exact duplicate of the files. It can be used for restoring the original files, should the original files become corrupted or deleted, accidentally or deliberately. Backup software allows the user to select the time and type of back-up they want and how regularly the back-up is to take place. Data files can be backed up to cloud storage or external storage devices.

DISK DEFRAGMENTER

- When a file of data is stored on a disk, it may consist of several blocks. There may not be enough blank or empty sectors next to each other to store all the blocks together which means they have to be spread out across the disk. The file is now said to be fragmented.
- When data is no longer needed it is deleted from the disk, which leaves some empty sectors. **Defragmentation software** is used to organise the data on the disk by moving the data blocks around to bring all the parts of a file together so they are contiguous. As a result, data retrieval is made easier and quicker. With fragmented files it takes longer for the read-write heads to move over the surfaces to find all the different fragments of files than if the data is held in sequence. In addition, the software provides additional areas of free space and more storage capacity

FILE COPYING UTILITY

- **File copying** is creating a duplicate copy of an existing file. The copy will have exactly the same content as the original.

DELETE UTILITY

- The **delete utility** is a piece of software which deletes files stored on a computer by moving it to the recycle bin or deleting it permanently. When a file is “permanently” deleted, the delete utility deletes the pointers that tell the OS where to find the file. The OS now considers the sectors where the file was stored as free and available for the writing of fresh data. Until new data is written to the space the file occupies, users can still retrieve the data using specialized software.

DATA COMPRESSION UTILITY

- **Data compression** is the modifying of data so that it occupies less storage space on a disk. It can be lossless or lossy. **Lossless compression** is where, after compression, the compressed file does not lose any quality i.e. the quality is the same as the original file before compression. If the file is converted back into its original state, there will be no loss of a single bit (binary digit) of data. When the lossless compression software sees a repeated sequence of bits it replaces the repeated sequences with a special character which indicates what is being repeated and how many times. This type of compression is normally used with spreadsheets, databases and word-processed files, where the loss of just one bit could change the meaning completely. **Lossy compression** permanently deletes data bits that are unnecessary, such as the background in a **frame** of a video which might not change over several frames. Lossy compression is commonly used with images and sound, where the loss of some data bits would have little effect. **JPEG** is an image file format that supports lossy image compression. Formats such as **GIF** and **PNG** use lossless compression.

DATA COMPRESSION UTILITY

- An advantage of data compression is that it means data can be transmitted more quickly over a network or the internet. Another advantage is that it saves storage space on a disk or SSD. Consequently, administrators spend less money and less time on storage. It also allows the streaming of high definition (HD) videos which would ordinarily occupy a great deal of bandwidth and memory.
- There are disadvantages however, such as the fact that data compression software uses a lot of computer memory during the compression process. Another disadvantage is that the process of loading or opening a compressed file takes a lot longer than opening the original. Also, lossy compression causes a slight lowering of the quality of the resulting sound and video files.

FORMATTING UTILITY

- **Disk formatting** is the configuring of a data storage medium such as a hard disk or SSD for initial use. It can be performed on a disk that already has files on it, but all those files would be erased. Disk formatting is usually carried out on a new disk or on an existing disk if a new OS has to be installed.

CUSTOM-WRITTEN SOFTWARE

- Custom Written Software (also called bespoke software or tailor-made software) is software that is specifically designed and built from scratch for a particular organization, business, or individual to meet their unique requirements. Custom software is created to solve very specific problems that generic tools cannot address efficiently. Examples include: Payroll & HR system for a manufacturing company, a school's student management software, Hospital management system for a private clinic, FedEx's package tracking system, Netflix's content recommendation program, a bank's website, etc.
- **Key Characteristics of Custom Written Software**
 1. **Built to exact specifications** - Every feature, workflow, and interface is designed according to the client's needs.
 2. **Full ownership** - The client usually owns the source code.
 3. **Scalable and flexible** - Can be modified easily as the business grows or requirements change.
 4. **Integrates seamlessly** - Works perfectly with existing system's hardware and software, databases, or third-party tools.
 5. **No unnecessary features** - Only includes what the user actually needs (no bloat).

