# GCSE Digital Technology

## Unit 1: Digital Technology (Core Unit)


# Theory Booklet

### Contents

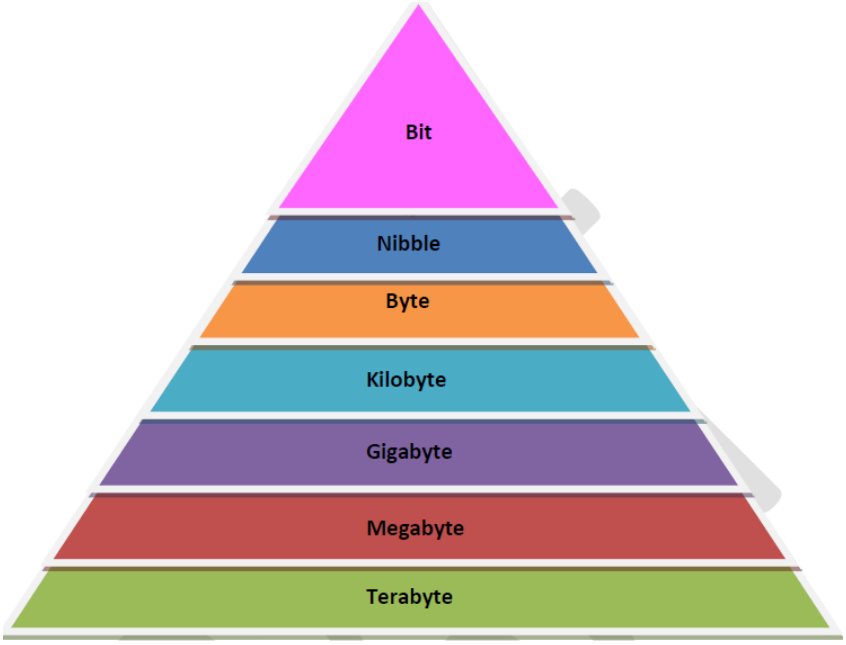
This section includes:

1. Digital Data
2. Computer Hardware
3. Software
4. Network Technologies
5. Spreadsheet Applications

# 1. Digital Data

**Definition:** Data is raw facts and figures with no meaning.

| Data Size | Data Units | Definition |
|---|---|---|
| 1 Bit | 1 Binary Digit | The smallest unit of storage is a bit. |
| 1 Nibble | 4 Bits | |
| 1 Byte | 8 Bits | |
| 1 Kilobyte | 1024 Bytes | |
| 1 Megabyte | 1024 Kilobytes | |
| 1 Gigabyte | 1024 Megabytes | |
| 1 Terabyte | 1024 Gigabytes | |




| Data Type | | Explanation | Example |
|---|---|---|---|
| Numeric | Integer | | 24, 152, 1000, -23, -12 |
| | Real | decimal | 1.34, 2.6, -0.124, -4.53 |
| Date/Time | | Long date<br>Medium date | |

<table>
<tr><td></td><td>Short date<br>Long time<br>Medium time<br>Short time</td><td></td></tr>
<tr><td>Character</td><td>A letter, number and symbol are all known as a character</td><td>A, 5, &</td></tr>
<tr><td>String</td><td>This is also sometimes known as ‘text’<br>A string allows letters, numbers, punctuation marks and symbols to be entered.</td><td><table><tr><td>Name:</td><td>Mary Black</td></tr><tr><td>Address:</td><td>1 Main Street,<br>Any town,<br>Co Anywhere</td></tr><tr><td>Email</td><td>mblack@mail.com</td></tr><tr><td>Car Reg</td><td>ONZ 7182</td></tr></table></td></tr>
<tr><td>Currency</td><td></td><td></td></tr>
<tr><td>Boolean</td><td>Yes/No or True/False</td><td></td></tr>
</table>

## Representing Images

### Pixels
The smallest unit of a picture which can be edited.

### Resolution

Resolution – This is the measure of the quality of an image. The higher (number of pixels) the resolution is, the better the quality of the picture.

**DPI – Dots per inch**

## Bitmapped Images

.

**Definition - Graphics made up of pixels which provide high quality These cannot be zoomed/scaled**

## Vector-based Images

**Definition** – Graphics made up of objects which can be zoomed/scaled

Differences between vector-based and bitmap images:

- Vector graphics can be resized without pixilation whereas bitmap graphics become pixelated.

- Vectors are made up objects Bitmaps are made up of pixels.
- Bitmaps are made up of pixels meaning they depend on resolution for quality whereas vector graphics do not depend on resolution for quality.

Summary table:

| | **Bitmap Graphic** | **Vector Graphic** |
|---|---|---|
| **What are they made up of?** | Pixels of different colours. | Objects. |
| **What can be edited?** | Individual pixels. | Individual objects. |
| **What is the file size?** | Large, as the computer stores details of every pixel. | Small, as the computer stores details of objects, which do not require much memory. |
| **What happens when they are resized?** | They lose quality. | They do not lose quality. |
| **How real do they look?** | Real. | Not real (many of them look like cartoon images). |
| **Native formats that the software can read** | BMP. | SVG. |
| **Common file formats** | BMP JPEG, GIF, TIFF, PNG. | |

Buffering and Streaming of Moving Image Files

Streaming

Allows a video to be viewed without a time delay or download. i.e. Real-time

Advantages:

- The user does not have to wait for the entire file to download to their computer.

## Buffering

This is a part of memory used to store the downloaded part of the video before watching it.

## Representing Sound

### Sample Rate (Sampling Frequency)

The sample rate is the quantity of samples taken per second. It is measured in Hertz (Hz).

Consider the original example which had a sample rate of 1 kHz:

### Bit Depth (Sample Resolution)

The bit depth is the number of bits that is allocated per sample taken.

### Bit Rate

The bit rate is the number of bits required to store 1 second of sound. The unit of measurement is bits per second (bps) or kilobits per second (kbps).

Bit rate is a straightforward calculation:

$$\text{Bit depth} \times \text{Sample rate} = \text{BIT RATE}$$

## Data Portability

Data portability is the ability to transfer data from one system or software application to another without having to re-enter the data

### JPEG – Joint Photographic Experts Group

- JPEG is one of the image file formats supported on the web.
- JPEG is a lossy compression technique

### TIFF – Tagged Image File Format

- This is a graphics file format and stores bitmapped images.

### PNG – Portable Network Graphic

- PNG is a compressed, bitmapped image file type that was initially developed for online image sharing.

PICT – Graphic File Format

- PICT

GIF – Graphic Interchange Format

- Graphics Interchange Format, another of the graphics formats supported by the web usually animations.

TXT - Text File/ASCII American Standard Code for Information Interchange

CSV – Comma Separated Variable

- A CSV file – Comma Separated Value

RTF – Rich Text Format

- This file format allows users to transfer data between different applications.

MPEG – Moving Picture Experts Group (MP3 for music and MP4 for video)

- Video files can be stored in a variety of formats e.g. MPEG, AVI. Short for Moving Picture Experts Group.

MP3 – MPEG Audio Layer 3

    - Produces high quality music files which are greatly compressed. Files are much smaller than other compressed music files e.g. .wav

MP4 – MPEG Video Layer 4

- MP4 is used for Blu-ray and also for iPod video files (they are often called MP4 files as well).

### 1.1.1 MIDI – Musical Instrument Digital Interface

Example garageband

AVI - Audio Video Interleave

- multiple video streams playing back from 1 file.

PDF – Portable Document Format

- PDF (Portable Document Format) is a universal file format developed by Adobe® - used on various platforms

WAV – Waveform Audio File Format

- Sound file

WMA – Windows Media Audio

- Sound file.

Data Compression

Data Compression is the process of trying to reduce the size of a file.

Two types of data compression include:

- Lossless Compression – the image data is stored without any loss of quality or data – uses a program called WinZip
- Lossy Compression – the data is stored by stripping out any unnecessary data and reducing the quality of the image. Example JPEG

