Computer Science IGCSE

23C T.Nemuulen

--Contents--

1.Data representation

BINARY SYSTEM

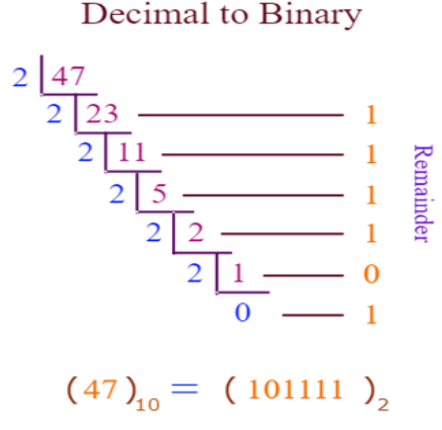
Binary is a system of numbers with a base of 2. Each number used increases by the power of 2.

DENARY SYSTEM

Denary is a system of numbers with a base of 10. Each unit used increase by the power of 10.

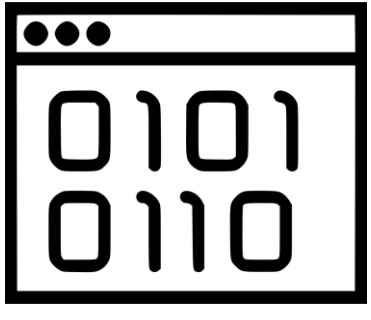
Decimal (Base 10)	Binary (Base 2)	Hexadecimal (Base 16)
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

	128	64	32	16	8	4	2	1
8 bit binary digit	1	0	1	1	0	0	0	1
	128 + 32 + 16 + 1 = 177							



EXAMPLE USE OF BINARY

- A register
- Robotics
- Digital instruments
- Counting systems



MEASUREMENT OF THE SIZE OF COMPUTER MEMORIES

Quantities of bytes						
Common prefix				Binary prefix		
Name	Symbol	Decimal SI	Binary JEDEC	Name	Symbol	Binary IEC
kilobyte	KB/kB	10^3	2^{10}	kibibyte	KiB	2^{10}
megabyte	MB	10^6	2^{20}	mebibyte	MiB	2^{20}
gigabyte	GB	10^9	2^{30}	gibibyte	GiB	2^{30}
terabyte	TB	10^{12}	2^{40}	tebibyte	TiB	2^{40}
petabyte	PB	10^{15}	2^{50}	pebibyte	PiB	2^{50}
exabyte	EB	10^{18}	2^{60}	exbibyte	EiB	2^{60}
zettabyte	ZB	10^{21}	2^{70}	zebibyte	ZiB	2^{70}
yottabyte	YB	10^{24}	2^{80}	yobibyte	YiB	2^{80}

https://www.html.am/

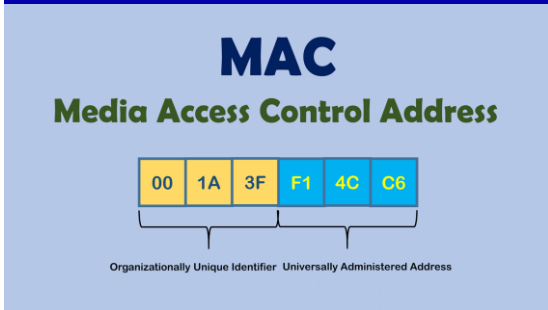
USE OF HEXADECIMAL

- **Web addresses**
  ASCII (American Standard Code for Information Interchange) code
- **Assembly language and machine codes**
- **Debugging**
- **Memory dumps**
- **HTML**
- **MAC address**

HEXADECIMAL SYSTEM

Hexadecimal is a system of numbers with a base of 16. Each number used increases by the power of 16.

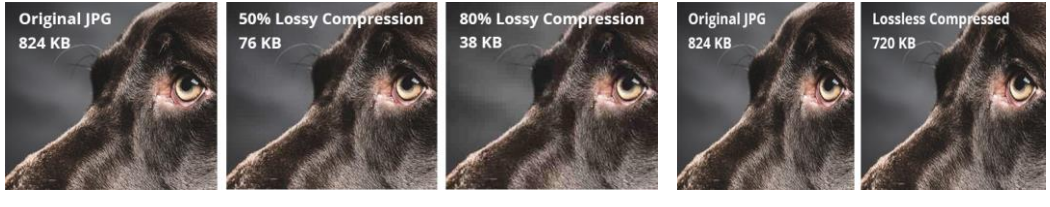
- **Hypertext markup language (HTML)**
  HTML (HyperText Markup Language) is the most basic building block of the Web. It defines the meaning and structure of web content.
- **Memory dumps**
  A memory dump is a process in which the contents of memory are displayed and stored in case of an application or system crash. Memory dump helps software developers and system administrators to diagnose, identify and resolve the problem that led to application or system failure.
- **Media access control (MAC)**
  Uniquely identifies a device on internet
  MAC Address ensure that physical address of the computer is unique.
  NN-NN-NN-DD-DD-DD -> The identity number of the manufacturer of the device and the second half is the serial number of a device.
  MAC addresses:
  - **UAA** (Universally Administered MAC Address)
  - **LAA** (Locally Administered MAC Address)
  Reasons why MAC addresses need to be changed using LAA:
  * Certain software used on mainframe needs all the MAC addresses of devices to fall into a strict format
  * It may be necessary to bypass a MAC address filter in a router or a firewall; only MAC addresses with a certain format are allowed through, otherwise the devices will be blocked.
  * To get certain types of network restrictions it may be necessary to emulate unrestricted MAC addresses



DATA STORAGE

Extension	Colour	Compression	Common Uses
JPG, JPEG	24-bit	Lossy	Photos, web pics
GIF	8-bit	Lossless	Web graphics – buttons, icons, etc
PNG	up to 24-bit	Lossless	Web – replacement for GIF
TIF, TIFF	24-bit	Lossless	Professional Photos etc

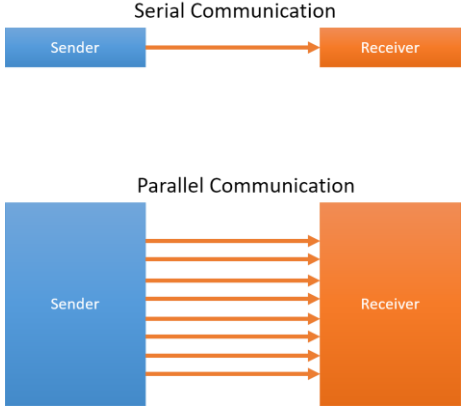
MIDI files are not music and don't contain any sounds. MIDI is especially a communications protocol that allows electronic musical instruments to interact with each other. The MIDI protocol uses 8-bit serial transmission with one start bit and one stop bit, is therefore asynchronous.

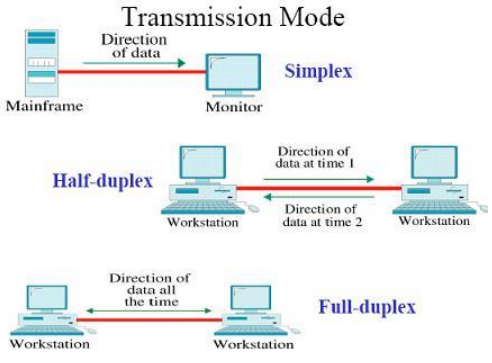


LOSSY COMPRESSION VERSUS LOSSLESS COMPRESSION

LOSSY COMPRESSION	LOSSLESS COMPRESSION
A compression that permits reconstruction only of an approximation of the original data, though usually with an improved compression rate	A class of data compression that allows the original data to be perfectly reconstructed from the compressed data
Also known as irreversible compression	Also known as reversible compression
Reduces the quality	Does not reduce the quality
Data reduction is higher	Data reduction is lower
Resultant file is smaller than the original	Resultant file is not as small
Commonly used to compress multimedia data such as audio (MP3), video and image (JPEG) files	Used for text, data files, audio, and images

2. Communication and information technologies





ASYNCHRONOUS DATA TRANSMiSSION

Sends control bits/ start bits and stop bits

SYNCHRONOUS DATA TRANSMISSION

Sends how many bits were sent

SERIAL DATA TRANSMISSION

- ★ Cheap
- ★ Safer
- ★ Suitable for long distances
- ❑ slower

PARALLEL DATA TRANSMISSION

- ❑ Expensive
- ❑ Less safe
- ❑ Limited to shorter distances
- ★ quicker

*bps - bits per second

Simplex mode	Half-duplex mode	Full-duplex mode
The communication is unidirectional.	The communication is bidirectional, but one at a time.	The communication is bidirectional.
A device can only send data but cannot receive it or it can only receive data but cannot send it.	Both the devices can send and receive the data, but one at a time.	Both the devices can send and receive the data simultaneously.
The lowest performance among the mods.	The performance is better than simplex but less than full duplex.	The highest performance among the mods.
Examples are radio, keyboard, and monitor.	Example is Walkie-Talkies.	Example is a telephone or mobile network.

ERROR DETECTION AND CORRECTION

- Parity checking
- ARQ-Automatic repeat request
- Checksum
- Echo checking

INTERFERENCE
Disturbances that can occur in the signals when sending data that may corrupt it

Parity check

- Even parity - parity bit should make sum of digits of pack of data even
- Odd parity - parity bit should make sum of digits of pack of data odd

ARQ
It uses an acknowledgement (a message sent by the receiver indicating that data has been received correctly) and timeout(this is the time allowed to elapse before an acknowledgement is received). If an acknowledgement is not sent back to the sender before timeout occurs, then the message is automatically resent.

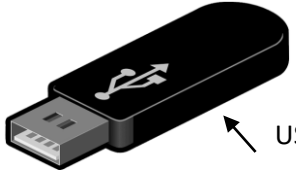
Checksum
Data is sent in blocks and an additional value, the checksum, is also sent at the end of the block of data. When a block of data is about to be transmitted, the checksum for the bytes is first of all calculated. This calculated value is then compared to the checksum transmitted.

Echo check
With echo check, when data is sent to another device, this data is sent back again to the sender. The sender compares two sets of data to check if any errors occurred during the transmission process.

