Standard Grade Computing

Introduction to Computer Systems

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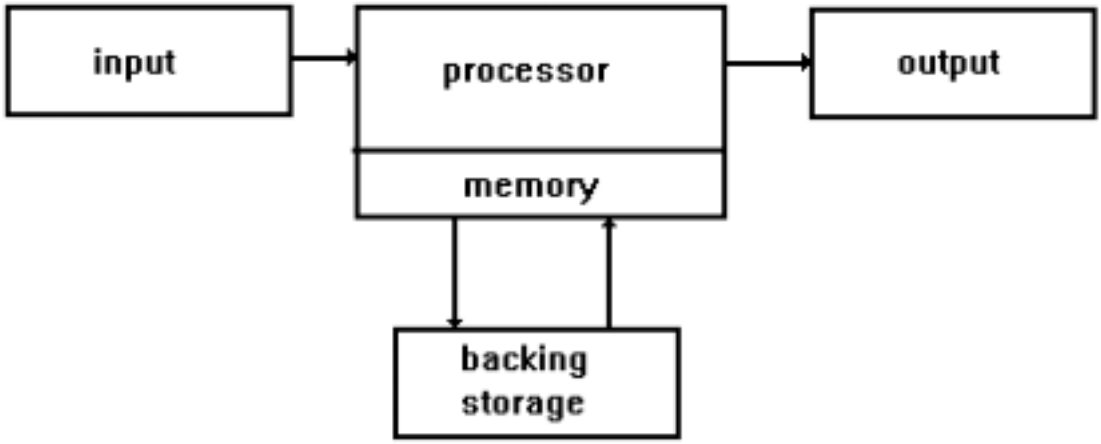
Introduction

What is a computer?

A Computer is a machine that can **store** and **execute** its own instructions. Being able to store and execute instructions makes it different from any other machine. Normally machines are only able to do one sort of thing. Computers can only do what you have given them instructions to do. Your computer can be a word processor, a games machine, a video editor or anything else you want, depending on the instructions you give it.

All computers have the same basic structure:



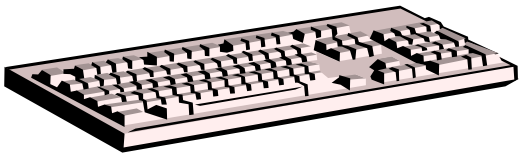
They need some way of taking information **in** and some way of giving it **out**.

The **processor** changes the information according to instructions it is given.

The information and instructions are stored on the **memory**, but because whatever is in the memory disappears when the computer is switched off, you need somewhere to store it. This is called the **backing storage**.

Input, Output and Backing Storage

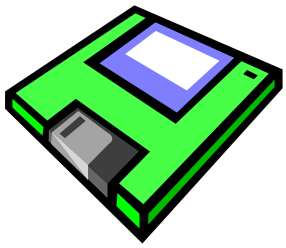
Some examples of **input devices** are: Keyboard and Mouse, Digital Camera, Scanner, and Midi Keyboard.




Some Examples of **output devices** are: Monitor, Printer, Speakers, and Video-Projector.




Examples of **Backing storage** devices are: Floppy Disk Drives CD Drives or Hard Disk Drives.



Storage capacity:

A floppy disk holds about 1MegaByte (Mb)
A CDROM holds about 650Mb
A Hard Disk can hold about 40GigaBytes (1 Gb= 40,000 Mb) or more

Inside the case

The **processor** is a chip inside the computer.

The **memory** is also a set of chips fitted inside the computer.

What makes a powerful computer?

There are many things which affect how your computer performs:

1. The speed of the processor

The faster the processor the more instructions It can process in a second so the faster programs will run. Speed is measured in **Gigahertz** (GHz) 1 Ghz is 1,000,000,000 instructions a second

2. The amount of memory fitted

The more memory fitted in the computer, the more information it can hold while it is running. Memory is measured in Megabytes (Mb)

3. The capacity of the hard disk drive.

The bigger the hard disk, the more programs and information it can store. Disk storage is measured in Gigabytes (Gb)

4. The resolution of the Monitor

Pixels are the coloured dots which make up the picture on a monitor screen. The more pixels the monitor can display, the higher the quality of picture it can display. A 17” monitor can display 1600 X1200 pixels (= 1,920,000 in total)

5. The Video and Sound cards

The more memory and processing power on the video and sound cards the faster the computer can update video or process sound

Hardware and Software

Hardware is the name given to the physical parts of a computer system.

As well as hardware, computers need a set of instructions and data in order to carry out the tasks we give them.

Software is the name we give to the data and instructions they need.

One way of remembering the difference is that:

- Hardware is normally something you can pick up and touch.
- Software is information or instructions stored in memory or on backing storage.

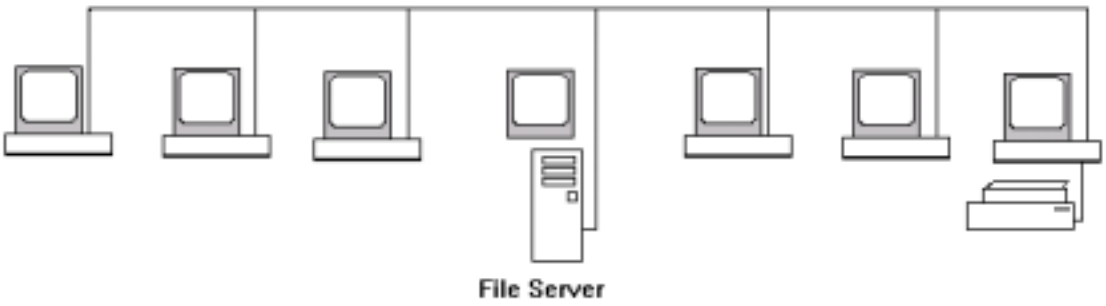
Data and Instructions

Instructions needed for the computer to carry out a task are often called **Programs**.
Examples would be word processors, database programs, spreadsheets, computer games, web browsers etc.

The information the program uses or produces is called **Data.**
Examples would be essays, game levels, videos, sound files, web pages, information stored in databases etc**.**

Computer Networks:

Connecting computers together into a network allows them to communicate with each other. This means that people using them can also communicate with each other.



The computer network in the school means that:

- You can log on anywhere in the school and see your own files
- All the computers in a room can share resources such as a printer or a hard disk
- All the school computers can share the Internet connection
- You can use the network to send email
- We can block viruses and back up files automatically on one central computer

The network is controlled by a number of powerful computers called **Network Servers**. The connections between the computers in the school is provided by **network cables** connected to the back of the machines.

Task 1

Set up a three column table in your word processor with the headings **Input** **Output** and **Backing Storage**.

Input	Output	Backing Storage

Put the names of as many different devices as you can into the three columns.

Task 2

Here is a list of computer terms. Arrange them into two lists, headed Hardware and Software.

Hardware	Software

monitor	program	mouse	plotter
CDRom-Drive	game	file	joystick
data	scanner	word-processor	
printer	processor	Memory chip	keyboard

Task 3

Here is a list of computer terms. Arrange them into two lists, headed Instructions and Data.

Instructions	Data

A PowerPoint presentation	Microsoft Word	A Visual Basic Program
Your last English essay	A computer game	A video on the Internet
An MP3 sound track	The barcode on a tin of beans	A web page

Computer Jargon

One reason why people sometimes find it difficult to learn about computers is because there are so many special computing words. Look at the following list and see if you can recognise the word which is being described. You can start to build up your own dictionary of computing terms.

Task 4

Match each of the following descriptions to the correct computing word.

Write out your answers in full so that you can refer to them later and add your own definitions as you learn new computer words

A) The physical parts of a computer system

B) The set of instructions and the data which are necessary to operate a computer

C) A set of computers which are connected to each other and which share access to a disc drive and printer

D) The set of instructions which the user enters to tell the computer what to do

E) An input device which allows the user to enter the program and data

F) The main part of a computer system which processes the data

G) A backing storage device which stores the program and data ready to be loaded into the computer's memory and run

H) An output device which displays text and graphics

1) An output device which allows you to get a printed copy of text and graphics

program	monitor	processor
keyboard	network	hard disk
software	hardware	printer

Practical Task 1

Ask your teacher for Practical Task Sheet 1

When you complete this task you will have written a short Visual Basic program which uses a number of **input** and **output** devices. You program will be made up of **instructions**, but will also use **data** stored on the network.

Summary

- A computer is a machine which can store and execute its own instructions
- A computers system is made up of
    - input device
    - processor
    - memory
    - backing storage
    - output device
- Computers need both **Hardware** and **Software**
- Software consists of **Data** and **Instructions**
- Computers can be connected together to make **networks**

High Level Languages

The computer's own language

The processor in all computers is made up of millions of tiny transistors which act as switches. These switches can only have two values – **on** or **off**. For this reason the language which the processor understands is made up of **ones** and **zeros** – a one corresponding to a switch which is on and a zero corresponding to a switch which is off. A system which uses two values like this is called a **binary** system

This language is often called binary or machine code and is very difficult for humans to read or understand. This is why the first computers were very difficult to program.

Machine Code

```
10101110011110101110011 1
00011101110011100001110 1
11001110101011101010111 0
01110001110111001110111 1
00011101110011101010111 0
01110001110101110011100 0
11101110011101011100111 0
11000111011100111001110 1
10011101010111001110101 0
11100111000111011100111 0
00111011100111010101110 0
11100011101110011101100 0
```

The very first machines were originally programmed using banks of switches on the front of the cabinet, which were set to the appropriate binary code, then input to the machine with a master switch line by line. Programming was done using a large manual of binary codes containing details of what each one would do. Errors were easy to make and difficult to detect.

Task 5

This example of a short machine code program transfers information between different parts of the computer.

01 001 100	Transfer contents of A to C
01 111 001	Transfer contents of B to A
01 100 111	Transfer contents of C to B

See if you can work out which parts of code refer to the transfer operation, and which refer to A B and C.

What would this code mean? 01 001 111

What are High Level Languages?

Because machine code was so difficult to understand and to write programs in, computer languages were developed which were easier for people to understand. These languages were called **High Level Languages.**

There are many high level languages – they are all designed with slightly different purposes in mind.

Task 6

Here is a list of high level languages. Use a computing dictionary or the Internet to match up these languages to their correct description:

LOGO	BASIC	Pascal
COBOL	VRML	C++
Java	HTML	Prolog

Definitions:

- A simple easy to learn language for beginners
- A language to teach young children about problem solving
- A language for business uses such as sending bills, stock control, banking etc.
- A language used to program internet applications like Instant messaging or chat-rooms
- A language used to write pages for the World Wide Web
- A language used to program computers so that they appear to be intelligent eg. Playing chess
- A language used to create virtual reality environments
- A language used to teach university students about programming
- A language used to write operating systems or other large applications

Task 7

Use the Internet or a computing dictionary to find out about some of the languages in the list below.

Algol	C#
Forth	Lisp
Postscript	PHP
COMAL	Java Script

Translating High Level Languages

High level languages are written using words similar to English words. This makes programs written in high level languages easy for humans to understand and easier to fix when mistakes are discovered. Because the processor only understands machine code, there has to be **translation** software available which translates the high level language into machine code.

As long as you have a translator loaded into your computer, it doesn't matter what kind of computer you use to write your High Level Language program. this means that programs written in High level languages are **Portable -** they can easily be moved from one computer system to another.

By loading up different translator programs, one computer can seem to understand a number of different High Level Language programs.

There are two types of translator, **interpreters** and **compilers**.

If a programming language is **Interpreted**, this means that it is translated into machine code line by line every time it is run. When you use a program written in an interpreted language like Basic or Java, there has to be a translator program running in the computer at the same time as the program itself.

> **Advantages:**
> It is easy to spot errors in an interpreted language, and often the machine can tell the programmer what is wrong or suggest corrections.
>
> **Disadvantages:**
> An interpreted program will be slower, and some of the memory will be taken up by the translation software. You will always need the translator to run the program.

If a programming language is **Compiled**, this means that it is translated directly into machine code before it is run. Once it is translated you no longer need the translator software to run the program.

> **Advantages:**
> Programs which have already been translated into machine code run much faster. You can give the compiled program to someone else and they can run it without needing the translation software.
>
> **Disadvantages:**
> You only find out whether you program works or not once it is compiled, and when the program is running the computer cannot give you any useful error messages.

Task 8

Copy out the sentences below and fill in the blanks:

translator program systems software programmer amended

high level language machine code corrected program

The computer's own language is called ..... and it uses just two numbers, 0 and 1.

It is easier and quicker to write a ..... in a ....., because it allows the ..... to think out and write a ..... in words that look like ordinary English . Also the ..... is easier to understand once it is written and therefore can be ..... or ..... more quickly.

The computer must have a ..... so that it can understand a ..... The ..... is part of the .....

Practical Task 2

Ask your teacher for Practical Task Sheet 2

When you complete this task you will have looked at a number of different programming languages and written the same program in each one. You will have discovered that there are many similarities between programming languages.