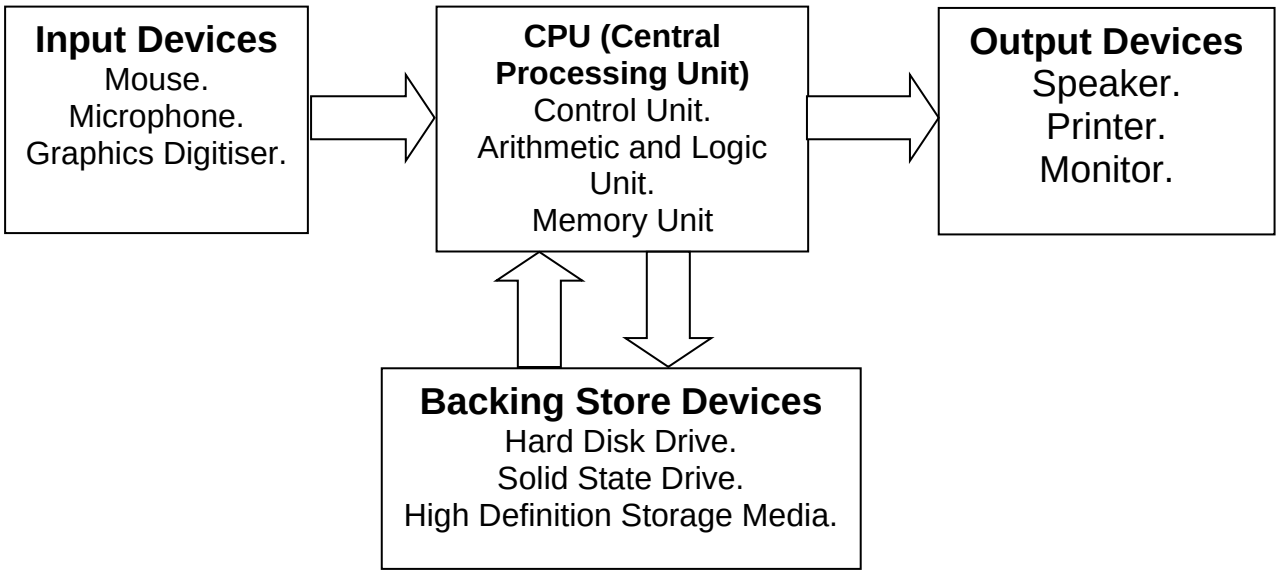
***Software for Compressing - Zip – WinZip***

Advantages of compressing files:

- Reduces the file size/ less storage space needed.
- Faster upload and download.

## 2. Computer Hardware

The following diagram illustrates a typical computer system:




### 1.1 CPU – Central Processing Unit

**Clock speed is how many instruction cycles the CPU can operate per second. Measured in Ghz e.g. 5Ghz CPU performs 5 billion instructions per second**

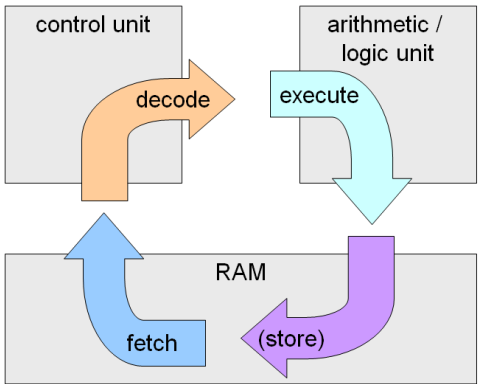
Fetch-execute cycle.

There are three main components of a CPU:

- Control Unit (CU).
- Arithmetic and Logic Unit (ALU).
- Immediate Access Store (IAS).

#### 1.1.1 Control Unit (CU)

- To decide which instruction to carry out next and fetch it from memory.




## 1.1.2 Arithmetic and Logic Unit (ALU)

This component processes data that requires arithmetic calculations to be carried out, such as addition, multiplication, subtraction or division. It also performs logical comparisons to assist with decision making by using logical operators AND, OR and NOT.

## 1.1.3 Immediate Access Store (IAS)

This component stores all programs and data temporarily whilst they are in use.
During the fetch-execute cycle, instructions are fetched from their specific storage location in the IAS using an address.

## Fetch-execute cycle

The CPU includes a number of registers.

## Program Counter (PC)

A program counter is a CPU register that stores the address (memory location reference) of the next instruction to be fetched...

## Memory Address Register (MAR)

The address of the current instruction or data being executed is temporarily stored in the MAR.

## Memory Data Register (MDR)

This register will temporarily store data being fetched from or written to the main memory of the CPU.

## Instruction Register (IR)

This register temporarily stores the current instruction to be decoded and then executed, having been fetched from the main memory.

## Accumulator (ACC)

The accumulator is a dedicated register which is part of the ALU. When calculations take place on data, the results are initially stored in the accumulator before being transferred and stored in the main memory. Therefore, it is the default location to store any calculations performed by the ALU.

## **Factors that influence the speed of processing**

## Clock speed

The clock speed is an indicator of the speed at which the CPU can operate. (GHz)

## Cache

Cache memory - small, fast located close to the processor. Stores frequently used instructions

## Processor Core

Dual – 2 processors
Quad – 4 processors

## Input, Output and Storage Devices

### Input Devices

### Microphone

This input device enters normally analogue sound into a computer system.

| **Advantages** | **Disadvantages** |
|---|---|
| • It is useful for a disabled person. | • Background noise causes |

| | |
|---|---|
| | interference when recording. |

Mouse

Pointing device

Graphics Digitiser

This is an input device which uses a graphics tablet (a flat surface) and stylus pen.

| Advantages | Disadvantages | Applications |
|---|---|---|
| • Makes entering some images such as maps very easy.<br>• Allows freehand | • Expensive.<br>• Hard to enter text. | • Transferring a map to a computer system.<br>• Putting architectural plans onto a computer. |

Touch Screen (Also an output device)

An input device in which the user touches a screen and the computer calculates where the finger is touching the screen and acts accordingly. They can also detect other objects such as a stylus.

| Advantages | Disadvantages |
|---|---|
| • No need for keyboard.<br>• More robust.<br>• No special skills required to use it.<br>• | • A special monitor is needed.<br>• |

Output Devices

Speakers

A speaker is an output device which provides sound provided the computer system has a sound card installed.

Printers

The speed is measured in pages per minute (PPM).

Laser Printer (Non-Impact Printer)

This is a page printer which works by using a laser beam to attract toner in the required positions onto a page. It then burns this toner into the page thus making the pattern permanent.

| Advantages | Disadvantages | Applications |
|---|---|---|
| • Very good quality output.<br>• Faster than an inkjet. | • Moderate to expensive cost, although purchasing costs have reduced.<br>• Toner can be expensive. | • Suitable for most purposes, in particular high volume printing. |

3D Printer (Impact Printer)

Usually cube shaped with a transparent “door” that can be opened to remove the finished product. The “product” is created in layers.

| Advantages | Disadvantages | Applications |
|---|---|---|
| • Streamlines production and design processes.<br>• Saves time and money at the initial product development. | • Equipment is very expensive.<br>• There is a wide range of printing materials from plastics, ceramics, metals and many others. The price difference between different materials is huge. | • Prototyping in the Medical, Aerospace, Automotive, Jewellery, and Art industries. |

Storages Devices

Computer memory is measured in bits

Hard Disk Drive (HDD)

This is a magnetic storage device consisting of one or more discs inside a metal case usually.

| Advantages | Disadvantages | Applications |
|---|---|---|
| • Relatively cheap.<br>• Large capacity storage.<br>• Faster data storage and | • They can fail and are prone to damage upon impact, leading to lost or corrupt data. | • Storage of computer programs and personal files. |

| | | |
|---|---|---|
| retrieval than most storage mediums. | • Not as portable as other storage mediums, due to size, weight and internal location. | |

## High Definition (HD) Storage Media

Computers today need as much storage as possible, they need equipment that can store high quality data. This includes HD-DVD or Blu-Ray, optical devices. Blu-ray is an optical disc format used to store high-definition video as well as games.

| Advantages | Disadvantages | Applications |
|---|---|---|
| • Blu-Ray and HD-DVD disks work the same way as DVD disks but can hold more high quality data. Better picture, better sound than previous optical media. | • You need dedicated players.<br>• With so much data it can take time to load a film. | • To store large amounts of high-quality data, such as films. |

## Solid State Drive (SSD)

A collection of memory chips controlled by its own software.

| Advantages | Disadvantages | Applications |
|---|---|---|
| • Portable<br>• Disk defragmenting is not required.<br>• Less power requirements. | • | • In some machines these are replacing hard disk drives. |

## Memory Cards

Memory cards are capable of storing a wide range of data files, such as audio and video clips, images, and text documents. Used in Digital Cameras and Mobile Phones.

## Smart Cards

Bank cards use a form of flash memory known as ‘chip and PIN’.

Memory

Random Access Memory and Read Only Memory

Memory can be classed into two types:

- **Read Only Memory (ROM). – Used to store the BIOS**
- **Random Access Memory (RAM) – The working memory**

ROM stands for Read Only Memory

RAM stands for Random Access Memory.

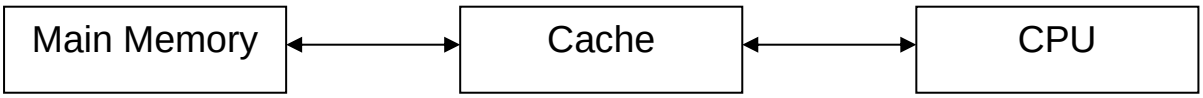
| ROM (Read Only Memory) | RAM (Random Access Memory) |
|---|---|
| • Data remains in memory when the computer is switched off **(non-volatile).**<br>• ROM means that you can read what's on the memory but you cannot change it<br>• ROM is typically less than 2MB in size.<br>• Used to store boot up program. | • Data disappears when switched off **(volatile).**<br>• It is faster accessing information than the hard drive.<br>• Used to store programs user data not yet saved.<br>• RAM allows you to switch between multiple windows. The more windows open the slower the computer will run.<br>• Most computers are sold with 1-4GB of RAM.<br>• Amount of RAM can impact on computer performance. |

**Note:** The amount of RAM a computer has can affect its performance – more RAM will improve a computer’s performance. More RAM will allow multi-tasking/ more programs open at once.

