

CHAPTER 1

COMPUTERS

INFocus

Computers come in all sorts of shapes and sizes and with vastly dissimilar price tags and performance abilities. And as a result, different types of computers have different uses.

In this session you will:

- ✓ gain an overview of information technology
- ✓ gain an understanding of the different types of computers
- ✓ gain an understanding of the different types of personal computers
- ✓ gain an overview of how the different types of computers are used
- ✓ gain an overview of computer performance.

INFORMATION TECHNOLOGY AND COMPUTERS

Information technology basically involves the use of equipment and techniques to handle and process information. The term is used more specifically to refer to electronic communications

and the use of computing which have really allowed the easy dissemination of information to enter virtually every aspect of daily life.

Information Technology

Since information technology is primarily concerned with communications, the earliest forms of information technology included the use of ochres and dyes to create cave paintings, the use of an abacus to perform calculations, and later, a printing press to disseminate information.

It is believed the term **information technology** itself was first coined in the 1970s to refer to the advances in electronic technology that burgeoned at the time. Today, it incorporates a wide spectrum of technology including communications, broadcasting, consumer electronics and computing.

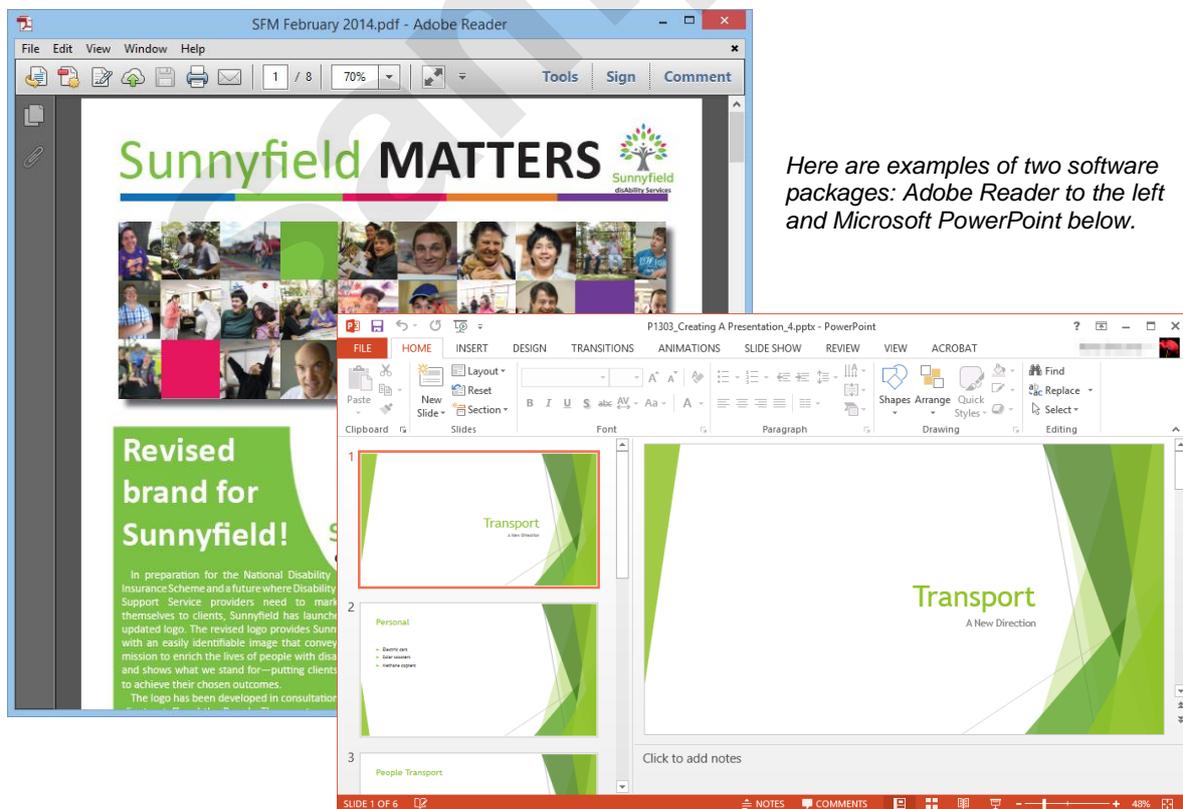
At the heart of the **information technology revolution**, as it has been called, are computers.

