Edexcel

IGCSE - ICT

CODE: (4IT1)

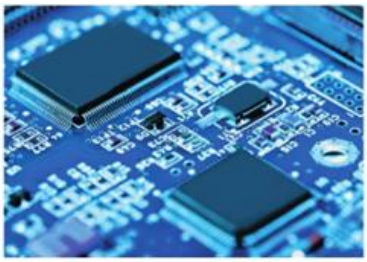
Unit 01

Digital devices

Types of digital devices

There are many types of digital devices. They range from very powerful **mainframe computers**, used by large organisations for complex processing tasks such as statistical analysis and bulk data processing, to **microprocessors** used to control washing machines, televisions and other household appliances.

▲ Figure 1.1 A mainframe computer



▲ Figure 1.2 A microprocessor

Personal computers

DESKTOPS

Desktops have more space for components than laptops and often provide users with the option to **upgrade** them or add additional components. A desktop computer usually needs to have **peripheral devices** connected to it, such as a monitor, a printer, a mouse and a keyboard.

SUBJECT VOCABULARY

mainframe computer a large, powerful computer that can do a lot of complicated jobs quickly and can be used by a lot of people at the same time

microprocessor the device that controls what a computer does; it takes data as input, does something with it and provides output

SUBJECT VOCABULARY

upgrade to make a computer better and able to do more things

peripheral device equipment that is connected to a computer and used with it

▲ Figure 1.3 A desktop computer

▲ Figure 1.4 An all-in-one computer

Laptops

Laptops include a keyboard, a screen, a track pad and a rechargeable battery. Having these features means that they can be taken away from the desk, which makes them an example of a portable device.

▲ **Figure 1.5** A laptop computer

SINGLE-BOARD COMPUTERS

Single-board computers (SBCs) are affordable computers used in education, **embedded computing** projects and **physical computing** projects. The Raspberry Pi Zero (see Figure 1.6) is an example of an SBC.

SUBJECT VOCABULARY

embedded computing computing hardware that is fixed into position and carries out a specialist task
physical computing interactive systems that can sense and respond to the world around them

▲ **Figure 1.6** The Raspberry Pi Zero (top) and its microSD card (top left)

Mobile phones

SPECIALIST PHONES

Some mobile phones have specialist features to provide **users** with functions that meet user needs.

SUBJECT VOCABULARY

user the person who uses a computer system

▲ **Figure 1.7** The SIM card from a mobile phone

▲ **Figure 1.8** The Alto 2 'talking phone' reads the names of contacts and text messages aloud to its user

▲ **Figure 1.9** Some mobile phones use tactile keypads, which are more responsive than other keypads, and give the user a choice of on-screen text size and colours

SUBJECT VOCABULARY

Wi-Fi (wireless fidelity) a way of connecting computers or other electronic machines to a network or the internet by using radio signals rather than wires
games console an electronic device that is used for playing computerised video games on a screen
application a program that allows a user to perform a task; applications are often called apps
virtual keyboard a keyboard displayed on and used via a touch screen

SMARTPHONES

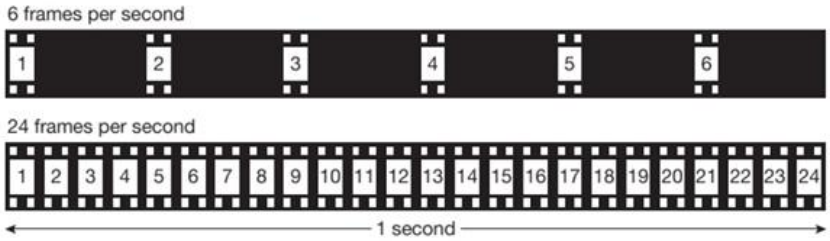
Smartphones are small computers with **Wi-Fi** and mobile phone connectivity to allow them to make phone calls and access the internet. They also include features of other devices such as cameras, media players and hand-held **games consoles**. **Applications** (or apps) can be downloaded onto the smartphone, which allow users to customise their smartphones with entertainment, educational and business features. Most smartphones use a touch screen to allow users to input information. A **virtual keyboard** is used to enter text, numbers and other characters.

▲ **Figure 1.11** A tablet device

TABLETS

Tablet devices or tablets are bigger than smartphones but have similar features.

CAMERAS AND CAMCORDES



▲ **Figure 1.12** High frame rates produce smooth results, whereas low frame rates can produce results that appear to stutter or jump

SUBJECT VOCABULARY

pixel a small dot that helps to make up an image

The quality of the image captured by the camera depends on the quality of the lens, the image processor and the resolution of the sensor.

■ A good lens allows light to travel through it without introducing any defects.

■ A good image processor can compensate for poor lighting conditions.

■ Digital images are made up of small dots called pixels. Better-quality sensors can capture more detail and produce images with a greater number of **pixels**.

▲ **Figure 1.13** The area of the image with the leaf becomes **pixelated** when enlarged

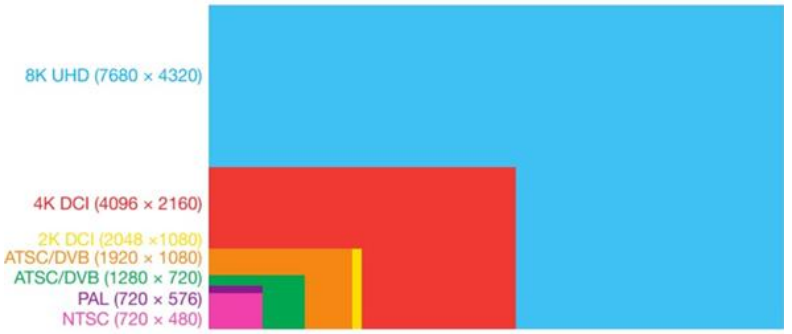
▼ **Table 1.1** Maximum display size at different **resolutions**

Resolution (number of pixels)	Maximum display size of image (in pixels, width × height) before pixelation occurs
1.3 megapixel (1.3 million pixels)	1280 × 960
2 megapixel	1600 × 1200
3 megapixel	2048 × 1536
4 megapixel	2272 × 1704
8 megapixel and above	2560 × 1920

Home entertainment systems

Television

Televisions display images with a resolution, which is the number of pixels used to display the image. High definition (HD) screens have a higher resolution than standard definition televisions, often stated as horizontal pixels x vertical pixels. Ultra-High Definition (UHD) screens, also known as 4K or 8K, have a horizontal resolution of approximately 4,000 or 8,000 pixels, making each pixel difficult to distinguish.



▲ **Figure 1.14** Comparison chart showing different screen resolutions

Smart televisions use apps and can download and stream content from the internet.

SUBJECT VOCABULARY

stream play a file on your computer while it is being downloaded from the internet, rather than saving it as a file and then playing it
smart the ability of a device to use data from sensors to perform a programmed action independently; smart devices are often also able to connect to the internet

SOUND SYSTEMS

Sound systems can play music from CDs or from local storage. They can usually be connected to personal devices like smartphones, **media players** and tablet devices using wired connections like **USB** or wireless connections like **Bluetooth**.

PERSONAL VIDEO RECORDERS

Some devices fall into multiple categories. For example, some satellite television devices contain both a **set-top box (STB**) and a PVR.

BLU-RAY AND DVD PLAYERS

Blu-ray and DVD players connect to televisions to play films and other content that is stored on DVD or Blu-ray disks. Blu-ray players will usually play DVD disks, but DVD players will not play Blu-ray disks.

▲ **Figure 1.15** A Blu-ray player

SUBJECT VOCABULARY

media player an electronic device that can store and play digital music and videos and show digital photographs
USB (Universal Serial Bus) a standard for wired connectivity that can also supply electric power
Bluetooth wireless connectivity that allows devices to connect over short distances
set-top box (STB) a device that sends video and audio received from a broadcaster to a television

Game consoles

Handheld versions of games consoles provide mobile gaming. Handheld consoles have a built-in screen and less storage than a full-size console. This means that the games that can be played on these devices often have reduced image and sound quality, reduced game complexity and limited storylines in order to reduce the amount of **data** that needs to be stored.

▲ **Figure 1.16** How many games consoles have you tried?

SUBJECT VOCABULARY

data values that represent information

Media players

Media players provide video and audio content to a television. This content could be streamed directly from the internet or accessed from networked or local storage. Media players can be connected to a television directly or using a wired or wireless network. They are controlled using a remote control or, in some cases, a smartphone app. Some media players offer output in 4K.

▲ **Figure 1.19** Have you used any other examples of media players?

▲ **Figure 1.20** Personal media players are portable so they need to function while on the move

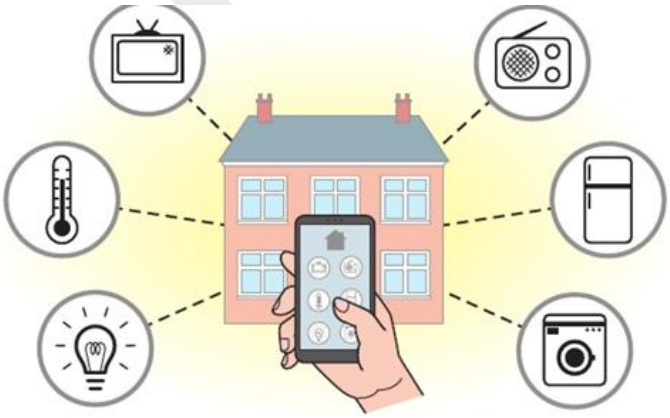
Navigation aids

GPS is a crucial component in navigation aids, such as Sat-Nav, which calculate the best route and provide updates if not followed accurately. These devices, used in cars, delivery vans, and ships, use GPS satellites to determine the device's location and orientation sensors. They display the user's position and orientation on a map, either stored permanently or downloaded from the internet.

SUBJECT VOCABULARY

GPS the Global Positioning System that uses radio signals from satellites to show your exact position on the Earth on a special piece of equipment

Home automation devices and smart assistants



▲ **Figure 1.21** Home automation devices can connect digital devices to control functions in the home

Multifunctional devices and convergence

A smartphone is a type of mobile phone, which means that its primary function is to make phone calls. It can also be used to take photographs or to function as a navigation aid, fitness tracker, music player or handheld games console. Because a smartphone can perform such a range of different functions, it is classed as a **multifunctional device**.

SUBJECT VOCABULARY

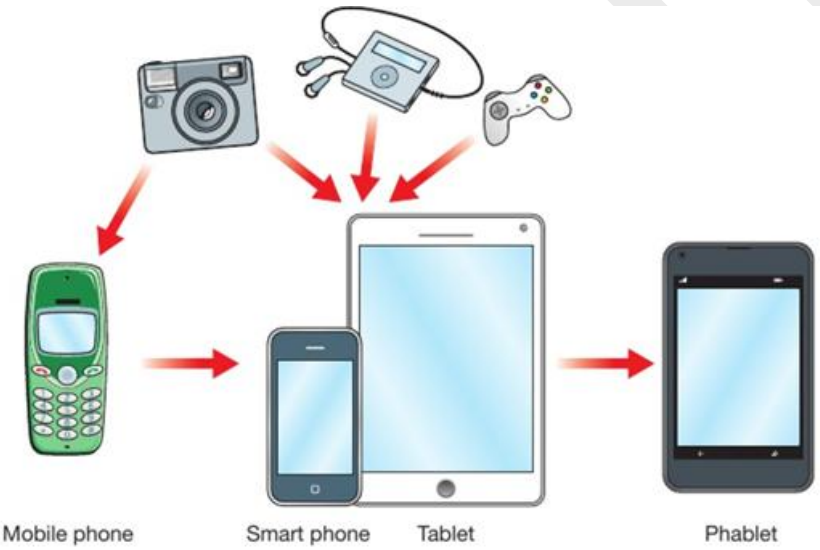
multifunctional device a device that can perform a range of different functions

As they develop, devices like smartphones often adopt technologies and features from other types of device. This is called **convergence**.