The processor will run programs when a phone is switched on but cannot store user data when the phone is switched off.

Cache Memory

A special type of RAM is called Cache Memory. It is memory that sits between the main memory and the Central Processing Unit (CPU).




It helps performance by storing frequently used programs in the cache memory and then if the user requests this data it is closer and so loads faster.

**Remember** - **Cache memory is Volatile and it is very small, fast memory located close to the CPU.**

## Software

### Applications Software

Applications software includes the everyday programs that you use such as Word Processors, Spreadsheets and Databases etc.

### Systems Software

The main functions of systems software are as follows:

- Allocating memory – The operating system organises the use of main memory between programs and data files.
- Storage – The operating system can manage the storage of data and files.
- Processing time – System software allocates processing time between the running programs and the users.

Systems software includes the Operating System and Utility Programs that control how the hardware of a computer works. An example would be:

- Operating System (Windows).
- Utility Program (WinZip).
- Drivers.

During a computer boot up the following sequence of events happen:

- Computer is switched on.
- The program in ROM is run / Boot up program is run.
- System configuration check / Memory check/ Hardware/ Peripheral check/ BIOS (Basic Input Output System) check.
- Operating system/ Software is run.

The difference between systems software and applications software:

- Systems software is often described as the interface between computer hardware and user application programs. It enables the user to operate its hardware and applications software.
- Applications software enables the computer to do a particular task such as word processing.

Operating System

**Purpose** of an Operating System:

- Allows the hardware/ software to communicate.
- Provides an interface between the user and the computer.
- Run software.


**Functions** you would expect an operating system to perform:

- Provide an interface between the user and the computer.
- Allows the user/ software to communicate with hardware/ system.

- Allocate internal memory (RAM) to programs and data currently being used.
- Manages system resources
- Controls peripheral devices.
- Error handling.
- Management of security.

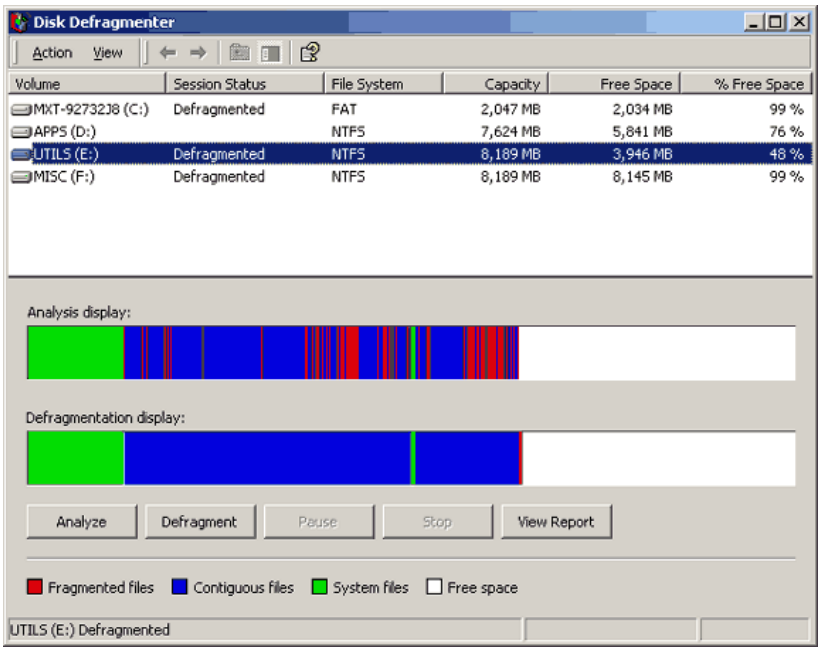
Utility Program (WinZip)

Some of the specific applications carried out by the utility program are:

- Disk defragmenting.
- Task scheduling.
- Backup.
- Restoring data.

Disk defragmenting

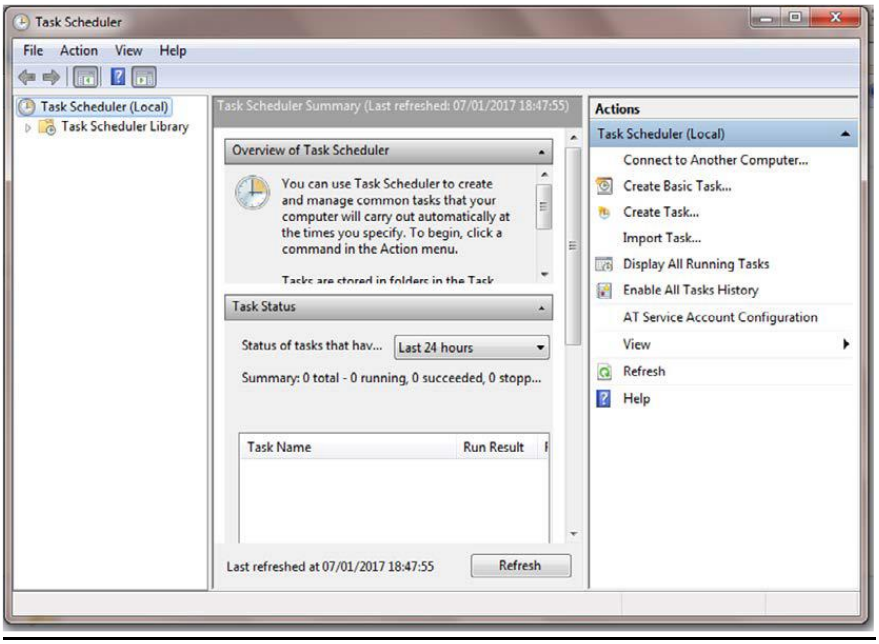
Rearranges the data on a hard disc so that all the data is stored together and it becomes quicker to access the files.




3.2.2.1 Task Scheduling

This is when the CPU will allocate time for each task or program that the computer has running.

You can use the task scheduler to ask the computer to perform specific tasks at times you choose for example setting it to run your antivirus software at night!! Below is an image of a typical task scheduler.




## Backup

A second copy of a file made and stored on a different storage device incase the first gets damaged or lost.

## Drivers

This is a piece of software supplied with a peripheral device which inserts the program/ code to allow the device to work on the computer. E.g. Printer/ keyboard etc.

## Anti-virus Software

Antivirus software is used to detect and quarantine or remove malicious software from the computer system.

Quarantine is isolating any files that are suspected of containing a virus.

## Modes of processing

### Real-time processing

In real-time processing, data is processed **immediately after it is input**. The output generated is processed quickly which influences the next input received.

Applications that use real time processing include:

- Airline/ concert booking systems.
- Online stock control systems.
- Air traffic control systems.

### Batch processing

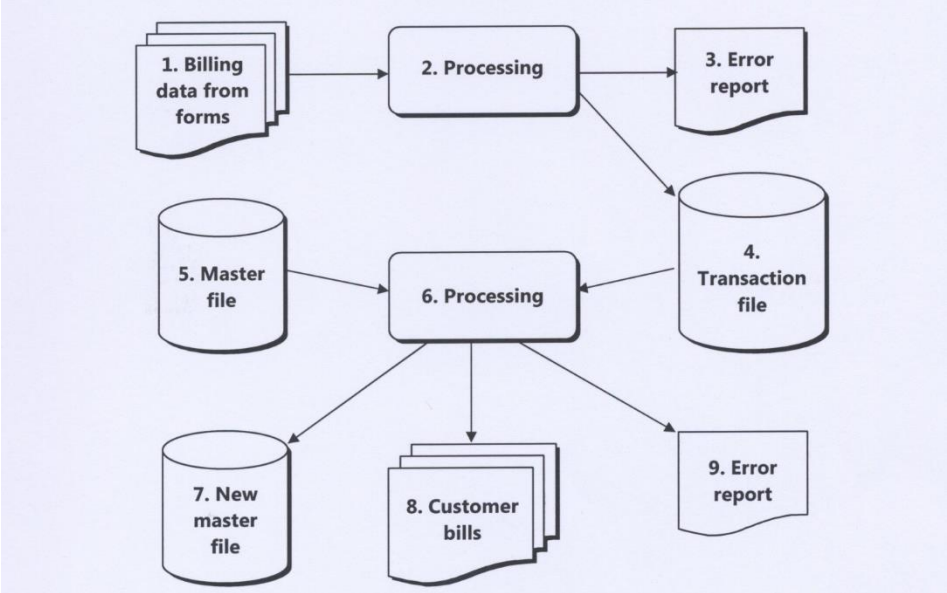
Batch processing involves collecting groups (or batches) of similar data over a period of time (days, weeks, months) and then inputting the data at an agreed time.
These batches of data are then processed collectively without human involvement.
Carried out at night.

Applications that make use of batch processing include:

- Billing systems (electricity/ gas/ telephone).
- Payroll systems (weekly/ monthly).
- Banking systems (monthly customer statements).

Reasons why batch processing is used for these applications include:

- No human interaction.
- High volume processing completed together.
- All bills need to be produced at once/ all bills calculated the same way.
- Data can be collected over time then processed together.
- Can be done at suitable times such as overnight.