Hardware and Software

A computer is made up of two components: the **hardware** and the **software**.

The hardware refers to the physical components of the computer including the monitor (the screen), the computer cabinet, the various peripheral devices such as the keyboard and mouse, and even the printer that is used to print information. In general terms, hardware means all of the electrical and electronic components of the computer together with the cabinets, boxes, or shells, in which they are housed.

The software refers to the instructions (also known as programs) that make the computer work. Basically, it is the software that tells the computer what to do and how to do it.



Here are examples of two software packages: Adobe Reader to the left and Microsoft PowerPoint below.

In very general terms, **hardware** refers to the tangible aspects of the computer (the case, the mouse, the keyboard, and so on), while **software** refers to the intangible elements of the computer such as the processing instructions.

TYPES OF COMPUTERS

Modern, electronic computers have been in commercial use since the mid-1960s. There are many different types of computer ranging from very large and powerful mainframe computers

through to very small and personal hand held computers, such as smartphones which are built on a mobile computing platform. The more common types of computers are detailed below.

Mainframe Computers

Mainframe computers are high performance computers used for large scale computing purposes that require greater availability and security than smaller scale computers can offer. They are normally used by large organisations for processing enormous amounts of information and data.

Mainframe computers consist of a central processing unit, which is usually housed in a highly secure part of a building, and a number of dumb terminals sprinkled around the organisation. A dumb terminal consists of a keyboard to input data and a screen to see the information. Dumb terminals, however, do not have any processing capabilities and all of the input is sent via cables to the central processing unit. A typical example is seen at the check-in counters at an airport – there may be dozens of dumb terminals all connected to the mainframe computer that handles the processing of tickets and flight information.

A mainframe computer may have thousands of dumb terminals connected to it.

Personal Computers

Personal computers are the complete opposite of mainframe computers. They were developed in the late 1970s to help alleviate the pressure that users were placing on mainframe computers.

Personal computers are used by an individual (hence the name *personal*) and differ from mainframe computers in that they have their own central processing unit. Unlike mainframe computers, where dumb terminals are connected to a remote central processing unit, with a personal computer the terminal and central processing unit are combined into the one installation. Instead of having many users at dumb terminals trying to access one (albeit very large) central processing unit, each personal computer has its own central processing unit handling data requests from only one user.

Network Computers

Network computers are usually personal computers that are connected to other computers. While personal computers offer personal freedom and independence from large mainframe computers, it is often important for users of personal computers to share data and information with other people. To allow this to happen, personal computers can be networked or joined together. This is normally done using either cables running between the computers or with wireless technology where no cables are necessary.

Laptop Computers

Laptop computers are personal computers that are portable and can be moved to and operated in many different locations. The systems unit, monitor and keyboard are combined into one unit for ease of transport. Laptop computers can be powered by a battery or plugged into mains power.

Since most laptop computers can be connected to networks and modems, they have the reach of a desktop computer and a greater versatility by virtue of their portability.

Tablet Computers

A tablet computer (also known simply as a tablet) is a small hand-held device that has the systems unit and flat touch screen built into the same case. The screen allows users to navigate easily and intuitively by touching the screen, and to type using the virtual keyboard which displays on the screen rather than having to use a physical keyboard. Tablets have been made popular by the introduction of the Apple iPad. Because tablets are relatively small (about 25cm), they cannot run complicated desktop software applications.

Smartphones

As well as making phone calls and sending SMS messages, you can use a smartphone, such as an iPhone, to read and send emails, browse the internet, view and take photos, view and record videos, manage your calendar, and more. Because of their small size, smartphones are highly portable, however it also means that they aren't as powerful as other computers and like tablets, they cannot run desktop software applications on them.

