

## ✂ A History of Computer

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As soon as human domesticated animals and started to carry on trade with others, they needed to keep track of numbers. First, people used their fingers. Then they used notches on sticks, counting stone and even knots tied in ropes. The abacus, a rudimentary computing device evolved in different cultures at about the same time. This simple device, which uses beads to represent digits and wires to hold places, is still used today.

## ✂ People and their Contribution

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As early as the seventeenth century, mathematicians and other scholars were eager to create a machine that could add, subtract, multiply, and divide numbers. Initially, the evolution of computing devices proceeded slowly. Yet an interesting thing happened with numbers. John Napier, Scotsman, discovered a way to manipulate numbers that would reduce multiplication and divisions to additions and subtractions – logarithms. Then Robert Bissaker invented the slide rule, which helped solve complex problems relatively quickly.

Blaise Pascal, a French mathematician and philosopher invented the first mechanical digital calculator, which could perform addition and subtraction on whole numbers. The Pascaline (Figure I), developed around 1640, was a financial failure. It was cheaper to have human labour perform the calculations, workers feared losing their jobs, and only Pascal could repair the machine. However, Pascal's concept of a decimals counting wheel using gears with ten teeth and one carrying tooth wasn't made obsolete until the development of the electronic calculator. A programming language, Pascal, was later named to honor his contributions.

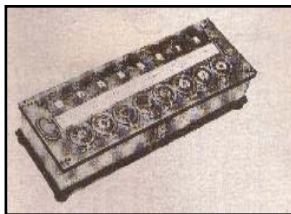


Figure I The Pascaline

## ✂ Nineteenth – Century Technology

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In 1804, the French inventor Joseph Marie Jacquard built and automated punch-card machine (Figure 2) that was used to operate weaving looms. Jacquard's invention used data coded on cards joined to create a series of instructions to automate weaving. This use of programmed instructions was a concept of great importance to modern computers. However, works in the mills feared this of automation would cost them their jobs.

In the 1800s, a British inventor and mathematician, Charles P. Babbage, designed an all-purpose problem-solving machine, the difference engine (Figure 3), which had a mechanical memory to store results. He also designed, but never built, an analytical engine that would have required half a dozen steam engines and would have taken up the space of a football field. Babbage's concept led to the modern computer and earned him the title "father of computer".

Babbage's confidante and partner, Augusta, Ada, the daughter of post Lord Byron and later Countess of Lovelace, understood Babbage's ideas, recognized their great value, and in the 1840s translated and wrote scientific papers defining them of others. She suggested using a binary system rather than the decimal system for storage. Lady Lovelace is sometimes called the first programmer because she also refined the design of the analytical engine to include the automatic repetition of a series of calculations – the loop. The looping procedure is extremely valuable to today's programmers.

George Boole, a self-taught English mathematician of the 1850s, realized that complex mathematical problems could be solved by reducing them to a series of question answered either affirmatively or negatively. The binary system of 1s for positive answers and 0s for negative answer is thus implemented. This theory of Boolean logic became fundamental to the design of computer circuitry.

Later, in the 1880s, Dr. Herman Hollerith built the first electromechanicals punch-card data-processing machine (Figure 4), which tabulated and sorted the data from the 1890 census. His Tabulating Machine Company was one of the companies that later became IBM.

## ✂ Early Twentieth- Century Technology

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There is a time in the computer's history after Hollerith. Progress was being made, but nothing spectacular was reported. However by 1931, at Massachusetts Institute of Technology (MIT), Vannevar Bush and his Colleagues created, modified, and perfected a differential analyzer, which was an electronic machine that solved simple differential questions. Although the mechanism resembled a giant dishpan with projecting steel rods, it was a mechanical analog-computing device. Performed calculation by rotation of various shafts.

George Stibitz, a research mathematician at Bell Telephone Laboratory, tinkered with the idea that Boolean Logic provided the natural language for electromechanical circuits. His device, created in 1937 from batteries, flashlight bulbs, wire, and tobacco-can strips of metal, controlled the flow of electricity. The Complex number calculator machine was a binary adder-a basic requirement for all future digital computers. In 1940, Stibitz and his colleague Samuel Williams successfully Demonstrated that this device could send calculation over a distance of 250 miles using Teletype machine.

In Iowa in 1939, John Atanasoff and Clifford Berry collaborated to build the Atanasoff -Berry Compute (ABC). The ABC (Figure 5), the world's first general purpose electronic digital computer, did not generate a lot of interest in the scientific community even though its purpose was to solve simultaneous linear algebraic equations. In fact, when Dr. Atanasoff contacted IBM about his machine, the company said that it would never be interested in an electronic computing machine.

### ✎ Vacuum Tube Technology

In 1941, during World War II, Konrad Zuse built the first operational general-purpose computer in Germany. His machine used binary logic even though Zuse had not heard of George Boole. Zuse proposed an updated model that used vacuum Tubes instead of electromechanical relays to increase the speed a thousand fold and suggested that the machine be used by the military to compare and evaluate aircraft designs and to break wartime codes. But Adio If Hitler refused funding, saying that the war would be over before the two years Zuse needed to finish the machine.

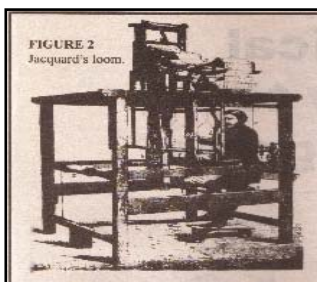


Figure 2  
Jacquard's loom

Figure 3  
Babbage's different engine



Fortunately for the Allies, the Polish secret service smuggled a replica of the German message-scrambling device, Enigma, to the British. Alan Turing, an eccentric English genius, unraveled the mysteries of the Enigma. In 1943, Turing and his colleagues capitalized on the vacuum-tube technology that Zuse had wanted to purpose. The British machine could process 25,000 character per second. In 1950, Turing also constructed the Automatic Computer Engine (ACE), which was touted as the first (arguably) programmable digital computer.

Most of the industries in the United States rallied to support the war effort. Thomas J. Watson, president of IBM, offered to supply thousands of punch-card sorting machine. Watson also knew about and offered IBM's support to Howard Aiken, a Harvard mathematician who wanted to build a general-purpose programmable computer that could calculate cannon shell trajectories. This device was similar to that which Babbage had proposed.

In 1944, Aiken completed the first automatic sequence-controlled calculator, the Mark I. It calculated with electromechanical relays and used electricity rather than muscles, effectively replacing Hollerth's gear mechanism. The Mark I was 51 feet long and 8 feet high (figure 6) and contained over 75,000 parts strung with 500 miles of wires. It used paper-tape input and punch-card output. Calculations of 23 digit numbers took only 3 seconds, with the Mark I, 6 months of manual calculations could be completed in 1 day.

Technology advanced rapidly, and many people worked on similar ideas simultaneously. As a result, some discoveries, and claims overlap in the history of the computer.

In 1941 John Mauchly, a physicist at the University of Pennsylvania's Moore School of Engineering, visited Atanasoff in Iowa, where the ABC computer was still in the early stages of construction. Mauchly was impressed with possibilities of the machine. In 1942, Mauchly and another Moore School colleague J. Presper Eckert, proposed to build a machine that would compute artillery firing tables for the government. This device was called the Electronic Numerical Integrator and Computer (ENIAC).

At 80 feet long and 18 feet high (figure 7), the ENIAC was twice as big as the Mark I. Instead of gears or mechanical relays, the 30 ton device contained over 100,000 electronic components, including 17,468 vacuum tubes took up a great deal of space, their use increased the speed of calculations a thousandfold. The ENIAC operated on the decimal system, which allowed the punched-card output to be read easily by humans. However changing programs or operations was extremely difficult because the instruction had to be wired into the circuitry manually, since it could take the operators as long as two days to manually replug the hundreds of wires involved when changing from one operation to another, the ENIAC was not a particularly efficient general-purpose computer. (Mauchly and Eckert claimed the ENIAC was the first general-purpose electronic digital computer, but October 19, 1973 court settlement declared that the Atanasoff-Berry computer was entitled to that honor.)

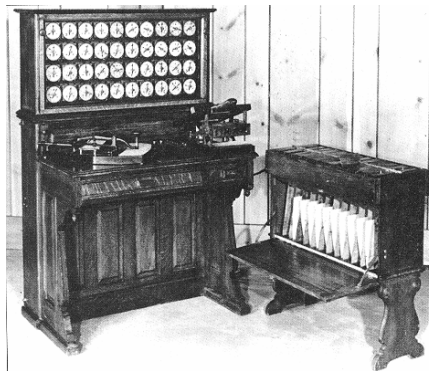


Figure 4  
Hollerith's Punched-card machine

The ENIAC was obsolete almost before it was completed, and Mauchly and Eckert planned a successor machine called EDVAC (Electronic Discrete Variable Automatic Computer). Completed in 1949, EDVAC stored its instruction electronically, using the binary system for instruction coding and input, the EDVAC was one of the first two stored-program computers. It consisted of five units: (1) arithmetical, (2) Central control, (3) Memory, (4) Input, and (5) Output. Improvements over the ENIAC included reduction of the number of tubes, increased memory, and increased ease of use, including an easier, faster way to set up new problems. The stored-program concept has been claimed by many. However, the definitive paper outlining this and other differences in design features has been credited to John von Neumann, the special consultant hired by the Moore School for the EDVAC project. Presented in the mid-1940s, John von Neumann's paper "First Draft of a Report on the EDVAC" served as a blue-print for future stored-program computers.

At the same time, Maurice V. Wilkes of Cambridge, England, incorporated von Neumann's stored-program concept into the EDSAC (Electronic Delay Storage Automatic Computer). The EDSAC was available just before the EDVAC.

The term "bit" as an abbreviation for binary digit was coined by John Tukey in 1946.

Around 1949 at Harvard, An Wang, founder of Wang Laboratories, developed magnetic-core memories. When current flows through wires inside a magnetic core, the electricity magnetizes the core in different direction. The direction of magnetization indicates certain data representation to the central processing unit. Subsequently, Jay Forrester at MIT discovered a way to organize magnetic-core memories into a grid, providing a more practical application than the previous serial connections. Computer became faster and more reliable, as well as capable of containing larger memories. Magnetic-core memory has given way to newer technologies, including semiconductor memories.

In 1951, Mauchly and Eckert formed their own company to create a commercially usable general-purpose computer, the UNIVAC I (Figure 8). Remington Rand bought the company when Mauchly

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and Eckert fell upon hard times. The UNIVAC I was the first general-purpose computer designed specifically for business data-processing application. Previously, computers had been used solely for scientific or military application. The U.S. census Bureau immediately installed UNIVAC I, using it for over 12 years. In 1954, the General Electronic Company in Louisville, Kentucky, used UNIVAC I to process the first computerized payroll. Before long, other companies, including Burroughs (now called UNISYS), Honeywell, and IBM, realized the commercial values of computers and began offering their own machines.