ADVANTAGES OF CUSTOM-WRITTEN SOFTWARE

- **Advantages of Custom Written Software**

1. **Perfect Fit for Needs** Solves your exact problems with no unnecessary features.
2. **Full Ownership & Control** You own the source code; no vendor can lock you out or stop support suddenly.
3. **Easy to Scale & Modify** Add new features (e.g., crypto payments, NHIS integration) without waiting for a vendor's update cycle.
4. **No monthly/annual license fees**; after development cost, you only pay for maintenance.
5. **You can sell it to make money** if needed by another individual or organization.

DISADVANTAGES OF CUSTOM-WRITTEN SOFTWARE

Disadvantages of Custom Written Software

1. **High Initial Cost:** Developing custom software from scratch can be **expensive**, as it involves design, coding, testing, and deployment. You must pay for skilled developers, project management, and long-term maintenance.
2. **Longer Development Time:** Creating custom software takes **weeks or even months** (sometimes years) before it's ready to use. Gathering requirements, testing, and revisions all extend the timeline.
3. **Maintenance and Support Responsibility:** Once built, **you are responsible** for updates, bug fixes, and adapting to new technologies. This often requires a long-term relationship with developers or maintaining an in-house IT team. If the developer leaves the company, future updates may become difficult or costly.
4. The software may contain a lot of bugs or errors as it has not been thoroughly tested like off-the-shelf software.
5. **Risk of Project Failure:** Poor planning, changing requirements, or lack of expertise by the developer can lead to **unfinished or ineffective software**. Example, A hospital system project might fail if requirements aren't clearly understood, leading to wasted resources.

OFF-THE-SHELF SOFTWARE

- **Off-the-shelf software** (also called **commercial software**) is a **ready-made application** designed and developed for a **wide range of users or organizations** with similar needs. It is **pre-designed, mass-produced, and sold commercially**, so users can install and use it immediately without custom development. Examples include: MS Office programs, Adobe Photoshop, Norton antivirus, Zoom meeting, etc.
- **Advantages of Off-the-Shelf Software**
 1. **Off-the-shelf** software is cheaper since the development cost is shared by many users. Only a license or subscription fee is required. Example: Microsoft Office is far cheaper to purchase than building a custom office suite from scratch.
 2. Can be installed and used immediately after purchase. Saves time for organizations that need a quick solution.
 3. **Regular Updates and Support** Software vendors provide frequent updates, bug fixes, and technical support to all customers unlike custom written software.
 4. **Tested and Reliable:** Used by millions of users, meaning most **bugs are already identified and fixed**. Proven stability and performance.
 5. **Wide Compatibility:** Designed to work on common operating systems and with popular tools and file formats. Example: Microsoft Office integrates easily with many third-party apps and cloud services.

DISADVANTAGES OF OFF-THE-SHELF SOFTWARE

1. **Limited Customization:** May not fit **perfectly** with a company's unique processes or needs.
Example: A school might find that a ready-made attendance system doesn't support its grading format.
2. **Ongoing Costs:** Many products use **subscription models**, so users must **keep paying** monthly or yearly fees.
3. **Unnecessary Features:** Often includes features you **don't need**, which can make the interface complex or confusing.
4. **Compatibility or Integration Issues:** Might not integrate easily with existing hardware or software already in use.

USER INTERFACES

- A **user interface** is the means by which the computer system interacts with the user. It enables the user, with the help of input devices, to communicate with the computer and then, via the OS, communicate with a piece of software or any output device. A good user interface is one which allows the user to perform this communication without encountering any problems; it needs to be user-friendly. It should also be intuitive; users should be able to predict what will happen if they take a certain action, for example if a button on a user interface looks like a button in real life (such as the on/off button on a computer), a user should be able to press it and get a response. The four major user interfaces available are the **command line interface (CLI)**, **graphical user interface (GUI)**, **dialogue interface** and **gesture-based interface**.