TYPES OF PERSONAL COMPUTERS

There are many different types of personal computers on the market today, but they generally fall into one of two categories: *fixed* devices, such as desktop computers and game

consoles, and *mobile computers*, such as laptops and netbook computers, tablets, smartphones, and programmable calculators.

Desktop Computers

As the name suggests a **desktop computer** is designed to sit on a desk. The desktop computer comprises several components.

The **system unit** (the rectangular box which houses the processing and storage components of the computer) can sit either on top of the desk or be turned on its end and placed on the floor butting up to the inside of a desk.

Other components, such as the **monitor** (screen), **mouse** and **keyboard**, connect to the system unit.

Desktop computers are still popular because it is easy to customise them, replace parts and fix them with much more ease than you can a laptop. It is also more convenient to be able to connect peripherals like screens and keyboard and computer mice that fit your needs.

Laptop Computers

Laptop computers are portable computers.

With laptops, the systems unit, monitor, keyboard and mouse are combined into one unit for compactness and ease of transport. They are preferred by people who need to do their computing work in a number of places: at an office, in a car, on a plane, at home, and even in coffee shops and restaurants.

Laptops are battery powered so that they can be used away from a power point source for several hours depending upon the type of work they are doing.

Tablet Computers

Tablet computers are a relatively new innovation made very popular by the introduction of the Apple iPad. Tablets are a hand-held device roughly the size of a small magazine. Like laptops, they contain all components in the one case; however, unlike laptops, tablets have a touch screen which replaces the physical keyboard.

Smartphones

Smartphones are mobile phones with an operating system. In other words, they are small portable computers. Along with a touchscreen, smartphones include common computer applications such as an internet browser, databases, multimedia, calendar, navigation programs and so on. As the popularity of larger mobile phones increases, users are relying on their phones for consuming media rather than simply making phone calls.

HOW COMPUTERS ARE USED

Each different type of computer (mainframe, personal, network, laptop and PDA) has its own typical area of usage. How these computers are used is often determined by their speed of

processing power, capacity of data storage, and above all, cost.

Mainframe Computers

Mainframe computers are normally used for processing and storing enormous amounts of information and data. Mainframe computers are used by banks for processing bank accounts, by electricity supply authorities for processing electricity bills, by the taxation department for processing taxation returns, by universities for processing results, and much more. They are also used in large organisations for processing customer accounts, payroll runs, inventory, warehousing, in airports for displaying flight information and ticketing, and the like.

Mainframe computers are expensive to purchase (from several tens of thousands to several million dollars/pounds/euros) and expensive to operate as they need to have dedicated facilities – such as an air-conditioned, secure room – and a team of specialist operators.

Personal Computers

Personal computers can be found in the offices of most organisations, from very large corporations, down to very small businesses. They are used for budgeting, accounting, letter writing, developing marketing materials, keeping contact of customers and suppliers, small inventories, and much more. They are also found in most homes where they are used for writing letters, homework, accessing the internet, sending electronic mail, personal banking, and the like.

Personal computers can store large amounts of data and are relatively fast at processing data. Personal computers offer the cheapest form of computing, costing from one thousand to three thousand dollars/pounds/euros.

Network Computers

Network computers use normal personal computers (either desktop or laptop) that have additional electronic components that enable them to be connected together. Once they are connected they can share data, be used to send email messages to one another, share devices such as printers and modems, and access specific applications and programs, and even the internet.

Network computers are found in most businesses large and small. Large businesses would most likely have a network in each department. The networks themselves can be interconnected so that employees within the organisation can remain in easy contact. Networks are also found in doctors' surgeries, accounting offices, motels and hotels.

The cost of the electronic components in networking is negligible often costing little more than 50 dollars/pounds/euros per computer. However, the cost of cabling within buildings can be expensive and new buildings are often designed with the necessary cabling infrastructure in place.

