THE COMPUTER
HOW IT WORKS
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Children's Book Trust, New Delhi
Over the 'generations'
They have started invading our life. They are almost everywhere, offices, banks, railway stations, post offices, schools, colleges...our homes! They are called computers. Just as the inventions of the train and the motor car revolutionized the way we travel from one place to another, computers have revolutionized the way we remember, write or communicate. Not only do they help us to draft a letter, a report or a book, but also to send it anywhere even without using any paper! They can like a radio or television also be used to share our thoughts, our emotions, our creations with many people, all at once.

**What is a computer?**

A computer is an information-processing machine, an electronic device, manufactured in a factory, that can perform many functions—till now done by humans only. It can see, listen, read, write, speak, show, learn, remember, think, analyze and decide. In short, it can communicate intelligently. It can do so not only with humans but also with other computers. It needs electricity from the main power line to be alive. Without electricity, a computer is a dead body. If a computer is connected to a UPS (Uninterrupted Power Supply) or a battery, it can work for a short duration even when there is no electricity.

Just as our body has many organs, each of which has a particular function, the body of a computer is also made up of several parts. Like our brain that controls other parts of our body, in a computer there is a device called a microprocessor that allows it to take decisions and control its
various parts. We have memory to retain information and ways to do various tasks, so has a computer. We have a face, a mouth and limbs to express ourselves, a computer has a screen (just like that of a TV) that acts like its face, a device called mouse is like its limb which can also write, draw and paint, and a small loudspeaker that enables it to speak or sing. We have eyes, ears, nose and skin to help us know our environment. Similarly, a computer has an operating system through which you can instruct it to perform various tasks. Some computers can also hear voices, see objects and sense touch through a microphone, a camera and a touch screen.

The computer family
There are several types of computers: Palmtop, Laptop, Desktop, Server, Mainframe and Supercomputer. A Palmtop is the smallest and looks like an overgrown calculator. It can be held in one's palm. A Laptop looks like a large book that can be kept on your lap while you work on it and can accompany you anywhere. Both a Laptop and a Palmtop work by using the
The ancestors of the present generation of computers, born in about 1920, did little more than a few rather hefty calculations. Obviously, they were not very popular. Leaders in the computer industry, like the IBM (International Business Machines) executives, felt that they could sell at best a few thousand computers worldwide. After all, how many people would be interested in investing a fortune just to calculate faster! Besides, these computers could occupy a big air-conditioned hall and consume a lot of electricity. People could store electricity from a battery. But the computers we come across most often belong to the family Desktop (nickname PC). A Desktop has a relatively large body and is usually made up of four detachable parts: one part looks like a small TV and is called a ‘monitor’; the second part resembles the keyboard of a typewriter and is called ‘keyboard’; the third, looks like a trendy box, called the ‘Central Processing Unit’ (or just CPU); and the fourth looks like a mouse and is called the ‘mouse’. A number of other devices, known as computer peripherals like, web camera, speaker, microphone and printer, often accompany it like faithful assistants. They enable it to see, hear, speak, or deliver desired results. Servers, Mainframes and Supercomputers are the heavyweight members of the family. We seldom come across them, but they are very important as they manage many PCs, keeping them connected and in touch with each other.

**GUI and Mouse**

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interact with them only through a pack of punched cards. Often it took a few hours before one got a printed output (there were no screens to see it). It is only after the birth of the PC, which has evolved in the last two decades, that the computers have become common and versatile. The punched card, or even the keyboard, is no more essential for people to interact with a computer. A user friendly Graphic User Interface (popularly known as GUI) and a pointing device (like the mouse) have made interaction much more effortless and easy.

When the first PC came into being, the screen of the monitor invariably used to be black and often blank to begin with. One was then required to remember and type in, very accurately, the commands for various jobs. Definitely, most people found it inconvenient. But not any more. Today as one switches on one's PC, one is welcomed by a colourful graphic display on the monitor. In fact, most often one can choose the picture. On the picture, there are some icons with a brief title. This display is known as the GUI. Moreover, in order to do a particular task on the PC, one does not need to type in a command, just a click of the mouse button is sufficient.

A mouse is a small plastic encased device, which can be used to control the position of the pointer, called the cursor, on the monitor by rolling it on a smooth surface or a mouse pad. Positioning the cursor on to a particular icon, or a title in a list, and clicking the button on the mouse is a sufficient command to open the required file.
What is inside it?