USB-UNIVERSAL SERIAL BUS

USB consists of:

- A four-wire shielded cable
- Two of the wires are used for power and earth
- Two of the wires are used in the data transmission



USB flash drive

✓	X
Devices plugged into the computer are automatically detected; device drivers are automatically uploaded	–
The connectors can only fit one way; this prevents incorrect connections being made	The maximum cable length is presently about 5 metres
This has become the industry standard; this means that considerable support is available to users	–
Several different data transmission rates are supported	The present transmission rate is limited to less than 500 megabits per second
Newer USB standards are backward compatible with older USB standards	The older USB standard (e.g. 1.1) may not be supported in the near future

IP ADDRESS

Each device on the internet is given a unique address knowns as the Internet Protocol.

- ➔ Written in 32 bit number 109.108.158.1
- ➔ Can be used instead URL
- ➔ Unchanged for web servers

ISP

Internet service provider are companies that provide the user with access to the internet

USB

USB is an asynchronous serial data transmission method.

structure

It includes semantics (meaning) and structural markup of the document

presentation

It is the style of the document.

```
<!DOCTYPE html>
<html>

    <head>
        <title> Title here </title>
    </head>

    <body>
        Web page content goes here.
    </body>

</html>
```

```
h1      {color:#444400;
         font-family:arial,sans-serif;
         text-align:center;
         font-size:32px}

h3      {color:#000040;
         font-family:serif;
         text-align:justify;
         font-size:16px}

p       {color:#404040;
         font-family:sans-serif;
         text-align:justify;
         font-size:12px}
```

HTTP

Hypertext transfer protocol is a set of rules that must be obeyed when transferring files across the internet.

WEB BROWSER

is a software which allows a user to display a web page on their computer screen.

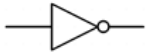
URL - Uniform Resource Locator

http://www.hoddereducation.co.uk/igcse_computer_science

- This is the protocol used (i.e http)
- This is the web server's name
- This is the file name (often the web page)

- The web browser translates the web server name into an IP address which is part of the URL.
- The HTML code is returned and is shown as a correctly formatted page on the computer screen.

3. Logic gates and logic circuits

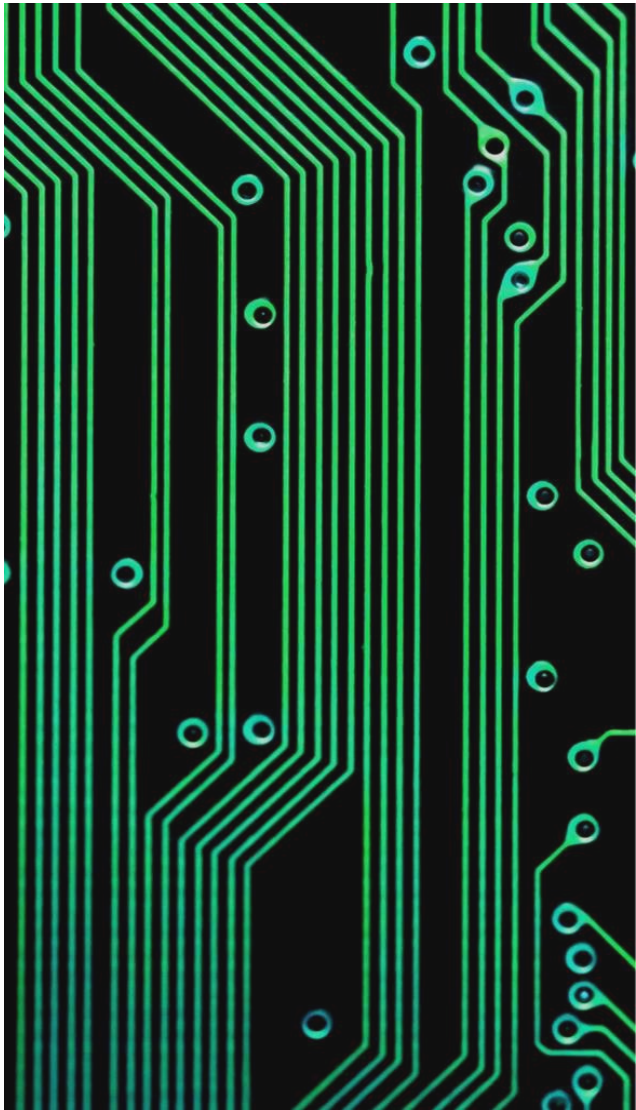
Logic Gate	Symbol	Description	Boolean
AND		Output is at logic 1 when, and only when all its inputs are at logic 1,otherwise the output is at logic 0.	$X = A \cdot B$
OR		Output is at logic 1 when one or more are at logic 1.If all inputs are at logic 0,output is at logic 0.	$X = A + B$
NAND		Output is at logic 0 when,and only when all its inputs are at logic 1,otherwise the output is at logic 1	$X = \overline{A \cdot B}$
NOR		Output is at logic 0 when one or more of its inputs are at logic 1.If all the inputs are at logic 0,the output is at logic 1.	$X = \overline{A + B}$
XOR		Output is at logic 1 when one and Only one of its inputs is at logic 1. Otherwise is it logic 0.	$X = A \oplus B$
XNOR		Output is at logic 0 when one and only one of its inputs is at logic1.Otherwise it is logic 1. Similar to XOR but inverted.	$X = \overline{A \oplus B}$
NOT		Output is at logic 0 when its only input is at logic 1, and at logic 1 when its only input is at logic 0.That's why it is called and INVERTER	$X = \overline{A}$

(Note: the three symbols in the Boolean algebra have the following meaning:
. represents the AND operation
+ represents the OR operation
a bar above the letter, e.g. ā, represents the NOT operation.)

X = A XOR B (logic notation)

$X = (a \cdot \overline{b}) + (\overline{a} \cdot b)$ (Boolean algebra)

(Note: this is sometimes written as: $(a + b) \cdot \overline{a \cdot b}$)



4. Operating system and computer architecture

OS - Operating System

Is essentially software running in the background which operates basic functions of a computer system .

When a computer is first powered up, the initiating programs are loaded into memory from the ROM chip. These programs run a checking procedure to make sure the hardware, processor, internal memory and bios (basic input-output system) are all functioning correctly. If no errors are detected, then the operating system is loaded into memory.

Causes:

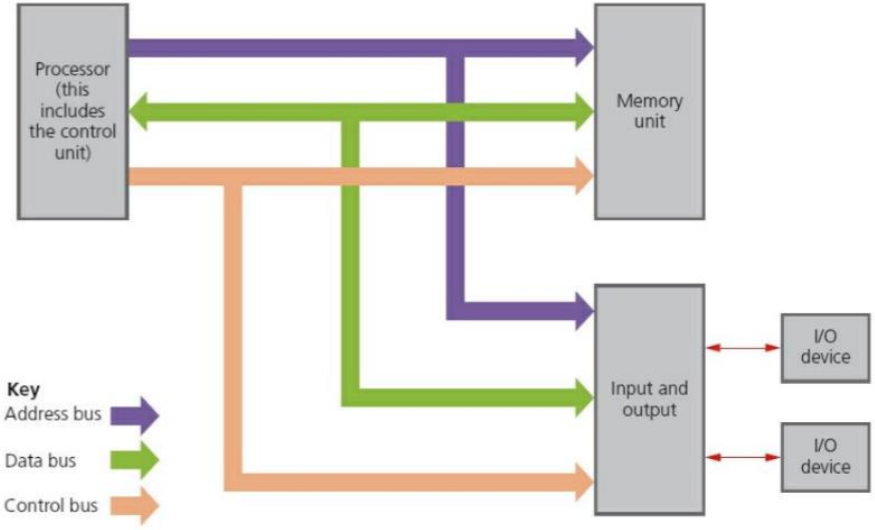
- A disk drive is ready to receive more data
- An error has occurred, such as a paper jam in a printer
- The user has pressed a key to interrupt the current process - an example could be ctrl+alt+break
- A software error has occurred

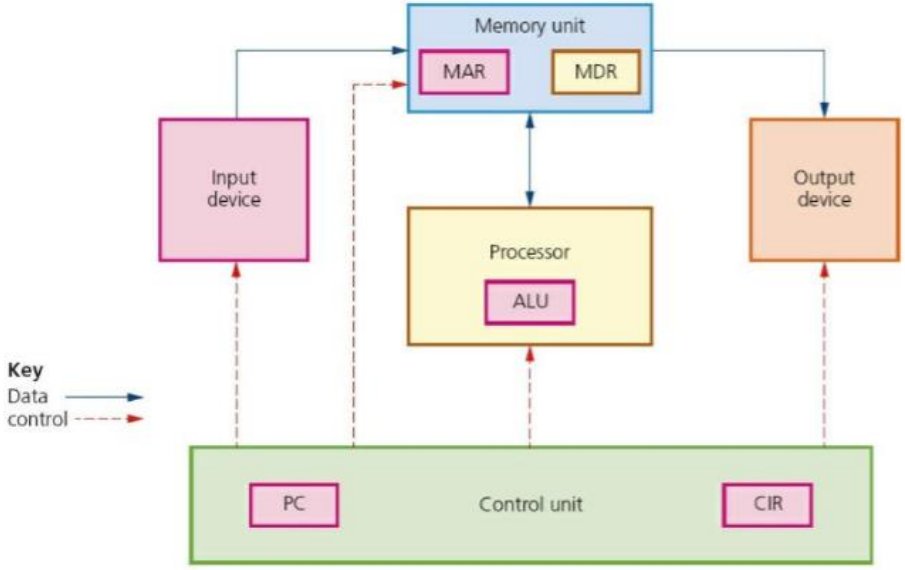
INTERRUPT

An interrupt is a signal sent from a device or from software to the processor. This will cause the processor to temporarily stop what it is doing and service the interrupt.

Interrupt allow computer to carry out **many tasks** or to have several windows open at the same time. This is done using an **interrupt handler** and once the interrupt has been fully serviced, the status of the interrupter task is reinstated and it continues from the point prior to the interrupt being sent.

Buffers are used in computers as a **temporary memory** area. These are essential in modern computers since hardware devices operate at much slower speeds than the processor. If it was not for buffers, processor would spend the majority of their time idle, waiting for the hardware device to complete its operation. Buffers are essentially filled from the processor or memory unit and whilst these are emptied to the hardware device, the processor carries out other tasks.





Type of bus	Description of bus	Data/signal direction
address bus	carries signals relating to addresses (see later) between the processor and the memory	unidirectional (signals travel in one direction only)
data bus	sends data between the processor, the memory unit and the input/output devices	bi-directional (data can travel in both directions)
control bus	carries signals relating to the control and coordination of all activities within the computer (examples include: the read and write functions)	unidirectional (signals travel in one direction only)

An **address** is the location of where data can be found in a computer memory. Each address in the memory is unique. A **register** is simply a high-speed storage area within the computer. All data must be represented in a register before it can be processed.