Laptop Computers

Laptop computers are personal computers that can be used while on the move. They are often used by people who travel a great deal, who need to give presentations in different locations, or who generally don't work from a fixed location or desk. They are also increasingly being used by students in schools. Laptops cost only slightly more than personal computers yet have the same capacity and power.

Tablet Computers

Tablets are primarily used as a platform for audio-visual media including books, movies, music, games, apps and web content. While tablets are mostly used by consumers, they are also used by many business users. For example, several airlines (including United and Alaskan Airlines) have replaced their pilots' paper manuals in the cockpit with Apple iPads. Other examples of uses in the workplace include lawyers responding to clients, medical professionals accessing health records during patient exams, and managers approving employee requests.

COMPUTER PERFORMANCE

Personal computers are not all alike and vary greatly in many aspects especially in the area of **performance**. Performance, or how quickly a computer performs a specific task, is dependent

upon a number of internal components and items. These include CPU speed, the size of the memory and the number of applications that are currently running.

How Computers Work

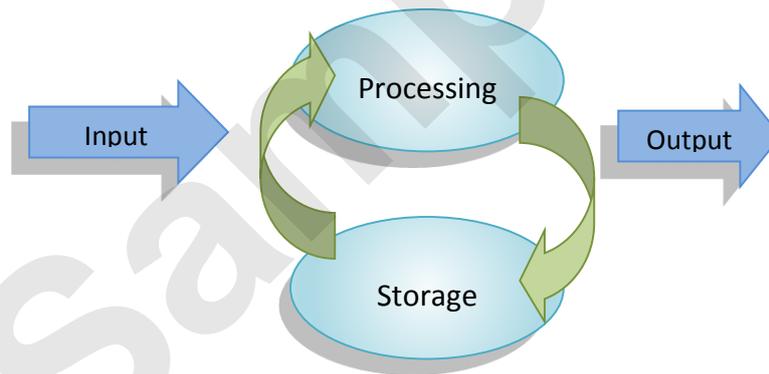
In simple terms a modern computer is an electronic device that allows you to **process** and **store** data. Data is entered into a computer using a variety of **input devices** – keyboard, mouse, scanner, bar code reader, writing tablet and so on. The most common input device is the keyboard.

Once the data has been entered into the computer it can be **processed** to provide relevant, timely and quality information. The information can be made available on a variety of **output devices** – the screen or the printer being the most common.

In this sense a computer is similar to a hand-held calculator. With the calculator you enter numbers using the keyboard and perform a mathematical operation. The result of the operation is displayed on the calculator's screen.

A computer differs from a calculator, however, in that it can process words as well as numbers. A computer also differs from a calculator because it lets you **store** the raw data, the processed information, and even the processing instructions, for future use.

As soon as you switch a calculator off all of the data that you have entered and the information that it has processed is lost. A computer allows you to **save** the data and the processes so that they can be used again later.



Factors Affecting Performance

Most of the processing that occurs in the computer takes place in the main electronic chip built into the computer. Since this is a mathematical, computational operation it is measured in terms of how long it takes. The power of a computer is therefore quite often described in terms of how long the computer's processing chip takes to perform these calculations. This measure is known as clock speed. The faster the clock speed, the more powerful the computer.

Another factor that affects performance is the size of the memory (RAM) of the computer. Everything that is processed must pass through the RAM chips in the computer. As RAM fills earlier data and information are cleared out to make way for the newer material. Obviously, clearing out RAM takes time. The more RAM there is in the computer the less necessary it becomes for the computer to shuffle data and information, and, consequently, the faster the computer performs.

Computer performance is also influenced by how much work the computer has to do. With earlier computers you had to stop an application before using another. This meant that if you wanted to do some accounting work you would have to close the current application you were working on before starting the accounting application. Today it is possible to have more than one application running at a time. For example, you will probably keep your email application open so that you can receive messages, while at the same time starting your word processing application to write letters, and your accounting package to raise invoices. However, since all applications need to be processed and stored in RAM, the more applications you have open at the one time the slower your computer will perform. It is desirable therefore to have as few applications open as necessary rather than open everything "in case" you may need it.