COMMAND LINE INTERFACE

- The command line interface (CLI) is a means of interacting with a computer using commands in the form of successive lines of text. The computer system will respond by producing results in a text format.
- Normally, a prompt appears on the screen to which the user responds by typing a command. The output from the computer could be to produce a list or take some other action. In the early days of computing, the CLI was the only way a user could get the computer to run software or carry out tasks. This type of user interface is rarely used today except by software developers, system administrators and more advanced users. Most individuals use a graphical user interface (GUI) when communicating with their computers. However, even within a GUI it is still possible to access a CLI.

ADVANTAGES/DISADVANTAGES OF COMMAND LINE INTERFACE (CLI)

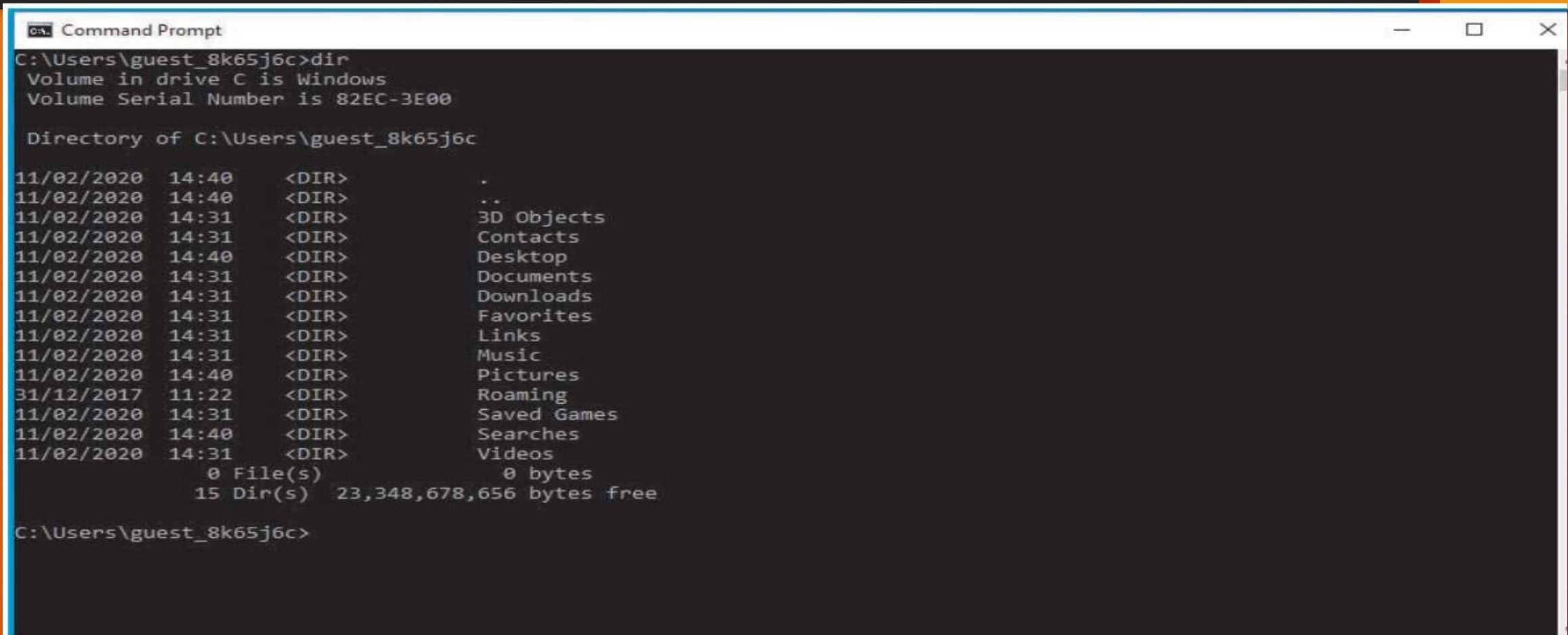
Advantages of CLI

1. **Fast and Efficient for Expert Users:** Once commands are learned, tasks can be performed **much faster** than using menus or buttons.
2. Ideal for repetitive or complex operations. **Example:** Deleting hundreds of files with one command instead of manually selecting each one.
3. CLI uses very little memory and processing power, since it doesn't rely on graphics or animations. Works well on older or low-powered computers.
4. Provides direct access to the operating system and software. Users can perform advanced configurations not possible in GUIs.

Disadvantages of CLI

1. **Hard to Learn:** Requires **memorizing complex commands** and syntax.
 2. Not beginner-friendly; errors can occur easily if commands are mistyped.