**Definition:** A transaction file is used to update the master file. A file used to hold readings/ current data/ current readings.

**Definition:** A master file provides customer's details for use on the bill and it provides the previous reading to compute the units used.

## Multi-user processing

A multi-user system involves many users at different computers sharing the processor of a powerful computer.

# Network Technologies

## Networks (WAN and LAN)

- LAN – Local Area Network.
- WAN – Wide Area Network.

A LAN tends to cover a small geographical area and uses cables to connect.

A WAN tends to cover a very large geographical area and it can use fibre optic and satellite for transmission.

| **LAN features** | **WAN features** |
|---|---|
| • A LAN is a group of computers and network devices connected together, usually within the same building.<br>• A LAN is useful for sharing resources like printers and files | • A WAN covers a large geographical area and this may also include different countries.<br>• Relatively expensive with regard to hardware such as satellite transmission and routers. |

## Worldwide Web, Internet, Internet of Things and Intranets

### World Wide Web – Best example of a WAN

- An application which runs on the Internet.

### Internet – This is the Hardware

- Network of networks.
- Does not contain information.
- Provides transport links for information to pass between computers.
- Contains services such as:
    - Email
    - Instant messaging
    - World Wide Web

### Internet of Things

**This is a concept where all physical objects will be connected to the internet.**

Smart home devices include systems to control lighting, heating or appliances such as vacuums, security cameras, ovens and fridge-freezers.

In the home, these devices can connect to a Wi-Fi network and be monitored by the user via an app on a phone or tablet.

Activity trackers and smart watches are becoming more common and use Bluetooth to connect to a smartphone which can show the user details of their step count, heart rate and track workouts.

| Advantages | Disadvantages |
|---|---|
| • There is an increased convenience for users, as they can monitor and control devices remotely or automate activities that they would previously have carried out manually. | • Due to the rapid expansion of appliances available on home and office networks, there is also an increased potential for hackers to attempt to access devices. |

Intranets

A private network website within an organisation.

- Not accessible by the public – only authorised users can log on and use it using a username & password.

Network Communications Technologies

Bandwidth refers to the range of frequencies through which data can be transmitted. It is measured in bits per second. The wider the bandwidth the more data can be carried therefore the faster the transmission speed.

**Definition of bandwidth: The rate at which data can be transmitted. It is measured in bits per second.**

How bandwidth affects the performance on a computer system:

- High bandwidth provides good quality output, for example, sound and picture while Skyping or streaming online.

- Low bandwidth may cause poor quality output  sound , for example, poor sound and picture or lagging while Skyping or streaming online.

Wi-Fi

Wi-Fi (Wireless Fidelity) It is a set of standards for using short range radio waves to allow computing devices to connect to a LAN or to the Internet.

| Advantages | Disadvantages |
|---|---|
| • Wireless connectivity between devices and computers on a network.<br>• Relatively cheap nowadays.<br>• Easy to connect to a range of enabled devices. | • Requires the computer/ device to be in range of a wireless router (generally the further it is from the router, the weaker the signal).<br>• Not as secure as wired connections. |

Potential problems with using Wi-Fi are:

- **Security** - Wi-Fi routers can be configured to require a password or can be made public for open access by any Wi-Fi enabled device.
- **Range** - The further away that a device is from the router, the weaker the radio signal will be.
- **Traffic** - Wi-Fi uses radio technology, so the number of devices that can connect to the wireless network is dependent on the number of channels available on the wireless router.

Bluetooth

This is a type of radio communication and networking protocol combined that lets devices that are within close range of each other communicate and exchange data (around 15ft). Bluetooth uses less power than other wireless technologies and is much cheaper

| Advantages | Disadvantages |
|---|---|
| • Data can pass through solid objects.<br>• Cheap<br>• Each to connect to a range of enabled devices. | • Data can only be transferred over short distances.<br>• Slower transfer speeds than other wireless technologies. |

Optical Fibre

**Fibre optic cable carries data in pulses of light** and is **not prone** to interference. It uses light to transmit data and are made of glass or plastic strands.

| Advantages | Disadvantages |
|---|---|
| • Higher bandwidth.<br>• Faster transmission of data.<br>• More secure – light is harder to intercept.<br>• | • Cable is expensive.<br>• Specialist installation required.<br>• |

Mobile Communication Technology – 4G (4th Generation)

| Advantages | Disadvantages |
|---|---|
| • Enables video calling and other services.<br>• Can be used to connect to the internet without requiring a broadband connection.<br>• | • Performance affected by network coverage and signal strength.<br>• Data transfer can be expensive.<br>• High battery consumption. |

Network Resources and their functions

Network Interface Card (NIC)

Each computer on the network should have a Network Interface Card installed to allow the computer to send messages on the network. WNIC – wireless network interface card allows computers to connect to a network without cables e.g. at home.

Network Cables

Used to connect computers to the file server. It can be either copper wire or fibre optics cables. Fibre optic cables have a faster transmission rate than copper wire.

Switch

Is a hardware device that connects a large number of computers together on a network. It will transfer data to the correct computer.

Router

A hardware device which allows two or more computer networks to connect to each other.

File Server

The main computer in any network.
Functions of a file server include:

- Storing data/ files.
- Storing all software/ system software/ operating system/ programs.
- Managing security on the network.
- Communicating with all devices on the network.
- Managing users' access to the network.

Network Topologies

Bus Network

- In this network, all computers are connected to **a main cable** known as a 'backbone'.
- Data can travel **in both directions** along the backbone.
- If a cable attached to the backbone fails, only that computer will fail to operate. If the backbone cable fails then the whole network will not operate.

**Terminator is used to stop the signals traveling back into network**

Star Network

In this network,

- all computers are connected by their own cable to a **central** powerful computer known as a file server.
- All data on the network must pass through the file server.
- If a cable fails it will only affect the computer it is connected to and the rest of the network will operated as normal.
- An additional computer can be added by attaching it (using its own cable) to the file server.

Ring Network

In this network

- there is no central or controlling computer.

- Each computer is directly connected to two other adjacent computers to form a ring.
- All data **travels in one direction** by visiting each computer in turn until it reaches its intended destination.
- If the cable fails then the **whole network** is affected.

### 5.1.1 Advantages and disadvantages of using a network within an organisation

| Advantages of Networks | Disadvantages of Networks |
|---|---|
| • Peripherals can be shared such as printers and scanners.<br>• Data can be shared.<br>• Users can log on at any workstation to access their files.<br>• | • Expensive to install.<br>• Require specialist knowledge to operate/ manage them.<br>• Potential for unauthorised users.<br>• |

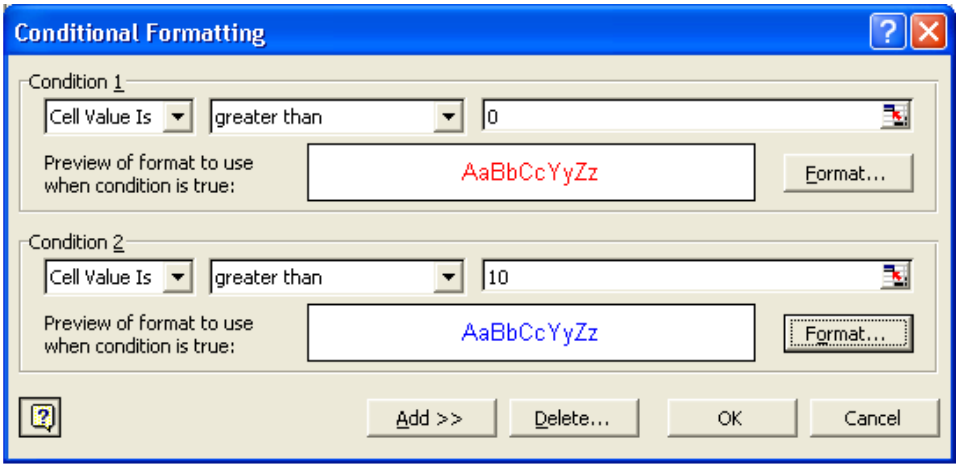
## Spreadsheet Applications

A model is a program which has been developed to copy the way a system works in real life.

It uses mathematical formulas and calculations to predict what is likely to happen based on data recorded about what actually did happen in the past.

A data model can be used to forecast. A business could use a spreadsheet to understand the effects that Price, Cost and 'Items Sold' have on their overall profit. They could set up a data model that links these together and adjust 'Items Sold' to see the effect it has, and so on. Values can be changed within the spreadsheet and they will automatically recalculate the formula.

- Conditional Formatting - alters the formatting of a cell as the result of a condition being matched, e.g. ‘if a cell value is greater than 0, change font colour to red/ cell colour to red/ increase font size etc.
    - Cell formatting can be dependent on more than one condition.




**Note:** Don't forget you can validate data in a spreadsheet just like you can validate data in a database.

Spreadsheet formulae

- Examples of spreadsheet functions are:
  - **SUM, e.g. '=SUM(C3:C20)'.**
  - **AVERAGE, e.g. '=AVERAGE (D3:D20).**
  - **MAX, MIN, COUNT.**
- The big advantage of using a formula is that once the spreadsheet is set up, a value can be changed and the spreadsheet will automatically recalculate the result for you.