CHAPTER 2

COMPUTER HARDWARE

INFocus

The most obvious part of a computer is its physical being – its existence. A computer is simply a box of wires, nuts, bolts and other sundry bits and pieces that you can touch, hold and pull apart. The physical items that make up a computer are known as the computer's **hardware**.

In this session you will:

- ✓ gain an overview of the main parts of a personal computer
- ✓ learn how to identify the **CPU** and its main functions
- ✓ gain an overview of computer speed
- ✓ gain an overview of **RAM** and its role in the computer
- ✓ gain an overview of **ROM** and its role in the computer
- ✓ gain an understanding of the external hardware components of a computer
- ✓ gain an understanding of computer peripherals
- ✓ gain an overview of keyboards and keyboard layouts
- ✓ gain an understanding of a range of input devices
- ✓ learn how to identify output devices used on the computer
- ✓ gain an overview of devices used for both input and output
- ✓ learn how to identify the main storage devices
- ✓ gain an understanding of how external devices are connected
- ✓ gain an understanding of the internal hardware devices found in a computer.

THE MAIN PARTS OF A PERSONAL COMPUTER

A personal computer is normally made up of three main components: the **monitor**, the **keyboard** and the **system unit**. The keyboard is used to input data (it is known as an **input**

device). The monitor is used to display information that has been processed (it is known as an **output** device). Most computers also have another input device known as a **mouse**.



The System Unit

The **system unit** is the *brain* of the computer. Here data and instructions received from input devices are processed and then sent to output devices for display. The system unit has a number of core and critical components under the hood as described in the following table.

Component	Category	Function
CPU	Processing	The Central Processing Unit (CPU) is an integrated circuit that is plugged into the main electronic board inside the system unit. Its job is to direct all of the activities within the computer and is where the processing of data takes place. The CPU acts as the 'brain' of your computer. Personal computers are often classified according to the type and speed of the processor they have fitted.
Hard disk	Storage	The hard disk is used to store data and information so that it can be used again at a later time.
RAM	Storage	Random Access Memory (RAM) is a temporary storage area for data awaiting processing by the CPU while the computer is switched on. The data stored in the RAM is erased when the computer is turned off.
DVD drive	Storage	The DVD drive on the computer is much the same as the DVD you use at home for playing movies. Large programs (especially games) are available on DVD and the DVD drive is normally used to load those programs onto the computer. The DVD drive can also be used to play your audio CDs on the computer and to play movies – providing you have the right software and sound card. Most of the DVD drives can also create (or <i>write</i> as it is known) DVD disks – this is known as <i>burning</i> a disk.
USB port	Storage or device connection	Another important part of a computer are the USB (Universal Serial Bus) ports . In computer jargon a port means a connecting socket. Most computers will have several of these ports because they can be used to do a number of different jobs, sometimes simultaneously. USB ports, for example, can be used to connect a mouse to your computer. They can also be used to connect a temporary storage device known as a <i>USB Stick</i> or <i>Memory Stick</i> to the computer so that you can copy data from the computer to it for safe keeping.

Peripheral Devices

There are a number of other devices that can be attached to a personal computer. These include devices such as printers, scanners for scanning in pictures, digital cameras, joysticks for playing games, and more. These devices are normally attached to special plugs at the back of the computer. Since they are peripheral to the main operation of the computer, they are sometimes known as **peripheral** devices.

THE CENTRAL PROCESSING UNIT

Arguably the most important electronic component of the computer is the **central processing unit**. Every computer needs to be **programmed** and it also needs to have **data**

upon which to perform these instructions. The **central processing unit (CPU)** directs the activities of the computer and helps it deal with the instructions and the data.



The CPU chip inside a personal computer is sometimes a bit tricky to spot. It is large and often has its own cooling fan sitting on top.