Which language is easiest to understand?

Which language is easiest to use?

Internal Documentation

Task 9

Look at the two Pascal programs below.

The two programs behave in exactly the same way, so it would be impossible for the person using them to tell the difference.

Once the compiler has translated them they would be translated into exactly the same machine code, so the computer would not be able to tell the difference.

There are many differences between these programs from the point of view of someone wanting to understand how they work or to alter them in some way.

Version 1

```
PROGRAM Area (INPUT OUTPUT);

VAR
length, breadth, area: REAL;

BEGIN

// Program to calculate area
// I King 28-11-03

WRITELN ('Enter length in metres');
READLN(length);
WRITELN('Enter breadth in metres');
READLN(breadth)
Area := length * breadth;
WRITELN('Area = ';area)

END
```

Version 2

```
PROGRAM Area (INPUT OUTPUT);VAR l,b,a: REAL; BEGIN
WRITELN ('Enter length in metres');READLN(l);WRITELN('Enter
breadth in metres');READLN(b)Area:=l*b;WRITELN('Area=';a)END
```

List as many differences as you can see between the two versions.

Which is better?

Why?

What you expect in a High level Language Program

Programs written in high level languages should be:

1. **Readable**: They should be easy to understand. This means that the programmer should use meaningful variable names which mean something rather than using single letters, and they should also include plenty of comments explaining how the program works. This is called **internal documentation**. If the program is clearly laid out using blank lines and indentation, then this also helps readability

2. **Maintainable**: Programs should be easily altered to suit new circumstances, and it should be easy for someone to fix mistakes This is only possible if the programmer has made the program readable in the first place.

3. **Modular**: They should be built up out of blocks which can work as independent sub-programs. These blocks are usually called **procedures**. Using them means less work in the future because these blocks can be adapted for use in other programs.

4. **Robust**: They should check for any input or output errors and should not “crash” unexpectedly. They should be fully tested before use.

5. **User Friendly**: They should tell the person using the program exactly what they need to do any time they need to input data. Programs which are not easy to use mean that mistakes in using them are much more likely.

6. **Efficient**: Programs should make the best possible use of the memory or hard disk space in a machine allowing for the above conditions.

All of these are important, but the most important ones are at the top of the list.

Common Features of High Level Languages:

High level Languages have several things in common:

- They have been written to solve a particular type of problem: They are **Problem Specific.**

- They are written in a language which is easy for humans to understand They are **English Like**

- They need to be **Translated** into machine code before the processor can understand them.

- They can be used on different computer systems as long as you have the translation software available. They are **Portable.**

  - All programming languages are made up of three standard control structures:

    Sequence: The machine obeys each command in the program in the order which they are given.

    Loop: The machine can be made to loop around a sequence of commands for a set number of times

    Branch: The machine can be made to obey one set of commands rather than another depending on what is happening in the program.

Practical Task 3

Ask your teacher for Practical Task Sheet 3

When you complete this task you will have taken a Visual Basic quiz program and altered it to make it ask different questions and to be more user friendly.

How does Visual Basic make a program more readable?

What did you add to your program to make it more User friendly?

Documentation

Programs should also include **Documentation**. If you had employed a programmer to write a program for you, you would expect them to supply:

1. **User Guide**: A step by step guide explaining how to use the program
2. **Algorithm**: A detailed plan of the program and how it works
3. **Listing**: A printed listing of the program code. The listing should contain **Internal Documentation**
4. **Test data**: Details of how the program was tested, what the test data was and what the results were. Printed output should be included where appropriate.

Programming Environments

How easy is the version of the High Level Language you have to use? The collection of tools you have available when you write a program is often called the **Programming Environment**.

Good programming environments will:

1. Highlight programming language key words, documentation or variables in different colours
2. Make it easy to change the program using tools like search and replace.
3. Give you understandable error messages
4. Make it easy to trace errors by letting you step through the program line by line

Summary

- Computers only understand their own language called **binary code**
- High Level Languages are easier for humans to use but they need to be translated before the computer can understand them
- There are two types of translator – **Interpreters** and **Compilers**
- **Interpreters** translate program code into machine code line by line
- **Compilers** translate program code all in one go
- **High Level Languages** are English-like and make it easy to spot mistakes in code
- Programmers should **document** their code to make it easier to understand and debug

Operating systems

What is an Operating System?

When a computer is switched on, the first piece of software it needs to be any use at all, is its **Operating System**. This is a program which is designed to understand simple commands typed at the keyboard or selected using the mouse and which translates them into machine instructions which the processor understands. It is the software which controls or **supervises** all the operations of the computer.

The operating system for a very small computers like the ones which control domestic appliances, mobile phones etc. can be stored entirely in Read Only Memory (**ROM)** and is ready as soon as you switch the computer on. This also means that the Operating System cannot be damaged or changed in any way.

In most Microcomputers, the operating system is loaded into Random Access Memory (**RAM**) from **disk**. The reason for this is that modern operating systems are very large, and not all of the operating system is needed in RAM at any one time. The disadvantage is that the operating system can become corrupted by other programs and cause the computer to hang up. If this happens, often the only solution is to switch the computer off and start it up again.

When a computer starts up, it needs to know where to find the Operating System and where to load it. These start-up instructions are stored in **ROM**. This is sometimes called the **Bootstrap Loader**.

Functions of an Operating System

The operating system performs several functions:

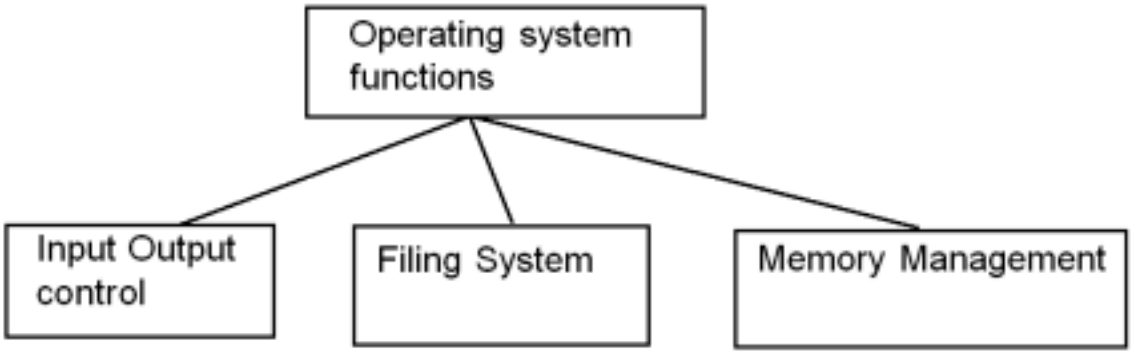
1. It controls the **input** and **output** devices attached to the computer (keyboard, mouse, visual display unit (VDU), printer etc.) and controls the information going to and from these devices. The **Central Processing Unit** (**CPU)** works at a much faster rate than either the keyboard or the screen, so the operating system controls how much time is spent doing what.

2. It keeps track of the **filing system** and where all the files are stored. The user doesn't need to remember where about on the disk a file is stored, only its name, for the operating system to find it. (often a file can be spread out over several parts of the disk, and the operating system keeps track of where each bit is)

3. It keeps track of what memory (RAM) is available and what is stored where. In a system such as Windows, where several programs are being used simultaneously, the operating system has to shift parts of the programs around between the disk and the RAM depending on which one the user requires. This is called **Memory Management**

4. It provides the **Human Computer Interface** (HCI) for the user. This is the Windows Icon Mouse Pull down Menu (WIMP) system most modern operating systems use.

5. It gives the user error messages when a problem occurs such as a command which is not understood, or a hardware or software failure. This is called **Error Reporting**.



Task 10

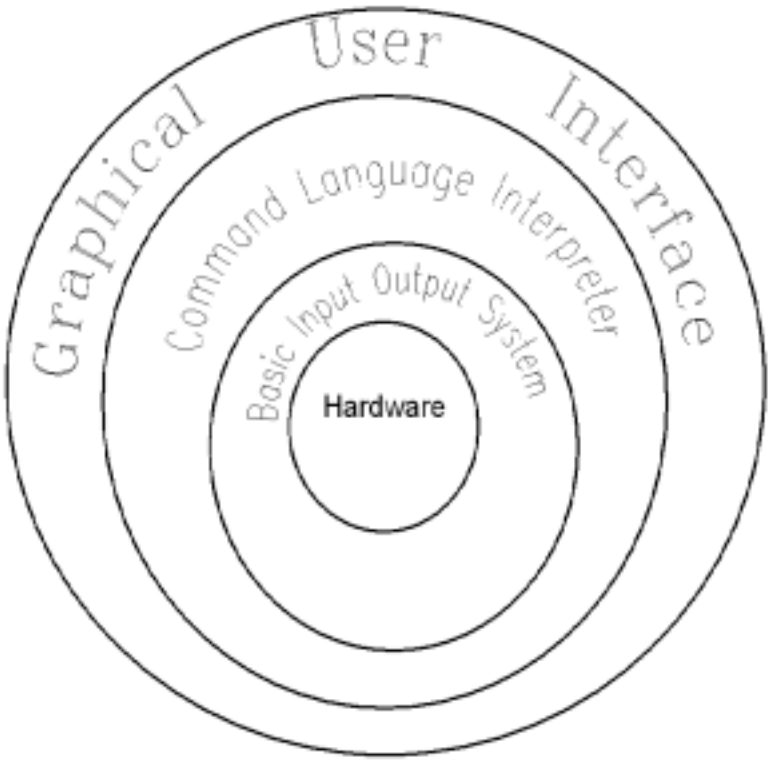
Copy and complete the following sentences, using the list of words provided.

program	lost	programs	backing storage device
memory	RAM	disk	filing system
keyboard	data	ROM	operating system
systems software		multitasking	

The .... is a ..... which runs continuously while the computer is switched on. Its job is to control how the computer works, for example it checks the ..... to see if any instructions have been entered, and then decides what action to take.

The Operating System is part of the computer's ...., and it can be stored on a ..... or in .....

An important part of the Operating System is the .... which controls the transfer of ..... between the computer's ..... and the .... This is necessary because the information is stored in ..... while the computer is running, and is ..... when the computer is switched off.



Parts of the Operating System

Command Language Interpreter

The Command Language Interpreter is the part of the operating system which translates English like commands typed at the keyboard into machine instructions which can be understood by the processor.

Basic Input/Output System

The Basic Input/Output System acts as a "slave" to the Command Language Interpreter, carrying out its commands by moving data to and from different parts of the computer system. For instance it will accept key-presses at the keyboard or movements of the mouse and echo these to the screen; it will send information from the processor to the printer, taking its commands from the Filing System.

The Basic Input/Output System has to be written in machine code, and is different for each make of processor. The Command Language Interpreter can be written in a High Level Language, and can run on many different makes of processor and computer.

Task 11

Copy and complete the following sentences, using words from the list provided:

keyboard	operating system	machine-readable
data	basic Input/Output system	
	command language interpreter	

The .... is part of the .... which translates commands typed at the ..... into .....-..... instructions

The ..../..... ..... is the part of the .... which directly handles the movement of ..... around the computer system.

Interactive, Background and Real Time Processing

Most microcomputer operating systems are Interactive. This means that the operating system is running at the same time as it is getting input from the user. This is called **Interactive Processing**.

Because computers can perform tasks very quickly, it is possible for the operating system to perform other tasks in the background while they are waiting for input from the user, or while they have been left switched on but not being used. These background tasks could be anything from printing, scanning for viruses, downloading updates from the Internet or saving files automatically. This is called **Background Processing.**

Some programs have to react to events immediately as soon as they occur. This type of processing is so important that it cannot depend on the user entering data or be done in the background while other programs are running. An example would be the program which controls a dangerous chemical process or a power station. It could also be the program stored in a dedicated microprocessor which controls the engine of a car or even a washing machine or microwave oven. This type of processing is called **Real-Time** processing.