IF statements/ logic functions/ V Lookups

- An If statement looks at a condition and returns a value depending on whether the condition was met or not, e.g. '=IF(A5>10,"ON TARGET","TOO LOW")'
  - Within the brackets the first piece of code represents the condition being tested (A5>10), the second ("ON TARGET") represents the value to display if the condition is true, and the third ("TOO LOW") displays the value to be displayed if the condition is false. If the figure in cell A5 is greater than 10 then the outcome will be "ON TARGET". If the figure is less than or equal to 10 then the outcome will be "TOO LOW".
- CountIf is a function that counts the number of cells in a range that meet a given condition e.g. '=COUNTIF (A5:A10,>50)' will count the number of cells in the range A5:A10 whose value is greater than 50.

- VLOOKUP scans the rows in the stated cell range. E.g. '=VLOOKUP(A13,Stock!$A$7:$G$21,2, FALSE)'. It scans the rows in the stated range and brings the data into the given cell, in this case it is A13.

**Advantages of V Lookup**

- Reduces data entry errors.
- Increases efficiency - *supported by a suitable example*.
- If a price changes you only have to change it in the reference table.
- Speed of data entry.

Disadvantages of V Lookup

- If there are errors in the look up table, there will be errors in the result.
- If the item changes value, then I will have to go and change the price sheet as well.
- If you rename or move the table it will not work.
- Data has to be sorted into order.

5.2 Cell References

- Absolute cell reference

An absolute cell reference will remain the same regardless of where it is copied to in a spreadsheet and is denoted by the use of the $ symbol

An advantage of using an absolute cell reference is that only one cell needs to be changed to make changes to other cells.

| Average Payment | Remaining Payment |
|---|---|
| =AVERAGE(C5:I5) | =$B$20-J5 |
| =AVERAGE(C6:I6) | =$B$20-J6 |
| =AVERAGE(C7:I7) | =$B$20-J7 |
| =AVERAGE(C8:I8) | =$B$20-J8 |
| =AVERAGE(C9:I9) | =$B$20-J9 |
| =AVERAGE(C10:I10) | =$B$20-J10 |
| =AVERAGE(C11:I11) | =$B$20-J11 |
| =AVERAGE(C12:I12) | =$B$20-J12 |
| =AVERAGE(C13:I13) | =$B$20-J13 |
| =AVERAGE(C14:I14) | =$B$20-J14 |

Graphs/ Charts in Spreadsheets

- Bar Graphs –
- Pie Charts –
- Scatter Graphs –
- Line Graphs –

Macros

**A Macro is:**
**A program written to perform a repetitive task automatically**.

Spreadsheet uses

- Spreadsheets can be used to predict profit, etc. To do this you could change the value/ price/ cost to show how the profit/ income is affected. You should mention changing a value in cell and how that change would impact on other values.
- You can sort data in a spreadsheet into ascending or descending order by highlighting the relevant columns using the filter and sort option.

## Cyberspace, network security and data transfer

Cyberspace

**Definition:** Cyberspace is a computer network of worldwide network of computers.

Hacking

Hacking is the act of attempting to gain unauthorised access to a computer system.

Pornography

Pornography is the representation of sexual activity. It is present on the internet in the form of videos and images.

Cyber stalking

Cyber stalking is the use of a network or other electronic communications to harass or scare someone. A cyber stalker may be a stranger or someone who the victim knows.

Data theft

Data theft is the act of stealing data from an unknowing victim or organisation with the intent of obtaining confidential information

Denial of service (DoS)

Denial of service is a web server's inability to service clients' requests for web pages. This means that if a user tries to access the web page, the web server is unable to send the page to the user.

Digital forgery

Digital forgery is a criminal act involving the creation of a copy of a document or image with the intent to profit from it.

Cyber defamation

Defamation is the communication of false information that damages a person's or business's reputation. Cyber defamation is the use of the internet to share that false information.

Spamming

Spam is an email or other electronic message that is sent to a person who has not requested it.

Phishing

Phishing is the practice of persuading individuals to disclose private information, such as bank account details or passwords, by sending an email pretending to be from an official body and requesting 'reconfirmation' of data that the organisation should already have.

Network Security

**Definition:** A hacker is a term used to describe a person who gains **unauthorised access** to a computer system.

**Definition:** A virus is a program/ file/ software which is designed to **damage a computer system/** corrupt files/ attack the system/ damage files. Viruses are spread through infected portable storage devices, **email attachments and the internet**.

**Definition:** Worms spread by **replication** and **do not have** to be attached to a document or program; a worm slows down processing on the network while it is reproducing.

**Definition:** Trojan horses that gain entry to a user's computer 'in **disguise**' -the user may think that it is a useful program; a Trojan horse provides hackers with an entry point to the user's computer.

**Definition:** Spam which involves bulk sending of electronic messages to people who have not requested the information; internet users see spam as junk emails which can fill their inbox.

**Definition:** A key logger is a type of spyware which will record every keystroke that a user carries out, and sends it secretly across the internet.

**Definition:** Spyware is **software which is used to gain unauthorised** access to information on a computer. Spyware is malicious software (malware) which is secretly installed on a user's computer

Virus Protection

Anti-virus software protects computer systems from misuse

Encryption

**Definition:** **Encryption is encoding/ scrambling data before transmission using an encryption key. Data cannot be understood in transmission; the key is needed to decode data. Data is unscrambled at destination using a decryption key.**

Usernames and Passwords

Characteristics of a good password:

- Mixture of letters/ numbers/ special characters/ upper and lower case.
- Changed regularly.
- Kept confidential/ Not a recognisable term/ word/ not easily guessed.
- Reference to a minimum length. For example, must be at least 8 characters long

Levels of Access

Sometimes it is necessary to only grant users certain files. For example, in a business the sales person does not need access to payroll files and the wages and payroll personnel do not need access to the sales figures. This is known as tiered levels of access in which different people are granted access to different files.

Example: School pupils, teachers and the Network Manager have different levels of access. Example of levels of access read only and read/write for particular files such as files in Shared Resources.

Backup

Backup is the process of making a copy and storing it in a different place so that if something happens to the original then the copy can be used to restore the system to its original state.

**Definition:** A copy of data in case the original version is lost or damaged.

Methods of backup on a LAN:

- Cloud.
- Magnetic tape.
- External hard drive.

Firewalls

Firewalls are used to control traffic over a network and any networks connected to it. They can be software or hardware-based and essentially **act as a barrier, designed to block unauthorised access whilst allowing outward communication.**

**Definition:** Hardware/ software which will prevent unauthorised access from across the Internet/ filters data. It prevents hacking/ viruses.

Functions of a firewall:

- Prevents files from entering or leaving the network.
- Protects from unauthorised access outside the LAN.
- Can assist in filtering websites.
- Can protect from viruses.

| **Threat** | **How can the manager protect the network?** |
|---|---|
| Virus attack | Install Anti-virus software and update regularly. |
| Hacking<br>Authorised User Misuse | Usernames and Passwords, Encryption, Levels of Access, Firewall |
| Data Loss | Backup |
| Physical Attack e.g. Flood/ fire | Fireproof safe<br>Keep on first floor |
| Attack/ theft | Lock doors, Camera, Security guards |

## Data Transfer

**Definition:** A protocol is a set of rules which govern how data is transferred/ transmitted around a network.

**Definition:** A network protocol is an agreed standard/ set of rules (for sending/ receiving/ exchanging data) on a network.

| Protocol | Explanation |
|---|---|
| TCP/IP | Transmission Control Protocol / Internet Protocol – internet protocol. |
| FTP | File Transfer Protocol – used to transfer large files over internet. |
| HTTP | Hyper Text Transfer Protocol – use to display web pages. |
| HTTPS | Hyper Text Transfer Protocol Secure – used when buying online. |
| SET | Secure Electronic Transaction – is a protocol used by Visa and MasterCard designed to make online purchases much more secure for card users. |

# Cloud technology

## What is Cloud Computing

**Definition:** Cloud computing is using the internet to provide services that would normally be provided by a local area network (LAN).

| Advantages |
|---|
| • Lower Initial Cost: Upfront costs can be kept low because cloud storage and associated applications can be rented from a cloud provider<br>• Unlimited Storage – Because it is transferred over the internet to other servers storage is unlimited.<br>• Automatic software updates<br>• Automatic back-up<br>• corresponding disadvantage. |

| Disadvantages |
|---|
| • Bandwidth Limitations – charges for greater bandwidth.<br>• Potential downtime – Relies on the internet connection so when its off no access.<br>• Security – Risk from hackers |

## Impacts of Cloud Computing

Cloud computing brings potential benefits to many industries, as well as personal users. Two application areas are described below: gaming and file storage and sharing.