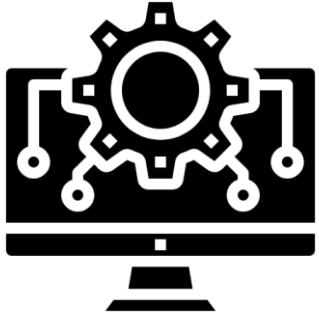
MAR - memory address register
MDR - memory data register
ALU - arithmetic logic unit
PC - program counter
CIR - current instruction register

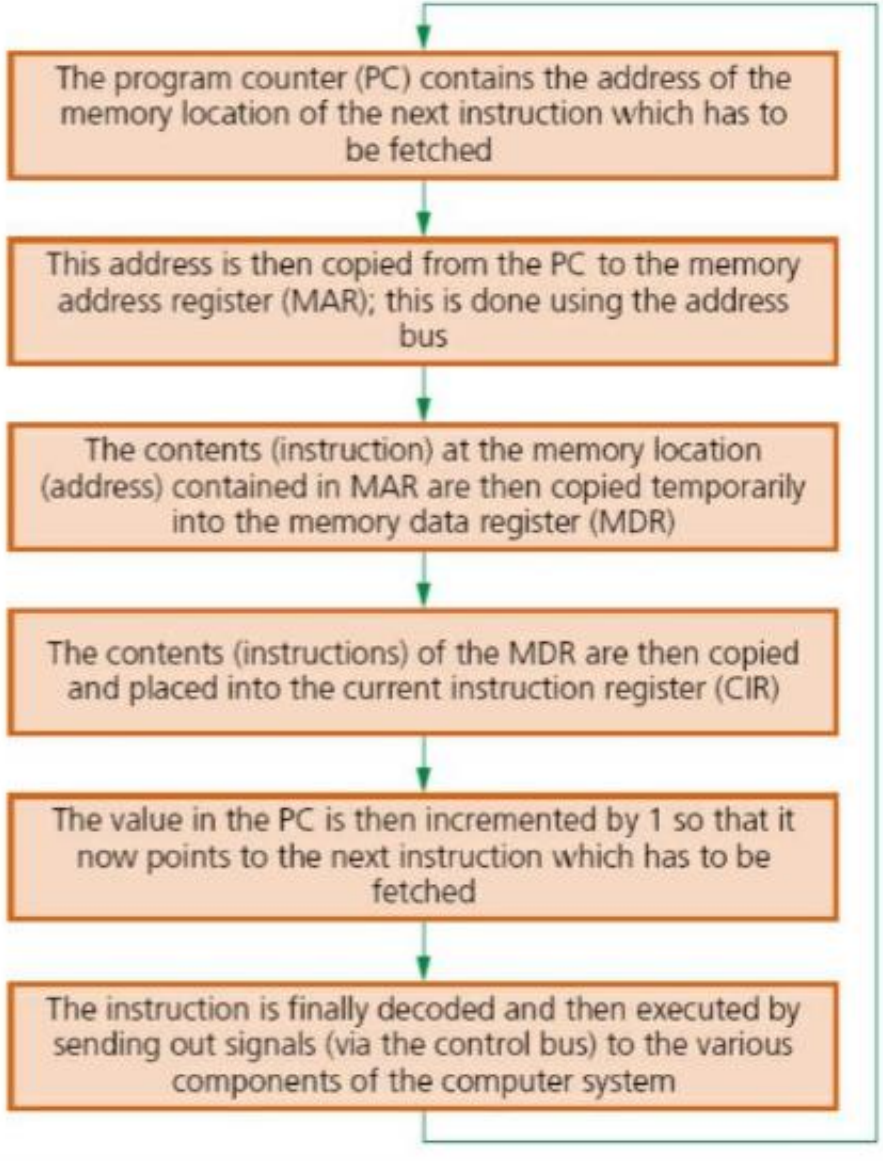
Control Unit

CU controls the operation of the memory, processor and input/output devices. The **CIR** contains the current instructio during processing. The **PC** contains the address of the next instruction to be executed.

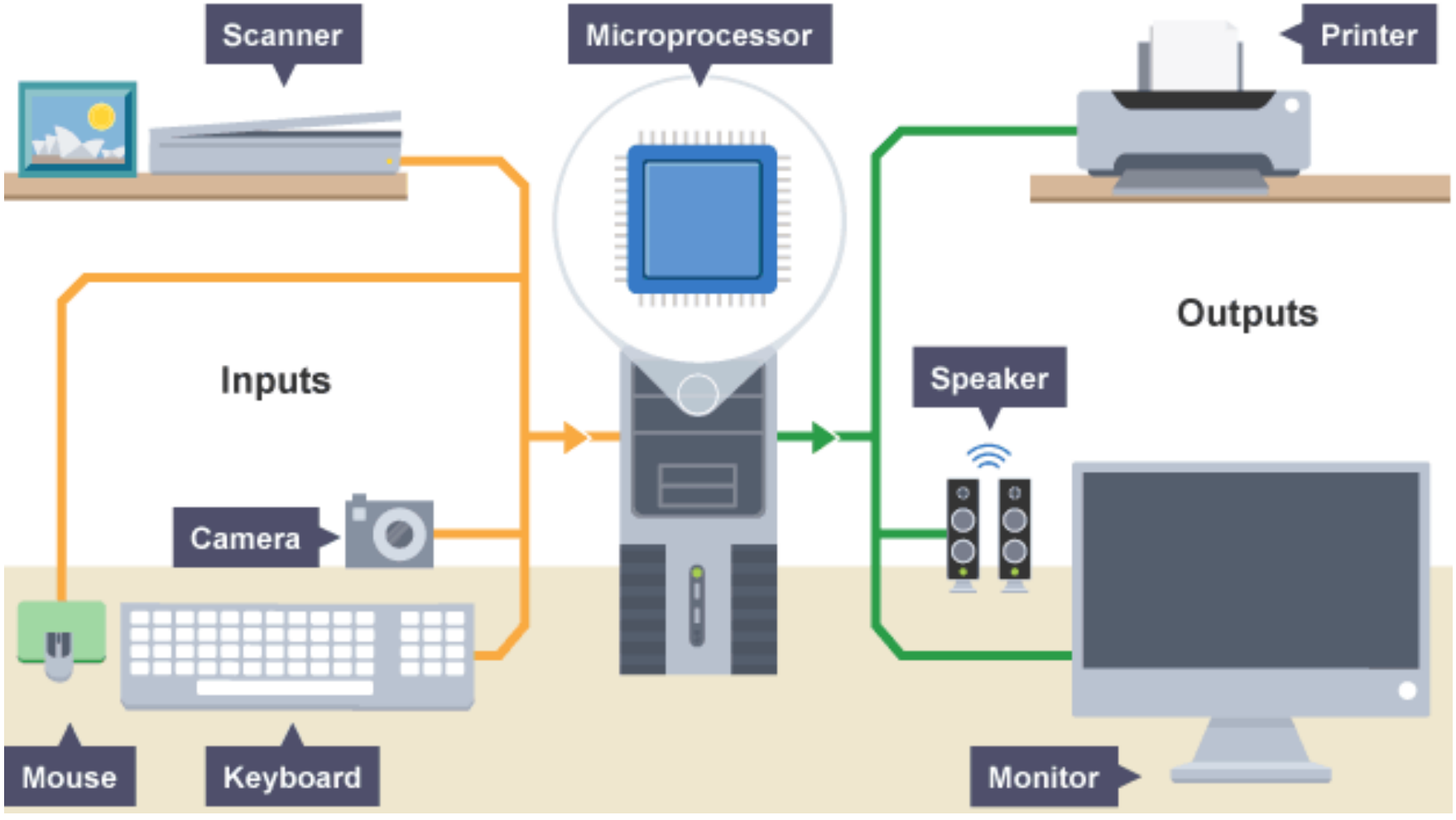
Carrying out instructions

To carry out a set of instructions, the processor first of all fetches some data and instructions from memory and stores them in suitable registers. Both the address bus and the data bus are used in this process. Once this is done, each instruction needs to be decoded before finally being executed.
This is also known as
"**Fetch - Execute cycle".**



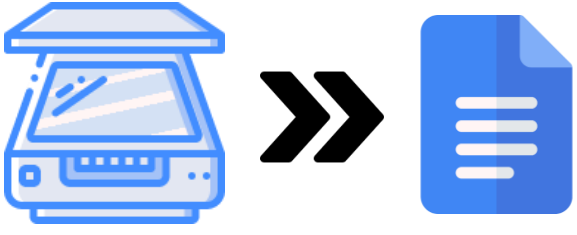


5. Input and output devices

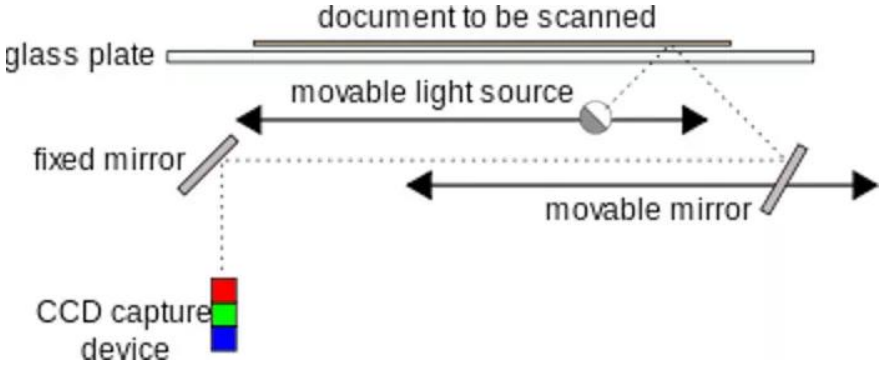


INPUT DEVICES

1. Document is placed on a glass panel
2. A **bright light** illuminates the document
3. A scan head moves across the document until the whole page is scanned. And image of the document is produced and sent to a lens using a series of mirrors
4. The **lens** focuses the document image
5. The focused image now falls onto a ***charge coupled device (CCD)*** which consists of a numbers of integrated circuits
6. Software produces a digital image from the electronic form



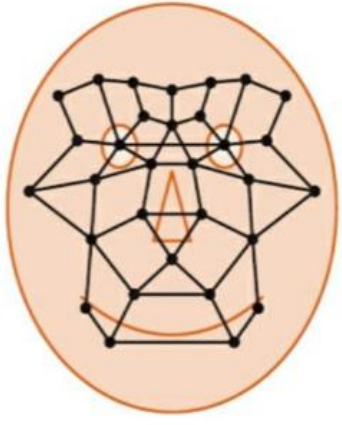
2D scanners



- *Optical Character Recognition (OCR)* is a software which converts scanned documents into a text file format
- If the original document was a photo/image, then the scanned image forms an image file such as JPEG
- Used to input **hard-copy** documents

OCR

Optical character recognition software allow the scanned text from the document to be converted into a **text file format.**



The passenger's face is also photographed using a digital camera as well as the image on the passport. The two images are compared using face recognition software.