From 1950 to 1952, the U.S. Navy and the Digital Computer Lab at MIT developed the Whirlwind computer, another early vacuum-tube stored-program computer. One of the students involved in the Whirlwind's development was Ken Osen, later the founder of Digital equipment (DEC). the Whirlwind simulated high-performance trainer aircraft, contained self-diagnostics, and performed 50,000 operations per second, but it was only about 85 percent accurate.

### ✎ Chip and Computer Technology

Other innovators appeared on the scene in the late 1950s. Both Jack Kilby, at Texas Instruments, and Robert Noyce, at Fairchild Semiconductor, discovered that resistors, capacitors, and transistors could be made from a semiconductor mater at the same time and that any number of transistors could be etched on silicon. Thus, the integrated circuit was born and refined (Figure 9). During this time, the integrated circuit was christened a chip. These 1959 discoveries were finally mass produced in 1962 and were included in the computers of the mid – 1960s.

Gene Amdahl's revolutionary IBM system / 360 series of mainframe computers were also introduced in the 1960s. They were the first general-purpose digital computers using integrated-circuit technology. The IBM system / 360 was a "family" of computers. This meant that small but growing companies could start with a relatively inexpensive, small computer system and then, as the company grew, add lager more powerful computers from the same family. Because software was compatible, a company could share programs among all the computers in the family. Later in his own company, Amdahl built a competitive computer that was less expensive, smaller in size, and faster.

Miniaturization, which had come about through various technological innovations, coupled with commercial success of computers led ken Olsen and DEC to produce the first minicomputer, PDP-I, in 1963. its successor, the PDP-8, was the first commercial minicomputer. It was considerable less expensive than a mainframe, and small companies could afford it to computerize their operations.

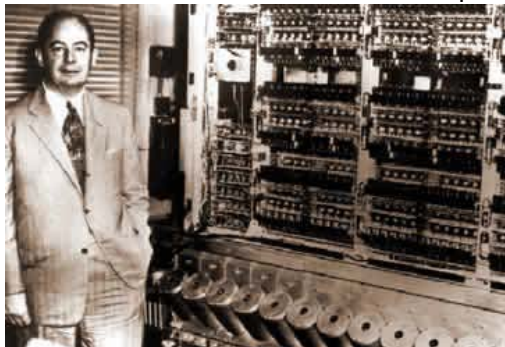


Figure 7  
The ENIAC



Figure 8

The UNIVAC I correctly predicted that Dwight Eisenhower would defeat Adlai Stevenson in the 1952 presidential election. A young Walter Cronkite confers with J. Presper Eckert, Jr., and the Computer operator.

However, miniaturization was not the only direction for computers. Computers were also becoming more powerful. In fact, the ILLIAC IV was a supercomputer first used at the Ames Research Center in 1972 for solving aerodynamic problem that were too large and complicated for other systems.

Meanwhile, in the mid – 1950s, advances were being made in the field of high – level English-like programming languages. FORTRAN (FORMula TRANslater) was developed by John Backs and a group of IBM engineers as the first problem-oriented algebraic programming language. Therefore, its orientation was more toward mathematicians and scientists than computer specialists.

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Rear Admiral (ret.) Grace Murray Hopper was instrumental in developing COBOL (Common Business-Oriented Language) as the first programming language designed for business data processing. Hopper also helped develop the UNIVAC I's compiler, a program that could translate other programs into machine language, the 1s and 0s that computers understand.

During the mid – 1960s, Dr. John Kemeny (a mathematics professor and president of Dartmouth) and his colleague Dr. Kurtz developed the computer language BASIC (Beginner's All-purpose symbolic Instruction code). They later developed a version called True BASIC, which uses structure programming tools to make programs easier to read, debug, and update. Today, numerous other high-level languages, including Pascal, C and Logo, are in use.

Douglas Engelbart introduced a hand-held device that could roll across a flat surface on wheels and cause a corresponding movement on the computer screen. This was the mouse. By 1970, Intel had created a memory chip that could store a kilobit of information. A kilobit translates into roughly 25 five-letter words. Another innovation at Intel came from Ted Hoff, who further improved the integrated circuit by compressing twelve chips into four. Thus the arithmetic and logic function of several chips could be contained on one chip, called a microprocessor. This microprocessor, called the Intel 4004 (forty-oh-four), made the development of the small computer, or microcomputer, a possibility. The first chips could handle only four bits of data at a time. However, eight-bit microprocessor chips were developed and used in early microprocessors.

The earliest microprocessor, the Altair 8800, was by Ed Roberts, who been called the "Father of the Microcomputer," founded a company called Micro Instrumentation Telemetry system (MITS). He developed the Altair to be sold in kit form to consumers (mainly hobbyists) for \$395. This computer used an early Intel microprocessor and had less than 1 kilobyte of memory. In 1977, competition for the Altair appeared in the form of Tandy's TRS-80 Model 1, which was not on microcomputers only. Supercomputers were being developed, too. In 1976, Seymour Cray-1 supercomputer was delivered to the Los Alamos Scientific Laboratory in New Mexico, and a control Data Corporation CYBER-205 was used by the Meteorological Service in the United Kingdom for weather predictions.

The first commercial computer store appeared in 1975 in Santa Monica, California. ComputerShack, a retail franchise group selling computer equipment, opened for business in 1977 in Morristown, New Jersey. It was to become the leading hardware and software outlet known today as ComputerLand.

The market for software was also growing. In 1974, Bill Gates and Paul Allen developed Microsoft BASIC, a high-level language for microcomputers. The language was used by the MITS Altair in 1975. IBM adopted Microsoft BASIC for its personal computer in 1981, a move that turned Microsoft into a thriving company. Most popular microcomputers – including the Apple II, Commodore 64, and Commodore PET – used Microsoft BASIC. Other successful Microsoft products include PC-DOS and MS-DOS, the operating system software that runs millions of personal computers.

The application software industry got its initial boost because Dan Bricklin, a Harvard Business School student, was not fond of the tedious mathematical calculations involved in the preparation of financial planning sheets – part of the assigned work. Preparing the worksheets was repetitive, requiring numerous hand calculations and recalculations to obtain meaningful results. At times, erroneous calculation in the middle of the worksheet affected other numbers, which had to be recalculated. This method was time-consuming and frustrating.

Bricklin thought that an electronic spreadsheet would be practical for businesspeople and other microcomputer owners. He teamed up with friend Bob Frankston and together they developed and marketed an electronic spreadsheet. The product, called VisiCalc, was the first of its kind in 1979 and stayed a best-selling package until 1983. At that time, lawsuits prevented timely upgrades from being issued to include 16-bit technology. Eventually, Bricklin sold the company and the rights to VisiCalc to Lotus, Inc., a name recognizable for its spreadsheet package Lotus 1-2-3. It would become the best-selling program for the personal computer.

Many microcomputer companies have come and gone, but one of the great rags-to-riches stories is Apple Computer, Inc. It was founded by Steven Jobs and Stephen Wozniak on April Fool's Day, 1976. The partner headquarters was located in Jobs's garage. Wozniak, the technical expert, made a microcomputer affordable for both the individual and the small businessperson. Because Jobs knew

very about circuitry or coding, he provided the marketing impetus for the small company. The first Apple computers came on the market in 1977. the Apple 11, was the first PC capable of generating color graphics.



Figure 9  
Comparison of size between vacuum tubes and an integrated circuit.

The microcomputer's microprocessor history evolved through a series of competitions primarily between Intel and Motorola. Of course, there are other microprocessing companies, but these two have been battling since Intel's 8088 was selected as the central processing unit for IBM's personal computer – a microprocessor coup. Then Motorola's 68000 microprocessor were chosen not only by Apple but also by companies that were building workstations. Microprocessor have changed drastically, moving from the 80286 in 1982 and subsequently to the 80486 of 1989. With the 80386, a 32 – bit microprocessor, Motorola and Intel ended before up tied for sales in 1988. With the introduction in 1993 of the Pentium chip, it appears that the 486 are now history in some people's books. It's almost as if even before the chip hits the market, its successor is in production.

Printers have evolved rapidly over time. The first Epson dot – matrix printer, the TX-80, appeared in 1978, followed by the Hawlett-Packard Laser – Jet in 1984. the following year, the Apple Laser writer incorporated page description languages so the parameters for the printed page could be specified.

D.C. Hayes and associates introduced the Hayes microcomputer modem 100 in 1978. Since then Hayes has set the standard for modems and most today are said to by Hayes-compatible. The modem was necessary device for accessing the popular on-line information service, CompuServe, that was founded in 1979.

Another benchmark in the microcomputer revolution was the introduction of the Apple Macintosh in 1984. The Macintosh was visually oriented, and its mouse made it remarkably easy to use. It was praised for its ability to produce graphics and to print text of near-typeset quality using Apple's laser Writer. Logitech obtained mouse technology rights and began producing the popular input devices in 1983.

In 1979, WordStar, a word processing program produced by Micropro International, became available. The popular microcomputer word processing software package WordPerfect was introduced in 1980. By 1993, a 6.0 release was on the market. Word was introduced as the Microsoft entry in to the word processing arena in 1983. Release 5.1 appeared in 1993 too.

Even though business was booming, total sales of microcomputers were still fewer than 1 million units until IBM came along. Table 1 shows rapidly sales have increased. IBM had been in the business of manufacturing and marketing office equipment and larger computer systems for years. In 1981, IBM presented the IBM Personal computer (IBM PC), which used a 16 bit microprocessor. That year other computer giants. Xerox and digital Equipment Corporation, also entered versions of microcomputers. Sony, Hawlett-Packard, NEC, North Star, Zenith, and others now have microcomputers on the market.

Adam Osborne introduced a truly portable microcomputer in 1981, the Osborne 1. it weighed only 24 pounds, had memory capacity of 64 kilobytes, and cost approximately \$1, 1975. it could be manufactured in just over one hour's time, using only 40 screws to put together the easy-to-find parts.

#### Table 1

##### Total Computers in Use in the U.S.

1978	500,000 units
1980	1,000,00 units
1983	10,000,000 units

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1983 500,000 IBM PCs in business alone  
1986 30,000,000 units  
1989 100,000,000 units  
1991 60,000,000 IBM PCs in business alone

Time magazine annually honors someone who during the year has made a difference in the world. In 1982, time chose the computer as its "Man of the year." That same year, Peter Norton produced the popular file recovery program called Notron Utilities for the IBM PC.