### 1.1.1 Gaming

1. Reduced costs from the developers as they don't have to pay high street shops to sell the games.
2. Larger global customer base through the internet.
3. Immediate downloads
4. Better visual effects

Disadvantage

1. Depends on how good your internet is if there are any glitches and if you can stream high quality.

### 1.1.2 Cloud impact on File Storage & Sharing

- Store very large files on servers
- Automatic saving of files
- Stored permanently
-

### 2.2.3 Impact of Cloud computing on file sharing

- Users can collaborate and share files anywhere in the world
- Allows employees in different parts of the world to work on the same project.
- Google Docs is an example.

# 2. Ethical, legal and environmental impact of digital technology on wider society.

### 2.1.1 The Computer Misuse Act (1990)

This act is to do with trying to stop criminals using a computer for their benefit.

- A hacker is a term used to describe a person who gains unauthorised access to a computer system.

- A virus is a self-reproducing program, usually designed to damage data, or to steal data.
    - Viruses are spread through infected storage devices and email attachments.

- Spyware is software which is used to gain unauthorised access to information on a computer. Spyware is malicious software (malware) which is secretly installed on a user's computer. It collects pieces of information about the user such as the websites they have visited and can even monitor keystrokes so that passwords can be captured and used by criminals.
    - Many infected websites that ask the user to install a plugin, will also install 'spyware'.

Examples of when The Computer Misuse Act comes into play:

- Planting a virus.
- Program theft.
- Unauthorised work.
- Deliberate data destruction.
- Fraud.
- Data theft.
- Hacking.

<u>Copyright Designs and Patents Act (1988)</u>

This Act was invented to stop copying material illegally

- The pirating of software that is copyright – Copying or distributing software or any manuals that comes with it, without the permission of the copyright owner.
- Running pirated software - Using software that has been illegally copied.
- Transmitting pirated software.
- Altering pirated software for gain.

<u>The Data Protection Act (1998)</u>

Deals with giving individuals who are the subject of personal data right of access to the data which is related to them.

The eight principles of the Data Protection Act state:

1. Data must be fairly and lawfully processed.
2. Date must be accurate and kept up to date.
3. Data must not be kept longer than is necessary.
4. Data held must be adequate and not excessive for the specified purpose.
5. Data must only be used for the purpose specified.
6. Data must be processed in accordance with the rights of the data user.
7. Appropriate measures must be in force to keep the data secure.
8. Data must not be transferred to a country outside the European Union unless they can ensure adequate protection of the data.

Several people are involved with ensuring that the Data Protection Act is effectively enforced. The following table summarises this:

| | |
|---|---|
| **Data Subject** | • **The** person about whom the data is stored. |
| **Data Controller** | **Responsibility:**<br>• Within an organisation who is responsible for controlling the way in which personal data is processed |
| **Information Commissioner** | **Responsibility:**<br>• Responsible for enforcing the Act.<br>• Makes public aware of their rights |

### 2.1.2 The Consumer Contracts (Information, Cancellation and Additional Charges) Regulations (2013)

- State the rights of the customer when shopping online.
- Full descriptions of products must be provided.
- Customer has the right to cancel within 14 days.
- Digital downloads are not protected.

## 2.2 Moral and ethical considerations


There are many benefits to the increased use of ICT in our lives; however its use has also brought many problems as well.

2.2.1 Impact of GPS and tracking

GPS stands for Global Positioning System.
How does GPS work?

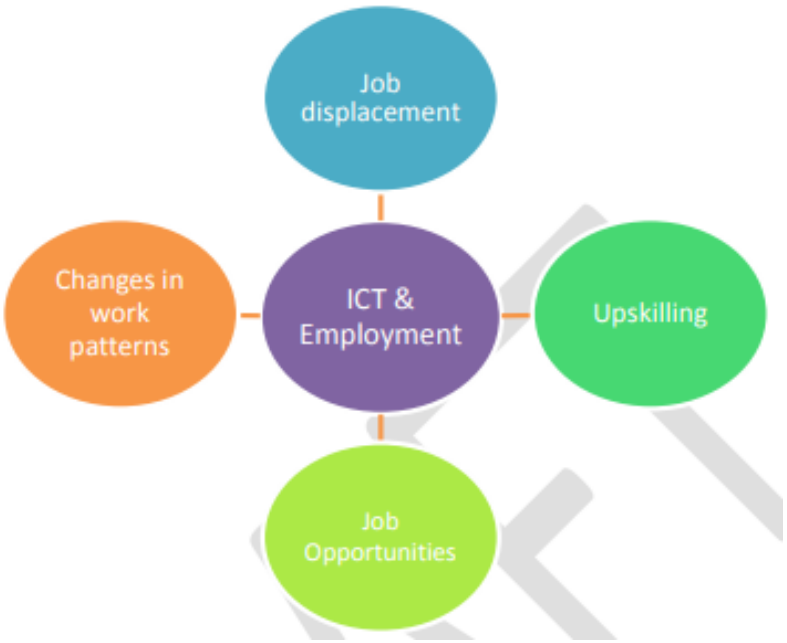
- Satellites transmit signals to earth.
- The GPS device receives these signals.
- The device calculates its location based on the information from at least 3 satellites (Triangulation).
- Then the location is shown on a map that is pre-installed in the GPS device

Uses of GPS:

Satellite Navigation Systems found in cars use satellites to pinpoint the location of the car to within a couple of metres

Changes in employment opportunities, skills requirements and work practices

The introduction of ICT in the workplace over thirty years ago had a




## Job Opportunities

| Advantages | Disadvantages |
|---|---|
| • **More jobs** available in businesses because of increased collection of information due to ICT.<br>• **More engineers** needed to fix computers.<br>• **More web designers** needed to develop and update sites. | • Employees' skills can get outdated very quickly. |

## Job Displacement

Some job roles completely disappeared with the introduction of ICT in the workplace.

| Advantages | Disadvantages |
|---|---|
| • Teleworking is more common for employees.<br>• ICT help for employees can now be received from online operators. | • More competition for jobs as location is not important.<br>• More competition for jobs as skilled workers can be located anywhere.<br>• Robots are more consistent than humans in businesses such as car manufacturing therefore employees are not required as much in this area. |

## Changing Working Patterns

Traditionally the working day for many employees was 9-5. However, the introduction of ICT meant that many organisations could now operate 24/7.

## The need for Upskilling

Employees require continuous training to take account of changing technology and to enable them to carry out their job.

| Advantages | Disadvantages |
|---|---|
| • Organisation can bring skilled trainers to the employees.<br>• In-house training means less expense for the company.<br>• Employees can be trained without the need to interrupt work.<br>• Employees can be trained at their own pace. | • Training may be overwhelming for the employee.<br>• Less personal help available to employees. |

## Teleworking

Working from home using ICT is known as teleworking. Through the use of devices such as laptops, smartphones and PDAs (Personal Digital Assistant),

**Definition: Teleworking is using ICT to enable a person to work from home.**

| Advantages to Employer | Disadvantages to Employer |
|---|---|
| • Reduced overheads and employee expenses (e.g. rent and electricity).<br>• More skilled workers as there is a wide geographical range. | • Difficult to monitor employee work.<br>• Data is potentially less secure. |

| Advantages to Employee | Disadvantages to Employee |
|---|---|
| • Working hours are flexible to suit other commitments.<br>• Allows people with disabilities the chance to work more easily.<br>• No need to relocate if moving to a new job. | • Increased distractions at home can reduce focus.<br>• No colleagues around to provide immediate support (technical and non-technical).<br>• Lack of social interaction with colleagues. |

| | |
|---|---|
| • Reduced travelling costs (and time). | |

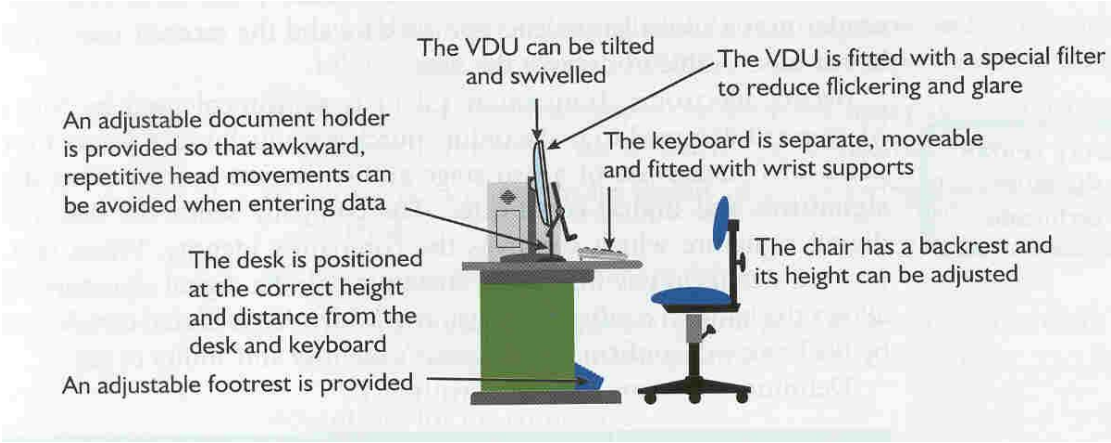
## Health and Safety

There are a number of health problems and injuries which can arise because of the use of

- Lighting.
- Furniture.
- Noise.
- Hardware.
- Software.
- Temperature control.