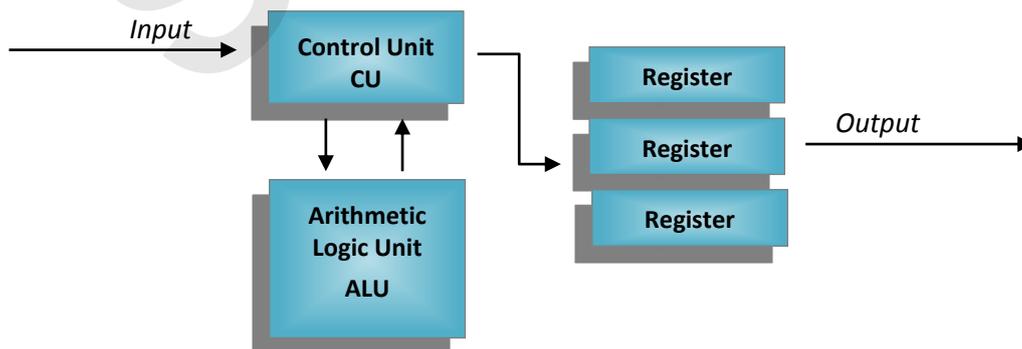
The CPU chip actually has several components that help it manipulate **programs** (instructions) and **data**. These components are:

- the **Control Unit (CU)**
- **registers** (*immediate access memory*)
- **Arithmetic Logic Unit (ALU)**.

The **Control Unit's** job is to receive the instructions and to carry them out. It receives instructions and carries them out millions of times every second.

The **registers** are the internal storage areas of the microprocessor and are where data is stored as it is being worked on by the Control Unit and the **Arithmetic Logic Unit**. The Arithmetic Logic Unit (ALU) carries out arithmetic and logical operations – while you don't have to be a mathematical whiz to operate a computer, the computer works by carrying out arithmetic operations which are effectively hidden from you in the background.

So how do all these components work together? Spend a few moments examining the following model.



The **Control Unit** receives instructions and then assigns the task to the **Arithmetic Logic Unit**. Virtually all tasks involve arithmetic such as adding, subtracting, multiplying, and dividing, or logical operations such as "and", "or", and "not". This combination of arithmetic and logic allows the computer to perform very simple all the way through to extremely complex operations.

The Control Unit directs the Arithmetic Logic Unit to perform the instruction. Once this is done the results are placed into **registers** as directed by the Control Unit. Eventually the results are shifted from the registers into the computer's **memory management unit** and then directed to an **output device** such as the screen or a printer.

COMPUTER SPEED

Since computers basically process instructions one would imagine a microprocessor's power is measured in terms of how many instructions can be performed in a given amount of time. In fact,

in the past the computer's power was measured in **Millions of Instructions Per Second** (MIPS).

Understanding Gigahertz

Millions of Instructions Per Second (MIPS) is a fair enough measure of raw grunt power. However, it's a bit like measuring the power of a car's engine – it tells us a lot about the engine, but not necessarily the motor vehicle itself. For example, any motor mechanic will tell you that a 351 cubic inch engine is very powerful. However, there will be a great deal of difference driving a 1955 Morris Major with a 351 cubic inch engine to a 2001 Ford Mustang with the same engine. In other words there are other factors to include in the overall performance of a computer than the sheer processing grunt of the microprocessor.

A more accurate measure of computer performance known as **clock speed** has been developed for this purpose. This measures the number of **cycles** (in, process, store, then out) rather than just instruction processing (process) a microprocessor can handle per second. In other words it measures not only how fast a processor processes, but how quickly programs and data are shunted through it. These days clock speed is measured in **Gigahertz** (GHz), where 1 GHz is equal to 1 billion cycles per second.

Speed And Processors

Clock speed has come a long way over recent years. The original IBM PC had a clock speed of 4.77MHz (or 4.7 million cycles per second) based on the type of main processing chip that was installed in it. Today's processors are measured in the thousands of Megahertz, known as Gigahertz.