Filing Systems

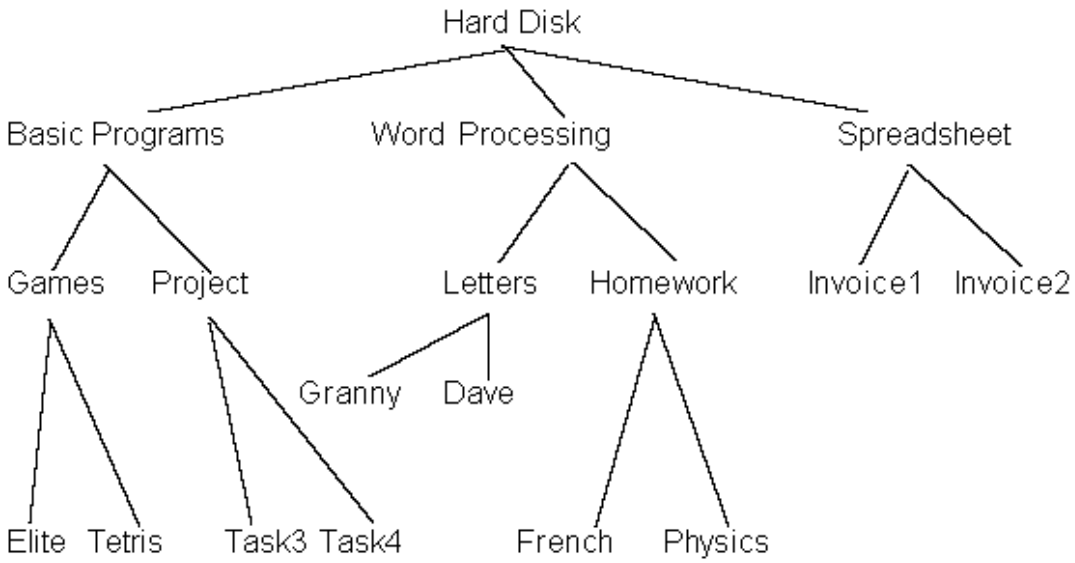
The filing system of a computer system is used to transfer information between the RAM and the backing store. This is important because all the information in RAM is lost when the computer is switched off. If you could not load this information back into RAM when you switched the computer on again, then you would waste many hours reprogramming it every time you wanted to use it.

The filing system of a computer is controlled by the operating system.

A floppy disk can store about 1.4 Mb of data (1.4 million characters)

A hard disk can store 40 Gb or more.
This means that there has to be some system of keeping track of files on a disk this size.

Most computers use a **hierarchical** filing system where files are stored in folders or directories, which can themselves contain further folders. A diagram of a typical hierarchical filing system could look like this:



The advantages of a hierarchical filing system like this are:

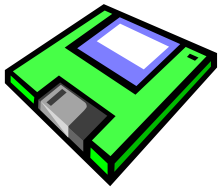
- You can organise your files and find them easily
- You can have files in different folders with the same file name
- On a network you can use a system like this to set up security so that people can not see each other's files

Hard Disks

Microcomputers use hard disks as backing storage, Hard disks are used because they can store very large amounts of information and information can be retrieved from them very quickly. Disk are **Random Access** devices. This means that it takes the same amount of time to access the data no matter where the information is stored on the disk

Floppy Disks

Floppy disk are also Random Access storage devices. They are cheap and portable, but they can not store a lot of information



Tape

Tapes are used for backing up data and keeping it safe in case a hard disk fails or data is deleted by mistake. Tapes are **Serial Access** devices. This means that the data is read from a tape in a particular order – the nearer the end of the tape, the longer it will take to retrieve it. Tapes are slow but cheap, so many tapes can be used to store different backup copies of data.

Disk Formatting

Data is stored on a disk as a series of magnetic 1s and 0s.

One of the jobs of a computer operating system is to keep track of where all files are stored on a disc. To help it do this the operating system **formats** a disk the first time it is used.

When a disk is brand new, it has nothing to help the operating system to know where it can store a file. Before it can be used the operating system formats the disk. This means that it magnetically marks the disk surface out into tracks and sectors.

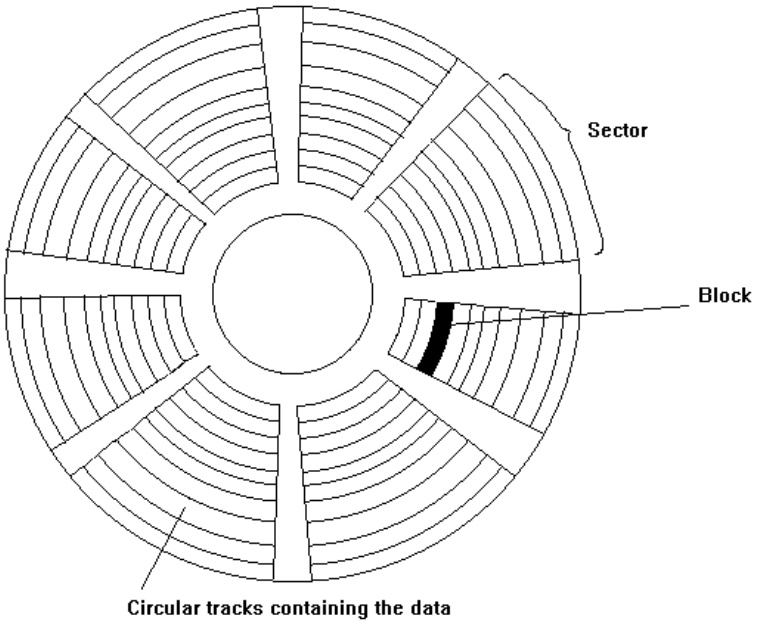
A **track** is a circular magnetic ring on the disk.

The disc is also divided up into wedge-shaped **sectors**. The diagram shows how a disk could be formatted.

A **block** of data on a disc can be uniquely identified by its track number and its sector number. Usually the first few blocks of data are used to store the directory information on the disc

Different operating systems format discs differently (different numbers of tracks and sectors). This means that once a disc has been formatted for use on one type of computer, it sometimes cannot be used in a computer with a different operating system, even if the disc is the right size for the disc drive.

Formatting a disc is the quickest way of removing old data.
Both floppy discs and hard discs need to be formatted before they can be used.



Device Drivers

A **peripheral** is an external device which is connected to the computer. Input, Output and Backing Storage devices are all peripherals.

When you attach a new peripheral to a computer, you often have to install software which allows the operating system to control the new piece of equipment. This software is called a **Device Driver** and is necessary so that the signals from the operating system can be translated into a form which the peripheral can understand and vice – versa.

Many operating systems come with device drivers for existing peripherals already available. They are installed automatically when the peripheral is connected.

New peripherals need to come with their own device drivers on disk if they have been manufactured after the operating system was released. Usually the device drivers come on a disk along with other utilities and software for using the device.

Graphical User Interfaces (GUI)

Modern operating systems are designed to be as user friendly as possible, and most have a **Graphical User Interface** (**GUI**)

A **GUI** means that:

- The user can tell the machine what to do using a pointer which moves around the screen when you move the mouse
- Files and folders are represented by pictures on screen (icons)
- Pull down menus appear when you click on a command with the mouse button.

Graphical User Interfaces are sometimes called Windows Icons Mouse Pull-down-menu (**WIMP**) systems.

Practical Task 4

Ask your teacher for Practical Task Sheet 4

When you complete this task you will have compared two types of operating system. One is an old fashioned **command** line operating system called MsDos. The other is a modern **GUI** operating system called Windows.

Summary

- The **Operating System** is the software which controls the computer
- The functions of the Operating System are:
  - Memory Management
  - File Handling
  - Peripheral Control
  - Interpreting user commands
- Modern Operating Systems have a **Graphical User Interface (GUI)** to make controlling the computer easier.
- **WIMP** stands for **W**indows **I**cons **M**ouse **P**ull-down menu
- **Interactive** processing is where the user communicates directly with the computer
- **Background** processing is where the operating system completes a job in the background without the user having to do anything.
- **Real Time** processing is where the operating system has to react immediately to external events
- A **Device Driver** is software which a peripheral needs to be installed so that it can communicate with the operating system
- Disks have to be **formatted** before an operating system can use them

Data Storage

Nowadays computers store lots of different types of data. Different types of data need to be stored in different ways because the computer uses this data in different ways.

Here is a list of the different types of data you might expect a computer to be able to store:

Type of Data	Examples
Text	Word Processed Documents, Text Files
Numbers	-200, 0.0003456, 56
Graphics	Pictures, Technical Drawings, Scanned Photographs
Sound	Music, recorded sounds
Video	Films, Animations

Data Storage Units

The units we use to store data are the same units we use to calculate the size of computer memory, but it is important not to confuse the two things. Remember that the contents of memory disappear when the computer is switched off – Storage is needed to save programs and data so that you can load it into the memory when you switch the computer on again

File sizes are normally given in **Kilobytes** or **Megabytes**.

(You can find the size of a file by right clicking on it and choosing **properties** from the menu)

A **bit** is a single **1** or **0** and **8** bits make a **byte**

A **byte** is the space needed to store a single character from the keyboard.

1024 Bytes = 1 Kilobyte
1024 Kilobytes = 1 Megabyte
1024 Megabytes = 1 Gigabyte
1024 Gigabytes = 1 Terabyte

Although the actual figure is 1024 (2 to the power of 10) you can use 1000 to give you a rough idea of the difference in size. This would mean that one Terabyte contains 1,000,000,000,000 Bytes

Typical storage capacities

A floppy holds **1.2 Megabytes**
A CD can hold **700 Megabytes**
A typical hard disk can hold **60 Gigabytes** or more

Text

The simplest way of storing text is by using a separate binary code for each character. It is important that everyone uses the same method of coding characters. This is standard method is called **ASCII Code**

American
Standard
Code for
Information
Interchange

ASCII code is used to transfer data between computers and to transfer data between applications.

Every character on the keyboard is given a different code made up of 7 bits This gives 128 ($2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^7$) possible combinations

128 different possibilities was enough for all the characters on the keyboard and a number of **control characters.** Control characters were originally used by teletype machines. They include tab characters, cursor keys, acknowledgement signals etc. Some of these can still be generated by pressing a keyboard key along with the **CTRL** key.

Here are some ASCII code examples:

Character	Code
0	0110000
1	0110001
A	1000001
a	1100001
space	0100000
%	0100101
&	0100110
=	0111101

Task 12

Use an ASCII code chart to convert the following message into characters:

1001101	1001111	1001101	1000101
1001001	1001110	1010000	0100000
1010011	0100000	1001100	0110000
1001001	1000011	1000101	0110000
1001111	1001111	1010100	0110111

ASCII Code Chart

Binary	Decimal	Character	Binary	Decimal	Character
0000000	0	NUL	1000000	64	@
0000001	1	SOH	1000001	65	A
0000010	2	STX	1000010	66	B
0000011	3	ETX	1000011	67	C
0000100	4	EOT	1000100	68	D
0000101	5	ENQ	1000101	69	E
0000110	6	ACK	1000110	70	F
0000111	7	BEL	1000111	71	G
0001000	8	BS	1001000	72	H
0001001	9	HT	1001001	73	I
0001010	10	LF	1001010	74	J
0001011	11	VT	1001011	75	K
0001100	12	FF	1001100	76	L
0001101	13	CR	1001101	77	M
0001110	14	SO	1001110	78	N
0001111	15	SI	1001111	79	O
0010000	16	IDLE	1010000	80	P
0010001	17	DC1	1010001	81	Q
0010010	18	DC2	1010010	82	R
0010011	19	DC3	1010011	83	S
0010100	20	DC4	1010100	84	T
0010101	21	NAK	1010101	85	U
0010110	22	SYN	1010110	86	V
0010111	23	ETB	1010111	87	W
0011000	24	CAN	1011000	88	X
0011001	25	EM	1011001	89	Y
0011010	26	SUB	1011010	90	Z
0011011	27	ESC	1011011	91	[
0011100	28	FS	1011100	92	
0011101	29	GS	1011101	93	]
0011110	30	RS	1011110	94	^
0011111	31	US	1011111	95	
0100000	32	Space	1100000	96	_
0100001	33	!	1100001	97	a
0100010	34	"	1100010	98	b
0100011	35	£	1100011	99	c
0100100	36	$	1100100	100	d
0100101	37	%	1100101	101	e
0100110	38	&	1100110	102	f
0100111	39	'	1100111	103	g
0101000	40	(	1101000	104	h
0101001	41	)	1101001	105	i
0101010	42	*	1101010	106	j
0101011	43	+	1101011	107	k
0101100	44	,	1101100	108	l
0101101	45	-	1101101	109	m
0101110	46	.	1101110	110	n
0101111	47	/	1101111	111	o
0110000	48	0	1110000	112	p
0110001	49	1	1110001	113	q
0110010	50	2	1110010	114	r
0110011	51	3	1110011	115	s
0110100	52	4	1110100	116	t
0110101	53	5	1110101	117	u
0110110	54	6	1110110	118	v
0110111	55	7	1110111	119	w
0111000	56	8	1111000	120	x
0111001	57	9	1111001	121	y
0111010	58	:	1111010	122	z
0111011	59	;	1111011	123	{
0111100	60	<	1111100	124	
0111101	61	=	1111101	125	}
0111110	62	>	1111110	126	~
0111111	63	?	1111111	127	DEL

Error Detection

Computers store information in blocks of 8 bits called a **Byte**
A 7 bit ASCII code left one bit free. The 8th bit (called a **Parity** bit) was used for error correction.

The total number of 1s in any ASCII code must be an odd number.
The parity bit is added to make the total odd

01101101
11111000

If the total is even then there must be a mistake in the code and it is rejected. Nowadays transmitting data is much more reliable so often the parity bit is used instead to extend the number of characters which can be represented. This gives 256 (2^8) possible combinations

Practical Task 5

Ask your teacher for Practical Task Sheet 5

This is a short practical task to give you practice in understanding how Parity bits work.