## Ergonomically friendly devices.

Ergonomically designed workstations reduce the chance of users developing problems such as RSI or back-strain.




## Potential Health Problems

| Health Problem | Causes | Prevention |
|---|---|---|
| Repetitive Strain Injury (RSI) | • Overuse of hand movements such as clicking a mouse which causes pain in the wrists. | • Use a wrist rest.<br>• Make sure the keyboard is at the right hand.<br>• Do not type for long periods.<br>• Press gently on the keys. |
| Headaches | • Eye strain | • Use an antiglare screen. |

| | | |
|---|---|---|
| | • Staring at the monitor for too long.<br>• Sitting too close to a monitor.<br>• Glare from the monitor. | • Position the monitor so there is no glare on the monitor.<br>• Sit at an appropriate distance from the monitor.<br>• Take frequent breaks away from the screen.<br>• Have a tilt and swivel screen. |
| Backache | • Sitting at the wrong angle to the computer.<br>• Sitting too long in one position. | • Use an adjustable chair.<br>• Do not slouch in a chair – sit up straight.<br>• Use a footrest. |
| Eye Strain | • Sitting too close to the computer screen.<br>• Staring at the screen at the wrong angle.<br>• Poor room lighting.<br>• A screen that flickers. | • Have a tilt and swivel screen.<br>• Do not sit too close to the screen.<br>• Have regular eye tests.<br>• Have screens which do not flicker. |
| ELF (Extremely Low Frequency) Radiation | • Working for long periods in front of a computer screen. | • Regularly take a break. |

It is important in the exam if you are asked 3 problems associated with playing computer games etc. over a long time you must not give 3 physical problems. You should answer physical as one problem!! Example of three is shown below.

**Problem 1 - Obesity/ Lack of fitness:**

- Sitting playing computer games for too long.
- Not enough exercise.

**Problem 2 RSI/ Injury/ Neck or Back Pain/ Eyestrain:**

- Repeating the same movement's over and over using joystick.
- Using excessive force when using devices that are linked with remote.
- Sensors.
- Poor posture/ slouching.

**Problem 3 Poor social skills:**

- Playing games instead of interacting with friends.

- Obsessed with virtual world created by game scenario and ignore real world.
- Negative impact/ influence on personality/ behaviour.

## Digital Applications

### Gaming Applications

**Definition:** Virtual reality uses simulations to recreate 'real' experiences in a virtual world.

| Advantages of Virtual Reality | Disadvantages of Virtual Reality |
|---|---|
| • Less cost.<br>• Safer.<br>• Extreme conditions can be simulated.<br>• Monitor performance.<br>• Cannot cause damage to equipment.<br>• Real life experience. | • Not all factors taken into consideration.<br>• Expensive to design/ Implement/ Set-up. |

Hardware devices required for virtual reality gaming:

- HMD (Head Mounted Devices)/ Headset/ Virtual reality visor/ Helmet/ Visor/ Screen.
- Gloves.
- Tracking devices/ Joysticks/ Controller/ Balance Board Bodysuits/ Clothing with pressure points.

### Gaming Applications in Education and Training

## 2.3 Simulation

**Definition:** Simulation is the use of a computer program to predict the likely behaviour of a real-life system.

Other widely used applications of simulation include weather forecasting and pilot training.

Meteorologists use computer simulations to predict the weather.

Trainee pilots often gain experience using a flight simulator.

| Advantages | Disadvantages |
|---|---|
| • Can re-run simulation over and over again.<br>• People and equipment are not put in danger.<br>• Conditions can be customised. | • It can never fully recreate a real-life situation.<br>• The system is expensive to purchase and develop.<br>• It does not deal with all possible situations. |

Differences between simulation and virtual reality:

- Virtual reality provides a real life experience.
- Additional hardware is used with virtual reality systems.
- Virtual reality systems require a lot of processing power.
- Virtual reality allows interaction.
- Virtual reality lets you control the situation.
- Simulation models a real life situation.
- Simulations show you/ predict what could happen.
- Simulations put values into models.

Example of difference: Simulation is different from virtual reality in that you are not trying to convince the pilot that they are in an actual plane but rather train them to fly a plane.

Mobile Phone Applications

Online Banking

| Advantages to the Bank | Disadvantages to the Bank |
|---|---|
| • Less staff will be needed in branches of the bank.<br>• Overheads such as building rental will be reduced. | • Harder to build personal relationships with their customers.<br>• Breach of Banks security – there is always the possibility of a banks security being breached by criminals. |

| Advantages to the Customer | Disadvantages to the Customer |
|---|---|
| • Can bank 24/7. | • Fear of lack of security. |

| | |
|---|---|
| • Can manage finances from anywhere.<br>• Greater access to financial services – can apply for loans and set up standing orders online.<br>• Easy transferral of funds/ pay bills/ other appropriate services, e.g. communication. | • If the web site goes down then customers cannot access their accounts.<br>• Customers' resistance to technology/ fear of technology<br>• Require access to technology/ reliance on technology. |

Security issues surrounding banks

- Banks have to employ specialists to be one step ahead of criminals.
- Investment must be made in coming up with new ways to keep customer accounts secure.
- To prevent hacking.
- Keep customer accounts and details secure.
- Invest in new technology.
- Employ trained personnel.
- Monitor customer accounts/ services.

Online Banking Services

- Change a PIN.
- Block credit/ debit cards.
- Print a balance.
- View a statement.
- Email the bank.
- Transfer money between accounts.

## E-commerce – shopping online

**Definition:** E-commerce is the use of the internet for ordinary commercial tasks such as retail sales and publishing.

| Advantages to the Company | Disadvantages to the Company |
|---|---|
| • Open for business 24/7.<br>• More customers – They now have a global market.<br>• No high street premises needed – Company could run the | • Initial start up costs of website.<br>• Maintenance costs of website.<br>• Potential lack of system security.<br>• |

| | |
|---|---|
| business from any sight as customers browse online and items are posted. This reduces overheads and means they can offer more competitive prices.<br>• | |

| Advantages to the Customer | Disadvantages to the Customer |
|---|---|
| • 24/7 - Shopping can be done from the comfort of your own home 24 hours a day, 7 days a week.<br>• Elderly and disabled people can shop for heavy items and have them delivered without the inconvenience of visiting the store.<br>• Shop in any country - Customers can shop all around the world from their own home.<br>• Competitive prices – As there is more shops to choose from. | • Customers may not have the skills or access for the Internet.<br>• Customers may worry about fraudulent use of their card details.<br>• Not all websites are authentic. Bogus web sites could con customers into giving personal information or card details.<br>• Items may not be as described and may be damaged in the post. |

Security while shopping online

Definition of terms associated with SET:

Digital Certificate: An electronic identification that confirms that the user is an authentic person. A bank will issue this certificate which contains information about the user.

Digital Signature: A code that guarantees a sender's identity. If an unauthorised person decrypts it, the digital signature will be altered; this means that the recipient will recognise that the code has been decrypted.

An easy way to see if the page you are on is secure is:

- **Closed padlock displayed at the bottom of most browsers** – **Look for an unbroken key**
- **URLs will usually start 'https' instead of 'http'** – Hypertext Transfer Protocol Secure.
- **Use a digital certificate/ signature** – This is information sent with a message that verifies that a user is who he/she claims to be.

## 2.4 Online Training

We have already seen how computer simulations are used in the training of surgeons and pilots. Computer-based training, in a more general form, is used much more widely than this.

Online training offers a number of advantages, including the following:

- **Reusability**: Once a learning resource has been created it can be used many times with little additional cost. This compares favourably with the cost of face-to-face training, whereby one or more human trainers must normally be present each time a resource is used.

- **Accessibility**: Online training can take place at a time and location that is convenient for the employee, and allows learners to progress at their own pace.

- **Environmentally Friendly**: Online learning can be more environmentally friendly because employees do not have to travel to participate. There may also be a reduced need for paper documentation as materials can be viewed online.

It should also be noted, however, that some learners feel that online learning experiences are not always as effective as face-to-face ones.

# Database Applications

**Definition:** A database is a collection of related or structured information held on computer (e.g. doctor's records, school roll etc.).

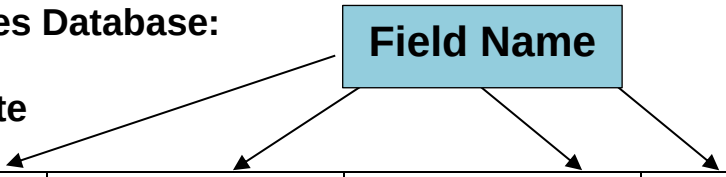
These can be problematic as (disadvantages):

- Data Redundancy - data is repeated unnecessarily.
- Data Integrity - data is less likely to be correct or is unreliable as the same data is stored/ entered several times increasing the likelihood of errors.

**Definition:** A table is the name for each group of similar data with rows for each instance of an entity and columns for each attribute.