CT - computer tomography

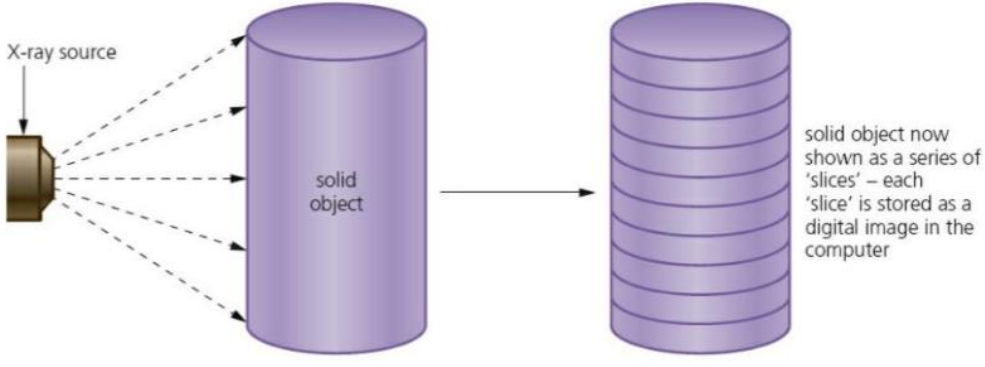
CT scanners are used to create a 3D image of a solid object.

3D scanners

Depending on how the image is formed, the type of tomographic scanner can have different names. For example:

• X-rays	CT scanners	computerised tomography
• radio frequencies	MRI	magnetic resonance imaging
• gamma rays	SPECT	single photon emission computed tomography.

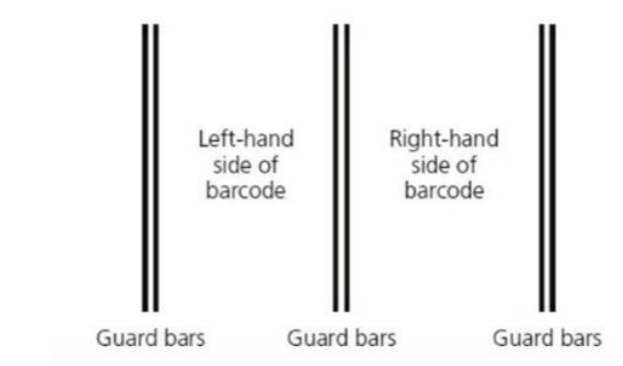
This is based on tomography technology which basically builds up an image of the solid object through a series of very thin slices. The scanned images can be used in **CAD** (computer aided design).

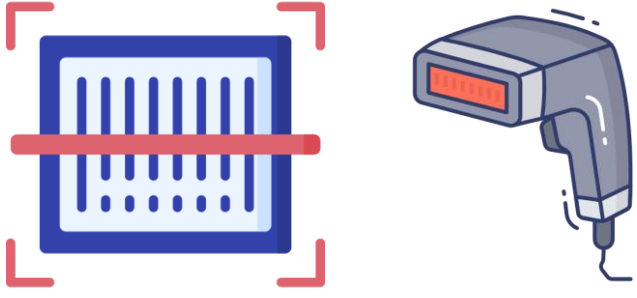


BARCODE

a machine-readable code in the form of numbers and a pattern of parallel lines of varying widths, printed on a commodity.

UPS (universal Product Code)





So what happens when a barcode is scanned?

- The barcode is first read by a red laser or red **LED (LIGHT EMITTING DIODE)**.
- Light is reflected back off the barcode; the dark areas reflect little or no light which allows the bars to be read.
- The reflected light is read by sensors (photoelectric cells).
- As the laser or LED light is scanned across the barcode, a pattern is generated which is converted into digital data – this allows the computer to understand the barcode.
- For example: the digit '3' on the left generates the pattern **L D D D D L D** (where L = light and D = dark); this has the binary equivalent of **0 1 1 1 1 0 1** (where **L** = **0** and **D** = **1**).

Devices used in stores:

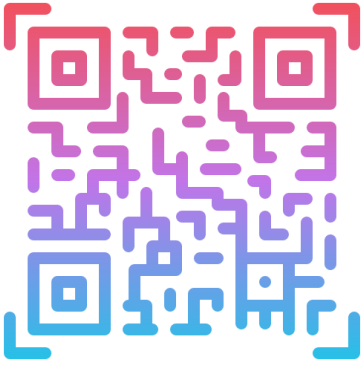
Input/output device	How it is used
keypad	to key in the number of same items bought; to key in a weight; to key in the number under the barcode if it cannot be read by the barcode reader/scanner
screen/monitor	to show the cost of an item and other information
speaker	to make a beeping sound every time a barcode is read correctly; but also to make another sound if there is an error when reading the barcode
printer	to print out a receipt/itemised list
magnetic stripe reader	to read the customer's credit/debit card
touchscreen	to select items by touching an icon (such as fresh fruit which may be sold loose without packaging)

AFTER BARCODE IS READ:

1. Barcode has been read
2. Barcode number is looked up in the stock database (key field)
3. Price and other stock items in the record is sent back to the checkout or **POS (Point of Sale Terminal)**
4. Number of stock items in the record is reduced
5. Re-order bought items

ADVANTAGES OF USING BARCODES:

- Easier and faster
- Up-to-date sales information
- No need to price every stock
- Can check customer buying habits
- Errors in changing customers are reduced
- Customer is given an itemised bill
- Cost savings can be passed on to the customer



Quick Response (QR) Codes

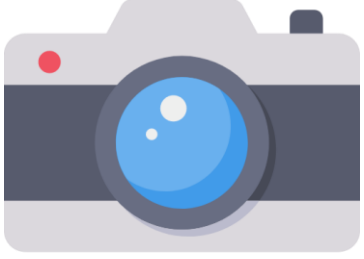
- Another type of barcode is the QR codes
- Made up of a matrix of filled in dark squares on a light background
- Can hold more storage than barcodes (7000 digits)

ADVANTAGES OF QR CODES:

- ★ No need for the user to write down website address
- ★ QR codes can store website addresses

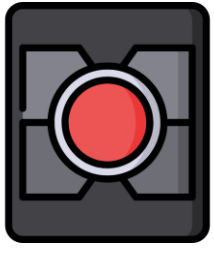
Digital Cameras

- Controlled by microprocessor which automatically adjusts the shutter speed, focus the image, etc.
- Photo is captured when light passes through the lens onto a light sensitive cell
- Cell is made up of pixels
- Number of pixels determines size of the file



Pointing devices

- Mouse/trackball
- Modern type; red LEDs to detect movement



Keyboards

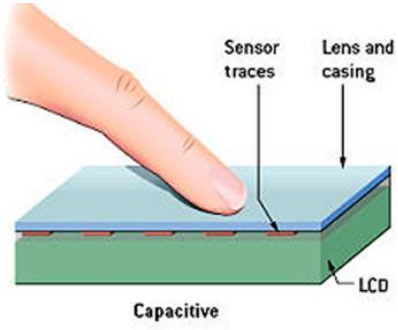
- Connected to computer with a USB connection or by wireless connection
- Each character has an ASCII value and is converted into a digital signal
- Slow method
- Prone to errors

Microphones

- Used to input sound to a computer
- When a microphone picks up sound, a diaphragm vibrates producing an electric signal
- The signal goes to a sound card and is converted into digital values and stored in computer
- *Voice recognition,* voice is detected and converted into digital

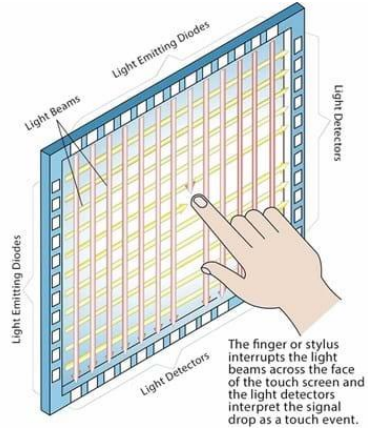
Touch screens

- ❖ **Capacitive** (medium cost tech)
- Made up of many layers of glass
- Creating electric fields between glass plates in layers
- When top layer of glass is touched, electric current changes
- Coordinates where the screen was touched is determined by an on-board microprocessor

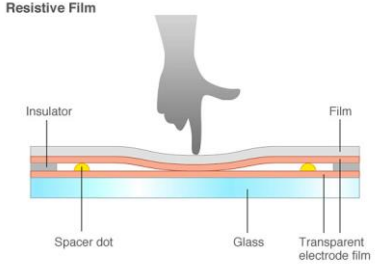


Capacitive

- ❖ **Infrared *heat*** (expensive)
- Use glass as the screen material
- Needs warm object to carry an input operation
- ❖ **Infrared *optical*** (expensive)
- Uses glass as screen material
- Uses an array of sensors (grid form)
- Point of contact is based on which grid coordinate is touched



- ❖ **Resistive** (inexpensive)
- Upper layer of polyester, bottom layer of glass
- When the top polyester is touched, the top layer and bottom layer complete a circuit
- Signals are then sent out which are interpreted by a microprocessor, determine where screen was touched



CAPACITIVE

- This is made up of many layers of glass that act like a capacitor, creating electric fields between the glass plates in layers.
- When the top glass layer is touched, the electric current changes and the coordinates where the screen was touched is determined by an on-board microprocessor.

Benefits

- This is a medium cost technology.
- Screen visibility is good even in strong sunlight.
- It permits multi-touch capability.
- The screen is very durable; it takes a major impact to break the glass.

Drawbacks

- Allows only the use of bare fingers as the form of input; although the latest screens permit a special stylus to be used.

INFRA-RED (heat and optical)

Heat-sensitive

- Uses glass as the screen material.
- Needs a warm object (e.g. fingers) to carry out an input operation.