The most enigmatic part of a computer is the CPU, or the brain of the computer. It is made up of many ICs (Integrated Circuits), and other kinds of components that are found in computers only.

A microprocessor is the central control area of the computer. It is a microscopic circuit of a silicon chip and is made up of silicon, aluminium or copper and plastic. It contains thousands of electronic devices known as transistors on a thin slice of silicon only about six millimetres square in size! It has many electronic switches inside it that helps it to do its task by stopping or allowing the electric current through them. A transistor is the basic unit of each such switch. It is through selective switching ‘on’ and ‘off’ of transistors that a microprocessor acts as the brain of a computer. A microprocessor used in the present generation of computers (say a P-4 computer) is made up of as many as ten million transistors, each connected to many others through microscopic lines of aluminium that act as wires. The last few generations of PCs are known by the name of the microprocessor like 386, 486, Pentium, Celeron, Xeon, Athlon, Cyrix.

One feature that distinguishes one kind of microprocessor from another is the ‘clock speed’, a built-in clock, that sets the pace for all activities inside it. The clock speed is measured in cycles per second.
Integrated Circuit

ICs are an essential component of any electronic device. An IC often looks like a small piece of plastic with many metallic legs. Inside an IC, there is a complex electronic circuit made up of different kinds of electronic components—transistors, resistors and capacitors. They are all connected to each other through extremely thin lines of copper and are engraved on a tiny chip of silicon.

(a unit also called the Hertz or Hz). You will come across words like MHz or GHz in the advertisements for computers in newspapers and magazines. The clock speed of the latest brand of microprocessors is above a billion Hertz.

There are several kinds of memory: the basic memory, the short-term memory and the long-term memory in a computer like in our brain. Although we do not have a unit that measures the memory of our brain, we do have a unit for the memory of a computer. It is known as byte.
**Bits and Bytes**

The smallest unit of the memory of a computer is a bit (an acronym for binary digit). A bit is a single transistor device in a computer, which is akin to a light bulb.

It has only two possible states, 'on' (often indicated by the numeral 1) or 'off' (indicated by 0). To store or convey more information, bits are organized into larger units called bytes—the commonly used unit of information in a computer. Each byte contains 8 bits and can represent only a single character or command. A brief letter to your friend may require just a few thousand bytes, whereas to store a postcard size colour photograph, it may require several million bytes.

The terms, KB (kilobytes), MB (megabytes) or GB (gigabytes) one often comes across in advertisements for computers, are more convenient units. Just as a businessman finds it convenient to talk in terms of lakhs and crores, computer users often say one MB rather than the 1024 kilobytes or one GB instead of saying one billion bytes. K stands for kilo or thousand. To be exact K stands for 1024 bytes. Very soon, when you grow up a bit, you will encounter the term TB (Terabytes, that is, a trillion bytes) too.

Corresponding to the various kinds of memory in our brain, computers have ROM (the basic memory), RAM (short-term memory) and the Disk Drive (long-term memory).
When we sit for an examination in school, we often cram up many facts so that we can remember them rapidly when we need them. We often forget these facts and instructions once the examination is over. The part of our brain that we use for this purpose is known as the short-term memory. The CPU also has a short-term memory. It is called RAM (Random Access Memory). RAM is also in the form of ICs that are made up of transistors.

Nowadays, a PC usually has more than 128 MB RAM. In sharp contrast to the ROM, RAM is a temporary memory. As soon as a computer is switched off or its power supply is disrupted, it forgets all the information in its RAM.

Our memory is responsible for the very basic functions of our body like breathing, eating, drinking or moving our limbs. Similarly, the CPU of a computer has a chip—an integrated circuit, known as the ROM (Read-Only Memory). It does not fade easily, just like our basic memory. Even when the electric supply to a computer is switched off, it does not forget. Like the microprocessor, it is also made up of a particular kind of transistor.