▲ **Figure 1.22** Some laptops now have touch screens that can flip 360 degrees, allowing them to operate as tablet devices

SUBJECT VOCABULARY

convergence when the designs of devices change so that they become similar to one another



▲ **Figure 1.24** As devices develop, their features often converge

▲ **Figure 1.23** Some tablet devices come with attachable keyboards, allowing them to operate as laptop computers

Features of digital devices

The digital devices that you use have a number of features, such as portability, performance and **connectivity**. Different devices will have different features.

Potability

For a device to be portable, it needs to be easy to carry and move around. This means that the portability of a device is directly related to its size and weight.

performance

A high-performance device performs its job or tasks quickly. The speed at which a device performs is determined by the speed at which it can carry out instructions from its software. Software instructions are carried out by the processor, which means that a faster **processor** will increase performance.

Instructions are loaded into the processor from **RAM**, which means that faster RAM will also allow instructions to be loaded into the processor more quickly.

When the space in RAM runs out, storage is used as an overflow, and this is known as **virtual memory**. This means that fast storage means faster access to instructions in virtual memory.

Storage

Files and **programs** are stored in storage. More available storage allows users to store more files and programs. Storage speed also affects performance, as you saw in the previous section.

SUBJECT VOCABULARY

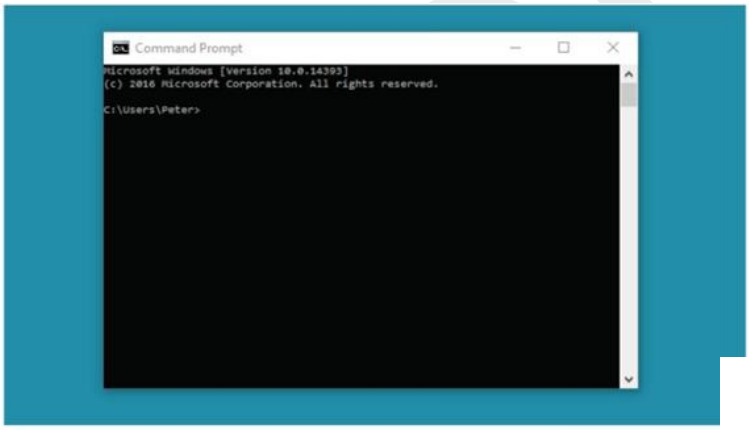
processor one or more Central Processing Units (CPUs) that carry out software instructions
RAM Random Access Memory, which is the memory in a computer system that is used for running software
virtual memory storage used by the processor once the space in RAM has run out

Users interface

Users give commands to a device through the user interface. There are several different types of user interface.

COMMAND LINE INTERFACE (CLI)

When using a command line interface, users enter text instructions, and the computer system provides results or feedback as text.



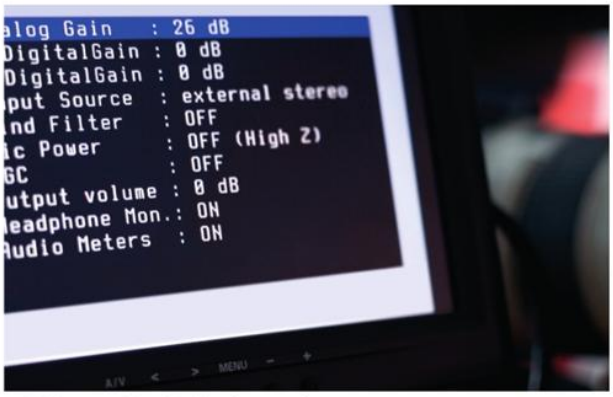
▲ Figure 1.25 A command line interface

SUBJECT VOCABULARY

file a collection of data that represents a document, image, database or similar
program a set of instructions that are carried out by the processor

Menu-driven interfaces

Menu-driven interfaces are easier to use than command line interfaces but can take more time as you must go through the menu structure each time you want to carry out a command, rather than typing the command directly into the system.



▲ Figure 1.26 A menu-driven interface for a monitor

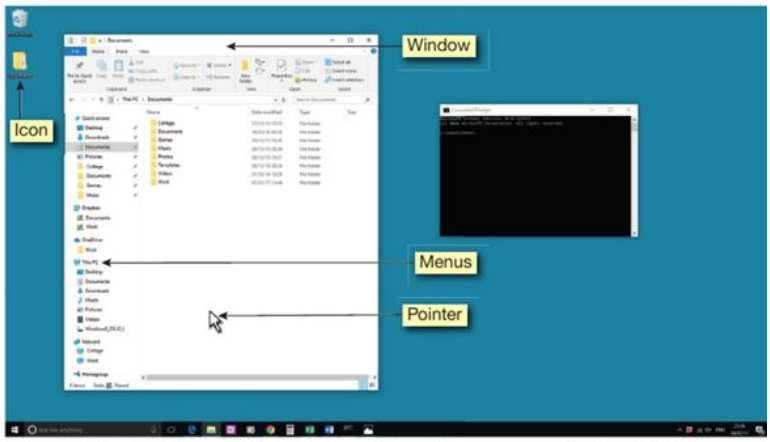
GRAPHICAL USER INTERFACE (GUI)

A graphical user interface is controlled by a pointer on the screen and uses a screen made up of windows, icons and menus.

■ Windows are areas of the screen that are dedicated to applications or operating system tasks.

■Icons are small images that represent an application. They can be selected with the pointer to open the application.

■Menus provide options for tasks relating to the operating system or open application.

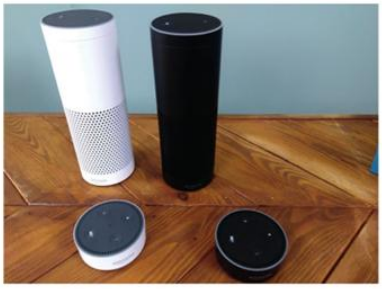


▲ **Figure 1.27** A graphical user interface uses windows, icons, menus and pointers (WIMP)

Voice interface

A voice interface allows the user to give spoken commands to a device. The device has voice recognition software which matches the spoken words against a library of words to find a match. To save storage on the device, the library of words is often stored online, so these devices usually require internet access.

▲ **Figure 1.28** Voice interfaces compare the spoken commands to a library of matched words



▲ **Figure 1.29** Some voice interface devices can control home entertainment systems, appliances and systems such as lighting and heating

GESTURE INTERFACE

This type of interface allows the user to control the device by swiping their finger or fingers across the screen, or by pinching their fingers together to zoom in or out. This type of interface is commonly found on devices with touch screens.

Connectivity

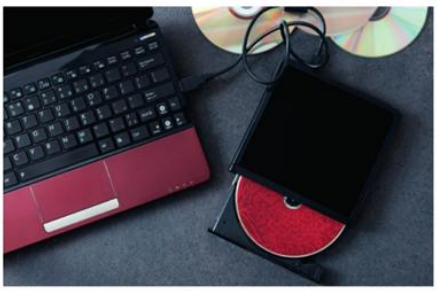
Devices can share data by connecting to each other using wired or wireless connectivity. Connectivity can be used to update software, **back up** files or play media from one device on another. Different connectivity types provide different speeds of data transfer and levels of convenience.

SUBJECT VOCABULARY

back up to make a copy of information stored on a computer in case the original is lost or damaged

Media support

Different devices can read data from and write data to different types of **media**. Examples of media include SD and microSD flash memory cards, and DVD.



▲ **Figure 1.30** Some laptops are too thin to incorporate an optical disk drive, so an adapter is required to connect an external drive

Energy consumption

Digital devices require electricity to work. One benefit of lower energy consumption in mobile devices is a longer battery life. Due to the rising cost of energy and pressure from customers and governments to be more environmentally responsible, manufacturers are creating digital devices that consume less energy.

SUBJECT VOCABULARY

media items such as memory cards and CD-ROMs that make information available to people and devices

Expansion capability

Some PCs allow users to install additional components. Some smartphones and tablet devices have expansion slots to allow them to make use of flash memory cards. Systems can also be expanded using ports such as USB ports. These allow the user to connect extra devices called peripheral devices

Security features

The data stored on digital devices may be private, valuable or both. This means that devices need to have security features to keep their users' data safe.

SOFTWARE SECURITY

To prevent unauthorised access to data, digital devices have a range of software security features to ensure that the person trying to use the device is allowed to do so.

SUBJECT VOCABULARY

lock to make a device inactive so that it requires a password or PIN to reactivate it
wipe to delete data from a device or drive

The operating systems of many devices can be set so that, when the device is turned on, the user must enter a password or personal identification number (PIN) before the device can be used. Another common security setting **locks** the device's screen or keyboard if it has not been used for a specified period, after which the password or PIN will be required to unlock it again. Such systems may even **wipe** the data after only a few failed attempts. This prevents criminals from freely guessing thousands of combinations to break into the device or system.

▲ **Figure 1.31** A smartphone's lock screen

▲ **Figure 1.32** Entry screen for a pattern PIN

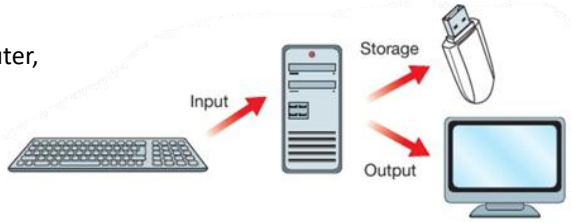
PHYSICAL SECURITY

Physical security to prevent theft is also important. Many devices use security slots which can have locks attached to secure them to furniture. Some attach to specialist slots. Others connect to a port on the device with special screws used to secure the locks in place. Figure 1.33 shows an example of a security lock.

Types of peripheral devices

Peripheral devices are devices that can be connected to a computer, such as a PC or tablet device. Peripherals can be connected inside or outside a computer and can be grouped into three types (see Figure 1.34):

- input
- output
- storage.



▲ **Figure 1.34** Data is input from devices such as keyboards and processed by a computer, and the results can then be sent to output devices such as screens

Input

KEYBOARDS

Keyboards use buttons known as keys, which users press to input text or to interact with software. Keyboards send data to the computer either using a wired or wireless connection. Different types of keyboards are used for different operating systems, languages and functions, as shown in Figure 1.35.

▲ **Figure 1.35** Different layouts are provided for different operating systems or language requirements

Combinations of key presses allow the user to access common software commands called shortcuts. Some people learn to touch-type, which is a method of typing without needing to look at the keys. This increases the speed at which these people can input data.

SUBJECT VOCABULARY

shortcut a combination of key presses used to access common software commands quickly

▲ **Figure 1.36** This is an example of a keyboard used with specialist video software; the keys are **mapped** to specialist commands

SUBJECT VOCABULARY

mapped linked

POINTING DEVICES

A **pointer** is used on a screen to select displayed objects. There are several types of device that allow you to control a pointer.

■Mouse: A mouse uses an optical sensor to recognise the movement of the device. Its sensitivity can be affected by the surface upon which it is placed. Some mice use roller balls to control the movement of the pointer.

