Formatting magnetic disks	Formatting a magnetic disk means creating and organising the tracks and sectors on the magnetic coated disk so that data can be stored. This process removes any data on the disk, analyses the disk for faults and creates a directory called a FAT (file allocation table). The FAT stores information about the file size, time and date of last modification and the address (track and sector number) of the file on the disk. If a sector is faulty it is called a 'bad sector' and data will not be stored on that part of the disk.
RAM	Random Access Memory is data that can be accessed directly anywhere on the memory site (disk or chip) without having to traverse all preceding data.

Magnetic tape	Magnetic tape is covered with a layer of magnetic material but unlike magnetic disks access to data is sequential rather than direct.
Sequential access	Although it provides slower access, data is accessed in order of its storage. It is used in magnetic tape because it is a cheaper form of storage for data that is not accessed frequently or for data that usually needs to be accessed in order.
Disk controller	This is responsible for the transfer of data between the computer and a disk drive. Examples of disk controllers are: • EIDE (enhanced integrated drive electronics) which supports storage capacity up to 8 Gb with a transfer rate of 66 Mb per second. • Ultra DMA (direct memory access) with transfer rate of 66 Mb per second and improved error checking using CRC (cyclic redundancy checking). • SCSI (small computer system interface), usually on an expansion card with transfer rates up to 80 MB per second. Supports multiple disk drives.

	...supports multiple disk drives.
ROM	Read Only Memory is also called firmware, which is programmed during the computer's manufacture and cannot be changed.
ROM BIOS	Read Only Memory for the Basic Input/Output System. These are the instructions located in ROM that tell the computer how to interact with the peripheral devices.
PROM	Programmable ROM. PROM is manufactured as blank memory and can be programmed once after manufacture.
EPROM	Erasable Programmable ROM can be erased and reprogrammed by the manufacturer. This allows the manufacturer to change the firmware to allow for upgrades, or new versions. EPROM is often used for computer games where changes of ROM are required.
Cache	A high speed ...

	EPROM is often used for computer games where changes of ROM are required.
Cache	A high speed memory located between the CPU and RAM that can be accessed quickly to be processed by the CPU. The most frequently used instructions are cached for easy and fast access, which allows the CPU to run faster because it does not have to take time to find instructions in the primary memory.
Registers	Temporary memory places within the CPU which are important in the fetch-execute machine cycle. Types of registers include: • **Address register** which holds the addresses of data and instructions in the primary memory.

	• **Accumulator** which holds the results of the last instruction executed. • **Storage** where the data to be executed is stored before execution. • **Instruction register** where the instruction is stored after it has been fetched from primary memory and before it is used in the ALU.
DRAM	Dynamic RAM is constantly refreshed 1000 times per second. DRAM chips are small and inexpensive.
SRAM	Static RAM is faster than DRAM as it is not constantly updated but is more expensive.

	as it is not constantly updated but is more expensive.
CD ROM	Compact Disk, Read Only Memory is a 12 cm wide plastic circle which can hold 650 Mb of data in a series of pits which reflect light back at varying frequencies. Once the data is stamped to the CD it is read only. Although the reading access is slower than for a hard drive, the CD provides useful and portable secondary storage. CD-R Recordable allows data to be written only once but read more than once. This is called a WORM environment, meaning 'write once read many'. A CD burner is used to write on a CD-R. CD-RW on which rewriteable data can be overwritten. The original data on the surface is erased when the disk is heated and cooled quickly.

DVD-ROM	Although it is the same size as a CD ROM, a digital versatile disk can store between 4 Gb and 17 Gb of memory. Unlike other forms of storage the structure of DVD data, video and audio have the same file structure called UDF (Universal Disc Format). This overcomes file incompatibilities in multimedia applications that slow down the retrieval of data on other forms of storage. DVDs can store full-length movies.
Flash memory	Is a non-volatile credit card size portable memory chip that retains its data when power is removed. It is used primarily in notebook computers and digital cameras.
Fileserver (networks)	A high speed computer in a LAN that stores the programs and files that are shared by the users who log in to the network.