By 1984, the IBM PC had become the de facto industry standard (that is, the most popular and widely used computer), with hundreds of companies designing software for it. IBM did not stay at the top of the heap for long, however. Because it was the most popular microcomputer, almost every microcomputer manufacturer presented a version. These are called IBM PC compatibles, or clones – machine that run the IBM PC software and work with other IBM PC equipment. Some compatible are made by Leading Edge, Tandy, Epson, Kaypro and Compaq.

In 1986, the Compaq DeskPro 386 computer, the first to use the powerful 32 – bit Intel 80386 microprocessor, was introduced. Compaq became the biggest competition for the corporate market of IBM. The even more powerful 80486 microprocessor first appeared in 1988. In 1987, the OS/2 operating system was announced. It had multitasking and multiuse features that made headlines in networking. New application, however, were developed more slowly than initially hoped for.

The year 1987 also saw the introduction of Page-Maker from Aldus Corp. the program incorporates both type and graphics images on a page. Multimedia applications that integrate video, animation, sound and text began appearing in 1989.

The next computer was introduced in 1989 as a computer system for educators. Deliveries began in 1989. that year also saw NEC technologies, Inc.'s UltraLite laptop computer weigh in at just over four pounds. IBM had produced a laptop computer in the mid – 80s that was less than a hit. The following year the first pen-based PC was completed, the GRID-PAD.

The late 1980s also saw Lotus bring suit against other spreadsheet software developers, claiming that their packages infringed on the Lotus copyright, that competitor's packages looked like Lotus, and that they operated like Lotus. Tereby, these actions earned the nickname "look and feel" lawsuits.

A nondestructive worm was introduced into the Internet network in 1988, bring thousands of computers to a halt. Windows 3.0, a graphical user interface product released in 1990, sold over 3 million copies. It offered pull-down menus and icons to identify its functions. Today's history can, of course, be found in computer and microcomputer magazines, newspaper head-lines, nightly news, and probably your own classroom. Table 2 lists many of the major contributors to the development od computers.

### **Technological evaluation of Computers**

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Over time, computers changed. They improved in speed, power and efficiency. The changes are recognized as a progression of generations, each characterized by specific development.

### **What is a Computer?**

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The word "Computer" comes from the word "Compute" which means to calculate. So a computer is normally considered to be a calculating device that can perform arithmetic operations at enormous speed. A computer is an electronic device or machine that accepts data in one form and "Process" it to produce data in another from. A distinction is sometimes made between data and information. "Data" is the name given to basic facts. Eg data can be anything like bio-data of various applications when the computer is used for recruiting personnel, or the marks obtained by various students in various subjects when the computer is used to prepare results, or the details (name, age, sex etc) different types in case of application of computer for scientific research problems etc.

When data is converted into a more useful or intelligible from then it is said to be processed into information. A program is set of instruction that is written in the language of the computer. A program is used to make the computer perform a specific task. Such as calculating interest to be paid to saving account holders pr producing a payroll.

## ✂ Historical Evolution of Data Processing

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**A. Manual      B. Mechanical      C. Electro Mechanical      D. Electronic**

✂ Therefore a more advanced definition for a computer is as follows

- A computer is a device that works under the control of a stored program. Automatically accepting, storing and processing data to produce information that is the result of that processing.
- A computer can store, process, and retrieve data as when required. The fact that computer process data is as so fundamental that many people have started calling it a "**Data Processor**"

## ✂ Characteristics of Computers

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### ✂ Speed

A computer is a very fast device. It can perform in a few seconds the amount of work that a human can do in an entire year.

### ✂ Accuracy

The accuracy of a computer is consistently high and the degree of accuracy depends on human errors rather than technological weaknesses, this can be due to imprecise thinking by a programmer (a person who write instructions for a computer to solve a particular problem) or due to inaccurate data input.

### ✂ Diligence

Unlike human, a computer is free from monotony, tiredness, lack of concentration etc., and hence can work for hours continuously without creating any errors and without grumbling.

### ✂ Versatility

A computer is so versatile that at one movement it is preparing the results of a particular examination, the next moment it is busy preparing electricity bills and end of the month pay-slips, and in between it may be assisting and office secretary to

Trace an important letter in seconds. Briefly, a computer is Capable of performing almost any task provided that the task can be reduced to a series of logical steps.

### ✂ Storage Power

A computer can store and recall any amount of information because of its storage power. A computer has the dual-advantage of temporary and permanent storage, hence even after several years, the information recalled will be as accurate as on the day when it was fed to the computer.

### ✂ No I.Q or Intelligence

A computer posses no Intelligence of its own. Its I.Q is zero, at least till today. It has to be told what to do and in what sequence. Hence, only a user can determine what tasks a computer will perform. A computer cannot take it own decision in this regard.

### ✂ No Feelings

Computer is devoid of emotions. They have no feelings and no instincts because they are machines. The judgments of a computer is based on the instructions given to them in the form programs written by human beings.

## ✂ Evaluation of Data Processing

Data processing is the collection and manipulation of item of data to produce meaningful information.



## ✂ Computer Hardware

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The objective of this section is to give an introduction to Computer Hardware. The physical devices of a computer system that can be touched or tangible are called computer hardware. In early stages,

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computers were used mainly to automate manual Data Processing System (Clerical Systems). To understand the basic components of Computer Hardware, it is very appropriate to consider a manual clerical system as an analogy. This compares the computer system hardware with a manual clerical system.

- **Comparison of Manual Clerical System & Computer System**

Computer System	Manual Clerical System
Data Input eg: Keyboard, Mouse	Input Device through eyes, ears, sensing
Data Output eg: Monitor, Printer	Output through voice, writing
In internal Storage and additional data Backing Storage & update	Some in the brain and additional data in filing cabinets & update
Temporary Storage As Main Memory	Temporary Storage As Brain
Data Processing Done by CPU	Data Processing Done by Human Brain
Expensive	Cheep
Special training is Needed	No Special training is Needed
The Work load is high the Accuracy is these	Work load is high the Accuracy goes Down
Fast	Competitively Slow

**Hardware can be classified into main categories such as:**

1. Input Device
  2. Output Device
- } Peripheral Devices

#### ☒ **Central Processing Unit (CPU)**

CPU is considered as the brain of the computer, which consists of.

#### ☒ **Arithmetic & Logic Unit (ALU)**

ALU performs all arithmetic & Logical (eg: Comparison) functions

#### ☒ **Control Unit**

The control unit, a maze of complex electronic circuitry, is responsible for directing and coordinating most of the computer system activities. It does not execute instructions itself, it tells other parts of the computer system what to do. It determines the movement of electronic signals between main memory and the arithmetic logic unit, as well as the control signals between the CPU and input / output devices.

#### ☒ **Internal Storage**

Is also known as, primary storage, Main storage, Immediate Access storage and RAM & ROM

#### ☒ **Random Access Memory (RAM)**

Stores programs, input data and information, can read write. This is the memory available for the user, it is volatile (temporary) and primarily used for

- Storage of copies of system software that controls the general operations of the computer. The main component of this software gets loaded into primary storage when the computer is turned on (at boot up).
- Storage of a copy of application program (the specific software for a job), which is subsequently retrieved by the control unit for execution.

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- Storage of data that has been input & awaiting processing.
- Storage of output data that has been produced as a result of processing until it is called for the data to be used again in subsequent processing or to be transferred to an output device.

✎ **Read Only Memory (ROM)**

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This is the permanent memory to store special control programs (systems software) written by the manufacturer to perform a variety of functions such as, loading of main components of the operating system at the time of starting a computer. (Bootstrap Program)

✎ **Programmable Read Only Memory (PROM)**

---

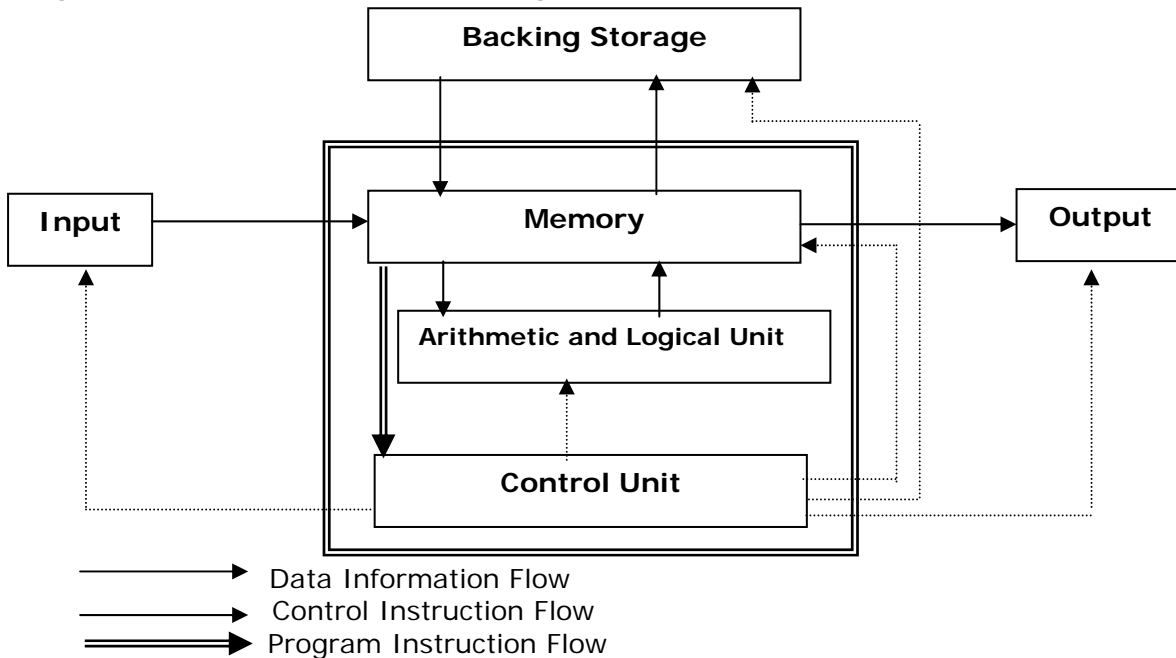
It has similar functions as regular ROM with one major exception user determines what data & instructions to store in PROM chip once recorded, cannot be changed.

✎ **Erasable Programmable Read Only Memory (E PROM)**

---

This is an improvement on PROM chip. It functions exactly the same as PROM, however with the help of a special device that uses ultraviolet light, the data or instructions on an E PROM chip can be erased and new data or instructions can be recorded in its place.

✎ **Logical structure of a computer is given below**



✎ **Electrically Activated Programmable Read Only Memory (EAPROM)**

---

A latest addition to the ROM family of chips, avoids the inconvenience of having to take chips out of the computer to change data & instructions. Instead changes can be made electrically under

software control. These chips are being used in POS terminals to record product details. This data can be easily updated as needed.