■ Tracker ball: A tracker ball is rolled to move the pointer. It does not have buttons to press.

▲ **Figure 1.38** Have you used a roller ball before?

▲ **Figure 1.39** Tracker balls are often used in installations like the kiosk shown here

■Track pad: The track pad surface senses finger movements, touches and presses.

■Joystick: Joysticks are commonly used on games controllers to move sprites around the game.

■Graphics tablet: A graphics tablet is a flat pad that is used with a stylus. Users use the stylus to draw or write on the graphics tablet. These devices are often used by digital artists and designers.

▲ Figure 1.41 Have you used a joystick like this one?

▲ Figure 1.42 Graphics tablets are often used by digital artists and designers

SUBJECT VOCABULARY

sprites on-screen graphics in a computer game, used to represent characters, vehicles and objects

SUBJECT VOCABULARY

stylus a pen-shaped device

SCANNER (INCLUDING OCR AND OMR)

Scanners use light sensors to record physical documents as images, which are then saved as files to the computer. Software allows scanners to read characters on the document and store the result in a text file. This is known as Optical Character Recognition (OCR). Optical Mark Recognition (OMR) software can also be used with scanners to detect simple marks on a document. A common use for OMR is for recognising and recording responses to multiple choice tests.

BARCODE SCANNER

A barcode is a pattern of lines and gaps that can be read by barcode scanners, which detect the width of lines and gaps in a barcode. Barcodes are often used on parcels, so that they can be tracked, and on items for sale in shops. The barcode represents letters and numbers which are used to identify the item.

▶ Figure 1.44 Linear barcode used to identify a parcel

There are two types of barcodes:
■linear
■ Matrix.

Matrix codes are also known as QR codes. They are newer than linear barcodes and have some advantages over linear barcodes, such as:
■They can hold much more information than linear barcodes
■They can be scanned from any angle.

▲ Figure 1.45 A Virtual Subway Store in South Korea

WEBCAM

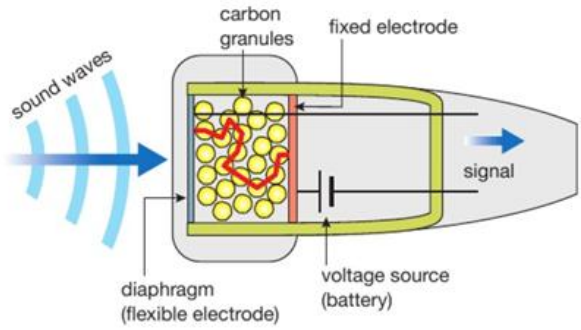
Webcams are specialised cameras. They are generally lower quality than camcorders and may have built-in microphones to capture sound. They can be used as security cameras and can stream images or video to the internet.

SUBJECT VOCABULARY

plain text text that is not specially formatted

MICROPHONE

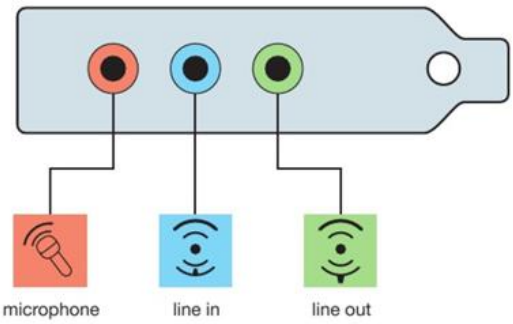
A microphone is used to capture sound. It uses a **diaphragm** which moves when air hits it. This movement produces an **analogue** electrical signal. A microphone converts the electrical signal to a digital signal with its **sound card**, which acts as an analogue-to-digital converter.



▲ **Figure 1.46** Sound waves hitting a microphone and being converted to an electrical signal

Small, low-quality microphones are often built into computers and are used for voice recognition, recording speech or allowing **VoIP** calls using software such as Skype.

▲ **Figure 1.48** This headset contains a microphone and headphone speakers



▲ **Figure 1.47** A microphone can be plugged into a port on the sound card

TOUCH SCREEN

Touch screens are used in many devices, including smartphones, tablet devices, laptops and desktop computers. There are two types of touch screen:

- resistive
- capacitive.

When a user presses on a **resistive** screen, the pressure causes two layers underneath the screen to touch and make a connection. Resistive touch screens are more durable than capacitive touch screens but are harder to read because more layers reflect more light. In addition, they can only recognise one touch at a time, so they are not suitable for multi-touch applications.

Under the glass of a **capacitive** screen, there is a layer of capacitive material. When a user touches the screen, a small amount of charge flows away from their finger because humans are conductive.

SUBJECT VOCABULARY

diaphragm a thin round object, especially in a telephone or loudspeaker, that is moved by sound or that moves when it produces sound
analogue representing information with continuously variable electrical signals that digital signals approximate
sound card a device built into or added into a computer to allow it to playback and record audio
VoIP Voice over Internet Protocol, which is the technology that allows people to use broadband internet connections to speak to other people, rather than using a conventional telephone

BIOMETRIC SCANNER

If you have watched a spy film, you may have seen a biometric scanner being used. Biometric scanners work by measuring part of the unique physical characteristics of a user, often multiple times, until a suitable average result is produced.

Four examples of biometric scanners are as follows.

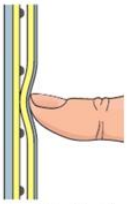
■Fingerprint recognition: These scanners read the patterns of arches, loops and whorls in a human fingerprint. Fingerprints are unique to each individual person, which makes them a useful method of identification, but fingerprints can be obscured, damaged or changed, such as by injury or disease.

▲ **Figure 1.52** Examples of different types of fingerprint patterns

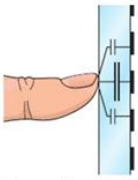
■Facial recognition: These scanners identify the structure of a human face to identify an individual.

■ Voice recognition: These scanners require a microphone to capture the voice. They then compare the voice print against a saved original and check to see whether the two prints match. (See page 26 for more information about microphones.)

Figure 1.54 Voice recognition software compares a voice print with a stored original and checks for a match



▲ **Figure 1.49** A resistive touch screen



▲ **Figure 1.50** A capacitive touch screen

▲ **Figure 1.51** A fingerprint scanner detects unique patterns in your fingerprints

■Iris recognition: Like fingerprints, the human iris has a unique pattern, though an iris scan is approximately 120 times more detailed than a fingerprint. This means that iris recognition is 120 times more reliable when identifying people.

CARD READERS

Cards can carry data using three methods. Each method needs a specialist type of reader.

■**Magnetic strip**: This is the least secure method as the data on the magnetic strip can easily be stolen by criminals who put the card through a card reader without the card owner's knowledge.

■ **Programmable chip**: Data on a programmable chip is only readable when a correct PIN is entered into the reader. In 2005, the UK introduced the chip and PIN system, which reduced certain types of fraud by 67%.

■**Radio Frequency Identification (RFID) and Near Field Communication (NFC)**: RFID is a short-range wireless communication method, and Near Field Communication (NFC) is a branch of RFID. RFID tags are cheap and small and they can be included in a variety of objects such as cards, key fobs and smartphones. They contain a unique identification number (ID) that is linked to records in a database.

▲ Figure 1.55 Some passports now contain a chip that holds biometric data about the passport holder that is compared with the results of biometric scans carried out at airports

▼ Table 1.2 Advantages and disadvantages of using biometric scanners

ADVANTAGES	DISADVANTAGES
Easier for users than passwords because biometric data cannot be forgotten	Cause privacy and security concerns because detailed personal information is stored electronically
More difficult to trick or confuse biometric scanners than some other methods	Possible to trick or confuse them
Can speed up transactions	Expensive to make and buy
Are not restricted by language barriers	Make some people feel uncomfortable

▲ Figure 1.57 Examples of cards using chip and PIN

SENSORS

Sensors are used to input data about the physical environment. They can automatically input data without the need for human action. Their output is then processed by a computer. Sensors are one of the main features of smart devices such as smartphones and smart environments such as **smart homes**.

SUBJECT VOCABULARY

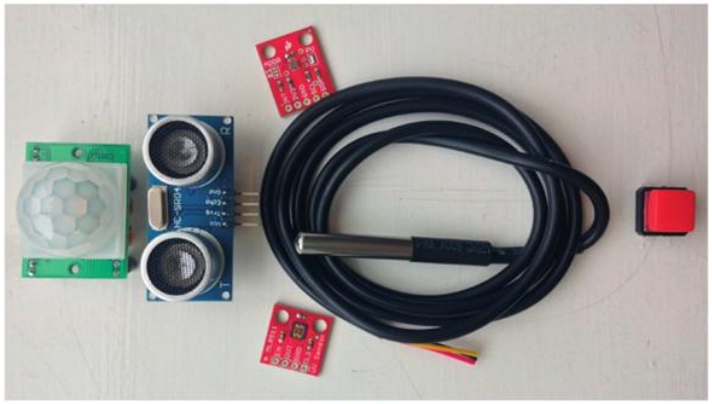
sensor an input peripheral that inputs data about the physical environment
smart home a home equipped with devices that can connect to the internet and be controlled remotely by a computer or smartphone app

▲ Figure 1.58 RFID tags can be included in a variety of objects

The use of sensors has many benefits, such as:
■They can be placed in remote or dangerous places
■They can monitor continually
■They remove the possibility of human error
■They can sense things that people cannot (such as small changes in pressure or gas levels)
■The data is easily (sometimes automatically) converted to a digital form.

There are many different types of sensor to allow for the monitoring of a range of environmental factors. Some of these factors are:

■ Light
■Moisture and humidity
■ Temperature
■Proximity and distance
■Motion and movement (such as Passive Infrared (PIR) sensors)
■Pressure.



▲ **Figure 1.59** (Left to right) motion sensor, **proximity** sensor, temperature sensor and button sensor; the red item at the top is a light sensor and the red item at the bottom is a UV sensor

▲ **Figure 1.60** Sensors are used in aircraft and data from them are displayed to the flight crew on instruments in the cockpit

Output

Output peripherals are connected to a computer and output the results of the computer's processing in various forms, including:
■Electronic display
■Printed text
■ Video
■ Audio
■ Tactile (touch) forms.

MONITOR

Monitors allow users to see the output from the computer on an electronic display. Features of monitors include:
■Screen size, which is measured diagonally
■ Resolution, which is measured in pixels
■ Energy efficiency measures, such as going into a low-power standby mode if no input is detected.

Some monitors also use touch screen technology

▲ **Figure 1.61** Monitors have evolved over time to provide better quality and more features

Printer

There are three types of standard printer: dot matrix, inkjet and laser.

■Dot matrix: These printers are sometimes called 'impact' printers. This is because the print is made by hitting or 'impacting' the paper through a ribbon of ink, and this process is very noisy.

■Inkjet printers: These printers use cartridges containing different coloured ink. Black ink is held in a one cartridge, while the colour cartridge is often split into three colours: cyan, magenta and yellow.

▲ **Figure 1.62** Laser (top left), inkjet (right) and dot matrix (bottom left) printers

■Laser printers: These printers contain a rotating cylinder or drum that holds an electrical charge. A laser is used to **discharge** certain points on the drum and 'draw' an image. Electrically charged **toner** is attracted to those points on the drum and is heated onto paper that is passed over the drum.