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Internet browsers	Software that allows users to access documents that are stored on other computers connected to the world wide web. Each web site has a unique address called a URL (uniform resource locator). A search engine is a database of web sites that can be searched by the web browser by using key words.
Passwords	Words that are used to control levels of access to computers or computer systems.
Microfiche	Transparent sheets of plastic that store about 200 sheets of miniaturised printed text. This is a non-computerised form of data storage, which is magnified using a microfiche reader in order to be read.
Frame buffer	The memory of the computer required to store the image of a single screen frame. The size of the frame buffer is greater when storing bit mapped or raster screens (as in paint programs) than for vector screens (as in draw programs).

Storing Graphical Data

Graphical data can be stored as a **bit mapped (raster image)** in the frame buffer or as a series of end points coordinated as a **vector image**.

If the image is stored as a bit mapped image it is possible to determine how much memory is required by the frame buffer by:

- First calculating the number of pixels being displayed on the screen.
- Multiplying that number by the number of bits required for each pixel, depending on the number of colours to be displayed.
- The number of colours to be displayed is equal to the index of the power of 2 that equates to the number of colours. For example:
  - For 2 colours ($2^1 = 2$), 1 bit for each pixel is required.
  - For 4 colours($2^2 = 4$), 2 bits for each pixel is required.

- For 16 colours ($2^4 = 16$), 4 bits for each pixel is required.
- For 32 colours ($2^5 = 32$), 5 bits for each pixel is required.

Note: Two colours is monochrome, that is, a screen of one colour with contrasting display such as black or white. Shades of black, such as grey, are counted as separate colours or tones.

- As the answer will be in 'bits' this must be converted to bytes and then kilobytes and megabytes:
  - Divide the number of **bits by 8** to convert it to bytes.
  - Divide the number of **bytes by 1024** to convert them to kilobytes.
  - Divide the number of **kilobytes by 1024** to convert them to megabytes.

Note: Rather than 1000 bytes in a kilobyte there are 2^{10}, which is 1024 bytes.

Example:

Calculate the size of the frame buffer (amount of memory) required to display an image on a screen with a resolution of 640 × 480 with 16 colours.

- For a resolution of 640 pixels across × 480 rows of pixels down, the total number of pixels on the screen is 640 × 480 = 307200.
- To display 16 colours ($16 = 2^4$) you need 4 bits for each pixel 307200 × 4 = 1229800 bits
- 1229800 bits/8 = 153825 bytes
- 153825 bytes/1024 = 150 kilobytes.

2.5 PROCESSING DATA

Processing manipulates data into information.
Types of processing include:

- Centralised
- Distributed
- Parallel.

Elements related to data processing

	Hardware	Software	Non-computer tools	Social and ethical issue
Processing	• CPU; ALU; CU; CU clock; registers. • Fetch-execute cycle. • Fast processing speed: ◦ Large RAM ◦ Large secondary memory for image, video and audio processing ◦ Affected by clock speed, bus capacity, word size, response time, CPU utilisation • Specialised hardware for centralised, distributed and parallel processing.	Utilities for text, numbers, images, video and audio data.	Documentation: • User manual • Data flow diagrams • System flow charts.	• Flexibility of use with distributed systems as more than one fileserver carries the processing responsibility within network. • Security issues with centralised systems. • Bias in the way participants in the system process data. • Copyright/ownership of processed data.