Practical Task 6

Ask your teacher for Practical Task Sheet 6

In programming, we often convert ASCII codes into decimal numbers to make them easier to recognise. When you complete this task you will have written a short Visual Basic program to convert ASCII codes into letters and back into numbers again.

Unicode

Now that computers and computer programs are used internationally, there is a need for more than 256 characters to account for foreign alphabets and scripts. **Unicode** uses 16 bits to code text, giving 2^{16} = 65536 different possible characters

Numbers

Computers store number as !s and 0s for the same reason as they store characters as 1s and 0s – the processor is built form millions of switches which can only be on or off. They store data on magnetic disks as magnetic 1s and 0s or on CDs which can only store optical 1s or 0s.

For this reason computers use a **Base 2** or **Binary** number system. Each digit is called a **bit.**

Humans use the **Base 10** or **Decimal** number system.

Base 10

10^4	10^3	10^2	10^1	10^0
Ten-Thousands	Thousands	Hundreds	Tens	Units
4	7	3	8	4

= 47,384

Base 2

2^4	2^3	2^2	2^1	2^0
Sixteens	Eights	Fours	Twos	Units
1	0	1	0	1

= 16 + 4 + 1

= 21

Task 13

1. Convert the following binary numbers into decimal:

   1001
   0110
   1000
   1110

2. What is the largest number which can be represented by 4 bits?

3. What is the largest number which can be represented by 8 bits (1 byte)?

4. What is the largest number which can be represented by 10 bits?

This may make it easier to see why 1 kilobyte is 1024 bytes and not 1000 bytes (1024 is 2^{10})

Task 14

You have come across two different ways of representing numbers, either in binary (if it is intended that a calculation is to be carried out) or as characters using a code such as ASCII.

If for example, the number is part of an address (e.g.12 Newton Road), or part of a car registration number (e.g. M234 PNS), then it is treated as a character.

Decide whether each of the following would be coded in binary or in ASCII format for storage in memory. Give a reason for your answer.

a) A telephone number
b) A date of birth
c) A postal code
d) your height in centimeters

Graphics

Computer graphics, whether displayed on a computer monitor, or printed out, are made up of tiny dots. These dots are called **picture elements**, usually shortened to **pixels**.

Bit-mapped Images

If a picture is in black and white, each pixel will either be a white dot or a black dot. The computer can store this information very easily. Each pixel can be represented by a single binary digit (bit). If a pixel is black, the computer can store a 0; if the pixel is white, it can store a 1. So, in the computer's memory, there will be 1 bit for every pixel.

Task 15

The following bits in a computer's memory are the pixels of a 10 x 10 grid, with 0 representing black and 1 representing white.

1100000111
1000000011
0011111001
0100100101
0111011101
1011111011
1010001011
1101110111
1110001111
1101110111

Draw out a 10 x 10 grid, and work out what the computer graphic is.

Storing computer graphics can require large amounts of computer memory (RAM).This example illustrates this for you:

Task 16

A computer has a screen which displays a picture 1600 pixels wide and 1200 pixels deep.

(a) How many pixels are there altogether on the screen?
(b) If 1 bit is needed for each pixel, how many bits are required to store a full screen picture?
(c) 8 bits equals 1 byte. How many bytes of memory are needed to store the screen?
(d) How much memory is this in Kb? (remember 1Kb = 1024 bytes and 1Mb = 1024 Kb)

This is the memory needed to store a monochrome (black and white) picture. If the display uses colour you would have to set aside even more memory. A modern 32 bit colour display would need 32 times this amount of memory.

Practical Task 7

Ask your teacher for Practical Task Sheet 7

This is a practical task where you are asked to change the number of colours in an image and see what effect this has on the file size.

Vector Graphics.

A more complicated but less memory intensive way of storing images is to make the computer store the picture as a set of instructions for re-drawing it. This means that the picture is stored as a set of instructions rather than as a set of pixels.

You can tell the difference between a bit-mapped painting program and a vector drawing program because the bit-mapped program will let you zoom in to the picture to alter details, but you will only be able to zoom in so far, and all you will be able to do is to switch pixels on or off, or to change their colours.

A vector drawing program like those used for Computer Aided Design, will let you zoom in much further without the **resolution** or quality of the picture changing.

You can also tell the difference when an object oriented drawing program loads up a picture, as you will see the picture being re-drawn by the computer.

Practical Task 8

Ask your teacher for Practical Task Sheet 8

This is a practical task where you are asked to create the same picture in a bitmapped graphics and a vector graphics package to see what the differences in file size are.

Task 17

1. List the differences between a bitmapped and a vector graphics package.

2. Decide which of these packages you would use for:

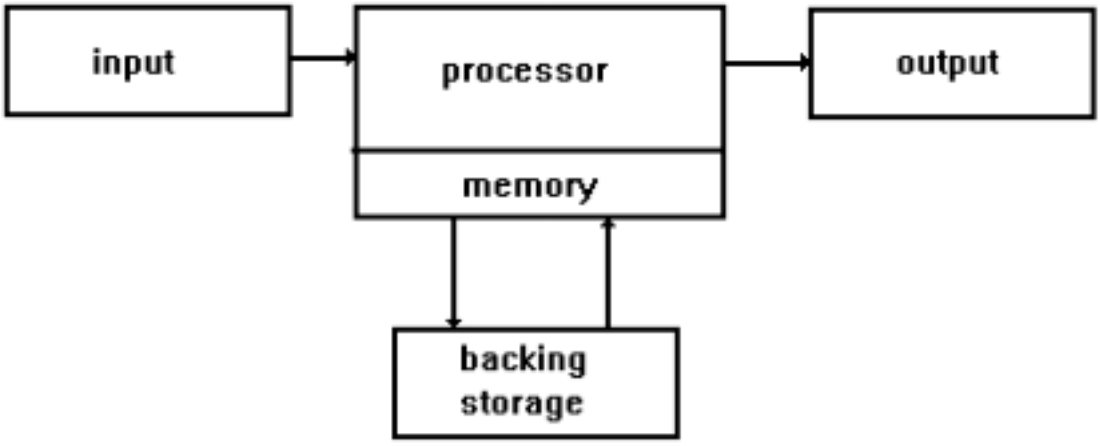
    a) Producing a front cover graphic for a project
    b) Designing a new kitchen layout
    c) Editing a scanned photograph
    d) Producing a 3D plan of an invention you want to patent.

Summary

- A **bit** is the smallest unit of information
- 8 bits make 1 **Byte** 1024 bytes make 1 **Kilobyte**
- 1024 **Kilobytes** make 1 **Megabyte**
- 1024 **Megabytes** make 1 **Gigabyte**
- Computers store text as **ASCII** code
- Every character has its own ASCII code
- Computers store numbers using **binary** code (base 2)
- Computers store graphics as **Bit-maps** or **Vector Graphics**

Inside the Processor

Look again at the diagram of a computer system



Memory

The Memory in a computer is where programs and data are stored while the computer is working.

There are two types of memory:

Read Only Memory (ROM) and **Random Access Memory (RAM)** The contents or RAM disappears when you switch the computer off, the contents of ROM are permanent. The more RAM in a computer, the more programs it can run and data it can hold at any one time.

RAM is used for programs and data. ROM is used to store things which need to be permanent such as the part of the operating system which tells the computer what to do when it is switched on.

Why more RAM makes computers run faster

Because one of the jobs of the **Operating System** is to keep track of programs in RAM and to swap programs between Hard Disk and RAM when there is not enough space, the more RAM fitted in a computer, the faster it will seem to be. This is because reading instructions and data from RAM is much faster than reading it from Hard Disk

RAM is fitted on video cards and used to store graphics data to make the job of the processor easier. RAM is also fitted into printers to store data while it is being printed. This frees up the processor to do other jobs while printing is taking place.

Addressability

The memory in a computer is divided up into thousands of separate boxes, each one of which is called a memory **location**.

Every memory location has its own unique **address** (a binary number) so that once data has been stored there it can be found again later when it is needed. This is the same idea as each house in your street having a different address so that the postman knows where to deliver your mail

A computer with 128Mb of memory fitted will have 134217728 (128X1024X1024) memory locations available

Finding an instruction or Information in memory is done by identifying the address of the information, and then transferring the contents of that address into the processor.

Memory Contents	Address
1011001111011110	0000
1011011101011110	0001
1001001011111010	0010
0011001111011011	0011
1001101111011100	0100
1011001111110110	0101
0011001110110111	0110

Practical Task 9

Ask your teacher for Practical Task Sheet 9

This is a practical task where you are asked to use the system monitor to see how memory allocation changes as you load different programs

The Central Processing Unit (CPU)

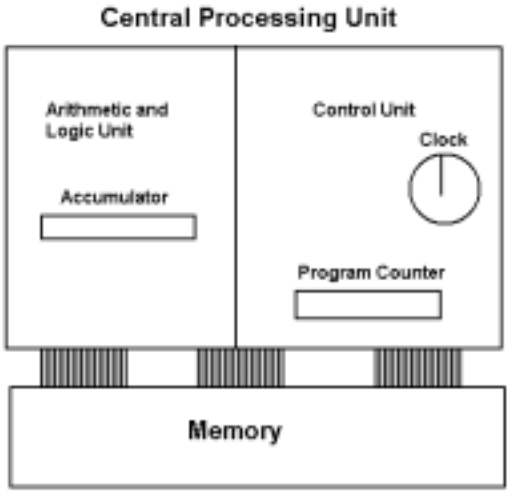
The **Processor** is made up of several parts including:

The Control Unit (CU) The Control Unit controls the step by step running of all the other parts of the Central Processing Unit by means of a clock and an instruction decoder. The speed of the clock is measured in **GigaHertz** (1 GHz = 1000,000,000 cycles per second)

The Arithmetic and Logic Unit (ALU) The Arithmetic and Logic Unit performs calculations under instructions from the Control Unit.

Registers Registers are small areas of memory within the processor. For example:

- The **Accumulator** which is used to store temporary results of calculations in the ALU.
- The **Program Counter** used to store details of where about in the memory the next program instruction has to come from.

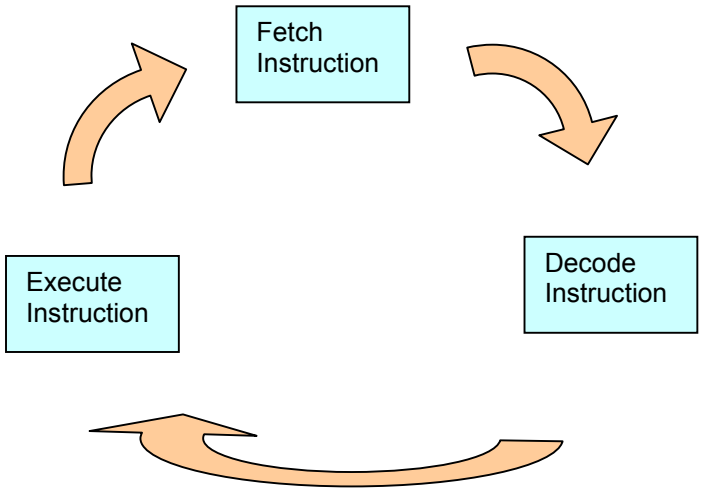


Practical Task 10

Ask your teacher for Practical Task Sheet 10

This is a practical task where you look at a simulation of a simple 4 instruction processor on the web

The Fetch - Execute cycle



When a program is running, the machine is following a simple cycle of operations. It is the fact that it can perform so many of them a second that it often seems as if something more complicated is happening. This sequence is known as the **Fetch-Execute Cycle**

Fetch
The address of the first instruction is loaded into the program counter and the instruction at that address in the memory is read into the Control Unit. The program counter is then updated to point to the next instruction.

Decode
The instruction is decoded by the Control Unit.

Execute
The instruction is executed by the control unit and the Arithmetic and Logic Unit if necessary, with the result being put into the accumulator.

This whole process is co-ordinated by the clock which is part of the Control Unit and sends a regular pulse which ensures that every part of the cycle happens in the correct sequence.

Word Size

The speed of a computer depends upon the speed of the clock, but it is also affected by how large an instruction it can decode at one time. This is called the **Word** size of a processor This in turn depends the number of connections between the memory and the control unit.
The word size of a computer is usually measured in bits. Early computers had a word size of 8 bits. As processors were developed they were able to deal with larger instructions. 16 bit processors, then 32 bit and 64 bit processors were developed.