### ✂ **Input Devices**

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There are a wide variety of input devices to input data, text, graphics, images & sound. As result the use of computer has extended to many areas in organizations & society. The traditional input method has the use of a keyboard.

### ✂ **Output Devices**

---

To be effective, the computers must produce the information (processed data) in the best possible form to a given situation. To achieve this goal a wide variety of output devices had been developed / evolved in the past. The most common output device is Video Screen (monitor of the Video Display Unit).

### ✂ **Instruction Flow Diagram of a Computer**

---

Data and instruction enter storage, and are held until needed to be taken on the data. Main storage is also supplemented by less costly auxiliary storage also called backing storage, eg: Hard Disks for mass storage purpose. Each computer has a Control Unit (CU) that fetches instructions from main storage, interprets them, and issues the necessary signals to the other hardware components making up the system. Of the CPU that does this is called the Arithmetic & Logical Unit (ALU). Results are taken from main storage (After Processing) and fed and output device. This may be a printer or monitor screen.

### ✂ **Secondary Storage**

---

Alternative Terminology: Backing Storage, External Storage & Auxiliary Storage. It is relatively long-term, non volatile (not requiring electrical power) & store large volumes of data. Contrast to primary storage, the secondary retains data even when the computer is turned off/ there are many kinds of secondary storage, the most common are magnetic tape, magnetic disk, magnetic diskette, streamer tape & optical disk. These media can transfer large blocks of data rapidly to the primary storage to gain access to the data.

### ✂ **Historical Evolution – Computer Generations**

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There had been five major stage or generations in the evolution of computer hardware. Each generation has dramatically expanded computer processing power & storage capabilities while simultaneously lowering costs.

#### ✂ **Computer generations in summary are given below**

#### ✂ **First – Generation (1951 - 1959)**

---

First – Generation Computers were powered by thousand of Vacuum tube. The UNIVAC 1 and others like it were large because of the massive number of tubes that were required. The Vacuum tubes themselves were large (the size of today's light bulbs). They required great amounts of energy, and they generated much heat. The computer's memory was stored on magnetic – storage devices, primarily magnetic tapes and magnetic drums. Most of the data were entered into the computers on punch cards similar to those used in Jacquard'd process. Output consisted of punch cards or paper. Binary (machine) language and assemble language were used to program the computers. Operations was under human control that is, operator had physically reset relay switches and wiring before a program could be run. Speed up to 10,000 inst/sec

- Vacuum tubes
- Magnetic tape for external storage – some magnetic drum
- Punched cards for input
- Punched cards and paper for output
- Machine and assembly language
- Human operators to set switches
- UNIVAC 1 typical example

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## ✂ **Second – Generation (1959 - 1965)**

---

The device that characterized the second-generation computers was the transistor. Transistors were made of a semi conducting material and controlled the flow of electricity through the circuits. Transistors were a breakthrough technology that allowed computers to become physically smaller but more powerful, more reliable and even faster than before. The transistor was developed at Bell Labs in 1947 by William Shockley, J.Bardeen, and W. H. Brattain. It was displayed for the public in 1948, and it won a Nobel Prize in 1956 however, it was not used in conjunction with computers until 1959.

Transistors were less expensive and smaller, required less electricity and emitted less heat than vacuum tubes. Also fewer transitions than tubes were required to operator a computer. Transistors were not so fragile as vacuum tubes, and they lasted longer. Because the components were substantially smaller, computers became considerably smaller.

Although magnetic tape was still the most commonly used external storage medium, magnetic – disk storage was used so that data could be located more rapidly. MIT developed magnetic – core storage in which each core stored one bit of information. Contrasted with tape and drum storage, in which the location of data had to be found first, magnetic –core storage made data instantaneously available. Punched cards and magnetic tape were the primary means for input, and punch cards and paper constituted the output.

Programming languages also became more sophisticated. High – level languages resembling English were developed, including FORTON, COBOL, BASIC, and PL/1. Like the first –generation computers, second- generation computers were primarily under the control of human operators. Speed 200,00 – 300,00 inst/sec

- Transistors
- Magnetic – core storage
- Magnetic tape most common external storage, but magnetic disk introduced
- Punched cards and magnetic tape for input
- Punched cards and paper for output
- High – Level language – FORTON, COBOL, BASIC, PL/1 and others
- Human Operator to handle punched cards
- Honeywell 200 typical example

## ✂ **Third – Generation (1965 - 1971)**

---

Integrated circuits signified the beginning of **Third-Generation computers**. Again, computers were smaller, more efficient, and more reliable than their predecessors. Unlike transistors and circuit boards that were assembled manually, **Integrated Circuits (ICs)** were single, complete electronic semiconductor circuits contained on a piece of silicon some time called chips. ICs could be manufactured by machinery, which intimately resulted in a lower cost.

Memory technology improved. By 1969, as 1,000 transistors could be built on a chip of sillion. Magnetic disk were improved and were used more for storage. Monitors and Keyboards were introduced for data input and output. Punch cards lost their preeminence as input and output devices.

A new program controlled the computer and its resources and used them more effectively. This new program was the operating system. It meant that human operators were no longer required, and processing could be done at computer speeds rather than human speeds. High-level programming languages continued to be developed, including RPG and Pascal.

Another phenomenon of this third generation was the concept of families of computers. Business that bought computers and programs found that almost before a system was fully adapted, it was outdated or unable to grow with their needs. IBM recornized this problem and created an entire product line, the IBM /360 series, which allowed necessary upgrading or expansion. Programs

written for one computer were compatible with any of the machines in the line. Business could upgrade or expand their data-processing operations as necessary.

Digital Equipment Corporation introduced the first minicomputer in November, 1963. its PDP-1 was substantially cheaper than a mainframe, thus making smaller computers available to yet another business market.

Speed up to 5 million Instructions Per Second (MIPS)

- Integrated circuits
- Improved disk storage
- Monitors and keyboards for input and output
- More high-level language, including RPG and Pascal
- First complete operating systems meant less involvement for human operators
- Family of computers introduced allowing compatibility
- Minicomputers used commercially
- IBM system / 360 typical example

✎ **Forth – Generation (1971 - Present)**

The significant distinction for **Forth – Generation Computers** lies in the techniques of implementation of integrated circuits by using **Large – Scale Integration (LSI)** of chips with several thousand transistors. In the mid 1970s the development of **Very – Large – Scale Integration (VLSI)** produced a chip containing a microprocessor. VLSI made the microcomputer possible. The Intel 80386 microprocessor followed. The Intel 80386 is faster and more powerful than its predecessors.

Magnetic disks became the primary means of internal storage. The proliferation of application programs for microprocessors allowed home and business users to adapt their computers for word processing, spreadsheet manipulating, file handling, graphics, and much more. Speed up to 200 MIPS

- LSI and VLSI
- Magnetic disk most common external storage
- Introduction of microcomputer
- Forth – generation language emerged and application software for microcomputers became popular
- Microcomputers used – Compaq Deskpro 386 typical example
- Burroughs B7700 and HP 3000 (minicomputer) typical example

✎ **Fifth – Generation (Future)**

Although many people disagree on the start of the **Fifth – generation computer** technology, some say that it with the creation and use of a computer with **artificial intelligence (AI)**. AI indicates the ability to perform humanlike thinking and reasoning. The unofficial original goal was a thinking machine by 1990. Although expert systems are already being used for specialized applications, true artificial intelligence, or computers that can think, are still merely concepts. Table 3 lists the generations of computers and their respective characteristics. The future remains to be seen, but since you will be part of the future, you may have some ideas or innovations of your own.

✎ **Historical Evolution - Price / Performance and Size Reduction.**

Type of Computer	Example
Supercomputer	Cray C90
Mainframe	IBM Enterprise System 9000
Super mini Computer	IBM AS/400
Minicomputer	IBM RISC 6000
Super PC	Inter Pentium, RISC
Microcomputer (Personal Computer) Laptop, Note Book Palmtop & Card Computers	IBM PS/2, Compaq

✎ **Digital & Analog Computers**

Digital Computers, process data that are represented in the form of discrete values (eg: 5, 7, 9) by operating on them in steps.

Eg: Computers used for business data Processing

**Analog Computers**, process data that are presented in the form of continuous variable. Inputs are from measurement of physical properties like Voltage, temperature, pressure, distance, and volume etc.

Eg: Computers used for process industries such as chemical plants, refinery, and steel manufacturing plants.

☒ **General & Special Purpose Computers**

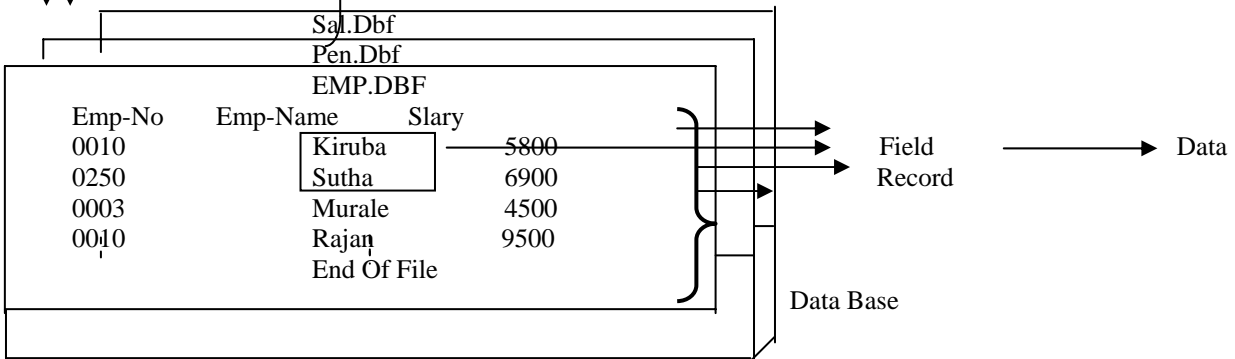
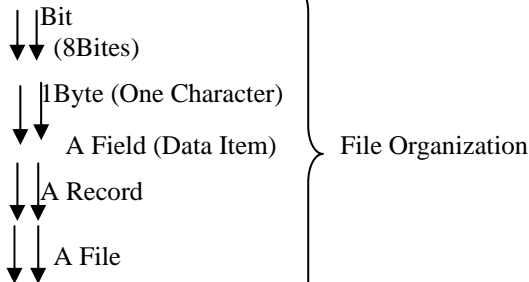
General-purpose computers are designed to solve a wide variety of problems. They can run different application programs like payroll, inventory control, in many programming languages like PASCAL, BASIC, can packages such as Lotus 123, Microsoft Excel, Word Perfect, Microsoft Word etc, can handle graphics.