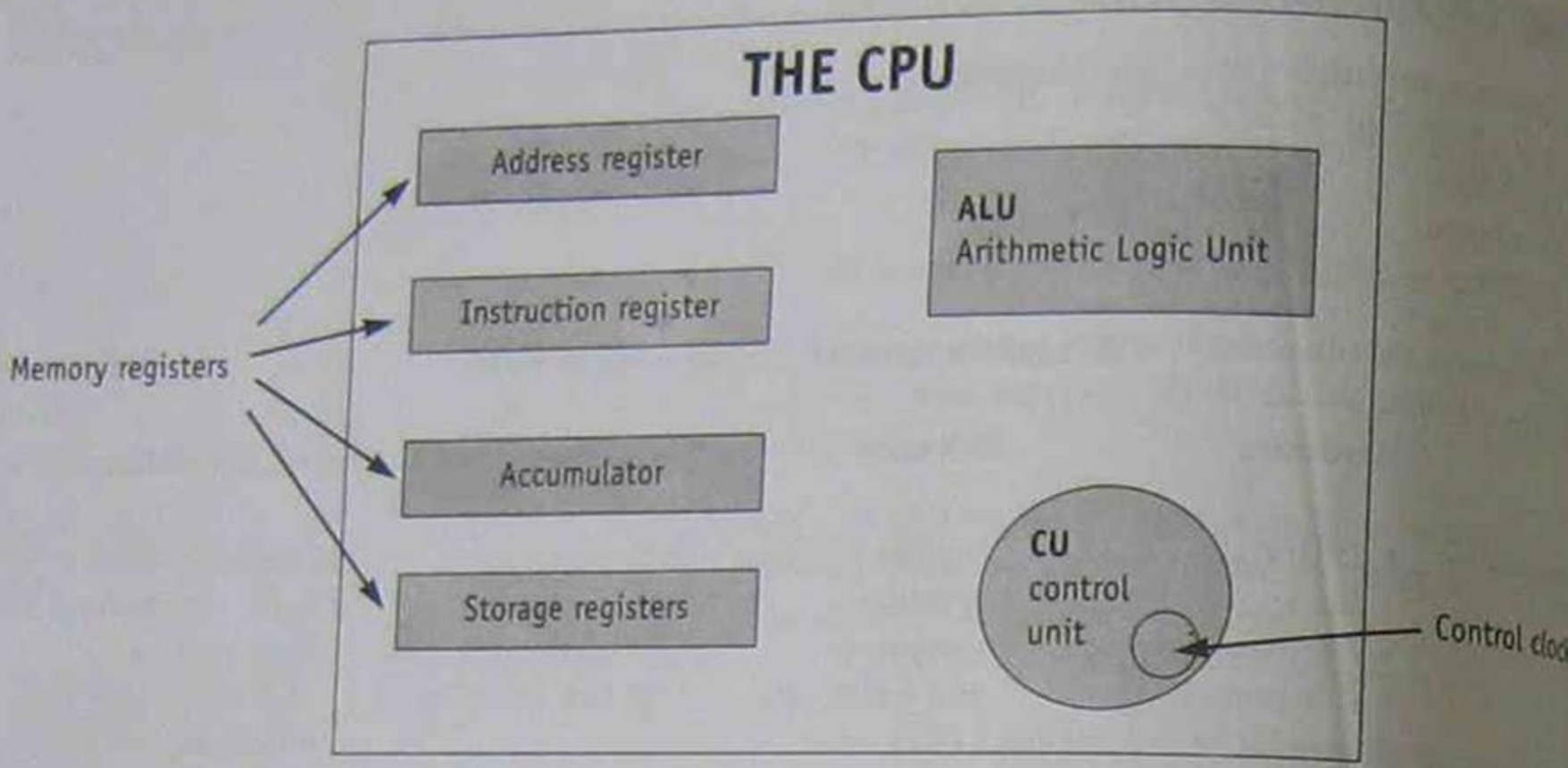