 3. **No Visual Guidance:** There are **no icons, menus, or prompts** to help users navigate. Users must know exactly what to type.
- **High Risk of Mistakes:** A **small typing error** can lead to unwanted actions, such as deleting important files.

COMMAND LINE INTERFACE



```
Command Prompt
C:\Users\guest_8k65j6c>dir
Volume in drive C is Windows
Volume Serial Number is 82EC-3E00

Directory of C:\Users\guest_8k65j6c

11/02/2020  14:40    <DIR>          .
11/02/2020  14:40    <DIR>          ..
11/02/2020  14:31    <DIR>          3D Objects
11/02/2020  14:31    <DIR>          Contacts
11/02/2020  14:40    <DIR>          Desktop
11/02/2020  14:31    <DIR>          Documents
11/02/2020  14:31    <DIR>          Downloads
11/02/2020  14:31    <DIR>          Favorites
11/02/2020  14:31    <DIR>          Links
11/02/2020  14:31    <DIR>          Music
11/02/2020  14:40    <DIR>          Pictures
31/12/2017  11:22    <DIR>          Roaming
11/02/2020  14:31    <DIR>          Saved Games
11/02/2020  14:40    <DIR>          Searches
11/02/2020  14:31    <DIR>          Videos
               0 File(s)                0 bytes
              15 Dir(s) 23,348,678,656 bytes free

C:\Users\guest_8k65j6c>
```

▲ Figure 2.4 A command line interface screen

GRAPHICAL USER INTERFACE

- A **Graphical User Interface (GUI)** allows users to **interact with a computer** using **visual elements** such as windows, icons, buttons, and menus, instead of typing text-based commands.
- Instead of typing in commands like in CLI, the GUI uses windows, icons, menus and pointers, collectively known as a 'WIMP' interface, to carry out commands, such as opening, deleting, and moving files. Other types of GUI use different input devices such as a touchscreen.

