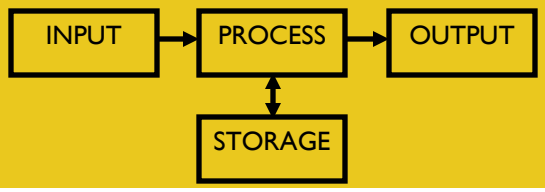
RAM: Random Access Memory
Volatile primary storage for currently used programs, e.g. the operating system (OS). If the computer were to lose power, all the data and instructions in RAM would be lost.

ROM: Read Only Memory
Non-Volatile primary storage for booting up the computer, and can include BIOS (Binary Input Output System). ROM is small FLASH memory and is usually set in the factory during manufacture. In the event of power loss, data will be retained.

CPU: Central Processing Unit
The processor is a microchip which carries out all the calculations and processes in a computer system. The CPU **F**etches data and instructions from RAM, **D**ecodes and then **E**xecutes it. A CPU with a *clock speed* of 3.4 GHz can carry out 3.4 billion **FDE** cycles (calculations) per second. The more cores a CPU has, the more FDE cycles it can carry out at the same time.

Von Neumann Architecture
A computer system uses **input** to **process** data before **output**ting it.



CPU Components
The CPU is made up of several **registers** for storing binary values during the FDE cycle:

PC (Program Counter): stores the next instruction.
MAR (Memory Address Register): stores the memory address of the current instruction.
MDR (Memory Data Register): holds the data to be written or read from memory.
Accumulator: holds the running total of calculated values (in the ALU).

Other components of the CPU include:

ALU (Arithmetic and Logic Unit): carries out mathematical calculations and logic (AND, OR, NOT).
CU (Control Unit): maintains a regular clock speed and manages the flow of data around a CPU.
Cache: extremely fast access memory for regularly used instructions.

Embedded Systems
An embedded system is a computer within another system (which is not a computer). E.g. a smart watch is a watch (not a computer) with a computer system embedded within it. Other examples include: a washing machine, MP3 player, digital camera, car with a sat nav. An embedded system is designed to perform specific tasks only.

Secondary Storage
Non-volatile storage required to store data when a computer system is turned off. When a computer is switched on, programs required are loaded from secondary storage into primary storage (RAM), e.g. the operating system (OS). There are currently **three** categories of secondary storage each with different comparable attributes:

Magnetic
Low cost, large capacity (usually TBs). Internal hard drives are durable but contain moving parts which can fail. Fast access, but not as fast as SSD. Non-portable.

Optical
Low cost, limited capacity (CD 750MB; DVD 4GB; Blu-ray 50GB). Can be slow to access. Non-durable and easily damaged. Portable.

Solid State (SSD)
Relatively expensive, and therefore smaller capacity (when compared to magnetic) (GBs/TBs). Fast access, and reliable. Durable, with no moving parts. Portable, e.g. USB thumb drives, SD cards.

Systems Software
The Operating System (OS) is software that is used to manage and control computer hardware (the system). An OS is essential for a computer system to work. There are five functions (the **FUMPS**) of an OS:

F: File Management (required to organise files/folders, including file extensions, e.g. doc, pdf, txt file formats)
U: User Interface (an interface allows users/operators to control computers using menus, icons, or a command line interface (CLI). Windows is a graphical user interface (GUI).
M: Memory Management/Multi-Tasking (this allows users to work on multiple documents whilst listening to music, and receiving emails, playing games, etc.)
P: Peripheral Management (a peripheral is hardware on the outside of a computer system, e.g. a mouse or printer. These peripherals require device drivers in order to work.
S: Security (an OS will manage who can log on to a computer system and provide user name/password access, as well as setting permissions on folders.)

Utility Software: useful software in addition to the functions (FUMPS) of an OS, including: encryption software, defragmentation, data compression, full/incremental backups.

Ethical, Legal, Cultural and Environmental Impacts

Data Protection Act: To protect personal data and respect privacy.

Computer Misuse Act: For computer (cyber) crime including hacking.

Copyright Designs and Patents Act: To protect artists' rights over their creations

Creative Commons Licensing: Allows free distribution of copyrighted work.

Freedom of Information Act: To give public right of access to public data.

Networks
Two or more connected computers, either wired or wireless.

LAN (Local Area Network): a privately owned network over a small *geographical* area, e.g. school, business, library. The network is managed and maintained by the school, business, etc.

WAN (Wide Area Network): two or more LANs connected together over a large *geographical* area, e.g. the Internet, ATMs. The network is not owned by any one company and management and maintenance are shared.