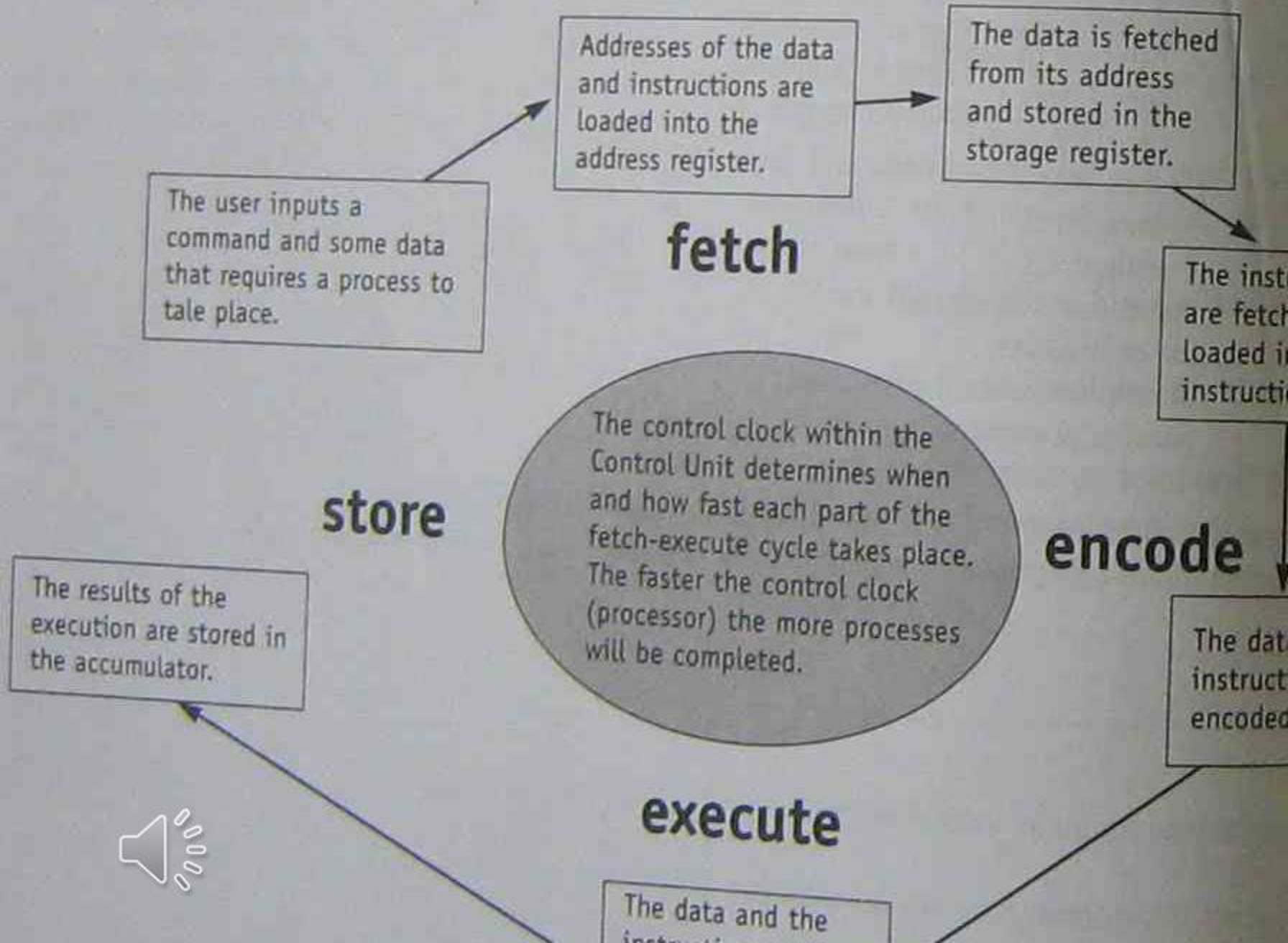