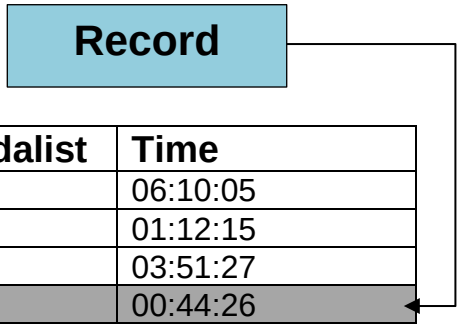
**Olympic Games Database:**

**Table 1: Athlete**




| Athlete_ID | Surname | Forename | Team |
|---|---|---|---|
| A001 | Van Avermaet | Greg | BEL |
| A002 | Cancellara | Fabian | SUI |
| A003 | Van Der Bruggen | Anna | NED |
| A004 | Armstrong | Kristin | USA |
| A005 | Fugslang | Jacob | DEN |
| A006 | Dumoulin | Tom | NED |
| A007 | Johansson | Emma | SWE |
| A008 | Zabelinskaya | Olga | RUS |
| A009 | Majka | Rafal | POL |
| A010 | Froome | Christopher | GBR |
| A011 | Longo Borghini | Elisa | ITA |

**Table 2: Event**




| Event_Name | Gender | Gold_Medalist | Time |
|---|---|---|---|
| Road Race | M | A001 | 06:10:05 |
| Individual Time Trial | M | A002 | 01:12:15 |
| Road Race | F | A003 | 03:51:27 |
| Individual Time Trial | F | A004 | 00:44:26 |

**Definition:** A Field is part of a record designed to hold a single data item of a specified type.

**Definition:** A Record is the basic unit of data stored in a data file. It is a collection of data items,

**Definition: Primary Key - A field that uniquely identifies an individual record in a table can be chosen as the Primary Key of the table.**

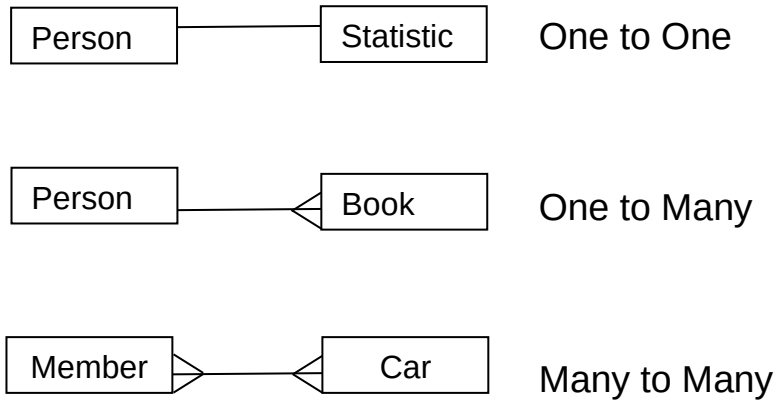
Examples include:

- Car registration Number
- Examination Candidate Number
- National Insurance Number

**Definition:** Foreign Key - When the primary key from one table appears as a field in a second table, it is known as a Foreign Key of the second table.

Relationships

Relationships between tables can be:



The way relationships are represented in a relational database involves the use of primary and foreign keys. If the primary key of one table appears as a foreign key in a second table, then we say that there is a relationship between the two tables.

The function of a relationship is to link files/ tables.

Advantages of having links between tables:

- Reduces redundancy/ repeated data.
- Increases integrity - data is less likely to be correct or is unreliable as the same data is stored/entered several times increasing the likelihood of errors.
- Reports/ Queries can be created using data from more than one table.

## 2.5 Data Types

**Definition:**

.

| | |
|---|---|
| CHAR(N) | CHAR(N) is string data type, whose values are constrained to have exactly N characters. For example, the following are all CHAR (4): “Fred”, “Fre”, “Fr d”, “1234”. |
| TEXT | TEXT is a string data type, whose values may have a variable number of characters. For example: “Fred”, Fre”, “Fr”, “F”, “Fred12345”. |
| | |
| INT | INT is a numeric data type that can store whole numbers - which may be either positive or negative. For example: 0, 1, 2, -99. |
| REAL | REAL is a numeric data type that can store numbers with decimal places. For example: 1, 2.718, 3.141, -2.718, -3.141. |
| DATE | DATE is a data type that can store dates. The display format can be specified - e.g. 1/1/2017, 1 Jan 2017. |

| | |
|---|---|
| TIME | Time is a data type that can store time values (hours, minutes & seconds). For example, 03:15:00 (quarter past 3 am). |
| BOOLEAN | BOOLEAN is a data type that can store the values TRUE and FALSE. |

## 2.6 Queries - Searching Databases

**Definition:** A query is **FIND**

### 2.6.1 Structured Query Language (SQL)

**Example 1**: In which event(s) did athlete A003 win gold?

```
SELECT Event_Name, Gender, Gold_Medalist
FROM Event
WHERE Gold_Medalist = 'A003'
```

The query processor's response to query this is:

| Event_Name | Gender | Gold_Medalist |
|---|---|---|
| Road Race | F | A003 |

## Reports from a Database

**Definition:** A report is the professional presentation of selected data from a database.

## Mail Merge from a Database

Mail merging allows you to create personalised letters using information from your database

The steps required to create a mail merge are:

- Create database of information and any necessary queries required (e.g. Find all members with overdue videos).

- Create the template merge letter and insert the merge fields as required (e.g. Dear <<Title>> <<surname>>).
- Merge the database table or query with the template letter and print.

Advantages:

- Faster – only type the letter once.
- More Personal – letter printed with names, etc. not just Dear Sir.

Forms

Forms are used in a database to **enter data.**

Data Validation

**Definition:** Validation is **the automatic checking of data** entered into a computer system.

| Validation Method | Explanation | Examples |
|---|---|---|
| Data Type Check | This is when the data entered must conform to a certain type of character.<br><br>Number<br>Text<br>Date/Time<br>Boolean | • Two numbers followed by a / followed by two numbers such as in a date of birth.<br>• Several letters followed by some numbers such as in a username or a postcode.<br>• Entering numeric text only such as in a name. |
| Range Check | Making sure the entered data falls within a specified range.<br><br>> 'greater than'<br>>= 'greater than or equal to'<br>< 'less than'<br><= 'less than or equal to'<br>= equals<br><> 'not equal to' | • All pupils have a score between 0 and 100.<br>• All children in a primary school are between 4 and 11 years old. |

| | | |
|---|---|---|
| Presence Check | This is when there must be some data to enter – there must not be missing data.<br><br>This is often shown by a red asterisk (*) on the internet. | • Making sure 31 results are recorded for a class of 31 pupils.<br>• Making sure a surname has been entered into a field. |
| Length Check | This is when the entered data must be a certain number of characters. | • Eight characters such as in a password.<br>• A phone number must have a certain number of digits.<br>• A MasterCard number must be 16 characters long. |
| Format Check | Some database packages allow the user to specify exactly what format the data being entered should take. One example would include an input mask. | • A postcode field would have the following format: LLNN NLL |
| Check Digit | This is a special type of validation check. A check digit is a method of ensuring that the very lengthy list of numbers in a barcode has been entered correctly. The check digit is a number which has been entered correctly. The check digit is a number which has been mathematically calculated and added onto the end of the list of numbers. By the time the computer has input the original list of numbers it has worked out what this last number should be. If it finds it does not match up with last number (the check digit) then it knows an error inputting the data has occurred and it does it again. | • This process is very common with the inputting of EAN numbers underneath barcodes on products or the ISBN book number. |

Big Data

**Large amounts of data which has the potential to be 'mined'**

Sources of this data include:

- Text, images and videos uploaded to social media sites;
- Medical records;
- Fitness monitors;
- Financial markets - share price data, currencies, etc.;
- Web server logs;
- Mobile phone records;
- E-commerce transactions;
- Device logs (internet of things).

There is no generally agreed definition of big data, and it is clearly not just about the size of the data sets. There is, however, widespread recognition that big data problems are characterised by what have become known as the **three Vs: volume, velocity and variety**.

- Volume

The amount of data stored by organisations
The data is from different sources and can have a big volume

- Velocity

This is the speed at which data can be processed. This will take large powerful computers to keep up with the speed of processing and allowing things to work in real time eg Facebook posts
For example:

  - It has been estimated that, in September 2016, there were almost 891 thousand transactions per day on the London Stock Exchange (Statista, 2016). Each transaction results in money moving between accounts, as well as shareholder registers being updated.

  - It has been estimated that there are between 4.5 and 9 million security closed circuit television cameras (CCTV) in the UK. While there is debate about the desirability of all this

surveillance, it is hard to ignore the potential to enhance security and combat crime.

- Variety

Refers to the different types and varieties of data which has to be stored and processed.
Eg videos, text, sound, images
This data can be structured –
Semi-structured –
Unstructured –

Interpreting Big Data

The management of big data is, however, only one part of the problem. There is no value in managing data unless we can **interpret it and extract useful information.** This is the role of data analytics.

Data analytics applies algorithms to raw data in order to spot patterns, relationships and trends. The algorithms may include statistical analysis as well as artificial intelligence techniques.