▼ **Table 1.3** Comparing printer types

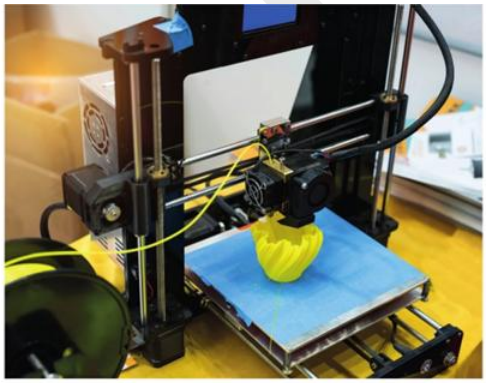
	SPEED	PRINTER COST	COST PER COPY	COLOUR PRINTING	QUALITY	EXAMPLES OF WHERE IT IS USED
Dot matrix	Slowest	Cheap	Low	Rare	Low	When multiple copies are required.
Inkjet	Fast	Medium	High	Yes	High	Home printing and photographs
Laser	Fastest	Expensive	Medium	Yes	Highest	High-volume printing, often used in offices

SUBJECT VOCABULARY

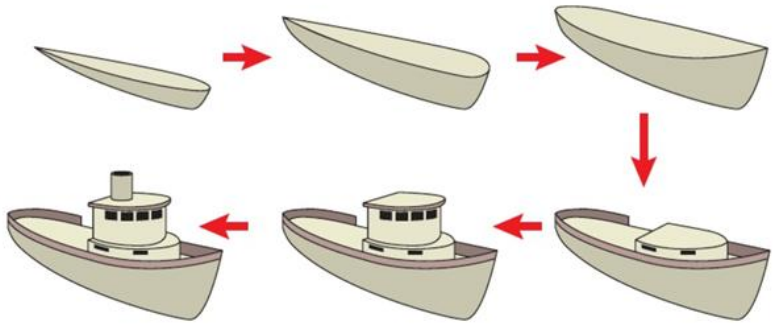
discharge remove the electrical charge from something
toner a type of ink

3D Printer

Three-dimensional (3D) printers create real-life versions of digital models. These printers work by adding layers of heated material from the bottom of the model all the way to the top. 3D-printed models take a long time to create.



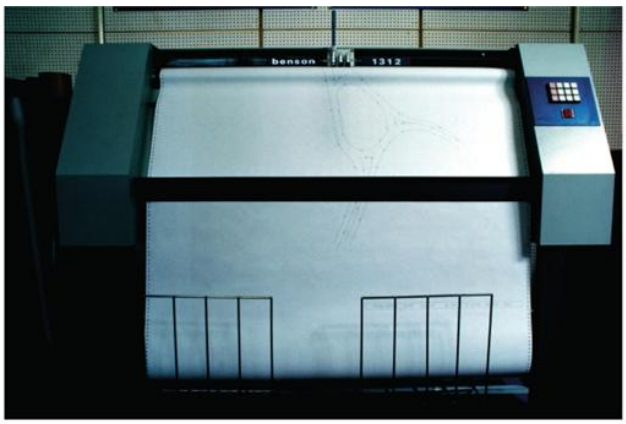
▲ **Figure 1.65** A 3D printer



▲ **Figure 1.66** Stages of building a 3D-printed model

Plotter

Plotters are used by a variety of professionals, including product designers, architects, engineers and cartographers. The plotter draws high-quality images created in Computer Aided Design (CAD) software onto large sheets of paper.



▲ **Figure 1.67** A plotter

DATA PROJECTOR

Data projectors are used for home entertainment, such as watching television or playing games, and for giving presentations in classrooms and business meetings. They have the following features.

■Light bulbs: These bulbs can have various brightness levels (measured in lumens) and are expensive to replace.

■Resolution: Like monitors, they use different quality screens (see page 9-10 for more about screen resolutions).

■Zoom functionality: The projected image can be made larger by enlarging the image using either optical zoom or digital zoom.

■Portability: Some smaller and lighter projectors are available, and these are easier to move around.

▲ **Figure 1.68** Data projectors are used to project a large image (or film) onto screens

SUBJECT VOCABULARY

optical zoom focusing a lens in order to zoom in on an object
digital zoom enlarging part of an image to produce the effect of zooming in

SPEAKER

Speakers allow a computer to output sound. Speakers often come in pairs to provide **stereo sound**. Multiple speakers are commonly used to provide **surround sound** in home entertainment systems.

SUBJECT VOCABULARY

stereo sound sound that comes from two sides (left and right)
surround sound sound that comes from four or more sides, used so that sounds from a film or television programme come from all around the viewer as they would in real life

▲ **Figure 1.69** A pair of speakers is required for stereo sound because one is used for the left side and one is used for the right side

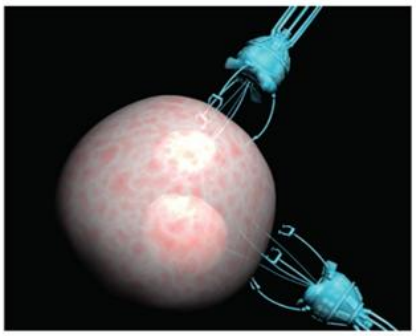
SUBJECT VOCABULARY

mono sound sound that comes from a single speaker

▲ **Figure 1.70** A piezoelectric 'piezo' speaker used in a watch

CONTROL DEVICE

Control devices are also known as actuators, and they are components of a system that make something happen in the real physical world. These devices are often mechanical.



▲ **Figure 1.72** Nanorobots allow doctors to make smaller incisions or cuts and more precise movements than they could if they used their own hands

▲ **Figure 1.71** Robots use actuators that are powered in many ways such as electricity, chemicals and compressed air

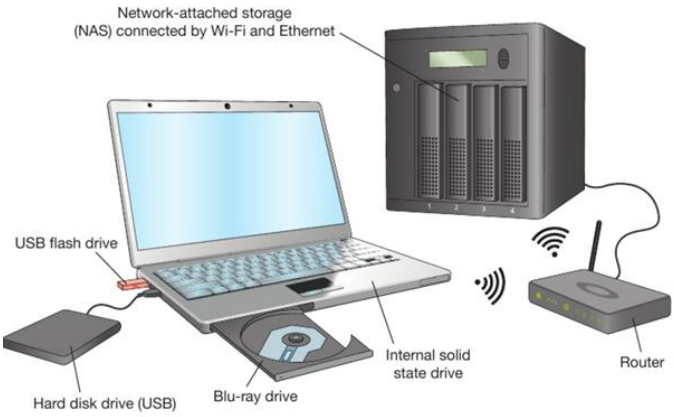
Secondary storage

Secondary storage is often referred to as 'storage'. However, it should not be confused with primary storage or main memory, which are terms sometimes used to refer to Random Access Memory (RAM) or Read Only Memory (ROM). You will learn more about RAM and ROM. Secondary storage is non-volatile, which means it will not lose data when the system's power is turned off.
Secondary storage is used for:

■Storing a document for future use
■Storing an application, ready to be loaded into RAM when the user opens the application
■**Virtual memory**

DEVICES

Storage devices are used to store data or software that is used in a computer system.
Storage devices can be either internal or external. Internal drives connect directly to the computer's motherboard. External devices are connected to the computer's exterior.



▲ **Figure 1.73** Storage can be internal or external

SUBJECT VOCABULARY

virtual memory space on a computer for storing instructions and programs until they are needed or being used
motherboard the circuit in a computer with connectors to which other components connect

SUBJECT VOCABULARY

backwards compatibility the ability to be used with older technology without having to be specially adapted

There are different types of storage device.

■Hard disk drives (HDD) contain hard disk media. The drives provide a connection from the disk to the motherboard, either directly or using a wireless adapter like Wi-Fi or a wired port like USB.

■Solid state drives (SSD, often referred to as flash drives) contain flash memory media. They are otherwise identical to hard disk drives.

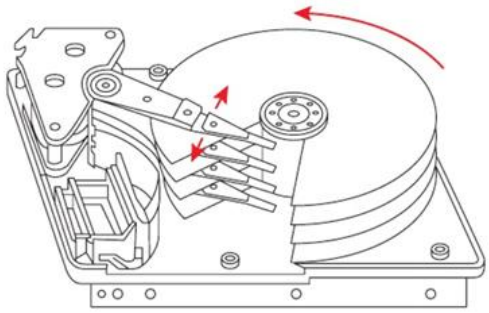
■Optical disk drives contain optical disk media. Newer drives are often compatible with older media. For example, a disk drive that can read Blu-ray media can also read DVD and CD media. This is known as **backwards compatibility.**

MEDIA

Hard disks

Hard disks are made up of many concentric **platters**. These platters make up a cylinder that spins on a central spindle. A **read/write head** moves on an arm across tracks on the platter. The amount of time that it takes the read/ write head to access data on the tracks is determined by how fast the cylinder of platters spins and how fast the read/write head is moved across the tracks.

Typical spin speeds are 5400 revolutions per minute (rpm) or 7200 rpm. The average **seek time** for a read/write head is 4-15 milliseconds (ms).



▲ **Figure 1.74** Read/write heads move across a hard disk platter to access data as the cylinder spins

SUBJECT VOCABULARY

platters circular plates
read/write head the part of a disk drive that passes across (or floats) the platters on a very thin layer of gas above the platters
seek time the time it takes for a read/ write head to locate the area on the disk where the data to be read is stored

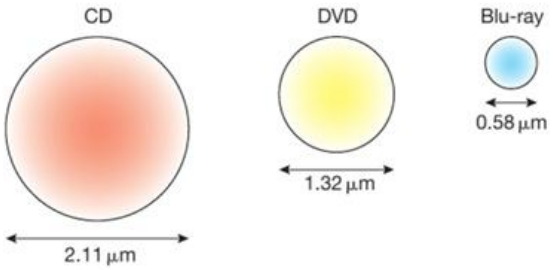
Optical media

Types of optical media include CDs, DVDs and Blu-ray disks.

■**CDs** can store up to 700 MB of data. The data is written to the disk using a laser, which writes data to a plastic layer beneath layers of aluminium and acrylic.

■ **DVD**s look very much like CDs. Data is written to DVDs using a shorter wavelength of red laser light, which allows DVDs to store more data. They can store 4.7 GB on a single-sided, single-layer disk. Double-sided, dual- layer disks can store as much as 18 GB.

■**Blu-ray** disks are similar to CDs and DVDs, but use a scratch-protection coating. Violet laser light is used to store data at greater density than the red laser light used in DVDs. They can store 25 GB on a single-sided disk, and double-sided disks can store 50 GB.



▲ **Figure 1.75** Comparison of various lasers used to store data on optical media

Flash media

Flash media are more energy-efficient than hard disks as they do not have moving parts. For the same reason, they are also less likely to fail when they are moved around. This makes them suitable for use in portable devices.

Magnetic tape

Magnetic tape was originally designed to record sound, but it is now also used to store data.

▲ **Figure 1.76** Magnetic tape is mainly used for backing up data in large organisations

▼ **Table 1.4** Comparing types of media

	HARD DISK	FLASH MEDIA	OPTICAL MEDIA	MAGNETIC TAPE
DATA ACCESS SPEED	Fast	Fastest	Slow	Slowest
MAXIMUM CAPACITY	Varies, up to 128 GB	Varies, up to many TB	CD 700 MB DVD 18 GB Blu-ray 50 GB	Varies, up to 185 TB
COST PER GB	High	Very high	Medium	Low
USE	Servers, personal computers, backups	Laptops, mobile devices	Multimedia (music, games and films), file backups	Whole system backups and archives
PORTABILITY	Not suitable	Yes	Not suitable	Not suitable

SUBJECT VOCABULARY

data access speed how quickly data can be read from or written to media
capacity the amount of data that can be stored on media
bit (binary digit) a single unit of information with a value of either 0 or 1; eight bits equal one byte

Storage media store data in binary form. This means that each bit of data holds one of two values: 0 or 1. Different media types interpret 0 or 1 differently.