Figure 2.2 The components of the central processing unit


The user inputs a command and some data that requires a process to tale place.
Addresses of the data and instructions are loaded into the address register.
fetch
The data is fetched from its address and stored in the storage register.
The inst
are fetch
loaded i
instructi
encode
The dat
instruct
encoded
The control clock within the Control Unit determines when and how fast each part of the fetch-execute cycle takes place. The faster the control clock (processor) the more processes will be completed.
store
The results of the execution are stored in the accumulator.
execute
The data and the

Processing Data Definitions

CPU	The **Central Processing Unit** is where all the processing is carried out. The CPU contains the ALU, CU, control clock and memory registers. Each of these is involved in the machine cycle or fetch-execute cycle. The CPU is on the motherboard that is built into the computer when it is purchased.
ALU	The **Arithmetic Logic Unit** (ALU) is located in the CPU and is the site of all calculations and data processing. Calculations include the use of logical (AND, OR, NOT) and relational (= , < , > , < >) operators to manipulate the data. The result of the calculation is sent to the accumulator register. The address from where the data is fetched in primary storage is held in the address register and once it is fetched the data itself is stored in the storage register until it is sent to the ALU.
CU and control clock	The control unit directs the movement of data (before processing) and information (after processing) within the CPU. That is, back and forward to primary storage and back and forward to the registers and ALU.

	back and forward to the registers and ALU.
Processing speed	The speed at which data can be processed within a computer. It is measured in Mega Hertz. The speed of a computer's control clock is a measure of its stated processing speed as advertised. For example, 800 MHz (800 million cycles per second).
Address register	A high speed temporary memory space within the CPU where the address of the data and instructions are stored, so that they can be fetched from primary memory during the machine cycle.
Accumulator register	A high speed temporary memory space within the CPU where the results of an execution are stored before being transferred to storage or used in another execution or process during the machine cycle.
Storage register	A high speed temporary memory space within the CPU where the data is stored, so that it can be executed using the instructions in the instruction register during the machine cycle.

Instruction register	A high speed temporary memory space within the CPU where the instructions are stored, so that they can be used to process the data that is stored in the storage register during the machine cycle.
Microprocessor	A single integrated circuit made up of a silicon chip that contains a CPU. The microprocessor and other components that make it work are mounted in the main board, called the motherboard.
Motherboard	The main board used to hold the microprocessor that is built into the computer when it is manufactured.
Logical operators	AND, OR or NOT are logical operators that are used in the mathematical calculations carried out in the ALU.

	carried out in the ALU.
Relational operators	Mathematical symbols that show a relationship between two values and are used for mathematical calculations carried out in the ALU. These include: = ; < (smaller than); > (larger than); = < ; = > ; < > (not equal to).
Boolean operators	Same as logical operators AND, OR, NOT in which the outcome can have one of two values.

Word size	The number of bits that can travel along a bus pathway at the same time. The wider the bus width the more bits can travel together. The size of the bus is often called its bandwidth. The bandwidth is measured in bits. For example, Nintendo 64 means that it has a bandwidth or word size of 64 bits of data.
Response time	The amount of time it takes the computer to respond to a command given by the user.
Centralised processing	Processing that is performed by a central computer in a network so that the workstations connected to the network do little or none of their own processing.
Distributed processing	Splitting of the workload for processing tasks between several different workstations on a network. Each workstation completes a task that contributes to the whole network's processing.

Parallel processing	A type of multiprocessing where several processors within one fileserver work on the same task, sharing memory and other network resources, and data is sent to multiple processors along parallel paths. This is a fault tolerant system because if one CPU crashes the others will take over its workoad, eg. RAID technology.
Thrashing	Occurs when there is not enough RAM or virtual RAM (memory borrowed from the hard disk) so that the computer spends more time sending data back and forth to secondary memory than it does in processing.
Documentation	A written description of any details about an information system that helps the user to interact with the software. For example, user manual, on-line help, tutorials, troubleshooting guide.
Data flow diagrams	A graphical presentation of the flow or movement of data through a system.
System flow charts	A graphical representation of the major inputs, outputs and processes within a system.

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	Hardware	Software	Non-computer tools	Social and ethical issues
Transmitting and receiving	• Terminal/CPU • Dumb terminal • Smart terminals • Modem (MOdulate/ DEModulate) • Facsimile (fax) • Scanner • Automatic answer • LAN (Local Area Network) • WAN (Wide Area Network) • PSTN (Public Switched Telephone Networks).	• Communication software • Protocol • Handshaking • Data compression • Electronic mail • Data encryption.	• 'Snail' mail • Telephone • Fax machines • Radio • Television.	• Data accuracy (integrity) • Data security • Netiquette • Authorship (acknowledgement of data source) • Privacy • Changing nature of work • E-commerce.