ROM stores the basic functions a computer has to follow as it is switched on. It also stores all the information about the other parts present in the computer. Therefore, it is the memory that a computer uses to check up whether all the parts are present or not. It raises an alarm in case something is amiss.
As we age, we get to remember many facts and instructions. The part of our brain that stores all such memories is the long-term memory. A computer has a variety of memory devices. The most significant one is the Hard Disk Drive (HDD). It is often the most voluminous memory of a computer. Unlike ROM or RAM, it is not an IC chip. An HDD comes as a factory-sealed unit that is made up of several aluminium (or glass ceramic) disks, called platters. Each of these platters has a coating of a thin film of a magnetic material, like the tape of an audio or video cassette. The memory of an HDD is divided into concentric circles on its platters called tracks. A read/write head attached to a movable arm reads information from or writes information on these platters. The platters are rotated at a very high speed with the help of an electric motor and the read/write heads move from the rim towards the centre of the platter. This way information can be read from, or written on almost any part of an HDD in a jiffy. It can store a lot of information including programs and data. By the end of the last century, the capacity of an HDD installed in a common PC had risen up to several GB, this is sufficient to remember text typed on several crore pages or an equal number of photographs or sounds. It continues to rise further almost every month. Unlike the RAM, but somewhat like ROM, the information stored in an HDD is not volatile, that is, it will not forget the data stored in it if the power supply is disconnected. An HDD can be transplanted from one computer to another with all the information stored in it.
Portable media
We often need to transfer or distribute information. Until recently, paper was the only medium for this purpose, but now we have other choices too. A floppy disk (FD) is one such choice. It has a platter very similar to those used in a Hard Disk. A device that can read or write from or to a floppy, is very commonly found in the CPU of a computer. Unlike a Hard Disk, the platter of a floppy is encased in a thin plastic case. It can be very easily inserted or removed from the Floppy Disk Drive (FDD), the device located in the CPU cabinet. In fact, when the PC was introduced in 1981, it did not have any HDD, and contained only an FDD.
A floppy disk is a portable medium for information. It can be used to transfer information from one computer to another or to keep a backup of vital information on the HDD. A floppy has only one platter and its most popular version has a capacity of only 1.4 MB. There are several other versions of similar portable memory, like the Zip drive, that were introduced recently. They have a capacity up to several GB.
A Compact Disc (CD) is yet another choice that has become very popular in the last decade. Unlike a Hard Disk platter or the floppy disk that has a layer of a magnetic material to read or write information from or to it, a CD has a thin layer of material that reflects light easily. The CD drives use a laser beam to read or write information from or on them.
There are two kinds of CD drives, one that can only read information written on a CD and the other which can write
or modify information on a Compact Disc.

The CD disks used in these drives are also of two kinds. The first is the CD-ROM, which is produced in very large numbers. It is just like a book or a newspaper. One can only read the information from a CD-ROM and cannot write information on it. The second is CDR disk which is like a floppy. The user can write and rewrite on it if his computer has a CDR drive. At present, a CD has a capacity of about 600 MB, but this can be augmented several times.

CD-ROMs are thin, plastic disks that look like miniature music records or disks. But, unlike the music records, a CD-ROM is not black, it is silvery on one side and printed on another. Since they can store so much information in so little a space, they have become very popular. Encyclopaedias, which hitherto occupied an entire bookshelf, are now available in a set of CDs that can be kept in a drawer. CD-ROMs and their latest manifestation, the DVD (Digital Videodisc) are also becoming popular for distribution of music and video.

Inside the CPU, the ROM and the RAM IC-chips are connected to the microprocessor through sockets and tracks of copper printed on a large circuit board. This printed circuit board is known as the motherboard. The keyboard, the mouse, the monitor, HDD, FDD, CDD are all connected to the motherboard through sockets and wires. In addition, the motherboard has
several other ICs and sockets to connect it to many other optional devices, such as the printer to print text or pictures; the speakers and a microphone (or a sound-card) to produce and record sounds; a scanner to scan and record images or text from a printed document; a video-card to get attached to a digital camera; a TV or VCR so that one can record or show video programmes from a TV or VCR on the computer; a modem to connect it to other computers through the telecommunication network, using the telephone network, which enables any computer user to send or receive information from a distant computer without using a portable disk.

The CPU of the computers found in a bank, railway booking office or any other office, that is, the Server computers and Client computers, often have another device installed in them known as the Network-Card. This device allows the
Networking computers to communicate with one another through wires linking them.