Optical

- Uses glass as the screen material.
- Uses an array of sensors (in the form of a grid); the point of contact is based on which grid coordinate is touched.

Benefits

- Both systems allow multi-touch capabilities.
- The optical system allows the use of bare fingers, gloved fingers or a stylus for input.
- Both systems have good screen durability; it take a major impact to break the glass.

Drawbacks

- It is relatively expensive technology.
- Heat-sensitive system only allows bare fingers to be used for input (gloved fingers or stylus don't work).
- Both systems (optical and heat-sensitive) have fairly good screen visibility in strong sunlight.

RESISTIVE

- This makes use of an upper layer of polyester (a form of plastic) and a bottom layer of glass.
- When the top polyester layer is touched, the top layer and the bottom layer complete a circuit.
- Signals are then sent out which are interpreted by a microprocessor, the calculations determine the coordinates of where the screen was touched.

Benefits

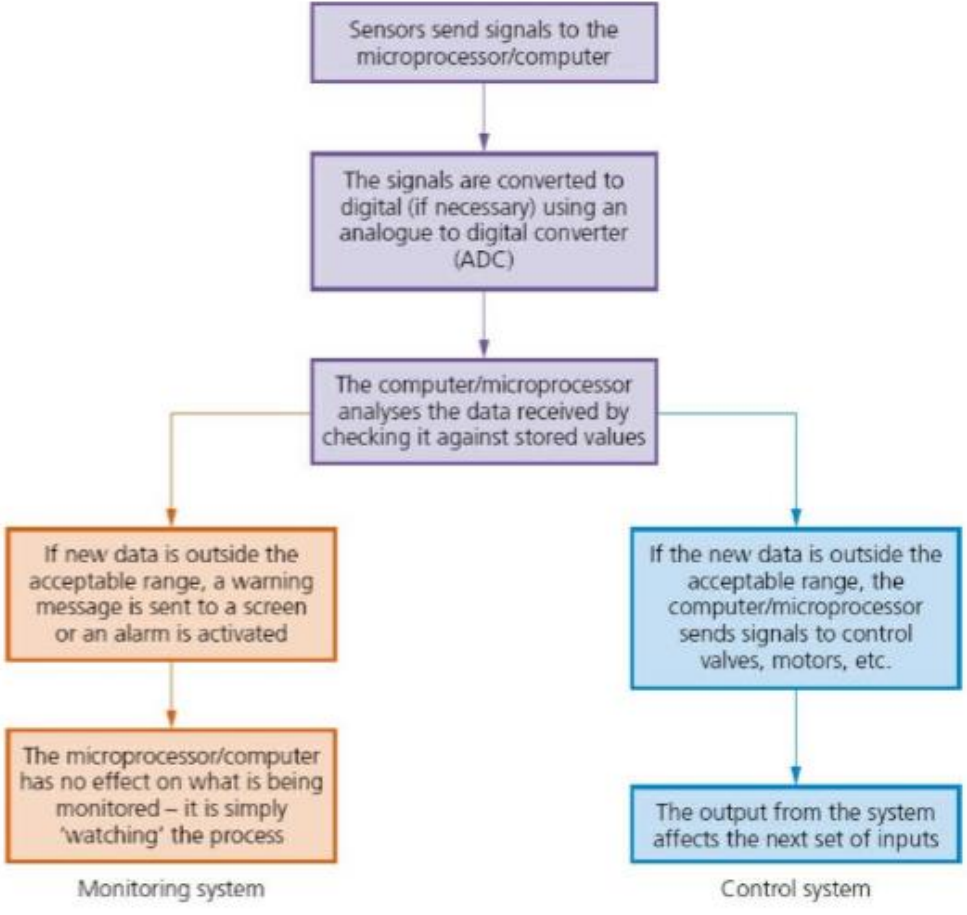
- It is relatively inexpensive technology.
- It is possible to use bare fingers, gloved fingers or a stylus to carry out an input operation.

Drawbacks

- Screen visibility is poor in strong sunlight.
- It doesn't permit multi-touch capability.
- The screen durability is only fair; it is vulnerable to scratches and the screen wears out through time.

SENSORS

ADC - analogue to digital converter
DAC - digital to analogue converter



Sensor	Application
temperature	• control a central heating system • control/monitor a chemical process • control/monitor the temperature in a greenhouse
moisture/humidity	• control/monitor the moisture levels in soil in a greenhouse • control/monitor the humidity levels in the air in a greenhouse • monitor dampness levels in an industrial application (e.g., monitor moisture in a paint spray booth in a car factory)
light	• switch street lighting on at night and off during the day • monitor/control light levels in a greenhouse • automatically switch on a car's headlights when it gets dark
infra-red/motion	• turn on the windscreen wipers on a car automatically • detect intruders in a burglar alarm system • count people entering/leaving a building
pressure	• detect intruders in a burglar alarm system • weigh things (e.g. check the weight of a vehicle) • monitor/control a process where gas pressure is important
acoustic/sound	• pick up noise levels (e.g. footsteps) in a burglar alarm system • detect the noise of liquids dripping in a pipe
gas (e.g. O_2 or CO_2)	• monitor pollution levels in a river or in the air • measure O_2 and CO_2 levels in a greenhouse • check for CO_2 leaks in a power station
pH	• monitor/control acidity/alkalinity levels in the soil in a greenhouse • pollution/environmental monitoring in rivers
magnetic field	• any application where detection of changes in a magnetic field is required (e.g. in cell phones, CD players, etc.) • used in anti-lock braking systems in motor vehicles

OUTPUT DEVICES

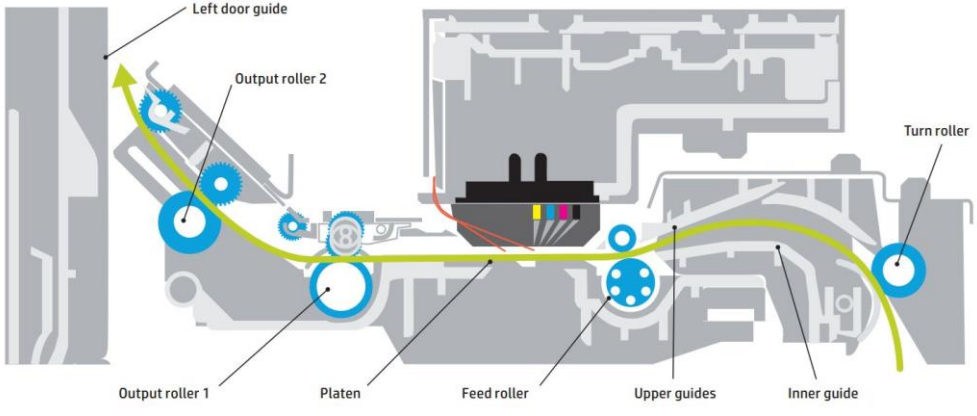
Inkjet printers

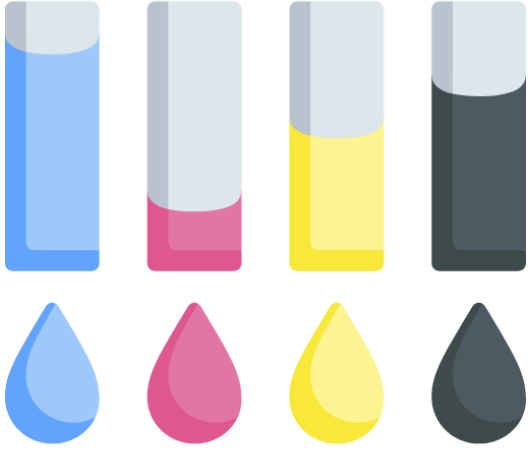
★ Prints out colored images.

1. A **print head** which consists of nozzles which spray droplets of ink on to the paper to form characters.
2. **Ink cartridges**
3. A stepper motor and belt which mover the print head assembly across the page from side to side.
4. A paper feed which automatically feeds the printer with pages as they are required

Ink droplets are produced currently using 2 different technologies:

+ **Thermal bubble** - tiny resistors create localised heat which makes the ink vaporise.
+ **Piezoelectric** - a crystal is located at the back of the ink reservoir for each nozzle/ the crystal is given a tiny electric charge which makes it vibrate.



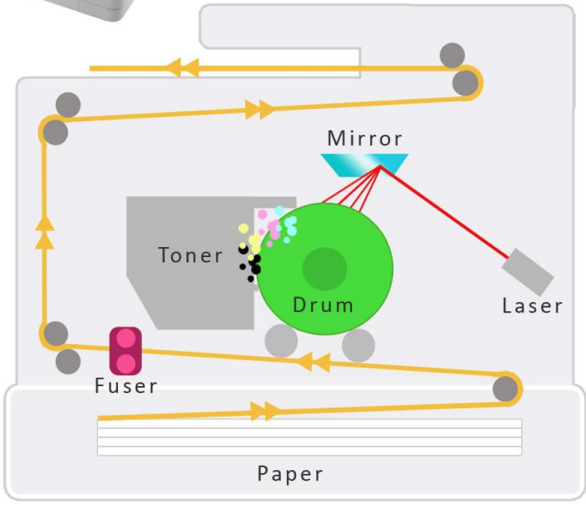


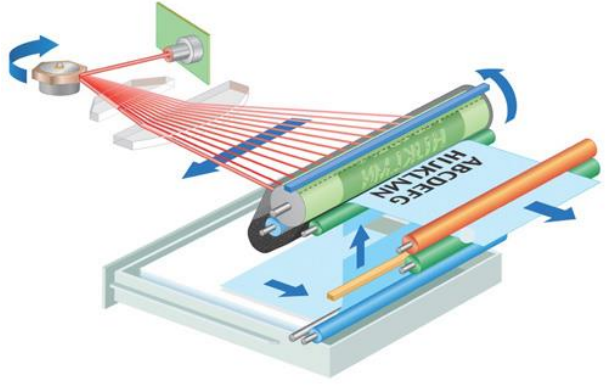
Laser printers

- ★ Laser printers use dry powder ink, static electricity to produce images. It prints the whole page in one go.
- ★ High speed
- ★ Don't run out of ink easily

1. Data from the document is sent to a printer driver
2. Data is stored in the printer buffer
3. **Printer drum** being given a positive charge; as the drum rotates, a laser beam is scanned across it removing the positive charge in certain areas; this leaves negatively charged areas
4. The drum is then coated with **positively charged toner** (powdered ink); it sticks to the **negatively charged parts of drum**.
5. Negatively charged sheet of paper is then rolled over the drum
6. The electric charge on paper is removed after one rotation of the drum
7. Paper finally goes through a fuser which is a set of heated rollers; the heat melts the ink so that it fixes permanently to the paper.