Examples of Social and Ethical Issues Related to Transmitting and Receiving

Data accuracy (integrity)

When data is entered into a database or other computer application incorrectly, or if incorrect data was collected originally, the data is said to lack integrity. In other words, it is not correct. This can lead to serious implications for a user applying for a credit rating if a database indicated they were a poor credit risk. This mistake can be passed onto several further databases and the user would have a difficult time proving themselves to be a good credit risk. In the movie *The Net*, Sandra Bullock's character has her social security and criminal records changed, causing serious difficulties in many areas of her life.

Data security

If data is not secured from unauthorised users it may be corrupted or changed. Again in *The Net*, criminals were able to bypass security measures by introducing a program that allowed them easy access into the computer system. As a result they were able to perform many criminal activities, thus causing havoc to many people.

Computer systems usually have several levels of security ranging from the restriction of physical access to computers themselves, to the requirement of passwords for accessing various parts of the system.

Netiquette

Netiquette refers to the unwritten expectation for acceptable and responsible behaviour when using the Internet, especially emails. Examples of poor netiquette include sending unsolicited junk mail (spamming); using capital letters throughout a document (shouting); using derogatory, offensive or obscene language (flaming); or breaching copyright by downloading and using someone else's intellectual property and calling it your own. Giving out your name or personal details in chat rooms is also considered poor netiquette.

Emoticons are special symbols that send an emotive message, for example, :-) is a happy face; :- (is a sad face; :-o is shock; ;-) is a wink.

Other shortcuts: FYI is 'for your information' and IMHO is 'in my humble opinion'.

Before a person uses the Internet they should make themselves aware of the rules of netiquette.

Authorship

Authorship is another name for the intellectual property of an author or artist. Intellectual property is protected by the laws of copyright which give only the author/artist the right to copy or control their work. If anyone uses someone else's intellectual property they should at least acknowledge the source or better still gain permission from the author to use it.

Privacy

All individuals have the right to privacy. With the introduction of computers, and especially large databases, it is very easy for anyone with access to a computer to breach privacy. There have been numerous examples of this in the media such as government department letters being sent to the wrong people and unauthorised persons accessing police records that contain sensitive information and then misusing the data.

Changing nature of work

The introduction of computers has meant that many people have had to change the way they do their work. All commercial companies have had pressure placed on them to computerise or else become uncompetitive in the marketplace. Many skilled jobs such as plan drafting and graphic design can now be completed by relatively unskilled persons. Even movie making and cartoon drawing now rely heavily on the computer.

E-commerce

One of the biggest impacts of computers in the workplace is in the field of commerce. Large numbers of commercial transactions now occur over the Internet. Those companies that have not yet chosen to become computerised find that they are quickly becoming uncompetitive. Individuals can now do their shopping, book plane tickets, buy and sell shares, do their banking and many other everyday things using the Internet rather than exchanging cash in person. The downside of this ease of access is that commercial crime is made easier, necessitating the constant updating of security measures. There is also a very real concern that people just don't meet each other face to face resulting in isolation and dehumanising, again as in the case of Sandra Bullock's character in *The Net*.

Synchronous vs Asynchronous Serial Transmission Modes

	Serial transmission can be synchronous or asynchronous • Synchronous transmission occurs when two computers synchronise their time clocks and agree on transfer protocol before transmission so that all data is sent at once without the receiving computer having to acknowledge receipt before the next packet of data is sent. • Synchronous transmission is faster than asynchronous and is used in large computer systems. • Asynchronous transmission includes a start bit before the data packet followed by a stop bit after the data packet as well as error checking bits such as parity bits. • Asynchronous transmission is commonly used in PC data transmissions.