There is also a power supply unit—a transformer—inside the CPU that supplies the right kind of power to each part of a computer because the main's electricity is too strong for the computer's delicate parts. The transformer weakens the voltage to suit the requirement. It uses the household supply or a battery of dry cells. The transformer and the microprocessor tend to get hot with time; therefore, there are small fans that blow air to cool them.

**How it works?**

As soon as the power supply to a computer is switched on, a computer program, called the Basic Input Output System (BIOS), stored in the ROM, initiates a check up. First of all, it checks if there is a working monitor attached to the CPU. If it finds one, it prompts it to display the details of the BIOS (and the software that enables the display) on the monitor screen. Then this program enables the CPU to check the other basic items—the keyboard, the disk drives and the RAM—to see whether they are functioning properly.

Once the computer system finds that all the essential components are in working order, it passes the control to another computer program known as the Operating System (OS). The OS is most often installed on the Hard Disk from a Floppy or a CD. But a part of it is transferred to the RAM of the computer as soon as it starts operating. A computer is ready to work only
after the OS is successfully initiated which allows a user to load on it other computer programs, known as the application software, for doing a specific task. Many big companies regularly develop such programs and sell them. All that a user needs to do to use these programs is to purchase a CD-ROM or a floppy on which these programs have been copied and carefully follow the instructions provided to install them on his computer. It only takes a few minutes for installing these programs on a computer. Once an application software has been set up, it can be launched for use by just clicking the mouse on the icon of the application, or its name in the directory, or even the name of the data file associated with it.

**Software**

In order to work as an information processing machine, a computer system needs to be taught to take instructions, process them and give the results. Computer programming is the art of training or teaching a computer. A particular set of instructions in a logical order in any computer language to complete a specific task is called a computer program. There are two types of softwares available in any machine: System Software and Application Software. Experts in computer programming know the language a computer understands and develop products known as software.
Operating Systems

Have you ever come across the phrase 'Windows'? It is the name of a very popular Operating System.

An Operating System is one of the basic necessities of a computer. It is a set of computer programs that enables a computer to do several very basic tasks, like formatting a disk. As we now know, the platter of a disk is divided into concentric circles, called the tracks. Formatting divides these tracks into pie-shaped distinct areas, called the sectors. Each sector is given a unique address so that when information is stored in a particular sector, it is addressable.

A unit of information stored in a computer is often called a file. Every file has a name given to it by the user. The name also includes a short phrase known as the file extension. The file extension is somewhat like our surnames, they tell us the lineage of the computer program used to make it.

There are two main types of files—data files and program files. While most program files have an extension (exe), a data file can have a variety of extensions depending on its nature. For example, it can be doc (text file); bmp (image file); wav (sound file) or mov (video file).

In computer parlance, when a computer follows the instructions of a program, it is said to execute it. A user of a computer...
equipped with a GUI Operating System can open a data file or ask the PC to execute a program file by just clicking the mouse on its icon.

An Operating System also creates a filing system for storing the information. The filing system is a catalogue of different files stored on it. It helps to keep track of file names, the date on which they were created or modified, the memory space they occupy, and the addresses of the sectors of the disk they occupy. An Operating System helps a user to see the directory. It also allows the user to modify the contents of a disk by either deleting some files, copying them elsewhere, or making new files and organizing their storage in folders. A folder in a computer is like a file used in offices to store related documents.

An Operating System also makes it possible to load other application software compatible with it, which enables the computer to help its user do many kinds of tasks. But, Windows is not the only OS. There are several other competing OS, such as DOS, MacOS, UNIX and LINUX to name a few.
The list of tasks that a computer can be programmed to do is almost endless. Here are a few of them:

**As a typewriter:** A computer is very often used to type letters, project reports, manuscripts or any matter that needs to be typewritten. It can act as an exceptionally intelligent typewriter, especially when it is loaded with a good word processor—a kind of application software. A good word processor can alert the typist about the spelling or grammar mistakes committed while typing and also suggest corrections. It can also type the text in a variety of fonts (shapes of letters), type styles and sizes.

**An All-Rounder**

There are several languages in which a computer can be taught to do tasks. The natural language of computers is made up of only 0s and 1s, known as the binary code. This is so because the operations of computer hardware are based on the ‘on’ and ‘off’ states of transistors. It is not very convenient for most of us to learn and use binary language. Therefore, experts have developed computer programs that translate programs written in our language, mostly English, into the binary code. BASIC and LOGO are two such languages that are easy to learn and use. There are many others too.
Thus, a word processor can help one to type a piece of text in several languages, say Hindi, English, Bengali and Malayalam, depending upon the software program that is installed.