Summary

- Memory comes in two types: **RAM (Random Access Memory)** and **ROM (Read Only Memory)**
- The contents of **RAM** disappears when the computer is switched off
  The contents of **ROM** remain even when the computer is switched off
- Every memory location has its own unique **Address**
- The **Central Processing Unit (CPU)** is made up of
  - The Arithmetic and Logic Unit
  - The Control Unit
  - Registers
- The speed of the processor depends on the **Clock** speed
- The **Word Size** of a processor is the maximum amount of data it can process in one go
- The **Fetch Execute Cycle** describes how instructions are processed in a computer

Computer Networks

Local Area Network (LAN)

Networks of computers are where a number of machines are connected together by a communicating cable. A **Local Area Network (LAN)** is one where the network is restricted to one building or group of buildings like an office or school.

Local Area Networks are useful because they mean that several computers can share an expensive peripheral like a printer or disk space on a server filing system. Users of the network can share files and they can move from machine to machine and still access their own data.

Shared benefits of a Local Area Network (LAN)

Resources	Services
Hard disk space	Email
Printers	Backup
Software	Virus Protection
Files	Network Security
Applications	Application Installation
Internet Access	Intranet

In local area networks, large numbers of machines are connected to one or more powerful central computers called a **File Server**. A file server has a large hard disk fitted where all the software and users files are stored. A network like this is called a **Client-Server** network

As well as doing the normal operating system jobs, on a networked system the operating system also has to check who has access to what files, and to share out resources like the hard disk and printers to users according to who has permission to use them.

A network usually has some kind of security system in operation. Normally users will have to type in a password to gain access to their own files, although there is a public section which contains software which every user has access to. The **Network Manager** is the person who controls the security and who sets up different programs for different users.

There are some disadvantages to connecting computers together into a LAN:

- The computer in a LAN depend on the server and cabling. If they stop working then no one can use the computers.
- You need to hire a Network Manager to maintain the network
- You need to make sure that the network is kept secure
- It is easy for viruses to spread around a computer network unless it is protected

Wide Area Network (WAN)

A **Wide Area Network** is one where computers or networks of computers are connected via telephone lines or cable over large distances, and often between different countries. The **Internet** is one example of a Wide Area Network.

Advantages and disadvantages of a Wide Area Network (WAN)

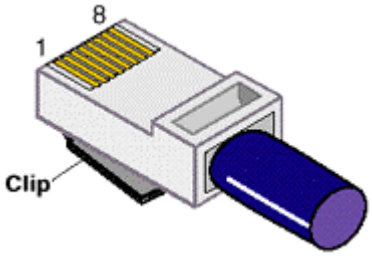
Advantages	Disadvantages
Email communication	Spam
World Wide Web information	Viruses
E-Commerce	Fraud
Video and Audio Broadcasting	Hackers
	Unsuitable material: Pornography, Racism, Propaganda

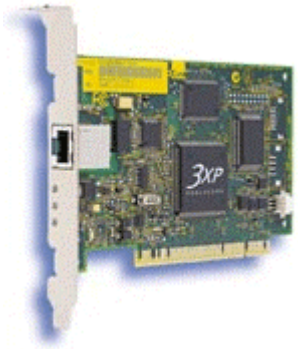
Task 18

Find out about and make a list of some of the tasks which network manager carries out for the school network.

How Networks are Connected

If you are connecting computers together in a Local Area Network, you normally use Network **cables** connected to a card in the computer called a **Network Interface Card (NIC)**.





If you are connecting a computer in your home to a Wide Area Network like the Internet, you need a **Modem**. A modem is a device which will dial up over a telephone line and make a connection to your **Service Provider**.

The modem may be **inside** or **outside** your computer.

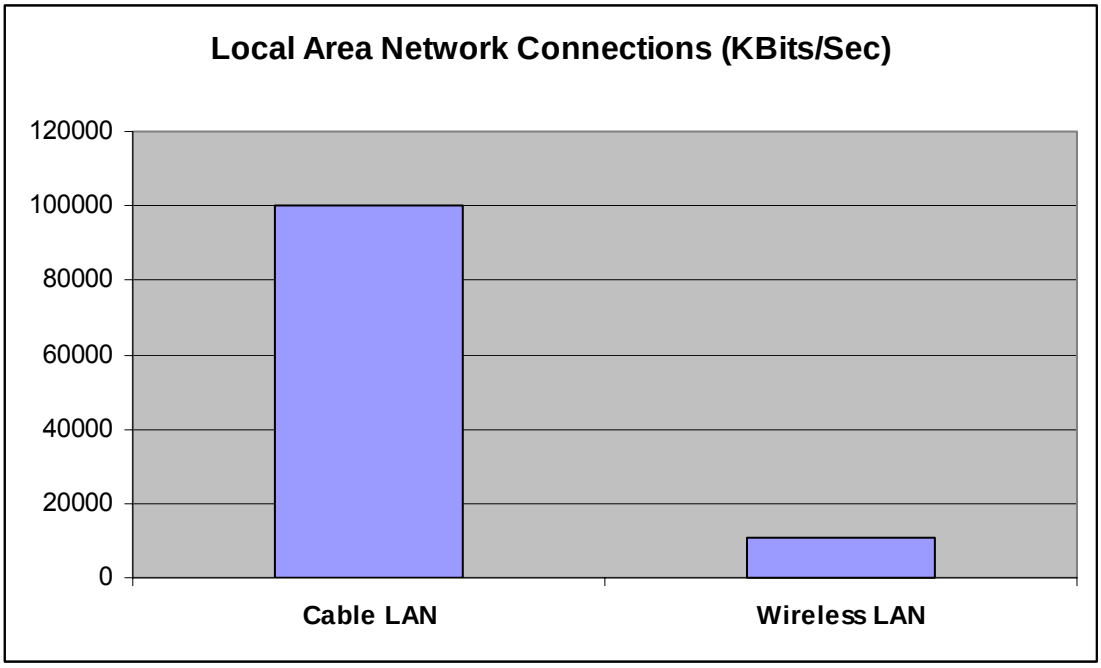
Computers can also be connected together using a **Wireless network card** and **Wireless hub**.

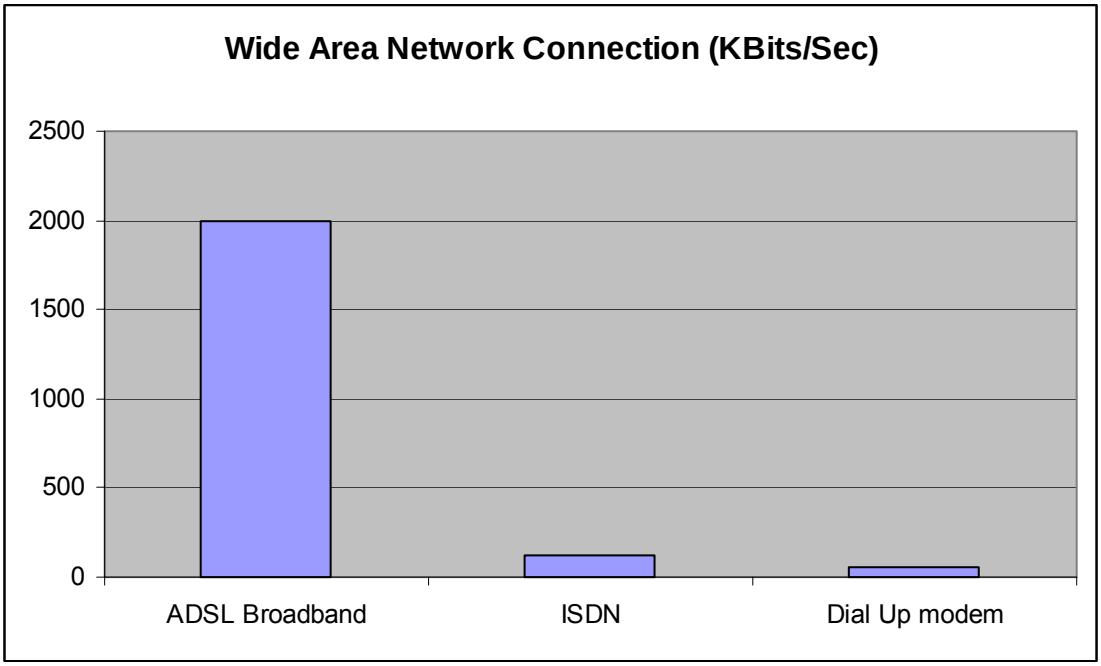
Transmission Speed

In a Local Area Network, the speed of the network can be **100Mbits/sec** (Megabits per second) or more, although a wireless connection is often slower.

Compare this to a modem connection which is only **56Kbits/sec** (Kilobits per second) at the most (2000 times slower!)

Even a **broadband** connection over a telephone line is unlikely to be any more than **2Mbit/sec**





Summary

- Networks can **be Local Area Networks (LAN)s** or **Wide Area Networks (WAN)s**
- Computer networks allow users to
  - Share peripherals
  - Communicate
  - Share services like Internet access and backup systems
  - Share files and software
  - Control security
- Networks can be connected using **copper cable, optical fibre** or **wireless**

Peripherals

Interfaces

External devices connected to the processor are called **peripherals**.
All computer peripherals need a piece of hardware and software to handle the transmission of data between them and the Central Processing Unit. This connection is called an **interface**. All interfaces will have a ROM chip containing the software, cables of some sort, and some suitable connectors.

Interfaces have to be able to deal with signals between the CPU and the peripheral to tell when each device is ready to transmit or receive information. They have to be able to transmit data at the right speed, be able to alter the voltage at which the data is sent, and to be able to store data temporarily as it moves from one device to another.

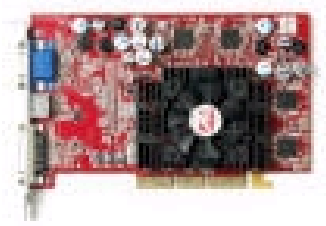
Interfaces can be **serial** which means that bytes are transmitted one after another down a single cable, or **parallel** which means that bytes are transmitted by simultaneously sending each bit down eight parallel lines in a cable. Many interfaces for common peripherals are built into the main board of the computer, but some specialised peripherals still need interface cards to be fitted. If you want a higher quality interface than the one fitted to your main board, then you have to purchase a different interface such as a **sound card** or a **graphics card**.

Sound Cards

Sound cards deal with converting the analogue sound input into a digital form which can then be stored on the computer backing storage and edited using appropriate software. Sound cards also convert the digital signal into an analogue value for output to speakers

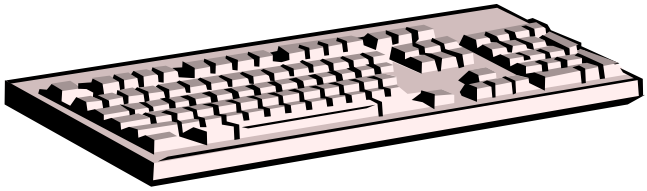
Graphics Cards

Graphics cards convert the signals from the output of the CPU into signals that the monitor can display. Graphics cards often have their own dedicated processors and memory fitted so that they can deal with fast 3D graphics for games. This means that the processor is not slowed down when playing games or displaying 3D images.



Input Devices

Keyboard



A standard keyboard has keys that produce the letters of the alphabet, keys to produce the digits from 0 to 9, keys to produce all punctuation marks as well as special command and function keys. Standard keyboards are often referred to as QWERTY keyboards because of the layout of their keys. Many keyboards have a numeric keypad at the side of the main keyboard. Several types of specialist keyboards have been designed for special purposes, for example for use on palmtop computers or for use by blind users.

When the user presses a key on the keyboard. The keyboard senses the key press, identifies which character it is, generates the ASCII code used to represent the character and, with the help of its interface, transmits the character to the central processing unit.

Mouse

A mouse is a small hand-held device connected to the computer by a cable. It usually has a ball on the underside of its cover and at least one button on the top.

Movement of the mouse across the desk moves the mouse ball. The movements of the mouse ball are detected by sensors. There are slotted wheels inside the mouse which move round when the ball is moved and the sensors count how many slots move past them and use this to measure how far the mouse has moved in each direction. This information is sent via the interface to the operating system. The operating system uses this information to control the position of the pointer on the screen. The user presses the button to perform tasks such as select icons and move windows. Mouse speeds are variable and can be set by the user.
Optical mice do not use a ball, but use a light and a light sensor to measure how far the mouse has moved.

Trackerball

A trackerball is often used as an alternative to a mouse and is used in a similar way. In the case of a trackerball, both the ball and buttons are on the top of the case. Trackerballs are often found on laptops since a trackerball does not need a flat surface and a mat, unlike a mouse They can be useful when using drawing packages since it gives fine control of the cursor.

Trackpad

A trackpad is a small pad which is sensitive to pressure and touch. In order to control the movement of the screen pointer, the user simply moves their finger across the surface of the pad. Selections are made by gently tapping on the pad.

Trackpads are often found on laptops. People using laptops find a mouse and mat bulky and inconvenient to use since they often work on the move without access to a proper desk or table.