Eg: Computers used in business organizations

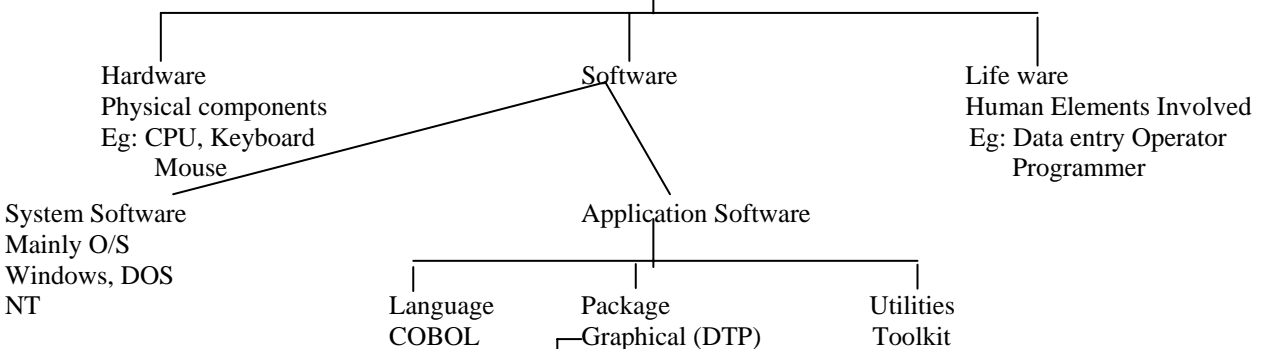
Special purpose computer is designed for a particular job only that is to solve problems of special nature. Eg: Digital Diary, Word Processor

☒ **Files Organizations**

- 1024Bytes - 1KB
- 1024Kb - 1MB
- 1024Mb - 1GB
- 1024Gb - 1TB



☒ **Total Computer System**



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FORTON	Eg: CorelDraw	NDD (Norton Anti Virus)
Pascal		
Java	—Word Processing	
Visual Basic	Eg: MS Word	
	—Spreadsheet	
	Eg: MS Excel	
	—Database	
	Eg: MS Access	

## ✎ System software

System software coordinates the various parts of the computer system and mediates between application software and computer hardware. A description of various types of system software is given in next few sections.

## ✎ Operating System (OS)

Operating system is a set of programs, which reduces the workload of the computer operator by automating some of the basic operations of the computer.

## ✎ Classification of operating systems

---

One possible classification is based on the number of users & tasks as given below

- A. Single user and single tasking  
Eg: MS DOS
- B. Single user and multi tasking  
Eg: MS Windows, Windows NT
- C. Multi user & Multi tasking  
A multi user system has powerful processor with central data and program storage connected to a number of dumb terminals.
  - For super personal computer multi user environment we use SCO UNIX, ZENIX, UNIX, operating system.
  - For mini, mainframe computer environments  
UNIX, SSP, OS / 400, VSE / SP, VM operating systems.
- D. Network operating system  
Eg: NOVELL Netware, Banyan Vines
- E. Virtual Memory  
Eg: VM (virtual machine) operating system of IBM mainframe.

## ✎ Utilities or house keeping software

These programs are used for routine, repetitive tasks, which can be shared by many users. These are also called service programs.

## ✎ Common types are

- |                         |   |                                       |
|-------------------------|---|---------------------------------------|
| i. Sort / Merge         | } | Windows                               |
| ii. File Copy / Dump    |   |                                       |
| iii. File Maintenance   | } | Foxpro, Foxbase, Dbase, Visual Foxpro |
| iv. File reorganization |   |                                       |

## ✎ Translators

A translator is a program that converts instructions written in a programming language (source program) to machine language instruction (object program).

✗ **There are five types of translators**

- i. Assembler
- ii. Interpreter
- iii. Compiler
- iv. Intermediate code generator
- v. Cross compiler

✗ **Editors or text editors**

When a source program has to be entered into a computer a special program called editor program has to be used.

Generally text editor is used to create & modify text files (documents). Line editors edit line by line.

✗ **Productivity Software**

This is a recent addition to the software supplied by the manufacturers with the hardware. The objective is to increase the efficiency of the computer system. These are in addition to operating system software, housekeeping and utility software. There is a range of productivity software supplied by various manufacturers.

Eg: SPOOLER software for multi – user computers

The spooler software, maintains a spool are in the disk storage, which can be considered as a collection of "VIRTUAL PRINTERS". It reduces the effect of bottlenecks in printing. When one printer has to handle a number of applications in a multi user system, applications outputs are spooled in a disc and print separate background jobs.

✗ **Programming Aids and Diagnostic Routines**

These include software packages available to assist programmers in testing and debugging programs.

Eg:

- Test data generator,
- Snap shot software,
- Interactive Debugger,
- CASE tools.

✗ **Data Base Management System (DBMS)**

DBMS is a comprehensive & complex set of software tools that allow users to create, maintain & manipulate and integral base of data.

✗ **End User Software**

Software tools that permit the development of application by end users them selves with little or no professional programmer intervention or that enhance the productivity of professional programmers.

Most of this end user software are classified under fourth generation language (4GL)

✗ **Spread Sheet Packages**

Eg: LOTUS 1-2-3, Quatro Pro, MS Excel, and Lotus for Windows.

✗ **Word processing package**

Eg: word Perfect, MS Word.

✗ **Graphics Package**

People learn better when information is presented visually. Graphics package can display numeric data in a visual format. There are two types of graphics packages.

✗ **Analytical Graphics**

Most analysis graphics programs come as part of spreadsheet programs, such as Lotus 1-2-3, thus, they are used by the same people who use spreadsheets. They are helpful in displaying economic trends, sales performance, and the like for easy analysis. Analytical may be viewed on a monitor or printed out.

✎ **Presentation Graphics**

You can use presentation graphics to communicate a message or to persuade other people, such as students in a class. Thus presentation graphics are used by marketing or sales people, or lectures to enhance the value of the lecture by making the presentation easily understood.

Eg: Harvard Graphics, Power Point, and Corel Draw.

✎ **Publishing Package**

Electronic publishing packages vary from large scale to small-scale systems. Small-scale systems are commonly known as "DESK TOP PUBLISHING" (DTP)

This technology can integrate, or combine, graphics and text on a professional looking page. Well – known desktop publishing package are page maker, and Ventura.

✎ **Application Software**

Application software includes a set of programs developed to solve user problem. Therefore it is user oriented

Eg: Payroll System - Preparations salaries & Wages

General Accounting Balance - Book Keeping, Preparation of Trail Balance, Profit & Loss, Sheet statements etc.

✎ **Addressing Concept**

For direct access each physical record should be have an address. The address consists of three components as follows.

The disk pack could be divided into a number of cylinders (say 200), each cylinder is divided into a number of tracks (say 10). Then each track is divided into a number of blocks. A block is the smallest unit of transfer between the disk and the internal storage. Hence, a unique address could be assigned to each sector in the disk.

✎ **Winchester Technology**

Uses a special technique the disk in hermetically sealed compartment & has robust mechanical features. They can operate in adverse environments that are dusty and humid, have grater reliability and higher storage capacity compared to older technology.

1. More compact and relatively high capacity.
2. The access arm operation is similar to removable disk system

✎ **Magnetic Diskette Drive & Magnetic Diskette (Floppy Disk)**

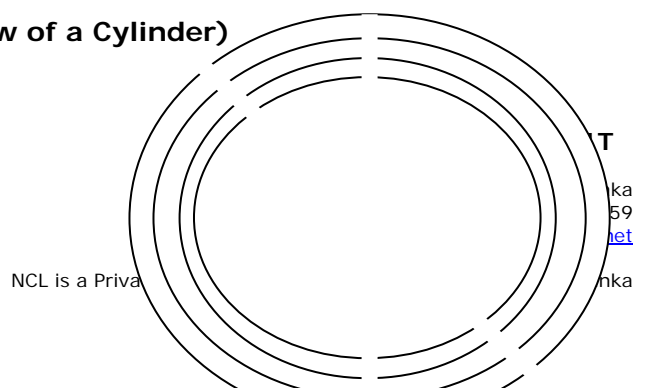
The first magnetic diskette introduced was 8" (diameter) with Mini / Mainframe computers as an offline data recording medium. Early generation of Micro Computers also used the same type of diskette as the backing storage. Later it was replaced by 5 ¼" & 3 ½" diskette models with improvements to the capacity as well as reliability.

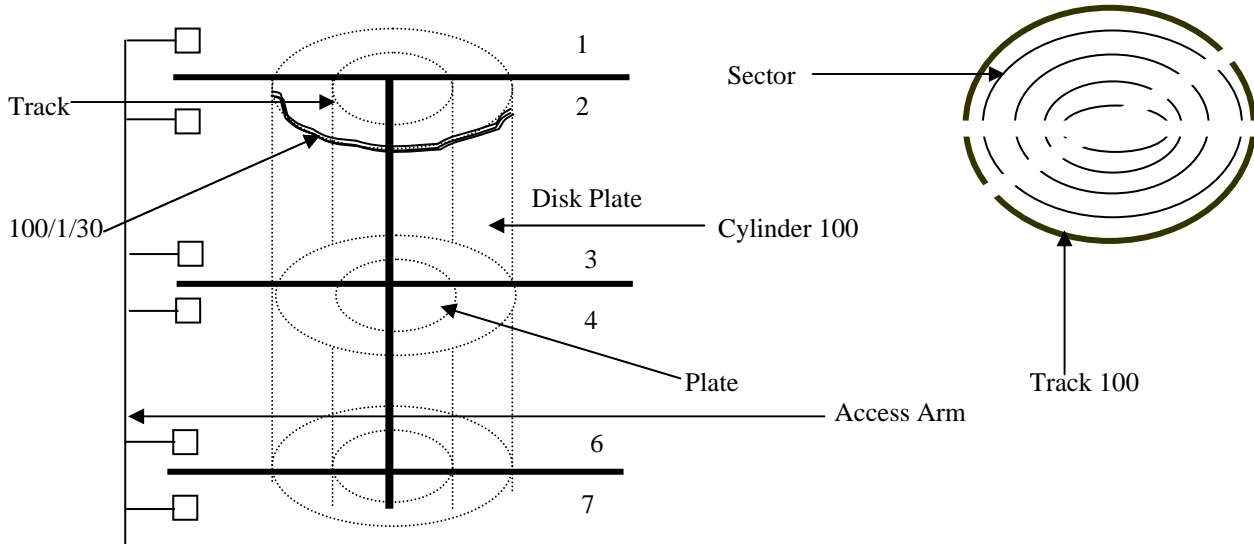
✎ **Disk Surface**

✎ **Vertical Section Through Access Arm (Side view of a Cylinder)**



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#### ✎ Main Feature of Diskette Drive

1. Access arm has two read / write heads to cover two surfaces
2. As the diskette is inserted into the drive & close it, the disk begins to rotate & attain a constant speed, at which time the read / write heads become operative.
3. The speed of rotation of Diskette is comparatively slow (360rpm) to the disk system
4. Read / write method is similar to disk system.