ADVANTAGES/DISADVANTAGES OF GRAPHICAL USER INTERFACE

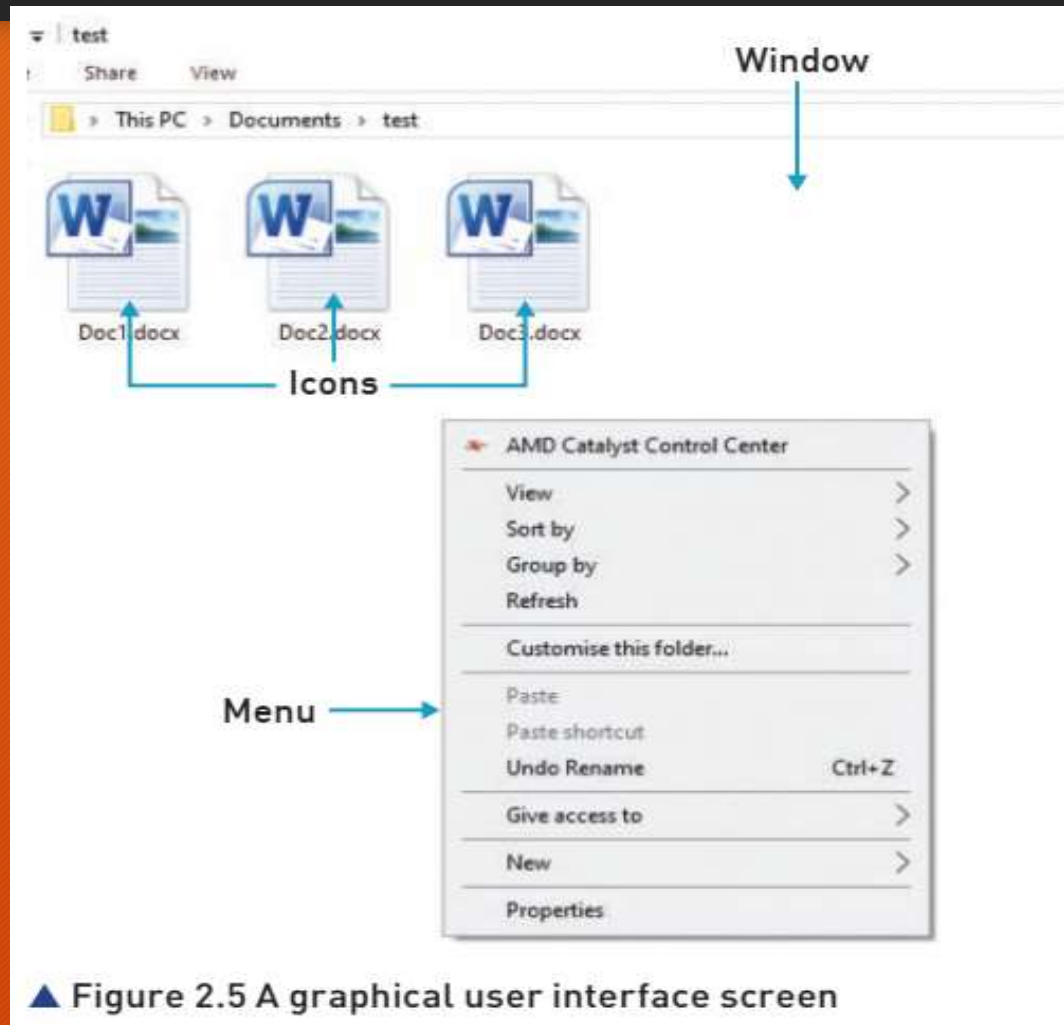
Advantages of GUI

1. **Easy to Use (User-Friendly):** GUIs are intuitive and simple to learn, even for beginners.
2. Users can perform tasks through visual actions like clicking or dragging instead of memorizing commands.
3. **Multitasking Support** Users can open and use multiple windows or applications at once. Example: Editing a document while browsing the web and checking email.
4. GUIs reduce typing errors by replacing text commands with clickable options or prompts.
5. Modern GUIs often include tools like **screen readers**, **magnifiers**, and **voice control** for users with disabilities.

Disadvantages of GUI

1. GUIs use **more memory (RAM)**, **storage**, and **processing power** than text-based interfaces.
2. Advanced users may find GUIs **slower** because they must navigate through menus instead of typing quick commands.
3. GUIs often **restrict access** to deep system functions or advanced options available in command-line interfaces.
4. Designing and developing a GUI is **more complex and expensive** than creating a simple text-based interface.

GRAPHICAL USER INTERFACE



DIALOGUE INTERFACE

- A Dialogue Interface (also called a Conversational Interface) allows a user to communicate with a computer system through spoken or typed natural language — like having a conversation. It's based on dialogue between the user and the system.
- The computer is able to use speech-recognition software to convert the spoken word into commands it can understand. Many cars have such a system whereby the driver is able to control their phone or radio without touching them. For example the driver is able to initiate a phone call by saying 'phone Graham' or switch a particular radio channel on by saying the name of the channel. Laptops and PCs often come with voice control these days.
- Examples of Dialogue Interfaces are Voice assistants like Siri, Alexa, Google Assistant, Cortana,
- The user is able to load and run software packages and files by speaking into a microphone and saying the commands. The computer or device responds with spoken words after the required text has been converted into speech.
- It requires the device to learn the way the speaker talks by asking the user to repeat certain sentences until it has 'learnt' the way they speak. It can, however, become quite capable of understanding simple commands.