Touch sensitive screen

A touch sensitive screen is a screen that has been adapted to sense the location of a touch on its surface. A touch sensitive screen presents the user with a number of options. By simply touching the surface of the screen with a finger or a stylus, the user can make a selection. This is achieved by having a touch sensitive membrane overlaying the surface of the screen. However, it is a very slow and tiring way to input large volumes of data.
A touch sensitive screen does not provide the user with any precise control over the input and would be quite unsuitable for drawing graphics. Touch sensitive screens are often used with low resolution monitors. They are popular at information points in public places for example, in an airport, since touch sensitive screens avoid the need to have any additional peripherals present.

Touch sensitive screens are used on some palmtop systems to replace the keyboard. Some display a keyboard on the screen and the user enters text by touching the screen with a stylus. Some accept hand-written input that is written directly onto the surface of the screen using a stylus.

Graphics Tablet

A graphics tablet is used to enter line drawings or bit maps into the computer system using a stylus or a puck. A graphics tablet is a flat board with pressure sensors just under its surface. Attached to the graphics tablet is a stylus which is moved around the surface of the tablet by the user to trace the outline of a drawing. The tablet's sensors detect the position of the stylus on the surface of the tablet. This information is sent to the CPU and is used to position the cursor on the screen.

The accuracy of the data entered depends on the resolution of the tablet. This depends on the number of sensors that a tablet has. The more sensors a tablet has, the more stylus movement can be detected. Good quality tablets give the artist very close control over the creation of a drawing.

They are often used by people working with computer aided drawing (CAD) packages, for example, in design and planning. They are also used by graphics artists to produce freehand drawings using painting packages.

Joystick

Joysticks are often used to control computer games, and may include **Force-Feedback** or other features to make the game more realistic. (Force Feedback is where the joystick or game controller will move or vibrate to make the game more realistic) They normally have a number of control buttons, and can me moved in different directions to control the movement of objects on the screen. Joysticks use variable resistors to sense how far the stick has moved and therefore how far to move the object on the screen. Force feedback steering wheels for driving games are a type of joystick and use the same connections on the computer.

Scanner

A scanner is an input device which will take any printed copy (either text or graphics, or both), and read it into the computer as digital information. Scanners do this by dividing the image up into tiny dots and recording the colour of each dot. The closer the dots, the clearer the image. This is called the resolution of the scanner, and is usually measured in dpi (dots per inch). Once into the computer's memory, the picture can be edited using a suitable graphics package.

If you scan text using a scanner, then in order to convert the image into editable text, you need to use Optical Character Reading (OCR) software.

Digital still camera

Digital still cameras enable the user to create a digital image and save it directly on to a disk or to a memory stick. The image can then be placed in a document in exactly the same way as a scanned image can. Many Digital Cameras have an LCD screen to enable you to view the images while they are still stored in the camera.

Digital cameras focus the image through a conventional lens on to a **Charge Coupled Device (CCD)** Sensor: Each of the thousands or millions of tiny pixels that make up the CCD convert this light into electrons. The number of electrons, usually described as the pixel's accumulated charge, is measured, then converted to a digital value. This is done using an analog-to-digital converter.

Digital Video Camera

Digital video cameras (camcorders) use a similar system to still cameras, recording the light focussed by the lens on to a CCD. In the case of the video camera, the images are transferred on to tape. Tape is necessary because of the large file size of digital video.

Webcam

A webcam is a digital video camera designed for use over the World Wide Web. Webcams enable users to **videoconference** over the Internet, or to remotely monitor buildings or public areas using a web browser.

Microphone

A microphone can be attached to a computer for sound recording. Laptops or multimedia monitors often have microphones built in.

Specialised Input devices

Disabled Users

Disabled users often need specialised input devices in order to enable them to use a computer. As long as a user can move a part of their body to switch an input device on or off, then they can control a computer, by selecting letters or commands from a menu. There have been a number of experiments done with disabled users which allow them to control a mouse by measuring their brain activity, and experiments on animals have shown that it is possible to connect sensors directly into the brain to enable them to operate computer controlled devices. This means that even severely disabled users can control their environment using a computer.

Virtual Reality

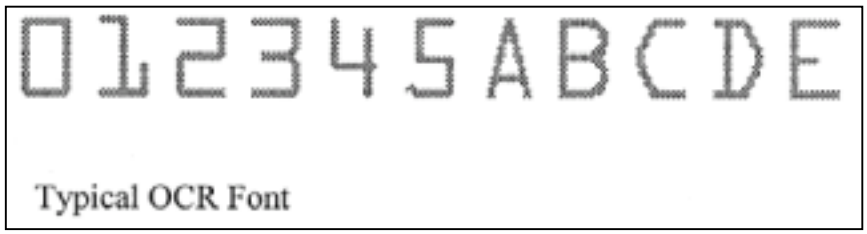
Virtual Reality is where a three-dimensional visual world created by a computer. The user wears special goggles or a headset and can enter and move about in this world and interact with objects as if they were inside it. Often specialised input devices like a data glove is used so that the computer can sense a user's hand movements when they pick objects up in a virtual world.

Machine Readable Input

Each of the input devices mentioned so far needs a person to use it. For example, someone is needed to type at a keyboard or draw with a stylus on a graphics tablet. However, certain types of data can be read directly into the computer system without the need for a human. In each case, special reading devices are used. Data that is in a form that can be read directly by a computer, without the need for a human operator, is known **as machine readable input**.

Optical Character Reader (OCR)

An Optical Character Reader reads printed characters into the computer. OCR systems vary. Some use specialised readers whilst others use a standard scanner with OCR software. A few Optical Character Readers can read specially formed hand-written characters.



Typical OCR Font

Light is reflected off the printed characters on a page. The computer recognises the shape of each character by comparing the pattern reflected with pattern stored in its memory. Once recognised, the system stores the ASCII code of the character.

The limiting factor is the time taken by the system to compare the letters being read in with the patterns it has stored in its memory.

Some OCR systems speed up the comparison process by dealing only with a set of numbers and letters tailored for a specific application, for example, reading the post codes on letters in an automatic sorting system. These systems can process thousands of addressed envelopes per minute.

High volume OCR can read thousands of documents per minute. OCR systems that make use of a standard scanner with OCR software can provide a quicker method of entering data than typing at a keyboard, but only if the document is clear and the characters are well formed. When documents are not clear, delays and errors occur, and the whole process is slowed down.

Magnetic Ink Character Readers (MICR)

Magnetic Ink Character Readers are used by banks to read data from cheques. Specially styled characters at the bottom of each cheque are used to represent the cheque number, account number and bank branch code. The characters at the bottom of cheques are created using a special ink that is magnetised. A sensor in the reader detects the magnetic pattern of the characters on the cheque and the data is read into the computer.

Automated data entry means that MICR can process large volumes of cheques at high speeds of around 2400 documents a minute.

MICR systems are extremely accurate because they recognise the magnetised characters easily and because stains and marks on the document do not produce errors – as they would with an OCR system.

Optical Mark Reader (OMR)

Sometimes called a mark sense reader, this system is used to read documents that are pre-printed with areas to hold marks made by a pen or pencil. The user completes the document by putting a mark in a selected area. Systems using OMR are programmed to read only specially formed marks. For example, in multiple choice exam papers, candidates put a vertical line in the box opposite their selected answer.

The data on the document is read by passing the document through the optical mark reader. The reader reflects light off the surface of the document to detect the position of the mark and converts this into a value which is input to the system. High speeds of data entry are guaranteed because the process is automated. The most efficient systems can process up to 10,000 such documents in an hour.

Optical Mark Readers are used for processing questionnaires, multiple choice questions and lottery entry forms.

Bar Code Reader

Hand held Bar Code Readers are used to scan bar codes on products in shops or to read tracking data on goods being manufactured in factories or being transported by carriers. Supermarkets use larger till based bar code scanners rather than hand held ones. They work by shining a light on to the bar code and reading the reflected light and dark information from the surface.

Task 19

Make a power-point presentation with a different slide for every type of input device you can find. On each slide put a picture of the device and a brief explanation of how it works and what it is used for

Output Devices

Monitors

Everything entered into a computer, and the results produced by the computer, are displayed on a screen or monitor. Most monitors use cathode ray tube (CRT) technology which is very similar to that used for televisions. However, LCD screens are sometimes used as an alternative to heavy and bulky CRT technology.

Inside a CRT monitor there is an electron gun that produces a beam of electrons that makes the picture on the screen. This technology produces good quality displays but is heavy and bulky.

Liquid crystal display (LCD) screens work very differently from CRT monitors. A LCD screen display is produced by passing an electrical current through the chemicals contained in the screen. Whenever a current is present, the chemicals turn black. It is the ‘blackness’ of the chemicals that forms the image on the screen. LCD monitors are lightweight, compact and can run on the low power supplied by batteries. This makes them ideal for use in portable computers systems such as laptops and palmtops. Full size LCD monitors are available for use with desktop systems.

Thin Film Transistor (TFT) monitors are a type of flat screen LCD monitor where each pixel is controlled by from one to four transistors

Printers

Laser Printers

Laser printers are high resolution printers. They are capable of producing high quality text and graphics.

Laser printers use a laser beam to trace the image of the page layout onto a photosensitive drum. This image then attracts toner using an electrostatic charge. The toner is then fused to the paper by heat and pressure.

Speeds range from 4 to 26 pages per minute (ppm). However, these figures are deceptive since they are the speeds taken to print after the printer has assembled the image of the page.

Print quality is determined by the resolution of the printer. The resolution of the printer measures the number of dots the printer uses to print one square inch. This can vary between 300 and 1200 dots per linear inch (dpi).

Laser printers vary a lot in price and quality. The more expensive ones come with built in network cards and are designed for heavy use in offices, Cheaper ones tend to be low volume and designed for home use. Laser printers have a high capital cost but low running costs (they are expensive to purchase but cheap to print)

Inkjet Printers

Inkjet printers are designed for use with desktop systems and are often dual mode – this means they can switch from monochrome to colour. Inkjet printers tend to be used in situations where demand for printed output is not high. They are very popular with home users.
The ink cartridge in the printer is made of a series of small jets. The ink within the jets is heated, and as it expands, it is forced out of the jet and aimed at the paper. The ink used in these printers will smudge if the paper gets wet. The printers are quiet and produce very high quality colour output.

In monochrome, printer speeds are typically up to 6 pages per minute. however, switching to colour mode reduces the speed to between 2 and 3 pages per minute. They produce high quality with print densities of 720 x 720 dots per inch being common. Prices are relatively cheap with typical purchase cost of around £ 50 to £120. Running costs, however, can be high. The cost of an ink cartridge (black and white) is between £12 and £18, but they may produce between 200-300 pages before needing replaced. Colour cartridges cost between £15 and £25.

Practical Task 11

Ask your teacher for Practical Task Sheet 11

This is a practical task where you compare a number of different printers according to their print quality, speed and cost

Plotters

Pen Plotter

Inkjet Drum Plotter

A plotter is used to produce line drawings such as plans and diagrams. For this reason, plotters are mainly used by engineers and architects. There are two types: pen plotters and inkjet plotters. Pen plotters use an arm to select from a series of pens that are held on a carousel – the pens are either coloured fibre tip pens or liquid ink pens. Once selected, the pens draw the image on flat sheets of paper set in a flatbed or on paper wound round a drum.

Inkjet plotters have their own memory to store data on the design being drawn and have a processor to convert the data into a series of dots to print on the paper. Ink is then dropped onto these dots from cartridges in the plotter.

The speed of a plotter varies according to the size and complexity of the drawing and the technology in the plotter. The more advanced plotters have their own processors and several megabytes of memory. A small drawing could take 30 seconds, whereas a large drawing could take 10 minutes. (These times include time for the ink to dry.) The best plotters have a throughput of around 40 large drawings per day. Up to 600 dots per inch can be achieved using the more advanced models.

At the lower end of the price range, prices start at £500 and rise to £1000. A middle range plotter for a small business would cost around £3500. Top of the range models cost upwards of £7500.

Task 20

Read each of the following situations carefully. For each situation, recommend an appropriate printer or plotter. Give reasons for your choice. Here are some questions you will need to think about.

- Is high quality output required?
- How fast does the printer have to be?
- is colour output required?
- Is the initial cost of buying the printer an issue?
- Are running costs an important factor?

Situation 1 An office is setting up a local area network. There will be thirty workstations on the network all sharing a printer to produce a range of document types including text and graphics. Many of these documents are for distribution to customers.

Situation 2 A small company is in the business of a) interior design and b) the renovation of older properties. For the design part of the business, the work involves the production of high quality graphical displays both on screen and on paper for customers. The renovation part of the business involves the production of formal plans that have to be approved by the building control authorities.

Situation 3 The local sports centre decides to produce a newsletter. It will contain short articles on sports events in the area complete with headlines and illustrations. A master copy will be produced and then photocopied for distribution. The budget is limited and costs must be kept to a minimum.

Situation 4 The Art department at Grants Grammar School has bought a computer system with a high resolution colour monitor and an art package called 'Professional Painter'. Pupils have been using the system to create artwork and posters. The results look stunning on the screen but they would like to get high quality printouts.