■ Hard disks change the magnetic charge of a platter to either negative or positive, depending on whether the value is 0 or 1.

■Optical media use tiny bumps on the disk's surface to represent 0 and 1.

■Flash media use different levels of electrical charge, held in tiny individual cells, to represent 0 or 1.

■Magnetic tape changes the magnetic charge of the tape to either negative or positive, depending on whether the value is 0 or 1.

▼ **Table 1.5** Units of storage capacity

NUMBER OF BYTES	WITH UNIT SYMBOL	NAME
1000	1 KB	Kilobyte
1000,000	1 MB	Megabyte
1000,000,000	1 GB	Gigabyte
1000,000,000,000	1 TB	Terabyte
1000,000,000,000,000	1 PB	Petabyte
1000,000,000,000,000,000	1 EB	Exabyte
1000,000,000,000,000,000,000	1 ZB	Zettabyte
1000,000,000,000,000,000,000,000	1 YB	Yottabyte

Chapter 02 - Software

System software

SUBJECT VOCABULARY

utility software (also known as utilities) system software that carries out configuration and maintenance tasks

Utility software

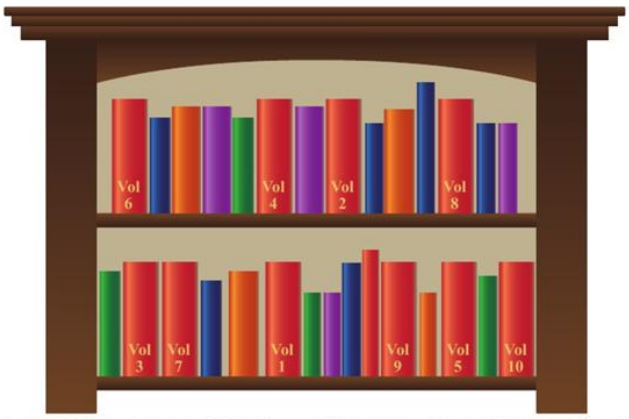
Utility software is one form of system software, which carries out configuration and maintenance tasks.

BACKUP

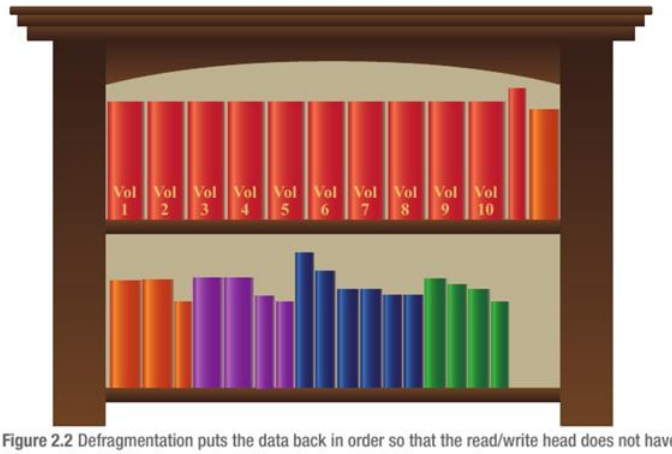
Backup utilities create a copy of files and programs. Backups can be set to run automatically (usually at a time when the system is not in use) or can be started by a user.
You will learn more about backups in Unit 3 Operating online.

DEFRAGMENTATION

As data is stored to hard disk, some systems spread it across the disk wherever there is free space. This means that sometimes data is fragmented and stored out of order or out of sequence.



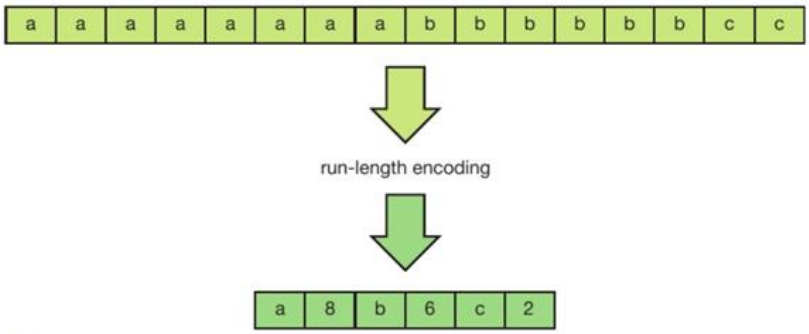
▲ **Figure 2.1** Data is sometimes stored in the nearest free space, which results in data getting out of sequence. This is an illustrative example.



▲ **Figure 2.2** Defragmentation puts the data back in order so that the read/write head does not have to search the disk for fragments of data. This is an illustrative example.

COMPRESSION

Compression utilities reduce the original size of a file or set of files. Where there are repeated patterns of data, rather than storing every repeated instance, only the first instance of the data is stored, alongside how many times it is repeated.



▲ **Figure 2.4** Run Length Encoding is one method of data compression

▲ **Figure 2.3** Data can be compressed to remove unnecessary use of code or space in the file. This is an illustrative example.

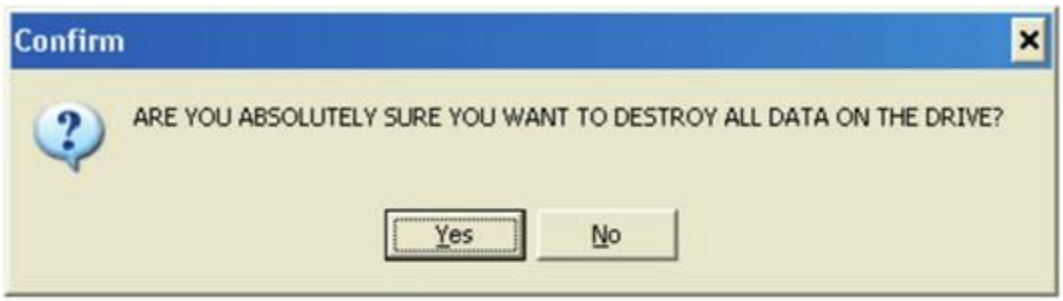
The resulting compressed file is not usually readable by the original application. Compression utilities also can **decompress** (extract) the data from a compressed file so it can be read by the original application again.

SUBJECT VOCABULARY

decompress extract data from a compressed file so that it can be read

FORMATTING

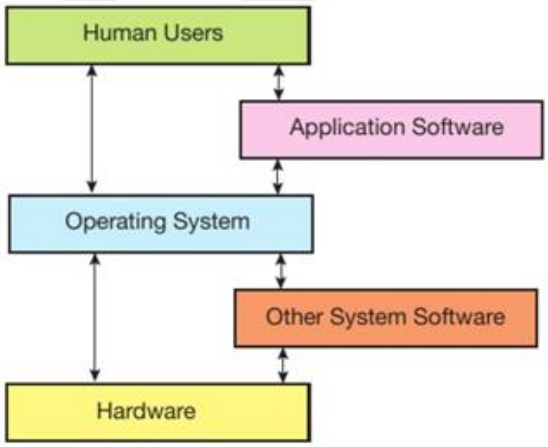
Disk formatting prepares storage media such as a hard disk drive or USB flash drive for its first use. If a disk has already been used, then formatting it will make all of the data on the disk unreadable by normal applications.



▲ **Figure 2.5** Accidentally formatting the wrong disk could result in the unwanted loss of data

Operating systems

Single-user operating systems only allow for a general user and do not provide the option to customise the user interface for different users.
Network operating systems have additional functionality, including:



▲ **Figure 2.6** The operating system lets the user control the hardware, either directly or by using applications software or system software

■Sending requests to a server when users log in with their username and password

■Separating user accounts and ensuring that users cannot access each other's files providing access to network storage and shared resources such as networked printers.

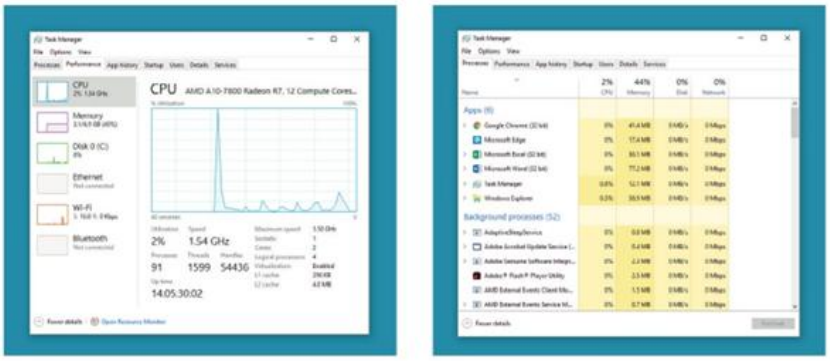
MEMORY MANAGEMENT

The operating system allocates the required amount of memory (RAM) to one or more applications. When the application no longer requires the memory space, the operating system makes the space available for other applications to use.

The operating system also handles the creation of virtual memory. See page 60 for more information about virtual memory.

RESOURCE MANAGEMENT

System resources include internal components, such as the processor and **graphics card**, and external devices, such as printers. As well as allocating memory, the operating system ensures that system resources are made available to applications when they are required.



▲ **Figure 2.7** Information about the use of memory and resources is provided by utility software

SUBJECT VOCABULARY

graphics card a device built into or added into a computer to allow it to display visual graphics

SECURITY

Operating systems can give users secure access to a computer's storage and other hardware through usernames and passwords, biometric scanning or personal access cards. This process is called authentication. Operating systems can provide software firewalls to authorise or prevent network data from remotely accessing a service or application.

SUBJECT VOCABULARY

authentication the process of confirming that a user is permitted to access certain files, hardware and software

firewall a system (hardware or software) that protects a computer network from being used or looked at by people who do not have permission to do so

PRINT SPOOLING

During large print jobs, the computer will have the pages ready for the printer faster than the printer can produce them. The operating system keeps each page in a queue ready for printing. This process is called print spooling.

SUBJECT VOCABULARY

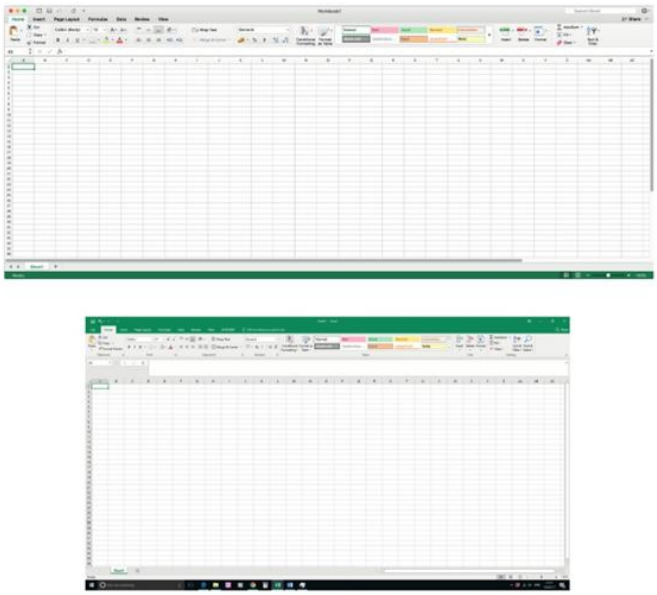
print spooling the process of keeping pages queued in order, ready to be printed by a printer

Application software

Software applications (apps) enable users to create digital products or perform non-operating tasks. They are downloaded from internet servers or app stores on devices like smartphones and tablets. Apps can also be installed from storage media like DVDs. Learn more about online software in Unit 4 Online goods and services.