How a laser printer works:





Laser printers

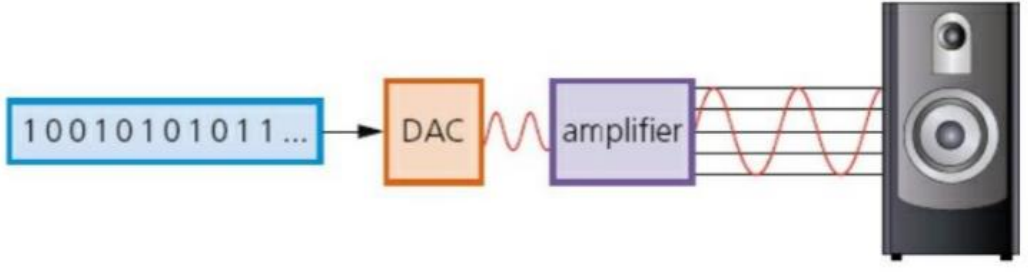
1. 3D design is made by CAD (computer aided design)
2. Solid object is built up layer by layer
3. Some excess materials should be cut

ACTUATOR

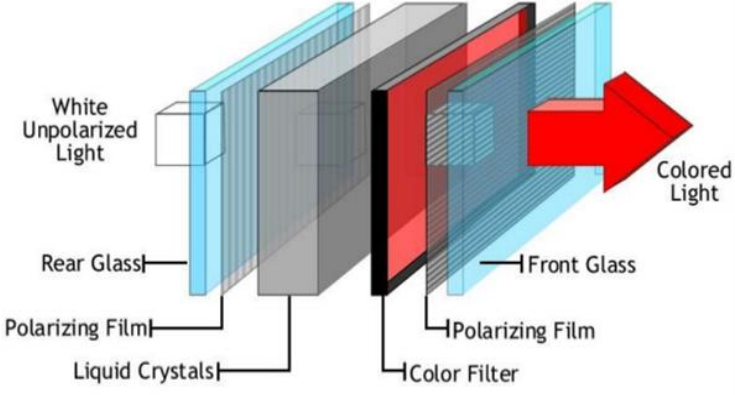
An actuator is an electromechanical device that is used in control applications.

3D printer

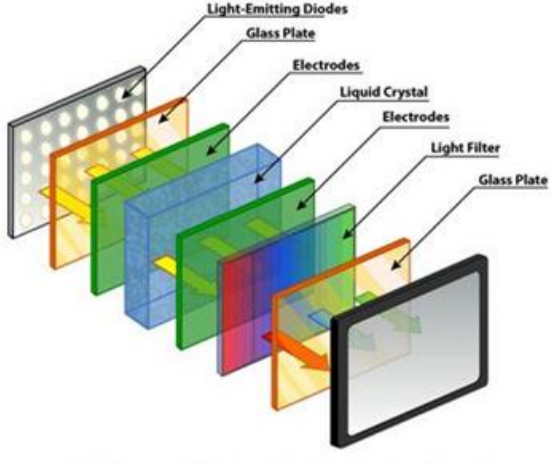
Loudspeakers



LCD monitor



LED monitor

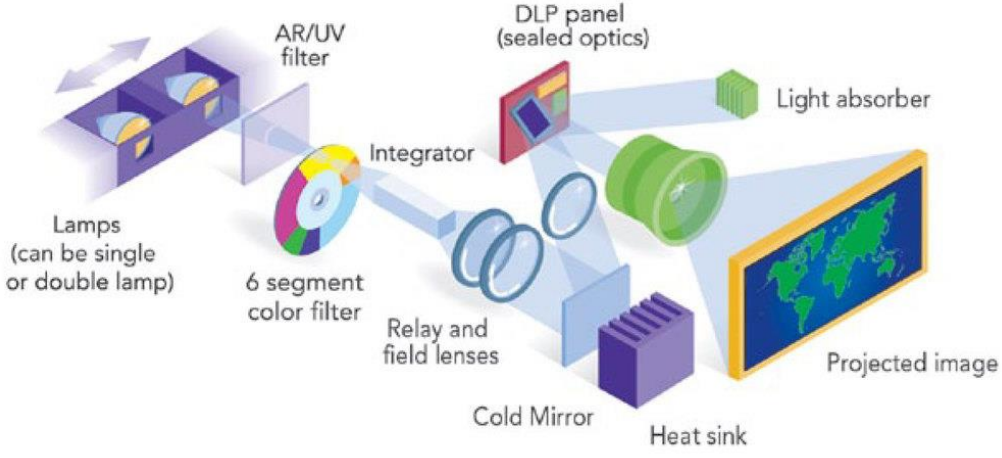


LED VERSUS LCD

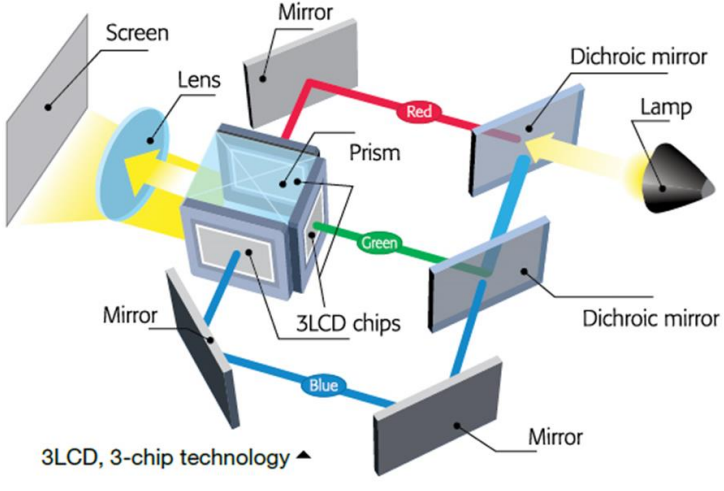
LED	LCD
Contrast ratio is high	Contrast ratio is medium
Medium viewing angle	Low medium viewing angle
High price	Low price
Low power consumption	Medium power consumption
Faster response time	Slower response time
More color accuracy	Less color accuracy
Thinner	Thicker

LCD	DLP
➢LCD projector tends to produce more saturated colors and sharper images. ➢LCD Projectors operate by shining light through transparent LCD cells.	➢DLP Projectors typically offer deeper blacks and higher contrast. ➢DLP projectors operate by reflecting light through mirrors placed in the form of a matrix over a DMD device.

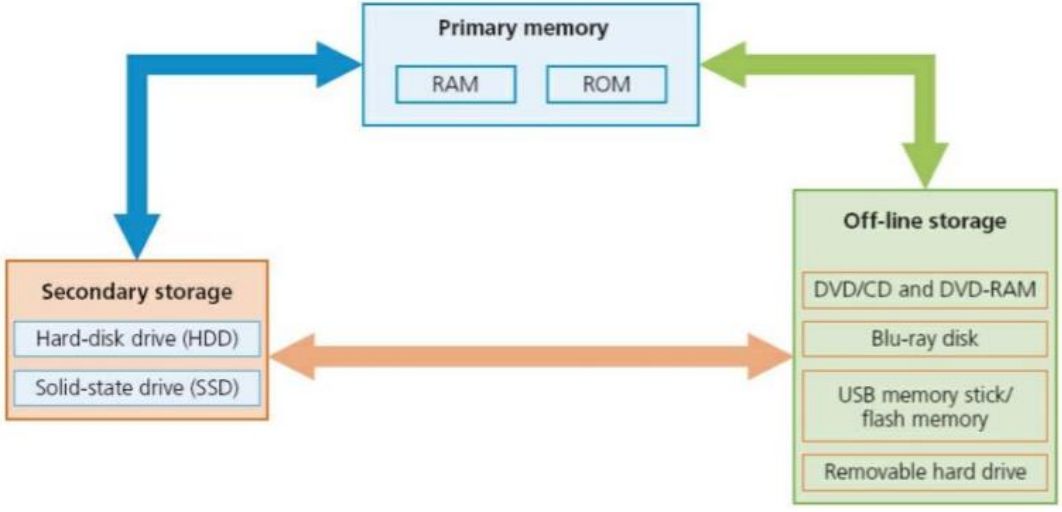
LCD projector

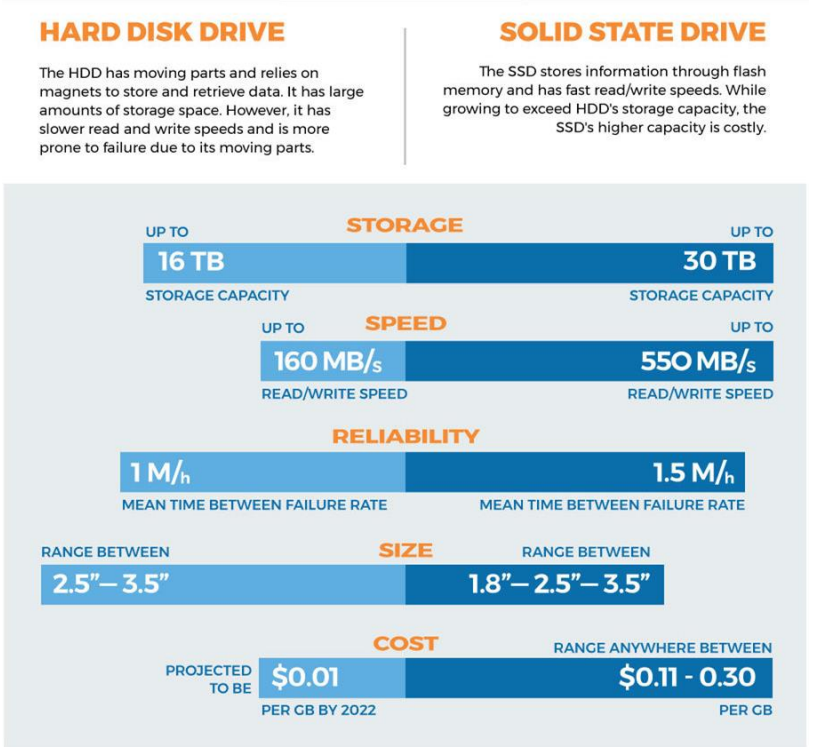


DLP projector



6. MEMORY AND DATA STORAGE





	RAM	ROM
DEFINITION	a form of data storage that can be accessed randomly at any time, in any order and from any physical location.	a form of data storage that can not be easily altered or reprogrammed.
STANDS FOR	Random Access Memory	Read-only memory
USE	read data quickly to run applications. It allows reading and writing.	stores the program required to initially boot the computer. It only allows reading.
VOLATILITY	volatile (contents are lost when the device is powered off).	non-volatile (contents are retained even when the device is powered off).
TYPES	static RAM and dynamic RAM.	PROM, EPROM and EEPROM.