Above all, it allows innumerable corrections and modifications of the text before it is finally printed.

As an office assistant: In offices and banks, a computer is used to maintain the accounts of their clients. A computer, especially when it is connected to other computers through a network-card, is an exceptionally useful office accessory. It makes it possible for many people to work simultaneously using the same ledger (information) at the same time.

As a library: One can refer to a large number of books and encyclopaedias just sitting in front of a computer. Most encyclopaedias are now available on CDs. After installing them on one’s PC, one can search them for information. Most often it is much quicker than looking through the printed version. In addition, if one has a modem installed and has subscribed to an Internet connection, one can search for information on any subject under the sky.

As a mailbox: One can send and receive messages from friends or business associates located anywhere in the world almost instantaneously. This is possible through a facility known as e-mail. Several hundred server-computers placed around the world act as virtual post offices. Members or subscribers of the
companies that provide this service can connect their computers to these server computers using a modem through telephone lines. Users can then send or receive messages through these computers (called mail servers). All the messages addressed to a particular member are stored in the Hard Disk of the mail server and one can see these messages on one's own computer only if one knows the unique code word known as the password chosen by the member.

As an art toolbox: A computer can also be used to draw pictures and paint them. It can also be utilized to modify photographs. For this another genre of application software called the image editor needs to be loaded on the OS. Most image editing software have all the tools that an artist
needs to draw and paint. Like the word processor, an image editor also enhances the capabilities of an artist. In addition, there are several application software that allow anyone to make cartoon animations.

As a music system: A computer can not only play your favourite music, it can also help you create music. Software is available that enables a user to produce and synthesize sounds of several musical instruments.

As a game machine: A PC can be used to play a variety of games. One can use a PC not only to play card games, but also to simulate a playground to play golf, cricket, football, or any other popular sport. People have developed many adventure games for the PC users. In these games, one can search for a lost treasure or fight an enemy using various kinds of weapons.

As a calculator: Charles Babbage invented his ‘Analytical Engine’ (present-day computer) to help him in his laborious calculations. Indeed computers can work out the most lengthy and difficult calculations in a jiffy. Supercomputers and
Mainframes can do calculations in just a few minutes that would take many mathematicians several years.

As a publisher: The Desktop PC can also be used as a desktop publishing machine. Several application software have been developed to do such a task. In fact, computers have displaced traditional printing methods and machines. One can see a page of a publication—a book, a magazine or a newspaper, on the monitor, as it would appear when printed.

Its weaknesses

As any other machine, a computer too has some shortcomings. It is better to know them before we start relying on it completely.

Although the electronic components used in a computer are susceptible to failure, the probability of this occurring is rather low. Years of research and development have ensured this. A much more frequent failure is the Hard Disk crash. The Hard Disk of a computer can get damaged and once this happens, all the useful information stored in it is often lost. Similar accidents are possible with the other disks and disk drives.

A floppy is often not very durable. After several cycles of write and rewrite operations, they often get damaged. A CD, although thought to be much more durable, demands extra care. If its silvery surface gets smudged with fingerprints, it can also get damaged.
A PC with a GUI Operating System needs to be shut down properly. If a computer is shut down abruptly, very often its HDD can get damaged.

A computer is susceptible to the viral attack. A virus can seriously damage many files. It can also cause irreparable damage to the Hard Disk.

**Virus and Computer**

Remember, the last time when you or someone close was down with a viral attack. One becomes very slow, erratic and lethargic. A computer infected with a virus shows similar symptoms. Viruses that attack our body are either air-borne or water-borne. A computer virus, on the other hand, is a computer program that can spread only through infected disks (mostly floppies) or files transmitted through the Internet.

While our body can recover from a viral attack on its own (given proper diet and care), a computer cannot. It needs a special kind of application software, called the anti-virus software, to find the nature of the virus and cure it.
This book, one of a series of information books, introduces the child to the computer—how it works and how it has developed.

Others in this series include:

The Television
The Telephone
The Motor Car
The Aeroplane
The Clock
The Railway Train
The Ship

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