#### ✎ Main Features of Diskette

1. A thin, flexible (floppy) disk is permanently sealed within a rigid, protective plastic cover.
2. Sizes were evolved through 8", 5/14" and 3 1/2" (diameter) – Microfloppy. Micro floppy will be the industry standard.
3. Storage capacities available today is 1.44MB. By using special software data can be compressed to store higher capacities up to over 2MB.

#### ✎ Magnetic Tape Cartridge

They operate on the same principle as normal 1/2" reel tape. Cartridge has automatic loading facility.

#### ✎ Digital Audio Tape (DAT)

It is an advanced form of tape Cartridge can store 1.3 Giga byte or more data.

#### ✎ Optical Disk Storage System

Data recording is by using laser technology. The common types of optical disk are

- a). Compact Disk Read Only Memory (CD-ROM)
- b). Write Once Read Many (WORM) times
- c). Erasable Optical (EO)
- d). Optical Card

#### ✎ Application of CDROM system

The most common applications are

1. As a medium for the distribution of catalogs, directories, encyclopedias, software, Images, Sound etc., which are high volume.
2. As a medium for the distribution of courseware, which includes: notes, tutorials, lectures (text, voice & images) & software. This way of using a CDROM system is an example of a Multimedia technology.

#### ✎ Write Once Read Many Times (WORM) Disk Unit

Eg: Document filing system

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### ✎ Erasable Optical (EO) Disk Unit

Data recording & reading technology is different to WORM disks. The laser beam heats the surface of a special alloy to generate spots. Heat of the laser beam causes the magnetic molecules in the alloy to align into a pattern (semi permanent) to represent binary digits) 0 & 1. Therefore it is re-usable as the magnetic disk. It is similar in appearance to a CD.

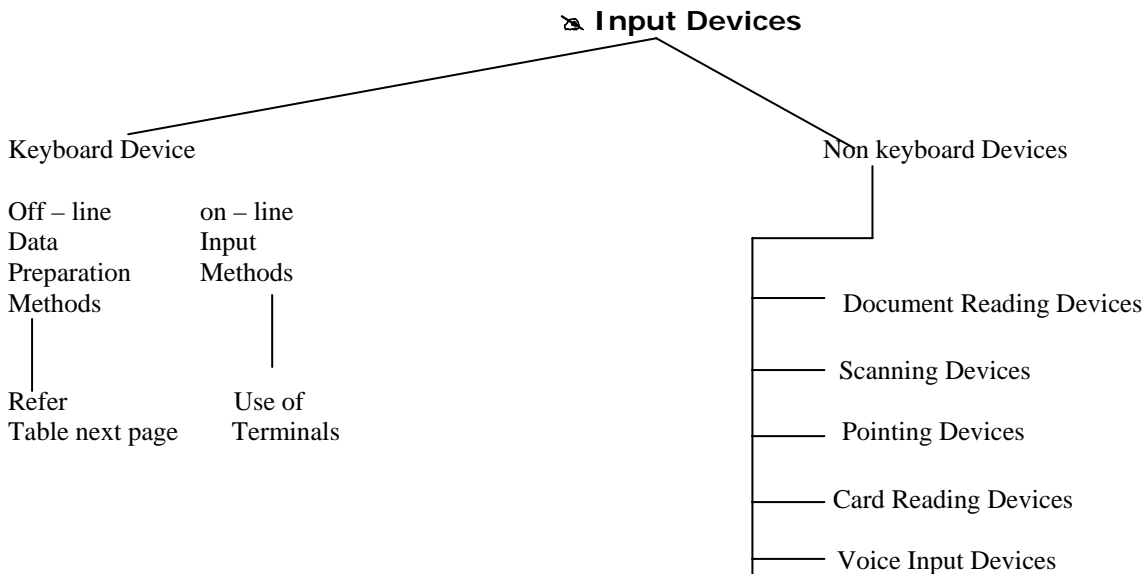
### ✎ Solid State Storage system

There are no moving parts in Solid State Storage Systems, but these are expensive

### ✎ Key Board Devices

### ✎ Offline Data Preparation Methods

The table on next page illustrates the Data Preparation Devices with corresponding input devices and media. These methods need special data preparation devices. The term "Offline" is used because this activity is done outside the computer and before input. In Sri Lanka the punch card system was popular with the computers used from 1969 to the late 1970s. Later, it was replaced having high volume batch processing and less time critical applications such as: Data Processing of Public Examinations, Provident Fund Applications, Census applications, Archival of high volume business documents etc.



### ✎ Keyboard Devices – on-line Terminals

#### ✎ The more common types of terminals are

##### a. Teleprinter Terminal

Consist of typewriter which provides input through a key board and output may be printed which is similar to machine used for telex messages. This is the oldest method & now it is obsolete.

##### b. Visual Display Unit (VDU)

VDU has a television type screen and a keyboard. Here input is y a keyboard and output through display on Cathode Ray Tube (CRT). This is the most common method of input.

### ✎ General Features of a Video Terminal

1. It is an Input / Output (dual purpose) device
2. The keyboard generally resembles a typewriter (QWERTY) keyboard, but there is a wide range of variations
3. Display clarity (Resolution) depends on the pixel density. Pixel is the smallest display element to represent single color. Each character is formed as a combination of pixels.
4. Standard screen display includes 24 rows by 80-column character matrix totaling to 1920 characters.
5. Screen movement is generally line by line – scrolling or page by page – Paging

6. Most of Video Terminals are “dumb” terminals. New models appear now in the market includes microprocessor with various levels of facilities.

#### ✕ **Intelligent Terminal**

And intelligent terminal can input and receive data as well as do its own processing. In addition to the keyboard, monitor, and communications link, an intelligent terminal also includes a processing unit storage capabilities, and software.

#### ✕ **Alternative Terminology**

Smart Terminal, workstation, Lan Station; Workstations are commonly used in CAD/CAM, research & development applications.

#### ✕ **A Point – of – Sale (POS) Terminal**

Is a smart terminal used very like a cash register, but it also captures sales and inventory data at the point of sale and sends it to the central computer for processing. Many supermarkets have POS terminal that are connected directly to a central computer so that the sales data can be immediately recorded. This type of terminal usually displays the price, the product number, and possibly the product description. In addition, this type of terminal is equipped with a cash-register-type keyboard, a cash drawer, and a printer to print the receipt. It can operate on standalone basis and data stored can be transferred to the main computer by using a computer medium such as a diskette.

#### ✕ **Banking / Financial Transaction Terminal**

The most common terminals are:

##### ✕ **Automatic teller Machine (ATM)**

A special intelligent terminal located outside the bank for a customer to operator on his own perform a limited number of banking transactions. Eg: Cash withdrawal, Cash Transfer, Cash Deposit, utility bill payment, Mini Statement etc.

##### ✕ **Teller Operator Terminal**

This is a specialized dumb / smart terminal for the bank teller operator who work in the front office of a bank to handle customer transactions.

##### ✕ **Normal Video Terminals**

##### ✕ **Portable Terminal**

It is consists of a keyboard, flat screen monitor and built in communication software / hardware which can connect from a remote location through a communication link to a computer. The portability of the terminal is due to its lightweight. There is a wide range of products available.

Eg: Terminal for traveling Salesman

##### ✕ **Non-keyboard Devices**

##### ✕ **Document Reading Methods**

These input methods eliminate the need of offline data preparation which improves the accuracy of input as well as the speed. In addition these input methods provide special functions in relation to specific applications. This method is commonly used for time critical, high volume, batch-processing applications.

##### ✕ **Optical Mark Recognition (OMR)**

The input device is Optical Mark Rader. Some of the foreign examinations like SAT or TOFEL the candidate application forms as well as the answer sheets are specially designed (Mark Sense Cards) to record data by using pencil marks. Open University of Sri Lanka also uses a similar method.

Data recorded in this form is converted into computer-usable form by an **Optical Mark Reader (OMR)**. The OMR device has a high-intensity light inside which is directed in the form of a beam at the sheet of paper being fed through it. The beam scans the marked forms and detects the number and location of the pencil marks. The data is then converted into electrical signals for the computer.

OMRs come in a variety of size and shapes that depend on the size of the forms to be read and the required loading and processing capacity of the reader.

### ✎ **Optical Character Recognition (OCR)**

Typewritten-and typeset-character Scanners for many years' typewritten data on source documents had to be reeked in to a computer – in some cases, it is still used today. As we mentioned before, optical character recognition technology was developed to avoid this massive duplication of effort. To help speed up and reduce the cost of converting typewritten (and typeset) data to computer-usable form, certain manufacturers developed special type fonts (typeface style) to be read by a scanning device. To assist this process the American National Standards Institute (ANSI) adopted a standard type font called OCR-A for use with special optical character reading devices. However, the more expensive OCR devices can read a variety of fonts.

### ✎ **Optical Character Recognition (OCR)**

Handwritten-Character Reader although the percentage of data recorded by hand has dropped substantially over the last 50 years, quit a bit of data is still recorded this way. As OCR technology advanced, designers felt that it would be possible also to convert handwritten data into computer usable form in much the same way that typewritten data is. Devices with this capability are the most sophisticated and versatile of the OCR devices. Because handwriting varies widely, specific guidelines must be followed so that the OCR reader will interpret the characters accurately.

### ✎ **Magnetic-Ink Character Recognition (MICR)**

This specially designed for the input of high volume cheques in the banking industry. The advantages of the MICR system are that (1) Human involvement is minimum, thus the potential for errors is small (2) The codes can be read by both people and machines (3) it is fast, automatic, and reliable. The cheque leaf taken into the machine, and magnetise the ferric particles present in the data printed at the bottom edge of it. At the first read station it recognizes data based on magnetic induction & convert into electrical signals. Generally at the second read station it reads again & compare with the first reading for accuracy. In addition to reading, it sort the cheque leaves in a bundle according to the bank code & output to respective pigeonholes.

Eg: Cheque clearing House of Sri Lanka.

### ✎ **Bar coded Document Reader**

Bar Code is a collection of thick and lines and spaces that represent data in binary.

Eg:

1. Courier companies parcel tracking system
2. File tracking system in an office
3. Record the movement of books in a Library
4. Super market issue of items

In courier application the parcel reference number is bar coded & record in all relevant documents & the parcel itself. This reference number is input to the computer system by using portable barcode scanner or wand reader. The wand has a Scanning device that analyzes light & dark bars for width & spacing. This wand reader is a special attachment to video terminal.