There is a strong correlation between software and processor speeds. Software is generally written for the speed of the processor of the day. This is especially true of software that involves the use of audio (sound) and animated graphics, especially games.

There are all sorts of tweaks and additions that can be made to a computer to make it run faster. Indeed, computers are a bit like cars – you can start with a standard model and then make adjustments to a variety of features to enhance (and sometimes even diminish) overall performance.

COMPUTER RAM

Before data can be processed, and after it is processed, it is placed into temporary storage known as **random access memory (RAM)**. The process operates a little like a post office. Mail

comes in on a regular basis and is stacked in the sorting bay waiting sorting. When it is sorted it is placed into various pigeon holes waiting to be picked up by the postal office for delivery.

Random Access Memory (RAM) is a temporary storage location in the computer where data is placed before and after processing.

The key word here is memory, because things in memory tend to be volatile, easily replaced, changed or purged.

RAM is really electronic storage and exists as an expandable bank of silicon chips plugged into the motherboard of your computer. These are often referred to as RAM chips.

Early computers allowed you to place up to 1Mb worth of RAM storage on your motherboard, but because of limitations of the software (the instructions that make the computer work) only 640Kb of that RAM was usable.

Today there is no real limit to how much RAM can be used.

Also because RAM exists in chips you can easily add more chips at a later time if you wish to have more RAM in your computer – or such is the theory anyway.

The performance of your computer is largely dictated by the amount of RAM that you have.

Some applications that you use on your computer require large amounts of RAM while others require relatively little. Programs that allow you to work with photographs or drawings are normally heavy users of RAM and require large amounts of RAM to facilitate faster operations.

The reason for this is that RAM will only ever be finite in size – you can't have an endless supply of RAM chips installed on your computer. As RAM storage is filled redundant data is removed, normally sent to a disk, and the new data is loaded into the vacated spaces. While this may take only fractions of a second, repetitive need to purge and replace RAM space slows operations down.

In modern computers you can simulate multi-tasking where it appears that the computer is performing multiple operations at the one time. In reality a sophisticated time-sharing operation is actually being performed by the computer. The downside however is that a great deal of data for one application is stored in RAM while another loads up and works. Therefore the more applications that you have open at any time the slower your computer will seem to become.



So RAM is volatile, meaning that its contents will be lost as soon as there is an interruption to power. RAM is also constantly changing with new contents flowing through on a regular basis.

When you start to push the boundaries of your computer you will eventually receive a message telling you that system resources are low. This quite often indicates that your RAM is reaching capacity and the computer is no longer sure what to remove.

COMPUTER ROM

When a computer is first switched on it seems to magically spring to life and start doing things – in reality, there is no magic, only smoke and mirrors. Every computer needs to have a basic

set of instructions that tell it what to do as soon as the power is switched on. These instructions are installed in a special part of the computer known as the **read only memory (ROM)**.

The *boot-up* instructions for the computer, which tell it how to start, are stored on a **non-volatile memory chip**. This processor is called **Read Only Memory (ROM)** because the computer can access the instructions and use them but they cannot be changed – in other words they can be *read*, but not *over-written*.

So, why bother?

ROM normally contains instructions that tell the computer to check what components have been installed and then to see if they are working correctly.

Part of the ROM instructions involve checking to see how much RAM is installed and to check that each of the RAM chips is functioning correctly. The computer will then check to see if there is a keyboard, a monitor, a hard disk, and if everything is functioning correctly it will eventually hand over the control to special software known as the operating system.

This self-analysis and checking performed by the instructions in ROM is sometimes referred to as the **Power On Self Test program (POST)**.

Unlike RAM you cannot remove the contents of ROM unless you have a relatively in-depth understanding of computer technology.

So ROM is non-volatile, meaning that it will remain unchanged even after the power is switched off. ROM also cannot be manually changed – it is fixed.

Sample