MIDI -(Musical Instrument Digital Interface)

consists of lists of commands to play music that does not contains any real sound.

Disk type	Laser colour	Wavelength of laser light	Disk construction	Track pitch (distance between tracks)
CD	red	780 nm	single 1.2 mm polycarbonate layer	1.60 μm
DVD	red	650 nm	two 0.6 mm polycarbonate layers	0.74 μm
Blu-ray	blue	405 nm	single 1.1 mm polycarbonate layer	0.30 μm

Blu-ray disks:

- Blue laser is used
- High storage
- Uses single disk
- Do not suffer from birefringence

CD:

- Red laser is used
- High storage
- Uses single spiral track
- Do not suffer from birefringence

DVD:

- Red laser is used
- High storage
- Uses single spiral track
- Suffer from birefringence (dual layering)
- DVD-RAM uses concentric track

Medium	Type	Capacity	Speed of access	Portability	Durability	Reliability	Typical use
Hard disk	Magnetic	500 GB-12 TB	Slow	Internal devices are fixed. External hard disks are portable	Reasonable, but prone to damage if dropped or knocked	Generally very reliable if looked after	Long-term storage of programs and data
CD-ROM/R	Optical	640 MB	Very slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Backups, archives, copies of data, distribution of programs and music
CD-RW	Optical	640 MB	Very slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Copies of data, transferring files between computers
DVD-ROM/R	Optical	4.7 GB	Slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Backups, copies of data, distribution of games, TV programmes and movies
DVD-RW	Optical	4.7 GB	Slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Backups, archives, copies of data
Blu-ray-ROM/R	Optical	50 GB	Slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Distribution of TV shows and movies
Blu-ray-RW	Optical	50 GB	Slow	Very portable	Easily scratched, damaged or broken	Generally very reliable if looked after	Backups, archives
Solid-state drive	Flash memory	256 GB-4 TB	Very fast	Internal devices are fixed. External hard disks are portable	Robust and resilient	Reliable	Long-term storage of programs and data where high performance is required
USB memory stick	Flash memory	2 GB-2 TB	Fast	Very portable	Robust and resilient	Reliable	Copies of data, transferring files between computers

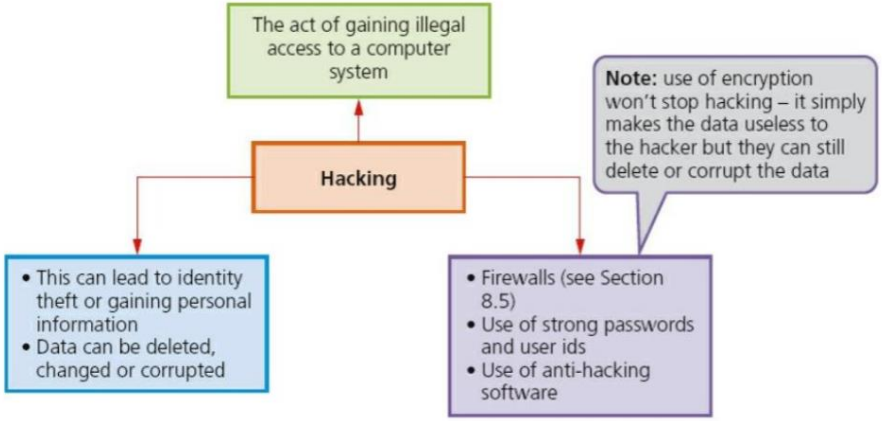
7. High and low level language

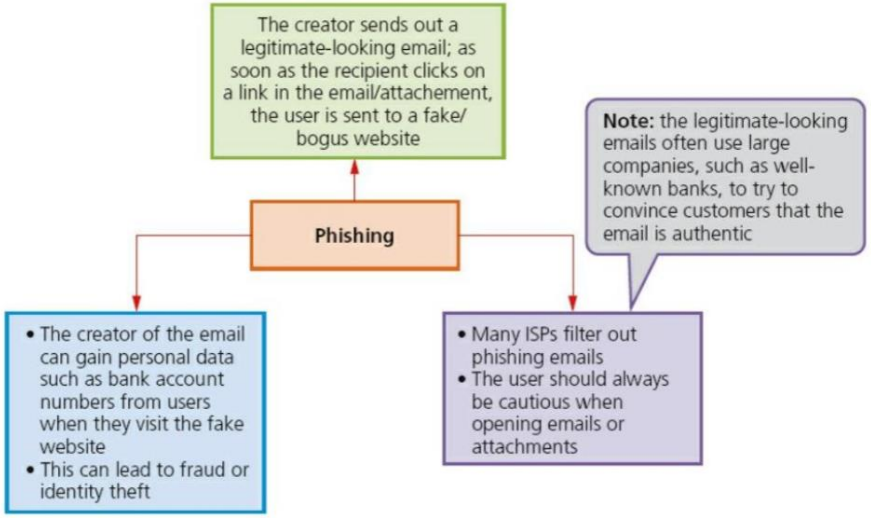
Compiler	Interpreter	Assembler
Translates a high-level language program into machine code.	Executes a high-level language program a statement at a time.	Translates a low-level language program into machine code.
An executable file of machine code is produced.	No executable file of machine code is produced.	An executable file of machine code is produced.
One high-level language statement can be translated into several machine code instructions.	One high-level language program statement may require several machine code instructions to be executed.	One low-level language statement is usually translated into one machine code instruction.
Compiled programs are used without the compiler.	Interpreted programs cannot be used without the interpreter.	Assembled programs can be used without the assembler.
A compiled program is usually distributed for general use.	An interpreter is often used when a program is being developed.	An assembled program is usually distributed for general use.

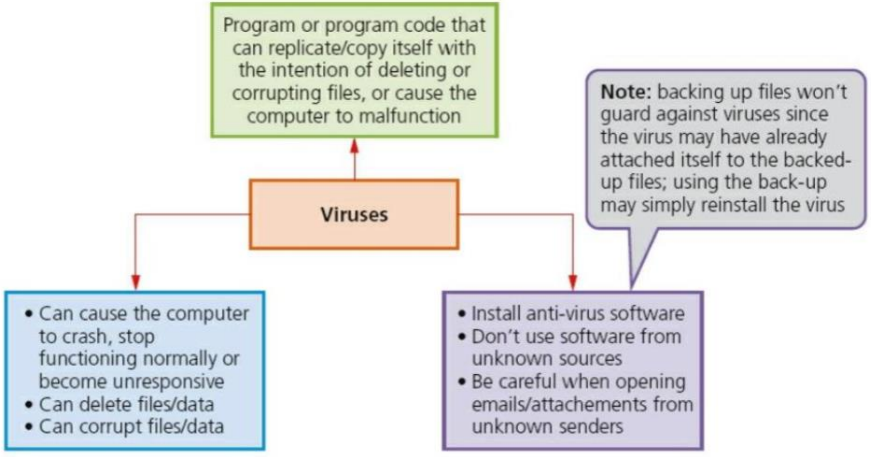
Syntax error: happens where a program statement does not obey the rules of the programming language.

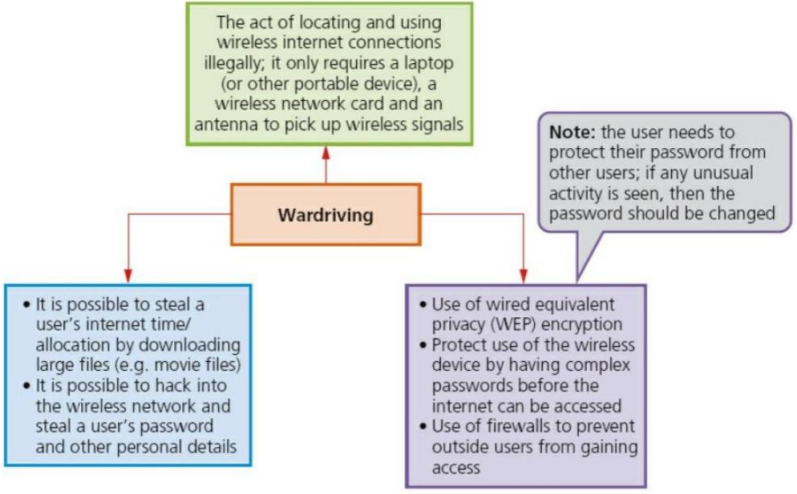
Logic error:
happens when the program does not do what the programmer wanted it to do