Office productivity software

Office productivity software is any application that can carry out work-related tasks. They are often available as an application suite.



▲ **Figure 2.8** Some developers provide versions of their apps for different types of computer and operating systems. The top window shows the Apple macOS version whilst the bottom window shows the Microsoft® Windows version.

WORD PROCESSING

Word processing software lets users create documents that mostly include words, but also some images. They can also include tables, hyperlinks, equations, simple drawings and shapes and charts.

Word processors are a good choice of application for creating:

- Letters
- Reports
- Essays
- Books

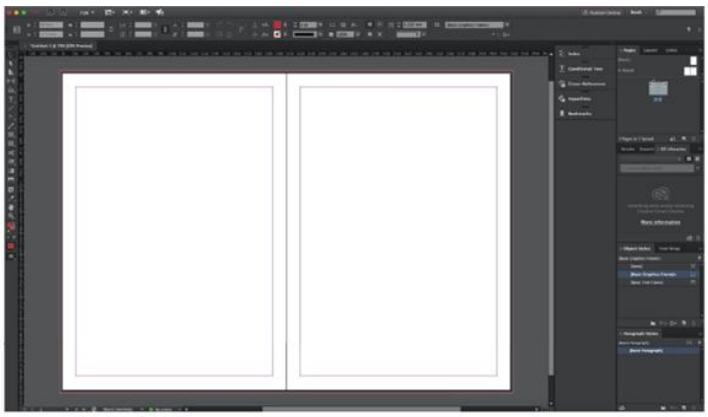
SUBJECT VOCABULARY

application suite a collection of application software that share the same look and user interface; often, they can share data between each other and share some functionality

hyperlink a link that can be clicked in order to go to another location (often a web page on the internet)

DESKTOP PUBLISHING (DTP)

DTP software has many similar features to those in word processing software. The main difference is the way in which the software allows users to work with complicated page layouts. An example of DTP software is Adobe® InDesign®2.



▲ **Figure 2.9** Page layouts in DTP software help the designer to see what the final version will look like when printed

SPREADSHEET

Spreadsheet applications are used to do calculations. Users can use and create formulae and functions to perform automatic calculations on values that can be entered and changed later. These features allow spreadsheets to be used to model financial scenarios and answer 'what if?' questions, such as 'What would the cost per ticket be if I changed the maximum number of staff required at my event?'.

Venue	Gold	1	3000
Catering package	Gold	1	30
Entertainment	Bronze	3	300
Decorations	Silver	2	300
Transport	Gold	1	80
Number of Staff required			20
Ticket price needed		£	59.25
Meets requirements?			No

Venue	Gold	1	3000
Catering package	Gold	1	30
Entertainment	Bronze	3	300
Decorations	Silver	2	300
Transport	Gold	1	80
Number of Staff required			30
Ticket price needed		£	55.92
Meets requirements?			No

▲ **Figure 2.10** Two scenarios from a financial model

Venue	Gold	1	=VLOOKUP(C11,$L$3:$R$5,5)
Catering package	Gold	1	=VLOOKUP(C12,$L$3:$R$5,3)
Entertainment	Bronze	3	=VLOOKUP(C13,$L$3:$R$5,4)
Decorations	Silver	2	=VLOOKUP(C14,$L$3:$R$5,6)
Transport	Gold	1	=VLOOKUP(C15,$L$3:$R$5,7)
Number of Staff required			=ROUNDUP(D5/10,0)
Ticket price needed			=(G14-J14)/D5
Meets requirements?			=IF(D19>D8,"No","Yes")

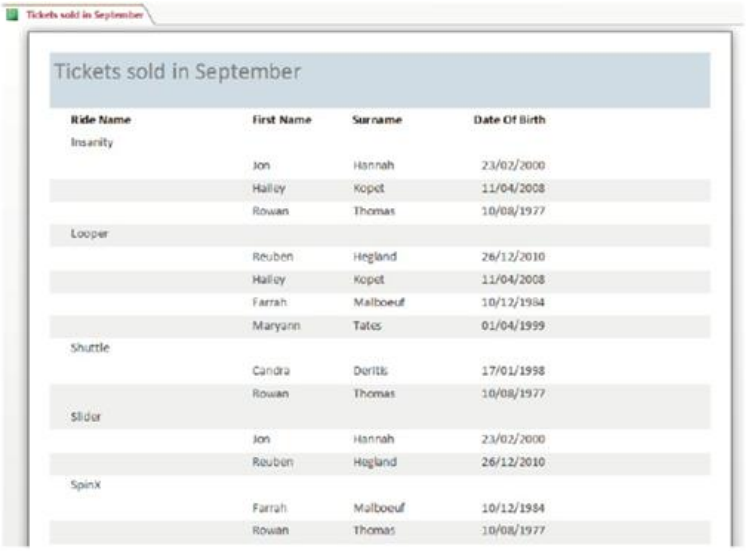
▲ **Figure 2.11** Formulae and functions are used for calculations that are carried out automatically when values change

DATABASE

Database management systems (DBMS) are used to enter, edit and search data. Some systems can also produce reports that dynamically display real- time changes to the data as it updates.

DBMS software features include:

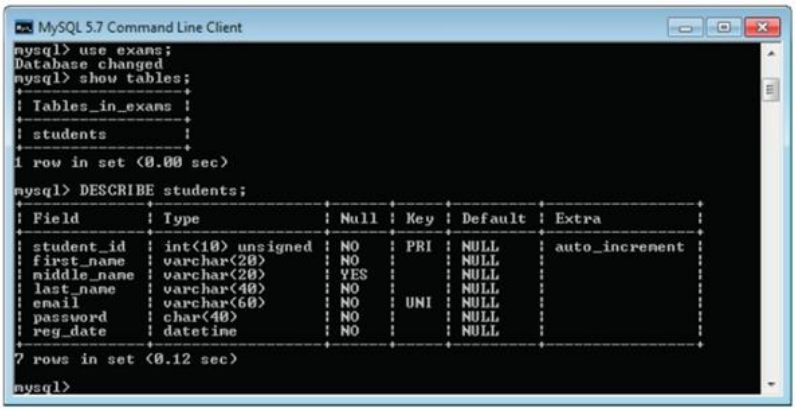
- Data entry forms so that users can input data
- Query editors so that users can select all data that meets certain criteria
- Report builders so that users can display data in a more readable format.



Tickets sold in September

Ride Name	First Name	Surname	Date Of Birth
Insanity			
	Jon	Hannah	23/02/2000
	Hailey	Kopet	11/04/2008
	Rowan	Thomas	10/08/1977
Looper			
	Reuben	Hegland	26/12/2010
	Hailey	Kopet	11/04/2008
	Farrah	Malboeuf	10/12/1984
	Maryann	Tates	01/04/1999
Shuttle			
	Candra	Derits	17/01/1998
	Rowan	Thomas	10/08/1977
Slider			
	Jon	Hannah	23/02/2000
	Reuben	Hegland	26/12/2010
SpinX			
	Farrah	Malboeuf	10/12/1984
	Rowan	Thomas	10/08/1977

▲ **Figure 2.13** A report from a database

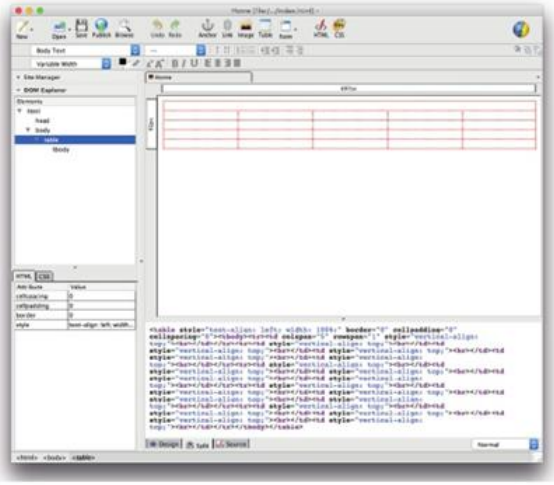


```
MySQL 5.7 Command Line Client
mysql> use exams;
Database changed
mysql> show tables;
+---------------+
| Tables_in_exams |
+---------------+
| students      |
+---------------+
1 row in set (0.00 sec)

mysql> DESCRIBE students;
+-------------+-----------------+------+-----+---------+----------------+
| Field       | Type            | Null | Key | Default | Extra          |
+-------------+-----------------+------+-----+---------+----------------+
| student_id  | int(10) unsigned | NO   | PRI | NULL    | auto_increment |
| first_name  | varchar(20)     | NO   |     | NULL    |                |
| middle_name | varchar(20)     | YES  |     | NULL    |                |
| last_name   | varchar(40)     | NO   |     | NULL    |                |
| email       | varchar(60)     | NO   | UNI | NULL    |                |
| password    | char(40)        | NO   |     | NULL    |                |
| reg_date    | datetime        | NO   |     | NULL    |                |
+-------------+-----------------+------+-----+---------+----------------+
7 rows in set (0.12 sec)

mysql>
```

▲ **Figure 2.12** This DBMS software uses a command line interface and contains fewer features

Web authoring

Web authoring software lets users create web pages that include text and images. The pages are output as **Hypertext Markup Language (HTML)**. HTML is read by web browser software. Web browsers translate HTML into pages that people can see and read. Web pages can be linked together to create a website for people to view on an **intranet** or on a **web server** on the internet.



▲ **Figure 2.14** Some web authoring software can display the code and design views one after the other

SUBJECT VOCABULARY

Hypertext Markup Language (HTML) a computing language read by web browser software
intranet a computer network used for exchanging or seeing information within a company
web server a computer that stores web pages and sends them to other devices that request them (often using web browser software)

Image editing

Image editing applications let users create and change **bitmap** images, such as digital photographs, or **vector graphics**, such as drawings or logos.

SUBJECT VOCABULARY

bitmap a computer image that is stored or printed as an arrangement of bits
vector graphic a graphical image made up of points and lines

GRAPHICS EDITORS

Graphics editing applications allow users to create or edit vector graphics. Features of graphics editors include:

■Vectorising images (that is, converting or tracing bitmap graphics to vector graphics)
■Layers (that is, having the ability to place some graphics on top of others) ☐ adding text
■Adding or drawing shapes and lines
■Resizing, aligning or moving shapes and lines
■Altering the colour of shapes, lines and fill areas.

PHOTO EDITORS

These allow users to edit and enhance digital photographs and images. An example of photo editing software is GNU Image Manipulation Program (GIMP). Features of photo editors include:

■Adjusting brightness and contrast
■Resizing the image
■ Altering sharpness and blurring
■Applying filters and effects such as distortion
■Red-eye removal
■ **Cropping**.

SUBJECT VOCABULARY

cropping using a photo editor to remove the edges of an image

Sound editing

Sound editing software allows users to edit audio files or to join together different audio files in order to create multitrack music or soundtracks for video. An example of sound editing software is AudacityR. Features of this software include:

■Cut and join audio clips
■**Mute** and **solo** some audio tracks
■Alter volume levels for individual tracks
■Change **tempo**
■Frequency equalisation (changing the levels of high and low pitch frequencies)
■Add effects like reverberation
■Apply audio processing:
• Reverse
•Noise reduction
•**Normalisation**
•Fade the volume in, so that it gets louder, or out, so that it gets quieter.