Client Server
A network that includes a central server which manages user permissions, and provides storage, security and file access. Clients send requests to the server, and the server responds. This is very common in a small business, school, library. Client servers can be costly and require expertise (a network manager) to set up.

Peer to Peer (P2P)
There is no server, and all devices (peers) have equal access with little or no security (which can be a disadvantage). Most homes use peer to peer networks because they are cheap and easy to set up.

Factors that Affect Network Performance
- Bandwidth (more users/more devices/heavier traffic requires more bandwidth)
- Bit Rate (number of bits downloaded/uploaded per second—the higher the better)
- Wired vs wireless (wired is considered faster and more reliable than wireless)
- Fibre optic vs copper (fibre uses light and is faster but more expensive than copper)
- Hardware (older hardware can slow a network down)
- Topology (how a network is set up and laid out can affect performance)

Network Hardware
NIC: all network devices require a **network interface card** to connect either wirelessly or wired.
Switch: connects devices over a LAN using IP and MAC addresses.
Hub: similar to a switch, but cheaper and less capable.
Router: connects LANs to WANs (typically to the Internet).
WAP: all wireless networks require a **wireless access point** to connect to a LAN or a WAN.
Transmission Media: network devices need to connect to each other wired or wirelessly. Wired network computers use copper (ethernet) or fibre optic cables. Wireless networks use radio signals.

Network Protocols: A protocol is a set of rules for communication.
HTTP: **H**yper **T**ext **T**ransfer **P**rotocol used by browsers to access websites.
HTTPS: **H**yper **T**ext **T**ransfer **P**rotocol **S**ecure used by browsers to access websites securely using encryption.
FTP: **F**ile **T**ransfer **P**rotocol used for sending files (particularly large ones) over a network.
SMTP: **S**imple **M**ail **T**ransfer **P**rotocol used for sending emails.
POP: **P**ost **O**ffice **P**rotocol
IMAP: **I**nternet **M**essage **A**ccess **P**rotocol
Ethernet: this protocol is used to connect wired networks
TCP: **T**ransmission **C**ontrol **P**rotocol
IP: **I**nternet **P**rotocol

Network Layers: Network protocols are organised into four (conceptual) layers for ease of management and design, e.g. most of the protocols above are in the top layer (and are to do with applications, e.g. email and browsing), whilst the lower layers use TCP/IP and ethernet to split network data into packets and physically connect.

All devices using a network use an **IP Address** (much like a house's postcode) to identify where on a network it is. An example of an IP address is: 192.168.100.1

All networked devices have a unique **MAC address,** which, unlike an IP address, never changes. MAC addresses are often represented in hexadecimal.

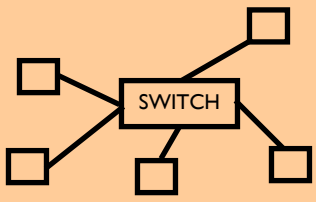
The **Internet** is a global network of connected computers. The Internet is an example of the largest **WAN** and describes a *physical* network of computers connected together by cables, servers, routers etc.

The **World Wide Web** (WWW) is *virtual* collection of websites and web pages, and uses the Internet infrastructure.

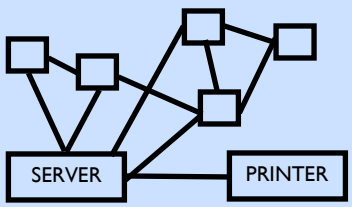
The **D**omain **N**ame **S**ystem (DNS) is a public table of web domains (e.g. bbc.co.uk, netflix.com) which maps to public **IP** addresses and allows web browsers to access websites without typing IP addresses in.

Public **web servers** (powerful computers on the Internet) provide **hosting** which means that anyone with a device (**client**) can rent or buy web space to build their own websites. **Hosting** is also used to store people's data (e.g. personal files and images) **in the Cloud**, which means they can access it from anywhere with access to the Internet.

Star Topology
Computers, printers and servers all connected to a central switch.



Mesh Topology
Computers connected to each other, with multiple routes to the server. Shared devices (e.g. printers) are connected to the server. This diagram is a partial mesh (as opposed to full mesh) where not all computers are connected to each other.



Network Security
The disadvantage of connecting computers together, is that personal private data on those computers can now potentially be accessed by anyone else on the network. Steps can be taken to protect networks, and these include using robust usernames and passwords, setting permissions on files/ folders, using **firewalls** to prevent unauthorised access, and installing **antivirus** software to prevent **malware** (*bad* software) from being installed.