### ✎ **Pointing Devices**

There are several types of devices to meet the requirements of various application characteristics. These devices mouse, improve the Human Computer Interface (HCI) & make computers easy to use (user friendly). Most common devices are given below.

### ✎ **Mouse**

The mouse is one of the devices connected to the computer by a small cable. As the mouse is rolled across the desktop, the cursor moves across the screen. When the cursor reaches the desired location, the user usually pushes button on the mouse once or twice to signal a menu selection or a command to the computer.

Mouse technology is often used with graphics-oriented personal computers. With special software for graphics, the mouse can be used like a pen or a Paint Brush to create figures and patterns directly on the video display screen.

Eg: used with CorelDraw or Haward Graphics, Desktop Publishing Applications

### ☒ **Light Pen**

The light pen is a special attachment to a graphics terminal, which uses a light sensitive photoelectrical cell to signal screen position to the computer. The pen is touched on the video display screen at the desired location, switch on the pen and pushed to close the photoelectric circuit, thereby indicating the x-y screen coordinates to the computer. Light pens are frequently used by graphics designers, illustrators, and drafting engineers. (Of course, data may also be entered using keyboard)

Eg: Computer Aided Design (CAD), Architectural applications.

### ☒ **Touch Screen**

Limited amounts of data can be entered via a terminal or a microcomputer that has a touch screen. The user simply touches the screen at the desired locations, marked by labeled boxes, to "Point out" choices to the computer. The software determines the kinds of choices the user has.

Eg: Inquiry Terminals for general public such as Terminals located in the lobby areas of a large building complex. This will enable users to operate without much technical knowledge & skill.

### ☒ **Digitizer**

An interesting method of input that is used in map making is the digitizer & digitizing tablet. The tablets, which come in different sizes, are the working surface. Each is covered by a grid of many tiny wires that is connected to the computer. Drawing places over this grid can be traced and entered into the computer by the use of a special pen or mouse like device with crushers that opens and closes electrical circuits in the grid and thus identifies x-y coordinates. Original drawing may also be entered. As it progress, the drawing is displayed on the screen, it later be stored or printed out. Digitizers are also used in design and engineering business such as those that develop aircraft, computer chips etc.

### ☒ **Card Reading Devices**

Card Reading Devices generally appear as a special attachment to another machine. The most common applications are given below.

#### ☒ **Magnetic Stripe Card Reader**

Magnetic Stripe Card is a plastic card with a magnetic stripe having specific data magnetically encoded.

Eg:

1. **Automatic Teller Machine (ATM)** Card with the customer Account Number. Magnetic Stripe Card Rader is built in to the Automatic Teller Machine installed outside the bank. To begin a transaction customer insert the card into the reader, which reads his account number into the computer.
2. **Employee Identification Card** it is similar to **ATM** card having employee number magnetically recorded. The employee may use his identification card for many purposes. It may be record his attendance (In & Out times) by using attendance recording terminal.

#### ☒ **Barcode Reader**

Now, bar-coded identification cards are becoming common as an alternative to the magnetic stripe cards. It is generally a low cost alternative but less reliable than magnetic stripe method of recording. The application method is similar to magnetic stripe card system

### ✂ **Kimbal Tag Reader**

Kimbal Tag Reader is built into the Point Of Scale Terminal (POS), which is a specialized cash register used in a super market as cashier terminal. Kimbal Tag is miniaturized & prepunched card.

Eg: Product code of a merchandise recorded attached to a ready made clothing item in supermarket, Kimbal Tag is the input medium.

### ✂ **Credit Card Reader**

Credit Card companies issue to their customers a plastic card with a magnetic stripe similar to an **ATM** card described in (a-i) above. Magnetic stripe Credit card reference number is recorded in the magnetic stripe. Credit card reader is built-in to a POS terminal similar to a Kimbal Tag reader.

### ✂ **Smart Card Reader**

Smart card is intelligent card with a microprocessor, memory & special software designed to use as a tiny transaction computer. This technology was pioneered in the mid 1970s in France. Smart card reader is a special device built in to various equipment to operate similar to an **ATM**.

Eg: Smart card to make a payment

### ✂ **Scanning Devices**

Digital Scanner translates images such as pictures or documents into digital form. This is one area where substantial research & development had been taking place in the recent past. A wide variety of products are now available in the market place. The most common products are.

#### ✂ **Hand Held Scanner**

Used mostly with small scale publishing (Desktop Publishing) systems to input pictures, logos etc.

#### ✂ **Flat Bed Scanner**

Used to input text based documents with or without images. Special software packages are now available to process these text-based images such editing, merging etc.

#### ✂ **Character Scanners**

There are hand held devices, which can read data printed in special type fonts (eg: OCR – A or B) or hand written data based on recommended guidelines. In addition there are Optical Readers, which operate at high speed to handle high volume batch oriented input.

#### ✂ **Voice Input Devices**

Voice Input Devices or Voice recognition systems convert spoken into electrical signals by comparing the electrical patterns produced by the speaker's voice with a set of prerecorded patterns. If a matching pattern is found, the computer accepts this pattern as a part of its standard "vocabulary". This technology is also used by people whose jobs do not allow them to keep their hands free and by handicapped people who are not able to use traditional input devices.

Eg:

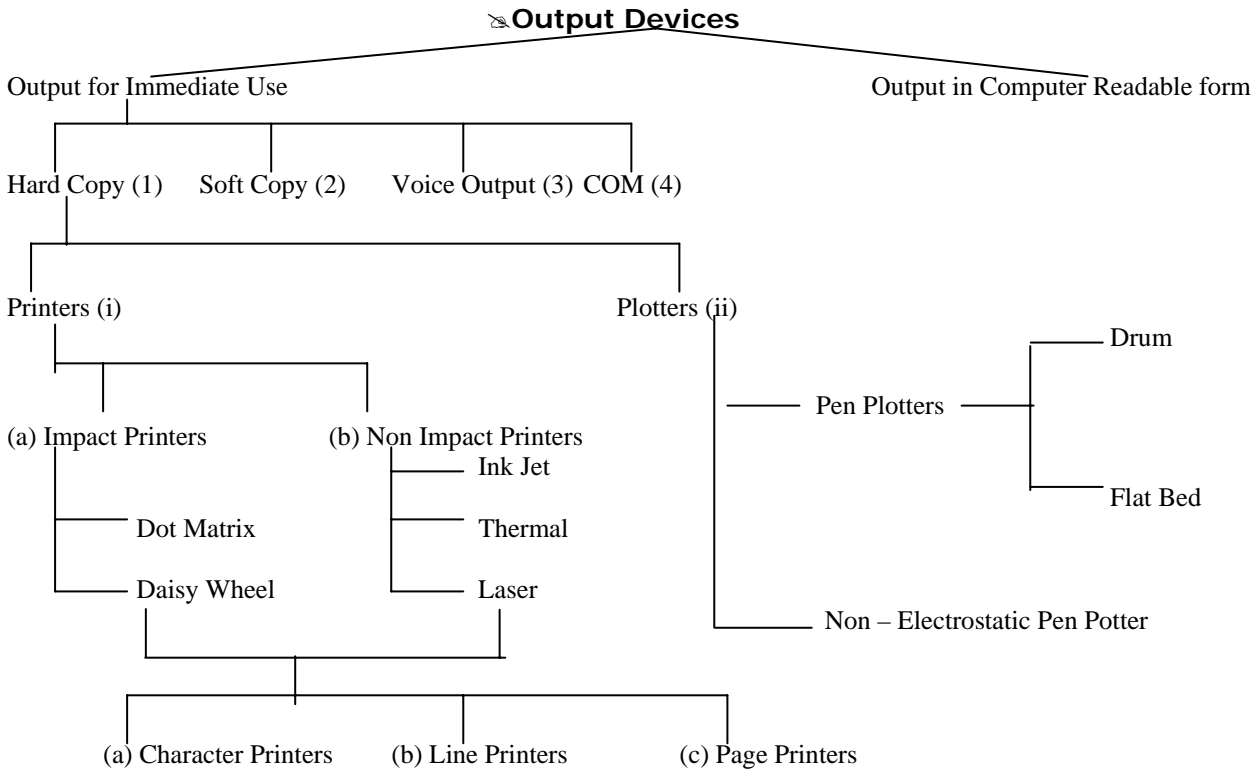
1. Astronauts space suits include Microprocessors and storage devices to allow astronauts to view Computerized displays across their helmet visors. These displays would be activated and manipulated by spoken command – convenient when you've got both hands busy on an outer space repair job.
2. Quality controllers in a factory speak to a voice Data Entry Terminal by using predefined words while they are inspecting the goods in a moving belt. A substantial amount research in voice recognition technology (Programming the Computer to recognize spoken commands) is taking place today.

Eg:

People in laboratories, invalids or quality controller's i.e people who inspect the quality of goods During manufacture & who take corrective action if the quality drops.

✎ **Output Devices & Applications**

Methods of output from computer contribute to improve the quality of information, which will have direct impact on effective decision-making in organizations. To achieve this goal you may need to use more than one output device & output medium. A possible classification of output methods is given below.



✎ **Output for Immediate Use**

✎ **Hard Copy**

The output is recorded on a tangible medium & it is humanly readable.

(i) **Printers**

(a) **Impact Printers**

Print mechanism strike against the paper. There are three types as given below

■ **Dot Matrix Printers**

The most widely used printer, the technology has improved during the recent past to include very high quality & reasonably low speed printers. The print is produced by a small "Print Head". Which strikes the printer ribbon against the paper with a matrix of wires/ pain.

✎ **Features**

- Prints one character at a time
- Characters are formed by a Matrix of dots
- The prints head may be 7\*5, 7\*7, 9\*9, or 24\*24. The more dots the better the image.

- Line widths are typically from 80, 120, 132, or 160 characters across.
- Speed are typically from 30 CPS (Character Per Second) to 250 CPS
- Can produce graphics as well as text.

### ■ Daisy Wheel Printers

Print a character as a time and used only for Word Processing. As a result of the present technology of Matrix Printers and Laser Printers, Daisy Wheel Printers are now obsolete. This another popular type of Low – Speed Printers. These printers are fitted with exchangeable Prints Heads called “Daisy Wheel”. To print each character the wheel is rotated and the appropriate character is struck against an inked ribbon on to the paper.

#### ✎ Features

- An Impact Shaped Character printer
- High quality print
- Can use coloured ribbons
- Speeds of 25 CPS to 85 CPS
- Similar to Don’t Matrix in terms of paper size and multiple copy printing
- Can produce graphics as well as text.