SUBJECT VOCABULARY

mute silence an audio track
solo only play one particular audio track
tempo the speed at which a track is played

SUBJECT VOCABULARY

normalisation increasing the average volume of a piece of audio to a defined maximum level

SUBJECT VOCABULARY

slide a single page of a presentation
pathway the sequence of or route through a series of slides

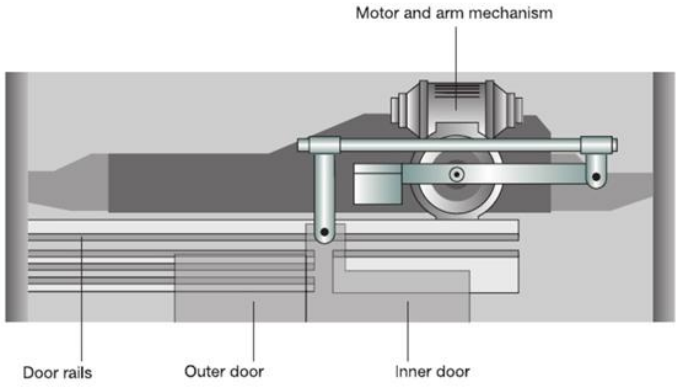
Presentation software

Presentation software allows users to create engaging multimedia content, including images, text, animation and video. This content can be placed on **slides** or **pathways** that are used to illustrate and support the spoken content of a talk given to an audience.

Control applications

Control applications are used to make something happen in the physical environment. This type of software is often used to automate the movement of control devices or actuators, such as motors.

▲ **Figure 2.16** Astronauts on the International Space Station use control software to move a robotic arm into position in order to capture a supply capsule

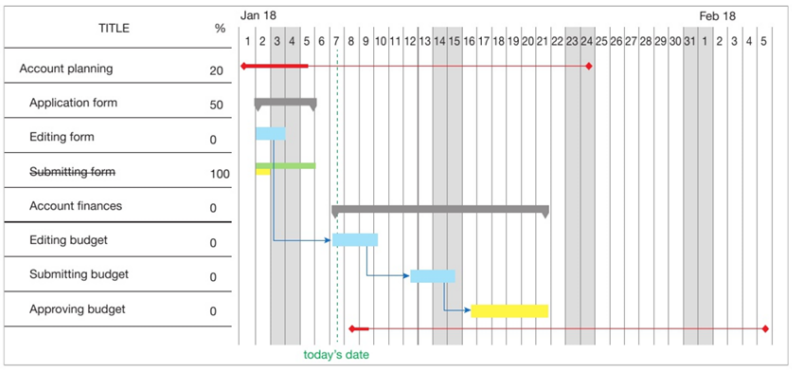


▲ **Figure 2.17** Lift doors are opened and closed automatically by control software when a sensor detects that the lift is level with the floor and has stopped

▲ **Figure 2.18** Smartphone apps can be used to control home heating and cooling systems

Project management

Project management applications are used to help plan and track the individual tasks in a project, so that project managers can make the most efficient use of the available resources. Some tasks cannot be started until a previous task is completed or has been partly completed, so it is important for a project manager to see which tasks are dependent on others. When all of these dependent tasks are combined together into a timeline, it is easy for the project manager to see the critical path. These applications can also be used to set milestones.



▲ **Figure 2.19** Gantt charts are often used to visualise the timelines and milestones for the individual tasks in a project

Communication software

Communication software provides remote access to systems and allows users to contact people using the internet. It can be used to send files and messages as text, images, audio and video.

WEB BROWSERS

Web browsers allow users to view web pages and websites created in web authoring software and hosted on servers that are connected to the internet. These servers may be in another country.

Browsers also allow users to access other systems that use the internet but are not on the World Wide Web, such as **file transfer protocol (FTP)** servers.

EMAIL

Emails can be sent. In addition, it often stores or uses a database of contacts, which is sometimes available as another application.

Email applications often provide features such as labels to help organise emails and **filters**.

SOCIAL MEDIA

Social media can be accessed through a web browser or by using locally installed apps.

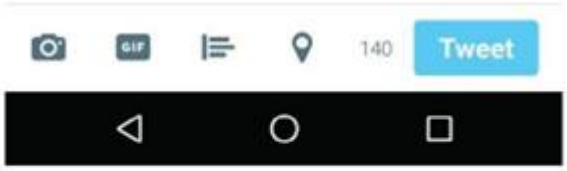
SUBJECT VOCABULARY

file transfer protocol (FTP) a method of exchanging data and files across a network

SUBJECT VOCABULARY

filter a computer program that only allows certain types of information to pass through it

▲ **Figure 2.20** Social media companies give access to their services through their web pages



▲ **Figure 2.21** Apps are available for mobile devices as well as PCs

SMS

Short messaging service (SMS) applications are found on mobile phones. They allow users to send up to 160 text characters per message using the mobile phone network. They do not require an internet connection.

MMS

Multimedia messaging service (MMS) applications extend the capabilities of SMS. MMS can deliver more than 160 characters per message and can include video, animations, images and audio. Like SMS, they are sent using the mobile phone network and do not require an internet connection.

INSTANT MESSAGING

Instant messaging applications are very similar to MMS applications, but they require a connection to the internet. They can allow users to see when other users are typing, and users can also prevent others from seeing when they are typing. Messages sent via instant messaging applications can include location data.

Software licensing

Sometimes, users require a software licence to be able to install and use software on a computer.
There are many types of software licence and the details of software licensing are complicated. To make things easier to understand, you can think about the two types of software that are available:

- Free or open source
- Proprietary.

SUBJECT VOCABULARY

free software software that can be modified or distributed by a user
open-source software software for which the source code is made available to users
source code a collection of instructions that forms a piece of software

Free or open source

Free software licences give users the right to study, modify, copy or distribute a program. The user can decide if, and how much, to charge for a copy of the software or any service provided by the software.

Open-source software licences make the **source code** available to users so that they can modify how the software works or distribute the modified or unmodified software.

SUBJECT VOCABULARY

proprietary software software that is marketed and distributed by its owner under a brand name
freeware proprietary software provided free of charge to users

Proprietary

Proprietary software is software that is marketed and distributed by its owner under a brand name. The software owner can decide the fee for the software and whether or not the software should be distributed.

Proprietary software can be made available for a fee or free of charge. When no fee is required, the software is called **freeware**.

Software updates

Updates to software are released by software developers for the following reasons:

- fixing security vulnerabilities or bugs
- increasing compatibility with newer operating systems
- improving performance and efficiency
- introducing new features
- improving usability.

Chapter 03 – Memory and process

MEMORY

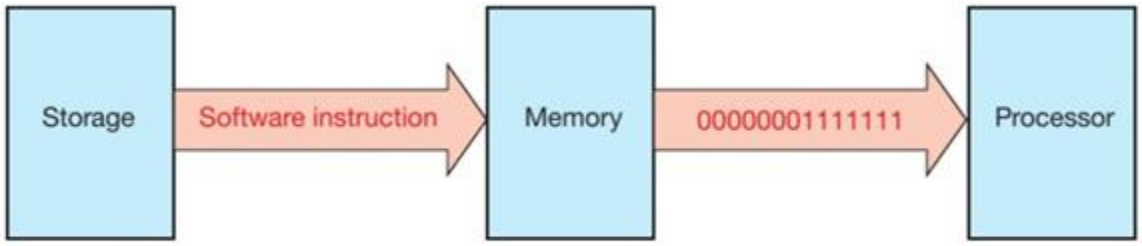
Memory can be accessed faster than secondary storage. Memory is used to store instructions so that the processor can fetch the instructions quickly in order to process them.

There are three types of memory that you need to know about:

- Random Access Memory (RAM)
- Read Only Memory (ROM)
- Flash memory.

Random Access Memory (RAM)

RAM is **volatile**, meaning that it cannot store data when it has no power. This means that, if you turn off your computer's power, any data held in RAM will be lost.



▲ **Figure 3.1** Processors fetch software instructions from memory. The processor then decodes and executes the instructions

Impact of the size of ram on the user

▲ **Figure 3.2** A user can increase the amount of RAM using RAM slots on a motherboard

RAM is used to store programs that are in use. The more RAM that is available, the more programs can run at the same time. This is important when you need to use many files or programs at the same time. When the computer system does not have enough space in RAM, the operating system creates virtual memory by using an area of secondary storage. Secondary storage is much slower than RAM, so the user will notice a big decrease in system performance when the processor has to access instructions from virtual memory. When a solid-state drive (SSD) is used as secondary storage, data is swapped to and from the SSD quickly and frequently. Although SSDs have faster access times than hard disk drives, this constant swapping can greatly reduce the performance of the SSD.

Read only memory (ROM)

ROM stores data permanently. Unlike RAM, ROM is **non-volatile**, meaning that data is not lost when the power is turned off. General purpose computers, such as home PCs and laptops, also use ROM to **boot** the system and load the operating system from secondary storage.

■ROM is generally used to refer to memory that cannot be changed after manufacture. Its full name is Mask Programmed Read Only Memory.
■ PROM stands for **Programmable** Read Only Memory. It is manufactured with the ability to be written to, but it can only be written to **once**.

Although the computer system cannot swap instructions in and out of ROM, it is possible to change the contents of some types of ROM so that the data on it can be updated. These types of ROM are called:
■ EPROM (**Erasable Programmable** Read Only Memory)
■EEPROM (**Electrically Erasable Programmable** Read Only Memory).

SUBJECT VOCABULARY

boot start up

SUBJECT VOCABULARY

firmware a type of software that controls a hardware device

Difference between RAM and ROM

▼ Table 3.1 Comparing the characteristics of RAM and ROM

	RAM	ROM (all types)
STORES DATA WHEN POWER OFF?	No (volatile)	Yes (non-volatile)
CAN SWAP INSTRUCTIONS IN AND OUT?	Yes	No
ACCESSIBLE IN ANY ORDER?	Yes	Yes
INTENDED TO STORE...	Temporary data	Permanent data
CAN BE UPGRADED?	Yes	No

Flash memory

Flash memory is a type of EEPROM. Like other types of ROM, it is **non-volatile**. It does not have any moving parts, so it has a fast access time and low power consumption. Because of its low power consumption, flash memory is used in the SSDs that are used in portable devices, such as laptop computers, as these devices often rely on internal batteries for their power. Flash memory is often used as removable storage in USB drives and SD cards.

PROCESSORS

A processor is made up of one or more Central Processing Units (CPUs). These carry out software instructions. In processors that are made up of more than one CPU, each CPU is referred to as a core. For example, in a quad-core processor, four cores are working during each **processor cycle**.

SUBJECT VOCABULARY

processor cycle the process of fetching a program instruction from memory, decoding the actions required by the instruction and then executing those actions

Processor speed is measured in clock cycles per second. This is the number of times per second the processor can carry out one or more instructions. Clock cycles are measured in units called hertz (Hz), kilohertz (kHz), megahertz (MHz) and gigahertz (GHz).

SUBJECT VOCABULARY

clock cycles per second used to measure processor speed; the number of times per second the processor can carry out one or more instructions

▼ Table 3.2 Measuring clock cycles

Name	Abbreviation	Clock cycles per second
Hertz	Hz	1
Kilohertz	kHz	1000
Megahertz	MHz	1000,000
Gigahertz	GHz	1000,000,000

Revision questions

(2023 Nov)

1). Gail uses digital devices for work.