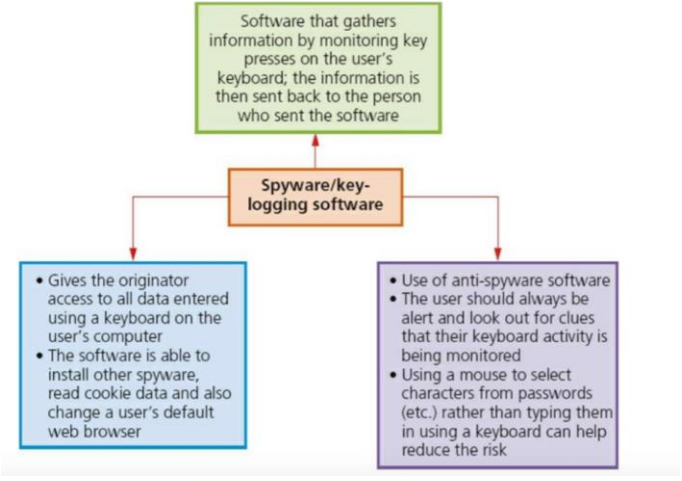
8. Security and ethics

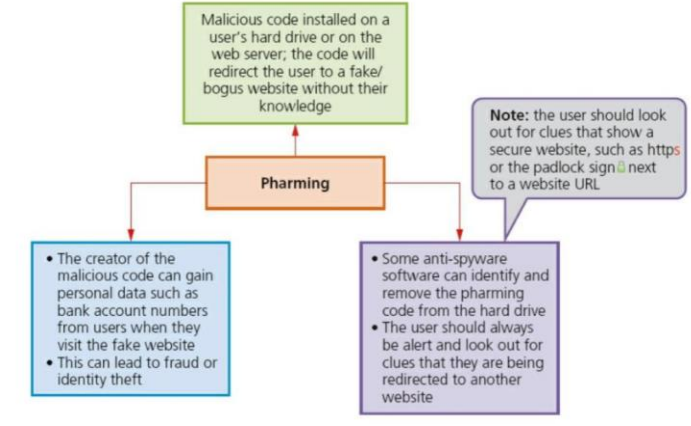






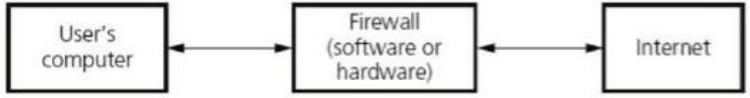






Accidental loss of data (for example, the accidental deletion of a file)	• Use of back-ups in case data is lost or corrupted through an accidental operation • Save data on a regular basis • Use of passwords and user ids to restrict access to authorised users only
Hardware fault (such as head crash on the hard disk drive)	• Use of back-ups in case data is lost or corrupted through the hardware fault • Use of UPS (uninterruptable power supply) to prevent power loss causing hardware malfunction • Save data on a regular basis • Use of parallel systems as back-up hardware
Software fault (e.g. incompatible software installed on the system)	• Use of back-ups in case data is lost or corrupted through the software fault • Save data on a regular basis in case the software suddenly 'freezes' or 'crashes' whilst the user is working on it
Incorrect computer operation (e.g. incorrect shutdown procedure or incorrect procedure for the removal of a memory stick)	• Use of back-ups in case data is lost or corrupted through wrong operation • Correct training procedures so that users are aware of the correct operation of hardware

Firewall



The **firewall** can be a hardware interface which is located somewhere between the computer and the internet connection. It is often referred in this case as a gateway.

Tasks carried out by a firewall:

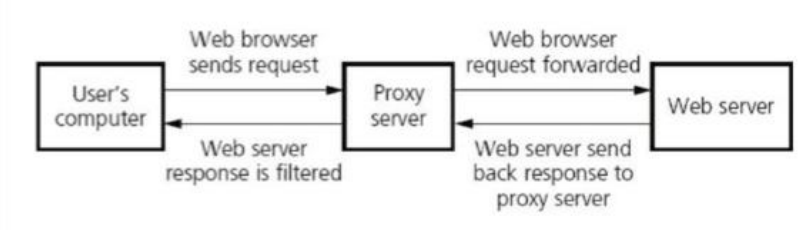
- **Examining the traffic** between the user's computer and a public network
- Checking whether incoming or outgoing data meets a given **set of criteria**
- If the data fails the criteria, the firewall will **block the traffic** and give the user a **warning** that there may be a security issue
- **Logging** all incoming and outgoing traffic to allow later interrogation by the user or network manager
- Criteria can be set to prevent access certain undesirable sites the firewall can keep a list of all undesirable IP addresses
- Helping to **prevent viruses or hackers** entering the user's computer
- **Warning the user** if some software on their system is trying to access an external data source. The user is given the option of allowing it to go ahead or requesting that such access is denied.

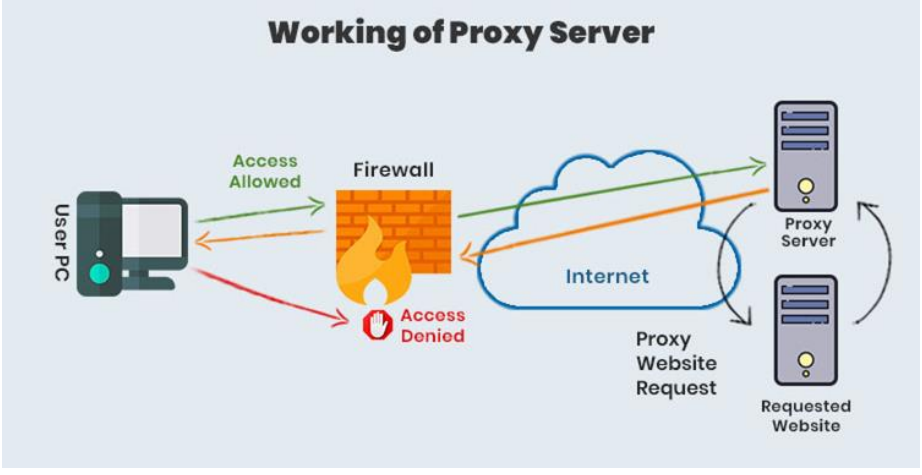
+ It cannot prevent individuals or internal networks
+ Employee misconduct or carelessness cannot be controlled by firewalls
+ Users on stand-alone computers can chose to disable the firewall, leaving their computer open to harmful traffic from the internet

Proxy server

Proxy servers act as an intermediary between the user and a web server.
Functions of proxy servers:

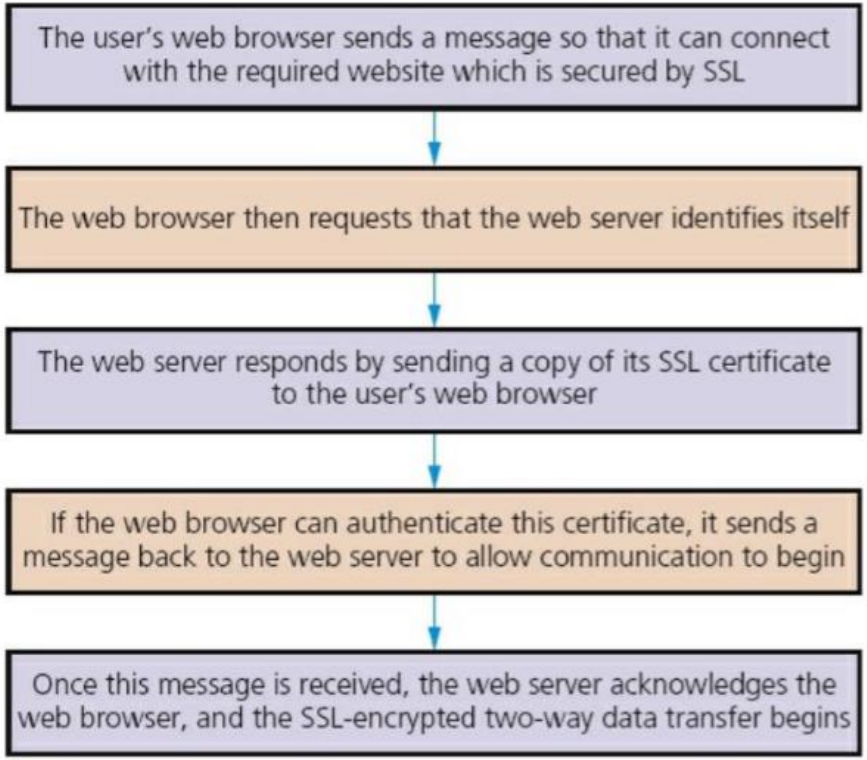
- Allowing the internet traffic to be filtered; they can block access to a website if necessary
- By using the feature known as a cache, they can speed up access to information from a website; when the user visits the website, it now goes through the proxy server cache instead, giving much faster access
- Keeping the user's IP address secret - this clearly improves security
- Acting as a firewall





- Firewalls work at security layer
- Proxy servers work at application layer

TLS and SSL



encryption

Transport Layer Security is a form of protocol that ensures the security and privacy of data between devices and users when communicating over the internet.

TLS is formed of **two layers**:

+ **Record protocol:** this part of the communication can be used with or without encryption (it contains the data being transferred over the internet)
+ **Handshake protocol**: this permits the website and the client to authenticate each other and to make use of encryption algorithms

Difference

The main difference between SSL and TLS is that the SSL is a protocol that provides communication security in a computer network while the TLS protocol is an **evolution of the SSL** protocol and consists of additional privacy and security features.

SSL VERSUS TLS

SSL	TLS
Standard security protocol for establishing an encrypted link between a web server and a browser	Protocol that provides communication security between client/server applications that communicate with each other over the interne
Introduced in the year 1994 by Netscape Communications	Introduced in 1999 by Internet Engineering Task Force (IETF)
Stands for Secure Socket Layer	Stands for Transport Layer Security
Not as secure as TSL	More secure
Comparatively less complex	A complex protocol

Cookie

A cookie is a packet of information sent by a web server to a web browser. Cookies are generated each time the user visits the website. Every time a user visits the website, cookies will have collected some key information about the user. They are able to carry out user tracking and also maintain user preferences. Cookies cannot actually perform any operations. The information gathered by cookies forms an anonymous user profile and doesn't contain personal information.

DoS attack (Denial of Service)

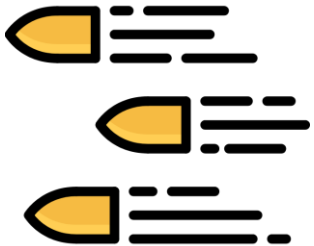
DoS attack is an attempt at preventing users from accessing part of a network, notable an internet server. This is usually temporarily but may be a very damaging act or a big breach of security. It doesn't just affect networks; an individual can also be a target for such an attack.

One method of attack is to flood the network with useless traffic.

1. Many requests are sent to the web server
2. The web server becomes flooded in traffic (cannot handle)
3. Website can no longer be accessed

Preventing:

- Use an up-to-date malware/virus checker
- Setting up a firewall
- Apply email filters



Normal data input = 999999 (9-any number)

VALIDATION CHECK:

+ Range check - Checks the data falls between an acceptable upper and lower value, within a set range (100)
+ Length check - Checks that the data entered is of an expected type, e.g. text or a number (9999)
+ Type check - Checks the number of characters meets expectations, e.g. an 8 character password (blabla)
+ Character check - checks if it contains any invalid characters or symbols (992$s%)
+ Format checks - checks if the data input is in a certain format (pattern) (AA99AA)
+ Presence checks - Checks that the user has at least inputted something, stopping them from accidentally entering nothing ( )
+ Check digits - An extra digit added to a number which is calculated from the other digits, this ensures the rest of the number has been entered properly

VERIFICATION CHECK:

+ Double entry - data is input twice, then they are compared
+ screen/visual check - asks if the user confirms
+ Parity check
+ checksum