Situation 5 The Programming Lab A small software company employs two programmers. They need a printer to produce program listings while they are developing the software. Their main office has a laser printer that is used to produce the final documentation.

Situation 6 The Kitchen Design company offers a free design service to their customers. Sales reps visit the clients in their homes to take measurements and discuss requirements. On returning to the office, the reps use a CAD package to produce an accurate plan of the kitchen. A hardcopy of this plan is then sent to the customer for approval.

Multimedia Output Devices

Speakers

Loudspeakers are an essential part of any multimedia computer system nowadays, and often these machines come with surround-sound, sub-woofers and other sophisticated sound equipment. Some monitors come with built in speakers.

Video Projector

Video projectors are used for presentations or home cinema. Video projectors may use an LCD screen which the light is projected through, or an array of mirrors which direct the light through different coloured filters.

Disabled Users

Braille Printer

Disabled users often need specialised output devices in order to enable them to use a computer. The type of output device will depend on the user. For instance a blind user may need voice output or a Braille printer. The WIMP interfaces which we find so user friendly are much more difficult for blind users than the older text based systems. Special software is available for reading web pages or other graphical screen displays, and there are now regulations to make web designers create web pages which are **accessible.** This means that the web page must be readable by text reading software.

Task 21

There are many types of disability - blindness, difficulties of muscle control, and many others. Think about one particular disability - perhaps someone you know, or have read or heard about. An example might be someone who has had a serious accident, and is paralysed from the neck downward, or an old person whose eyesight is very poor, or someone like Professor Stephen Hawking, who has a disabling disease.

For the example that you have thought of:

(a) Make a list of the problems that person would have with conventional computer equipment;
(b) Research any sources you can to find out what special devices are available to solve these problems;
(c) Draw a diagram of a suitable system, showing the input and output devices chosen.

Task 22

Make a power-point presentation with a different slide for every type of output device you can find. On each slide put a picture of the device and a brief explanation of how it works and what it is used for

Backing Storage Devices

In magnetic storage systems, the surfaces of the disks or tapes are coated with a substance that can store data as magnetic patterns. These magnetic patterns are written to and read from the surface using an electromagnetic read/write head. Examples are tape, floppy disks and hard disks. **Optical Storage Devices** use laser technology to store and retrieve data. Examples of these are CD-ROM, CD-R or CD-RW and DVD-ROM, DVD-R or DVD-RW. Both magnetic and optical systems store data in digital form equivalent to 1s and 0s.

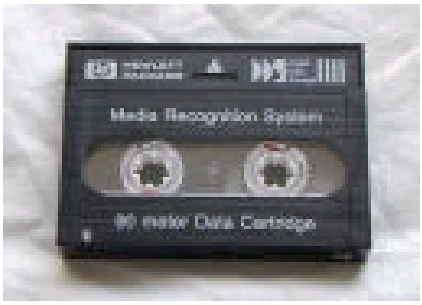
Serial Access

Serial access is where the items in a file are read one at a time from the start of a file in the order in which they are stored. Magnetic Tape is a serial access medium. When data is read from a tape, the read head inside the tape drive starts at the beginning of the tape and reads each item in turn as it comes to it. Serial access is slow, particularly if the data to be read is at the end of the tape.

Random Access

Random access is where the system can go straight to the data it requires. A magnetic disk is a random access medium. To read data stored on the disk, the system simply has to know the address on the disk where the data is stored, and the read head can go directly to that location and begin the transfer. This makes a disk drive a faster method of data storage and data access than a tape drive.

Magnetic Tape



Home microcomputers originally used domestic cassette recorders as a backing storage devices because they were cheap and readily available. The disadvantage was that they had a slow data transfer speed (not more than 50 characters per second) and because tape is a serial access device this meant that the data could only be accessed in the same order as it was stored. (If you wanted to load a program at the end of the tape then you had to run the tape through before you could access it)
Nowadays Tapes are used for making backups. They are used because they are cheap compared to hard disks, they can be taken to a safe place and although they are slow, it is not often that data needs to be retrieved from them.

Tape cartridges look very like mini video cassettes and can only be read in one direction.

At the lower end of the range, transfer rates from hard disk to cartridge tape of 9 Mbytes per second can be achieved. Typically, 12 Gb of data per tape cartridge can be stored A cartridge tape drive costs around £150 and tape cartridges cost around £10 each.

At the top of the range, tape cartridge systems can achieve 200 Mb per second. Typically, 25Gb of data can be stored on each tape cartridge. The cost of a high end tape cartridge system will be in the region of £2400.

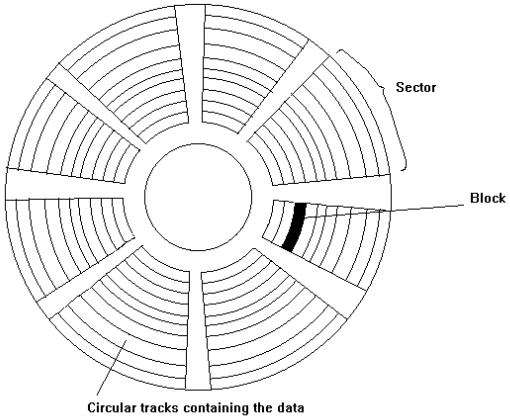
Floppy Disk

A floppy disk is a thin plastic disk coated with a magnetic material and held inside a protective plastic sleeve. Before it can be used a floppy disk has to be formatted. This is done by the operating system and involves mapping out the disk into storage circles called tracks, and the disk into sectors. Each track is thus divided into storage units called blocks. The processor then writes data to every block and then reads it back to check the disk. Some operating systems will mark bad blocks and store their location so that they can be avoided when the operating system is asked to store files on that disk. Other less sophisticated operating systems will just reject the disk.

The floppy disk drive contains a spindle that rotates the disk while the electromagnetic read/write head either writes to, or reads from, the disk surface. In desktop computers, the floppy disk drive is built into the main body of the computer cabinet. On portable computers, the floppy disk drive mechanism can be removed.

The information about where files are stored is usually stored on the first track of the disk. This is called the directory of the disk. To find the beginning of this track, the operating system needs to locate the special index hole in the disk. The program uses this as a base point. Obviously if this data is damaged or lost then as the operating system cannot locate where different files are stored, all the information on the disk will be lost.

Floppy disks can store 1.44 Mbytes. The floppy disk drive is built into desktop computers as standard. Floppy disks cost about 30p each.



Hard Disk

A hard disk is a rigid disk with a magnetised surface. The surface is divided into tracks and sectors on which data is stored magnetically. The disk rotates on a spindle inside the hard disk drive at speeds of up to 10,000 rpm. The data is read by a read/write head fixed to an arm that moves across the surface of the disk. Hard disks are usually sealed in a protective container to prevent dust corrupting the data.

Hard disks rotate at much higher speeds than floppy disks, reaching speeds of up to 10,000 rotations per minute. This means that the fastest hard disk can transfer data from disk to computer at the rate of up to 33 Mb per second.

In hard disk drives, the read /write heads are very close to the surface of the hard disk. This means that hard disks can store data much more densely than a floppy disk. Since the hard disks are rigid, they can be stacked one on top of another in layers to increase the available capacity. At present, the largest hard disks available can store 200Gb of data or more, but this figure is constantly being improved.

The cost of hard disks systems varies according to the specifications of the hard disk. A small capacity hard disk of up to 40Gb will cost around £50. A large capacity hard disk of up to 120Gb will cost in the region of £80

USB Flash Drive

A USB drive uses flash RAM to store data. When you plug the drive into a USB port, the drivers are automatically installed and the PC will show details of a new removable drive which can be written to and read from like any other disk drive. Capacity varies, but 128Mb and 256Mb drives are common. USB drives are slower than hard disks, but faster than CD-ROM or floppies. They are very convenient because they are small, portable and very robust.

CD-ROM, CD-R, CD-RW

The term CD-ROM is short for Compact Disc Read Only Memory. CD-ROM disks can only be used to read information stored on them. The user cannot save data to a CD-ROM disk. CD-R disks can be written to but the data cannot be erased so the disk gradually fills up. CD-RW disks can be written to and files deleted just like an ordinary disk. CDs are very cheap compared to other media, and they have the added advantage of not being damaged by magnetic fields.

CD-ROM writers use a high powered laser to store data by making tiny ‘pits’ in the surface of the CD-ROM disk. The pattern of these pits is read by a sensor in the CD-ROM drive that detects light reflected off the surface of the disk. Patterns are then turned into binary numbers. CD-R and CD-RW writers use a laser to change the optical properties of a dye in the disk.

The speed varies from drive to drive. The original CD drives read data at a rate of 150 Kbytes per second. There are now 56 speed drives available.

Capacity of CD-ROM disks can store 700Mb 650 a CD-ROM drive can cost around £25 with a CD-Writer costing about £50. CD-Rs cost about 20p each if they are bought in bulk.

DVD-ROM, DVD-R, DVD-RW

DVD-ROM drives use a higher laser wavelength than CD-ROM. This means that tracks can be smaller and closer together, and pits in the surface can be smaller, A DVD-ROM disks can store 4.5Gb of data.

DVD-R and DVD-RW are similar in performance to their CD equivalents.

Many computers now come with DVD/CD drives which can read both types of disk. Similarly there are DVD/VD writers available. Both cost more than their CD equivalents.

Task 23

Study the previous notes on four different types of backing storage: magnetic tape, floppy discs, hard discs and CD-ROM and look up any references that you can find in textbooks.

For each of the four types, write a brief note, making a comment for each one under each of these headings:

- storage capacity (how much data can be stored)
- cost(obvious!)
- access speed(does it take long to load or save data)
- read / write ability (can you alter the data that has been stored)
- main advantage (one particularly good aspect)
- main disadvantage (the biggest weak point)
- when it might be used (a situation where it would be the most appropriate)

Practical Task 12

Ask your teacher for Practical Task Sheet 12

This is a practical task where you compare the actual storage capacity of a high density floppy disc, a hard disc, and a CD-ROM disc by loading the same file from each type of storage, and time how long it takes.

Backup

Everyone using a computer system needs to backup software and data in case of loss or damage. No one wants to lose data, whether it is on your own desktop computer at home or on your system at work, school or college. If it is your own personal data that has been lost, the awful feeling you get when you realise that hours – and perhaps weeks – of work have just disappeared, will ensure that in future you pay attention to the need for systematic regular backups.

If the data lost belongs to an organisation or business, the consequences could be very serious. The loss of important client information, account details, reports, designs, plans or research material could financially damage a business. Whether it is a business or a school, a college or a factory every organisation needs to have a well structured approach to backing up data. Such a strategy is an essential part of any computer system.

Rules for a well organised backup system:

- Keep multiple copies of the data as backups themselves can get lost or damaged
- Store the data in separate locations in case of problems
- Make backups at regular intervals
- Test the system regularly

Task 24

Make a Power-Point presentation with a different slide for every type of backing storage device you can find. On each slide put a picture of the device and a brief explanation of how it works and what it is used for

Task 25

Read each of the following situations carefully. For each situation, recommend the most appropriate type of storage device - in some cases, you may wish to recommend more than one device. Give reasons for your choice. Here are some questions you will need to think about.

- how much data needs to be stored?
- is speed of access important?
- will the choice of device be influenced by cost?

Situation 1 A medical centre has around 6000 patients on their books. One of the doctors suggests keeping all their records on a computerised database. Some of the doctors are concerned about the possibility of the loss of data.

Situation 2 Inverdon Academy has just set up a whole school network. The file server has a 4Gbyte hard disk that holds all the system files, applications software and user files. The staff are worried about what would happen if the data was corrupted, or the hard disk failed. They need some sort of backup system.

Situation 3 The secretary of Hackers Golf Club uses an integrated package to keep a database of members, produce letters and do the accounts.

Situation 4 Mniisoft produces multimedia software for use in primary schools. The software incorporates high quality graphics, sound, video clips and text. They need to decide which form of storage to use to distribute their software.

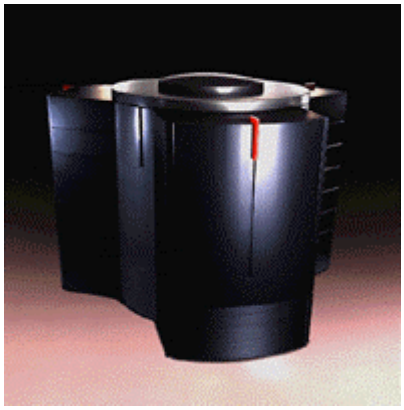
Situation 5 Intelbank is a new international bank. They already have thousands of customers. They need a strategy for data storage that can be expanded steadily over the years.