ADVANTAGES/DISADVANTAGES OF DIALOGUE INTERFACE

Advantages of a Dialogue Interface

1. Users can interact in everyday language, either by speaking. No need to learn complex commands or menus.
2. **Hands-Free Operation:** Voice-based dialogue systems allow users to operate **without touching** the device. Useful while driving or multitasking. Example: Saying “Call Mom” to your phone while driving.
3. Helpful for users with **visual or physical impairments**, since they can use speech instead of text or mouse input.
4. **Faster for Simple Tasks:** Quick to perform small actions like setting alarms, playing music, or checking schedules.
5. **Hands-Free Operation:** Useful when hands are occupied or when touch-based input isn’t practical e.g. a surgeon during surgical operations.

Disadvantages of a Dialogue Interface

1. **imited Understanding:** Systems may **misinterpret accents, slang, or background noise**, leading to errors. Example: A voice assistant might misunderstand “set an alarm for two” as “send an alarm for you.”
2. **Not Suitable for Complex Tasks:** Difficult to use for tasks requiring **precision, multiple options, or large amounts of data**. Example: You wouldn’t want to write a detailed report using voice commands.
3. **Privacy and Security Issues:** Conversations may be **recorded or stored**, raising concerns about **data privacy**.
4. **Requires Internet Connection and Good Hardware:** Many dialogue systems depend on **cloud processing and microphones**. Poor internet or bad microphone quality affects performance.

GESTURE BASED INTERFACE

- A **Gesture-Based Interface** allows users to **interact with a computer or device using physical movements or gestures**, such as hand motions, facial expressions, or body movement instead of using a keyboard, mouse, or voice commands. These gestures are detected using **sensors, cameras, or touch-sensitive surfaces**.
- An example of where this type of interface is used is in 'smart' homes where a gesture can turn on the lights, for example.
- A camera in conjunction with an infrared sensor detects the movements being made in front of it. The computer, using a special type of software, searches through all the gestures it has stored in a database to match it with the input. Each stored gesture is linked to a specific command which is then executed after the gesture has been matched.
- Examples are: Smartphones/Tablets (Pinch to zoom, swipe to scroll), Smart TVs (Change channels or volume by waving hands), etc.

ADVANTAGES/DISADVANTAGES OF GESTURE BASED INTERFACE

Advantages of Gesture-Based Interface

1. Users can control devices through **simple, natural body movements** that feel more human and direct. **Example:** Swiping left or right to flip through photos feels intuitive and easy to learn.
2. **Hands-Free Operation:** Useful when **hands are occupied** or when touch-based input isn't practical. **Example:** Surgeons can browse medical images during operations without touching equipment.
3. Helpful for users with certain disabilities who cannot use traditional input devices like keyboards or mice.
4. **Faster for Simple Actions:** Some gestures (like swiping or pinching) can perform actions **more quickly** than navigating through menus.

Disadvantages of Gesture-Based Interface

1. **Limited Precision:** Gestures may lack **accuracy** for detailed tasks like text editing or design work. **Example:** Drawing or selecting small items can be difficult using gestures.
2. Needs **cameras, sensors, or motion detectors**, which can be **expensive** to install and maintain.
3. Continuous use of hand or arm gestures can lead to **user fatigue**,
4. **Lighting, background movement, or camera placement** can affect gesture recognition accuracy.
5. Users must learn **which gestures perform which actions**, especially if they are not standardized across devices.

ACTIVITY

- 1 Write down **two** advantages of using a GUI rather than a CLI.
- 2 Write down **two** disadvantages of using a gesture-based interface rather than a dialogue interface.