(a) Describe how the size of RAM can impact the user experience. (2)

(b) State the number of instructions that can be executed every second by a 3.5 GHz processor. (1)

(c) A CD drive is a type of optical storage device.

(i) Give **two other** types of optical storage device. (2)

(ii) One disadvantage of optical media is that it has a lower storage capacity than solid state media. Explain **two other** disadvantages of using optical media rather than solid state media. (4)

(d) Gail's laptop uses memory management.

(i) Which **one** of these has the role of managing memory? (1)

- A. Applications
- B. Control software
- C. Operating system
- D. Utilities

(ii) Explain the purpose of memory management. (2)

(iii) Which **one** of these is the largest amount of data? (1)

- A. 0.2 GiB
- B. 2000 KiB
- C. 0.02 MiB
- D. 0.002 TiB

(iv) There is often no fee required to use open source software.
Give **two** other characteristics of open source software. (2)

(v) Which **one** of these is the purpose of application software? (1)
A. To carry out tasks for the user
B. To protect against malware
C. To secure the operating system
D. To spool print jobs

(vi) Which **one** of these is the reason why screen resolution is important? (1)
A. Higher resolution means larger screens have less pixelation
B. Higher resolutions cannot be used on larger screen sizes
C. Larger screens will pixelate more when users are further away
D. Lower pixelation is achieved with lower resolution screens

2). (2023 June)
Camille uses digital devices for work.
(a) A distance sensor is used as an input for an embedded system in a car.

(i) Describe how a distance sensor is used by an embedded system in a car. (2)

(ii) Which **one** of these is another example of an input for a device? (1)
A. LED
B. Monitor
C. Scanner
D. Speaker

(b) State the number of instructions that can be executed every second by a 3.2MHz processor. (1)

(c) GPS can be used to monitor people's movements.
State **one** other way of monitoring people's movements. (1)

(d) Camille's laptop uses secondary storage.

(i) Which **one** of these is a feature of a hard disk that allows data to be read?

- A. It allows electrons to be stored
- B. It is reflective
- C. It is magnetically charged
- D. It connects directly to the network

(ii) Here is a diagram that shows secondary storage.
Four files (A, B, C and D) are stored on it. Each file is made up of several blocks (1, 2, 3, etc) (1)

			C1	A1	A2		D1		B1	C2	C3		B2	D2	

Complete the diagram to show the state of the storage after running a defragmentation utility. (2)

(iii) State **one** type of storage media that stores data as electrical charges. (1)

(iv) Which **one** of these is the largest amount of data? (1)

- A. 0.010 GiB
- B. 0.100 TiB
- C. 0.001 MiB
- D. 1.000 KiB

(v) State **two** characteristics of hard disk drives that make them more suitable for use with servers than magnetic tape. (2)

(vi) Which **one** of these is a reason for using local storage rather than online Storage? (1)
A Data stored locally is harder to intercept
B Local storage media cannot be encrypted
C Online storage cannot be backed up automatically
D Online storage is always compressed

(e) Which **one** of these is processed by the CPU? (1)
A. Connectivity
B. Embedded systems
C. Hardware
D. Malware

(f) Camille's laptop uses memory.

(i) Which **one** of these statements is true? (1)
A. ROM is never used in laptops
B. ROM always stores more instructions than RAM
C. ROM contains values that can be changed by applications
D. ROM is used to store startup files

(ii) Give **one** drawback of increasing the size of random-access memory. (1)
(g) Which **one** of these is a function of an operating system? (1)

- A Convergence
- B Media access control
- C Memory management
- D Office productivity

3). (2022 May)

(e) Letta uses a camera with a 128 GiB memory card.
Each photograph uses 3 MiB of storage.

(i) Construct an expression to show how many photographs can be stored on the memory card. (2)

(ii) Which one of these is the type of storage used by the memory card? (1)

- A. Cloud
- B. Flash
- C. Magnetic
- D. Optical

(iii) State one reason why Letta's camera uses ROM. (1)

(iv) State one benefit to Letta of the camera software using compression. (1)

(f) Explain one advantage of increasing the speed of the camera's processor. (2)

(g) Letta backs up some photographs using an optical disk drive.

(i) Complete the labelling of this diagram of an optical disk drive. (2)

(ii) Describe how an optical disk drive reads data from a disk. (4)

(iii) State one type of optical media Letta could use with the optical disk drive. (1)

(h) Cameras and camcorders are examples of products that use an embedded system.
Give one other example of a product that uses an embedded system. (1)

Letta arrives at a hotel.
(i) Letta fills in a form at the hotel reception desk.
Which one of these is an OCR reader used for? (1)

A Finding data
B Opening e-books
C Recognising barcodes
D Scanning text

4). (2022 May)
Letta downloads software to her laptop.

(a) Explain two reasons why locally installed software is used for editing video. (4)

(b) State two purposes of communication software.

(c) Explain why systems software should be updated regularly. (2)

(d) List two peripheral devices that could be used to input text by people who are unable to use a mouse and keyboard. (2)

(e) Explain one benefit of using defragmentation after installing software on a magnetic hard disk. (2)

(f) State the type of utility software that reduces the size of a file. (1)

5). (2021 Nov)
1 Kay uses a laptop for work.

(a) Which **one** of these features would be improved if she used a desktop replacement? (1)

- A. User interface
- B. Energy consumption
- C. Portability
- D. Performance

(c) Kay makes copies of her work files. (2)
One reason magnetic tape is used for this is because it can store more data than other storage media.
Explain **one other** reason magnetic tape is a good choice. (2)

(d) Kay often prints her work.

(i) Describe how an inkjet printer works. (2)

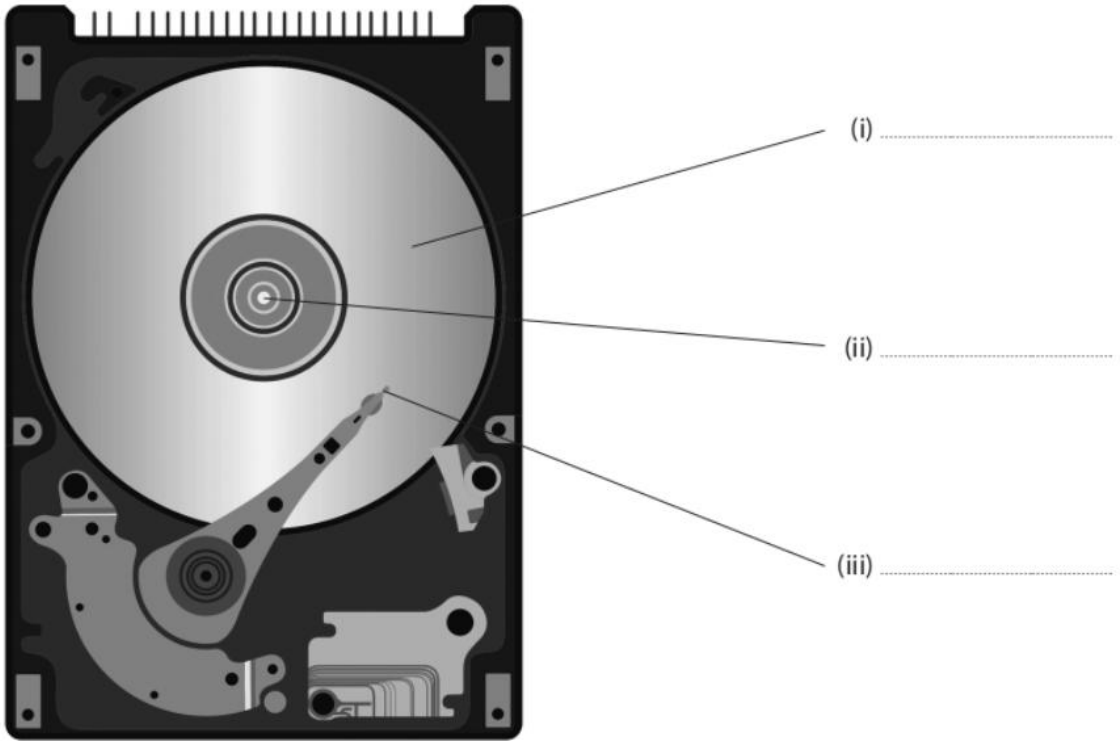
(ii) A printer has 32 MiB of cache memory.
Construct an expression to show how many bits are in 32 MiB. (3)

(iii) State the output device that would produce this object.

(e) Draw one straight line from each characteristic to the correct hardware. (3)

Characteristic	Hardware
Has the largest capacity	Compact disc
Stores applications while they are in use	Magnetic disk
Stores instructions needed to load the operating system	Random access memory
	Read only memory

(f) Complete the labelling of this image of a storage device. (3)



(g) Explain one benefit of increasing the size of RAM in a laptop. (2)

(h) Explain why print spooling is necessary. (2)

6). (2021 Nov)
Kay uses a range of software.

(a) State the type of utility software that prevents data from being understood without using a key. (1)

(b) State **one** reason why data is compressed before being transferred across a network. (1)

(c) Describe how utility software can reduce access times for large files stored on magnetic media. (2)

(d) State **two** types of application software. (2)

(e) Which **one** of these identifies how OMR recognises text? (1)
A. Magnetic
B. Online
C. Optical
D. Random

(f) Describe how application software is different from systems software. (2)

7). (2020 Nov)
(b) Which one of these uses magnetic media? (1)

- A. Solid state disc
- B. Flash disc
- C. Hard disc
- D. Optical disc

(d) The amount of RAM in a computer can be increased.

(i) Explain one benefit to the user of increasing the amount of RAM. (3)
(ii) One characteristic of RAM is that it can be increased.

Describe how two other characteristics of RAM and ROM affect their use. (4)
(f) Which one of these is a type of storage media?

- A. CD drive
- B. Magnetic tape
- C. RAM
- D. SSD

(g) The laptop can store 128 GiB of data.
Construct an expression to show how many bits are in 128 GiB. (3)

8). (2020 Nov)

(b) The laptop has a built-in keyboard and mouse.
Draw a diagram to show how Sachini can connect two other devices to the laptop that will enable her to control a game.
Label each device and the connectivity you use in your diagram. (3)

(d) Describe the function of a web browser. (2)

(e) Describe how Sachini can update the game software. (2)

(f) Give **two** reasons why Sachini should update the game software. (2)

(g) The game is stored on a DVD-R.

Explain why the game does not require rewritable optical storage media. (2)
(h) The laptop uses a fingerprint scanner.
Which one of these describes this device? (1)

- A. Media support
- B. Expansion capability
- C. Security feature
- D. Storage

11). (2020 Nov)
(d) The payment system uses an open-source operating system.
(i) State what is meant by the term 'open-source software'. (2)
(ii) State two functions of an operating system. (2)

12). (2019 May)
Kiki buys a smartphone.

(a) The smartphone uses a sensor that detects movement of the device.
One way in which the smartphone uses data from the sensor is to switch itself off if dropped.
Give two other ways in which the smartphone could use data from the sensor. (2)

(f) The smartphone has a 4 GHz CPU.
Describe the function of a CPU. (2)

(g) The smartphone uses application software.
Describe the purpose of application software. (2)

(h) Explain **one** benefit of using solid state storage with a smartphone. (2)

(i) Kiki's smartphone uses an open-source operating system.
Which **one** of these describes the source code in an open-source operating system? (1)
A. It is owned by a company
B. It is made available to users
C. It is more secure
D. It uses less processing power