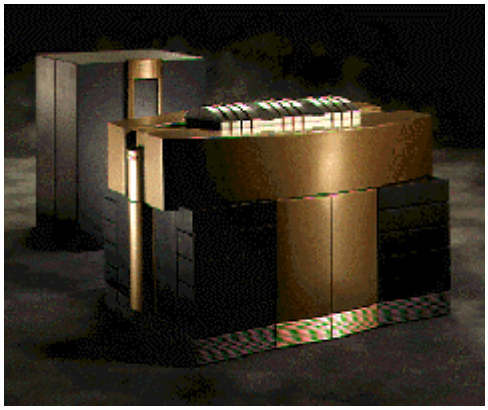
Summary

- Input, Output and Backing Storage devices are called **Peripherals**
- Peripherals communicate with the **Central Processing Unit** via an **Interface**
- Input devices vary depending on what sort of information you want to get into the computer.
    - Characters (keyboard, **OMR**, **OCR**)
    - Sound (microphone)
    - Movement (mouse, trackerball)
    - Pictures (camera)
    - Magnetic (**MICR**)
- Output devices vary depending on what sort of information you want to get out of the computer
    - Print on paper (printers, plotters)
    - Visual Display (monitor)
    - Movement (robot arm)
    - Sound (speakers)
- Backing storage devices can be **Random Access** or **Serial Access**
- Backing Storage devices vary in **speed**, **storage capacity** and **cost**
- **Backups** should be taken **regularly** and kept in a **safe place**

Types of Computer

Supercomputers





Supercomputers are used for processor intensive tasks such as predicting the weather, designing new medical drugs etc. They are extremely expensive, and are usually only owned by large institutions like universities.
They often have multiple processors, and are usually super-cooled

Mainframes

Mainframes are used by large organisations. They often have several hundred “dumb” terminals which are just keyboards and monitors which use the processor in the mainframe instead of having a processor of their own.

Desktop Computer

A desktop computer is the type of computer most people are familiar with, either at home or at work. Here is a typical specification for about £800 (June 2003):

2.8Ghz processor
512 Mb memory
60Gb hard disk
64Mb graphics card
17" Monitor

Laptop Computer

Laptop computers are popular because they are portable and can run for several hours without being attached to a mains cable. They have a flat screen, and often use a touch pad or tracker ball instead of a mouse. Many laptops have wireless network cards fitted so that they can connect to the Internet without having a cable attached. They often have removable peripherals such as disk drives or CD drives to reduce their size and weight

They tend to be more expensive than a desktop machine of a similar specification.

Palmtop Computers

Palmtop machines are smaller than a laptop, and often use a cut down version of a desktop operating system. Many use a stylus and touch-screen as input. Machines like these are often referred to as a Personal Digital Assistant (PDA) and are used as electronic calendars, diaries, address books and calculators

The History of Computing

Here are two pictures of early computers – one from 1870 and one from 1975

The Difference Engine (1870)

The Altair (1975)

One thing that is certainly true about computing is that the scene is always changing. Every year, something new appears, and something else starts to look old-fashioned. Prices change, sometimes upwards, but mostly downwards. New hardware is developed, and software becomes more and more sophisticated.

Task 26

Use old magazines, catalogues and books to answer the following questions:

2. Try to find the dates of the following events:

   (a) the first mechanical computer;
   (b) the first electronic computer;
   (c) the first digital computer;
   (d) the first desktop microcomputer;
   (e) the first portable computer;
   (f) the first laptop computer;
   (g) the first hand-held computer.

3. Look at the advertisements for PCs in some computer magazines from this year and from 2 years ago. For each year, write down:

   (a) the processor speed for the most advanced computers available;
   (b) the standard memory size;
   (c) the typical prices.

5. Look at some current computer magazines. What are the "in" developments at the moment.

6. If current trends continue, what would you expect a computer system 10 years from now to be like. Describe the hardware and software that you would expect to be normal, and what you think it might cost.

Glossary

Accumulator
An accumulator is a small memory location in a processor which can store the result of the last calculation

Address
An address is the number the processor uses to identify a memory location

Algorithm
An algorithm is a written description of a program, usually in an English like language called pseudo-code

Analogue to Digital converter
An analogue to digital converter changes analogue signals such as sound or video into digital signals which the processor can understand.

Arithmetic and Logic Unit
The Arithmetic and Logic Unit (ALU) in a processor deals with calculations and logic.

ASCII Code
ASCII code is the code computers use to store text

Background Processing
Background processing is where the operating system tells the processor to completes a job only when it is not needed for anything else.

Backing storage
Backing storage is where programs and data are stored when the computer is switched off. Backing storage can be a hard disk, floppy disk or optical storage.

Backup
Making a backup is when a copy of data is made and kept in a safe place in case of disaster

Binary
Binary code is the name for the base 2number system which computers use

Bit
A bit is a single unit of information such as 1 or 0

Bit-map
A bitmap is a method of storing a graphic image where every pixel is stored as a bit which is either on or off

Bootstrap loader

The bootstrap loader is part of the operating system in ROM which starts when the computer is switched on and tells it to load the rest of the operating system

Branch

A branch in a program is when the computer makes a choice according to what has happened e.g. IF temp > 25 THEN switch_off_heater

Broadband

Broadband is a type of fast Internet connection

Byte

A byte is 8 bits. A byte can store a single character.

CD-R

A CD-R is a CD which can be written to but not erased

CD-ROM

A CD-ROM is an optical disk which can store up to 700Mbytes of data. A CD-ROM is a CD which is read only

CD-RW

A CD-RW is a CD which can be written to and erased again

Central Processing Unit

The Central Processing Unit (CPU) is the chip at the heart of a computer which processes data and instructions

Charge Coupled Device

A Charge Coupled Device (CCD) is a semiconductor which is sensitive to light. These devices are used in digital cameras

Client-Server

A client-server network is one with a server and a network operating system

Clock

The clock in the central processing unit controls the speed which instructions are processed

Command Language Interpreter

The Command Language Interpreter (CLI) is the part of the operating system which translates and executes user commands

Compiler

A compiler translates a high level language program into machine code all in one go

Data
Data is information which has not been organised

Decimal
The decimal number system is a base 10 number system

Device Driver
A device driver is the software needed by an interface so that the processor can communicate with a peripheral device

DVD
A DVD is an optical disk which can store up to 4.5Gbytes of data

Error Reporting
An operating system uses error reporting to give error messages back to the user when a problem occurs

Fetch Execute Cycle
The fetch-execute cycle is the sequence of operations which a processor goes through to read and execute an instruction

Flash Drive
A flash drive is a device which plugs into the USB port of a computer and can act like a portable hard disk, but using RAM instead of moving parts.

Formatting
Disks have to be formatted by the operating system before they can be used

Gigabyte
A gigabyte is 1024 Megabytes

Gigahertz
One gigahertz is a million cycles a second

Graphical User Interface
A Graphical User Interface (GUI) is part of the operating system which helps users control a computer

Graphics Tablet
A graphics tablet is an input device which can be used to draw electronically using a stylus.

Hard disk
A hard disk is a magnetic backing storage device normally fitted inside a computer

Hardware
Hardware is the physical parts of a computer system

Hierarchical Filing System

A hierarchical filing system is one where folders can be created within folders to help organise files

High level language

A high level programming language is one which is English like and has to be translated into machine code before the processor can understand it

Human Computer Interface

The Human Computer Interface (HCI) is the software which allows people to communicate with a computer program

Inkjet printer

An inkjet printer works by squirting minute jets of ink on to the paper to make text or pictures

Interactive Processing

Interactive processing is where the user communicates directly with the computer program

Interface

An interface is a combination of hardware and software which connects a peripheral to the processor

Internal documentation

Internal documentation is the comments and meaningful names which help make a computer program readable

Internet

The Internet is a collection of computer networks joined together over the world

Interpreter

An interpreter translates a high level language into machine code line by line

Kilobyte

A kilobyte is 1024 bytes

Laptop

A laptop computer is a portable computer which can run from battery power with an LCD screen

Laser Printer

A laser printer uses toner powder and a high voltage static charge to create printed output

Liquid Crystal Screen

Liquid crystal screen technology is used in laptop computers to create flat portable monitors

Local Area Network

A Local Area Network (LAN) is a collection of computers connected together within the same building or organisation

Loop

A loop is a sequence of instructions in a program which are executed over and over again a set number of times or until a condition is met

Low level language

A low level language is one which is not easily understood or does not need to be translated into machine code

Machine code

Machine code is the binary code which is the only language computers can understand without translation

Magnetic Ink Character Reader

A Magnetic Ink Character Reader (MICR) reads characters written in magnetic ink from cheques or other documents

Mainframe

A mainframe computer is a large powerful computer which can process many instructions from many terminals simultaneously. It allows many users to share the same processor

Megabyte

A Megabyte is 1024 Kilobytes

Memory

Memory in a computer can be Read Only Memory (ROM) or Random Access Memory (RAM) and is used to store data and instructions

Modem

A modem is used to connect a computer to the internet via a telephone line

Modular

A program which is modular is made up of sections which can be used and tested independently

Multimedia

A multimedia system presents information in a variety of formats such as sound, graphics or video

Network

A network is one or more computers connected together so that they can communicate

Network Interface Card

A Network Interface Card (NIC) is the connection on a computer which is used for networking

Network Manager

A network manager looks after and controls a computer network

Operating system

The operating system is the software which controls the running of a computer

Optical Character Reader

An Optical Character Reader (OMR) is able to scan printed text and turn it into ASCII code

Optical fibre

Optical fibre is used to connect computer networks together over long distances

Optical Mark Reader

An Optical Mark Reader (OMR) scans paper documents which have had information stored on them using marks

Palmtop

A palmtop computer is a small portable computer which can be used easily while being held in one hand. Palmtops often use a stylus and touch-screen as an input device

Parallel interface

A parallel interface is one where there are several lines transmitting information simultaneously. Printers often use a parallel interface

Parity

Parity is a error correction system where an extra bit is added to an ASCII character code to make the total number of 1s odd

Peripheral

A peripheral is a device which is connected to the processor for input, output or backing storage

Pixel

A pixel is a single dot on a monitor which is used to make up the display

Plotter

A plotter is an output device which uses pens or an ink cartridge to produce large drawings or diagrams

Portable

Software which is portable is software which can easily be re-translated to be used on a different operating system

Processor

The processor is the chip which executes instructions in a computer system

Program

A program is a set of instructions for a computer

Program Counter

The program counter is the register in the central processing unit which stores the address of the next instruction to be executed

Programming environment

A programming environment is the collection of tools and software which helps users when writing code in a programming language

Pseudo-code

Pseudo-code is the English-like code which is used to design computer programs

Random Access Memory

Random Access |Memory (RAM) is memory which stores data and instruction while the computer is running. Its contents disappear when the computer is switched off

Random Access

Random access is where it takes the same amount of time to find a piece of data no matter where on the disk or memory it is stored

Real Time Processing

Real time processing is where the processor reacts immediately to external events

Resolution

A high resolution display or printout is one made up of a large number of picture elements and can display a high quality picture

Read Only Memory

Read Only Memory (ROM) is memory whose contents do not disappear when the computer is switched off

Sequential Access

Sequential access is where data is stored in sequence (on a tape for instance) and the time it takes to access it depends on where it is on the tape

Server

A server is a powerful computer which provides resources to other computers on a network

Service Provider

A service provider is a company which is able to connect users to the Internet

Software

Software is the data and instructions which make up computer programs

Sound card

A sound card is an interface which can be fitted to a computer to connect loudspeakers or a microphone

Supercomputer

A supercomputer is a very powerful and very expensive computer. Supercomputers are usually designed to solve complex mathematical problems like predicting the weather or designing new medicines

Thin Film Transistor

Thin Film transistor displays are flat screen displays where 4 transistors control each pixel

Tracker-ball

A tracker ball looks like an upside down mouse and is used to control a pointer on a screen where there is no flat surface or if the user is disabled

Unicode

Unicode is a new version of ASCII code which uses more bits but is able to display more foreign language characters

USB

USB is short for Universal Serial Bus and is an interface which can accept many different types of peripheral without having to re-boot the computer

Vector Graphics

Vector graphics is where an image is stored as a set of instructions for re-drawing the picture rather than as a bit-map

Video card

A video card is an interface which is used to connect a monitor to a computer. Video cards can sometimes have their own processor and memory and can be very expensive if you want to use them for high quality graphics and animation

Video Projector

A video projector can display the output of a computer on a large screen

Videoconference

Videoconferencing is where groups of people can communicate using computers where they see a video of the people at the other end as well as being able to hear them.

Virtual Reality

Virtual reality is where the computer displays graphics which appear in three dimensions as if the user was in a real environment. Users often have to wear a special head set to use virtual reality

Web-cam

A web-cam is a small camera connected to a computer which can be used for taking pictures or video conferencing

Wide Area Network

A Wide Area Network (WAN) is a network of computers connected over a large area

WIMP

WIMP is short for Window Icon Mouse Pull-down menu

Wireless hub

A wireless hub is used to connect wireless computers to a network

Word

Word is the term used to describe the largest amount of information a computer can process in one instruction