### (b) Non Impact Printers

Print mechanism does not strike against the ribbon or paper. The most common types are given below

#### ■ Ink Jet Printers

Ink – Jet printers work in much the same fashion as dot- matrix printers in that they form images or characters with little dots. However, the dots are formed, not by hammer like pins, but by tiny droplets of ink, and the text these printers produce is of letter quality. These printers can almost match the speed of dot – matrix printers – up to about 270 cps - and they produce less noise.

#### ■ Thermal and Electrostatic Printers

Thermal Printers use heat to produce an image on special paper. The print mechanism – rather like a dot – matrix print head – is designed to heat the surface of chemically treated paper so that a dot is produced based on the reaction of the chemical to the heat. No ribbon or ink is involved. It can print multiple colours.

#### ■ Laser Printers

Laser printer technology is much less mechanical than impact printing (that is, no print head to move, no print hammers to hit), resulting in much higher speeds and quieter operation. The process resembles the operation of a photocopy machine. A laser beam is directed across the surface of a light –sensitive drum and fixed as needed to record and image in the form of a pattern of tiny dots. The image is then transferred to the paper – a page at a time – in the same fashion as a copying machine, using a special toner.

When high speed laser printers also called page printers were introduced, they were very expensive. Their cost could only be justified in large data processing organizations where a print speed capability of between 10,000 and 20,000 lines (about 300 pages per minute) was required. However, recent laser printer technology has made desktop versions available at very reasonable prices.

The desktop laser printer has become a very popular output device for microcomputer – based systems. Many practitioners of desktop publishing, that is publishing you do yourself, prefer desktop laser printers because of the high – quality images (300 – 1200 dpi) they produce. The primary limitation of affordable desktop laser printers at this time is restriction to single – color output. However, they are very popular in the business community. To help you understand why, table below compare the various types of non-impact printers.

#### ✎ Another Classification of Printers

As shown below, printers can be classified into Character, line & Page Printers. This is based on method of printing.

- Character Printers** - Speed in Character Per Second (CPS) used for low to medium volume Applications.  
Eg: Matrix, In Jet.
- Line Printers** - Speed in Lines Per Minute (LPM) used for high volume medium quality applications.  
Eg: Printing of public examination results.
- Page Printers** - Speed in Page Per Minute (PPM) used for medium to high volume, high quality Applications.  
Eg: Print a master copy of a magazine by using a Laser Printer.

## ii. Plotters

A plotter is a specialized output device designed to produce high – quality graphics in a variety of colors. Drum plotters and flat bed plotters both use pens and electrostatic do not. In a drum plotter, the paper is mounted on the surface of a

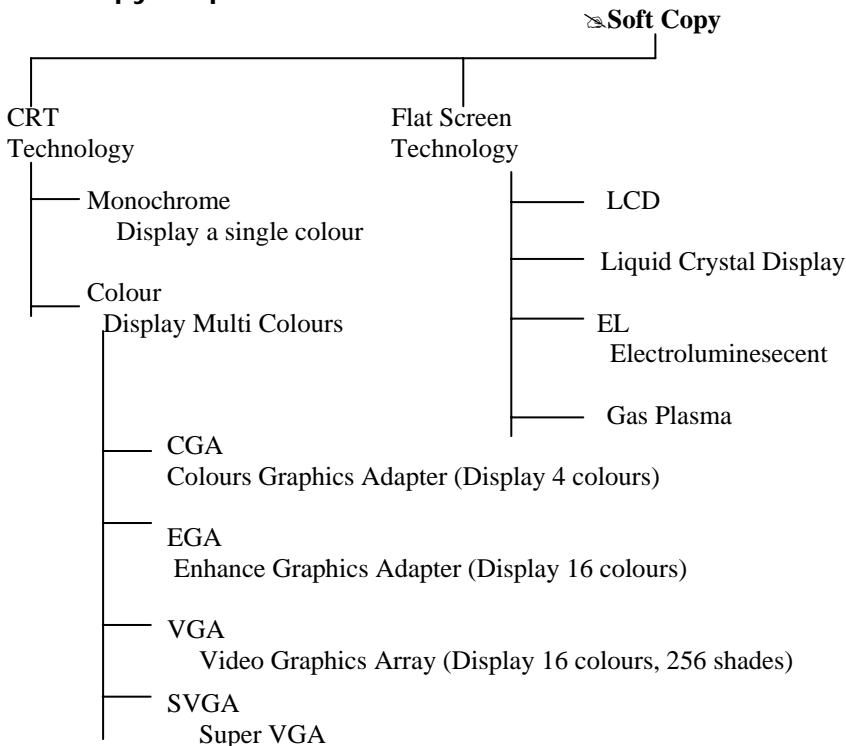
**Drum.** The revolves and the plotter pens (which are similar to felt – tip pens) are horizontally positioned over the target area. When the paper has rotated to the correct point, the pens are dropped to the surface moved left and right under program control across the paper as the drum revolves. When the image is complete, the pens are raised from the surface.

**Flatbed** Plotters are designed so that the paper is placed flat and one or more pens move horizontally and vertically across the paper.

Electronic Plotters use electrostatic charge to create images out of very small dots on specially treated paper. Electrostatic plotters are faster than pen plotters and can produce images of very high resolution.

Eg: Used by Architects, Surveyors, and Engineers.

## Soft Copy output Method



## ✎ Display Technology – Technology Overview

Display technologies have evolved over the past very rapidly. Technological development in summary is given below

### i. Cathode Ray Tube (CRT) Technology

The screen display is made up of small picture elements called pixels. The image clarity or resolution depends on pixel density.

### ii. Flat Screen Technologies

The disadvantages of the CRT – large size, high power consumption, and fragility, plus occasional flickering images have led to the development of flat screen technologies. Flat screen technology is particularly useful for laptop computers, which can be used in the office and then taken home or on trips. Trips producing a truly lap – size, or laptop, computer – that is, one that is fully functional and weighing 15 pounds or less – has not been easy, and designing the video display has been the most difficult problem. Interest in laptop computers encouraged researchers to explore different approaches in developing high resolution, low- power – consumption flat screens with the same graphics capabilities of the traditional CRT. Common flat screen technologies are: Liquid Crystal Display, Electro Luminescent Display, and Gas Plasma Display.

## ✎ Voice Output Method

Voice output should be a more useful medium. This technology has to overcome many hurdles. The most difficult has been that every individual perceives speech differently, that is the voice patterns, and pitches and reflections we can hear and understand are different for all of us. It is not always easy to understand an unfamiliar voice pattern. At this point, two different approaches to voice output have evolved Speech coding and Speech coding relies on human speech as a reservoir of sounds to draw from in building the words and phrases to be output. Sounds are codified and stored on disk to be retrieved and translated back as sounds. Speech coding has been used in applications such as automobiles, toys and games, speech synthesis electronically produce voice without the use of a human voice.

Researches are continuing to develop and improve voice output technologies. Many new products using voice output are expected to appear in the market place during the next decade. The largest application to data for the speech synthesis approach to voice output converting text into “spoken” words has many potential uses, including providing reading machines for the blind. And of course, sound output does not have to be in voice form, it can be music (synthesized music is as most readers know, a booming business) or special – effects sounds, such as the sound accompaniment for computer animation, in cartoon etc.

## ✎ Size Classification

### Super Computer

These are massive main- frame which process billions of instructions per seconds and which can support more than 10,000 or so terminals simultaneously. Super computers are used by government departments particularly in the defense and space fields, for weather forecasting, a large “number – crunching” exercise and in such specialist areas as aircraft design, nuclear research, oil expirations, etc. these computers need carefully controlled environments and high security. They are now classified into **Super – Mini and Super – Micro Computers.**

### ✎ Min – frame Computer

Main – frame computers are also called the dinosaurs of the computer industry. A main – frame computer is housed in its own computer room, where careful control of the temperature, humidity and the amount of dust is maintained. Only authorized personal are allowed into such a room.

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Main – frames work at the rate tens of million of instructions per second (MIPS) or more, and are able to access Giga – byte (Gb) of data from their backing storage. One thousand or more terminals may access such a machine simultaneously, often from remote locations.

Such machines are fast powerful, and are used by organizations having a need for vast amounts of rapid processing, such as banks, large mail – order companies, insurance companies, government departments, large manufacturing concerns and airlines.

### ✎ **Mini Computer**

A mini computer is a machine, which lies between a main – frame computer and a microcomputer in terms of price, power, speed, size and capabilities. These are typically used in business with less than 100 employees for special purpose or smaller scale general business applications. Mini computer environment are also multi – user or network environments.

### ✎ **Microcomputers**

Microcomputers are analogous with the term personal computer (PC) and is the smallest and most popular type of computer. A PC is a single – user system. IBM dominates the microcomputer market and is the de facto standard. Several companies market microcomputers, which are compatible with the original IBM design. When a machine is designed deliberately to be similar to an IBM machine, it is known as a CLONE.

The newer microcomputers are known as super micros. They have fast processors, large memory and high hard disk capacities. They support several simultaneous users, and can run more than one program at once this is known as MULTI – TALKING. Portable microcomputers are categorized into lap – top computers notebook computers and palm – top machines.

### ✎ **Data Representation within the Computer**

In order to understand the data representation within the computer, some knowledge in Number system will be useful. Therefore in this section Decimal & Binary Number systems are considered.

#### ✎ **Decimal Number System**

The decimal digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. In this system the ten is called the “base” or “radix”. Hence we get the decimal system, which means based on “tens”. Another concept that is important about number system is that they all depend on positional value. The positional value is the base raised to the power of the digits position.

We refer the left most position, (most valuable) as the Most Significant Digit (MSD). The digit in the most position (least valuable) is referred to as the Least Significant Digit (LSD).

#### **A. Basic Rules**

The largest symbol (digit) in any number is equal to one less than the base

Eg: in decimal base is 10 and largest symbol is 9

B. Each position has a value. The positional value of the LSD. Is the base raised to the zero power, which makes it equal to one.  $X^4 X^3 X^2 X^1 X^0$

C. The number of digits in the number system is equal to the base. Eg. In decimal system base is = 10, Therefore the number of digits = 10 ie 0 to 9.

#### ✎ **Binary Number System**

In electronics and other related concepts there is always a duality: for example, clock wise magnetism or counter clock wise magnetism, current on or off and current is passing in one direction or opposite direction.

Hence electronic systems used this duality for all its internal operations, Binary Number concepts is based on dual symbols 0 and 1. Therefore computers use binary number concept in internal data handling.

In Binary there are only two digits or symbols (ie 0 and 1). Based is 2, it should be obvious that since the binary system has only two symbols (0 and 1), and decimal numbers greater than 1 will required more than one digit in its binary representation.