2.0 INTRODUCTION

Education is about the future and the nation's future prosperity depends on the quality of the present education of those who will become tomorrow's work force. Children, who are today in primary and secondary schools, will be the bearers of this computer based industrial and social reavolution in the country from which no individual household, business of employment are changing rapidly and today's children will need to be trained for girls which such technological advances will generate. If these opportunities are to be accepted, an essential part of the children's spectrum of educational skills will be familiarity with the uses and applications of computers.

A computer processes information with high speed and accuracy. In addition to these, it has the following capabilities:

(i) a computer excels at numerical calculations;
(ii) a computer can store and retrieves vast bodie of
(iii) a computer can generate high resolution graphics and colours;
(iv) a computer can measure time accurately;
(v) a computer can generate random number tables and random statements; and
(vi) a computer can make communication efficient because of its capability of working in networking environment.

The above mentioned capabilities make the computer a powerful medium for providing highly flexible and effective learning experiences. At the primary stage, children have a short attention span and, therefore, quite often a variety of learning strategies are adopted to reach them.

According to Margaret (1989 p. 608):

> Everyday I cannot wait to get to school because I cannot wait to get on to the computer and work on the work processor. I am eager and I think every other pupil in my class is as eager as me. Therefore, I think children would be eager to come to school if they experience seeing their own creation of words on the computer screen.

The test of the future.......... TO DAY!”. A dozen years ago, a minority graduate students used that slogan to attract volunteers to the first experimental trials of computerized adaptive testing [CAT].
2.1 HISTORY OF COMPUTER

Charles Babbage, regarded today as the Father of Computer, wrote: It is not a bad definition of man to describe him as a tool making animal. His earliest contrivances to support uncivilized life were tools of the simplest and crudest construction. His latest achievement in the substitution of machinery, not merely for the skill of the human hand but for the relief of the human intellect, are founded on the use of tools of a still higher order.

Every phenomenon or invention has had a number of people involved in its creation. The initial idea may have been one person's but the development and improvements on it have almost always been a result of several experiments, by different people. The history of computers is such a story, which is illustrated with the names of a number of architects whose inventions and discoveries perhaps did not bear any direct significance at that time, to the development of modern age computers.

The most early methods of simple calculation were done with the help of counting pebbles and twigs or cave markings or tally bars [as used in statistics today], and even the use of one's own fingers and toes! [This in fact is how the decimal system of counting with a base of 10 evolved because we have 10 fingers & 10 toes].
Necessity, it is said, is the mother of invention and it is thus that the first mechanical calculating device was created by the Equities, way back in 450B.C. This simple device is known as the ABACUS and comprises of a number of rods, each bearing beads, enclosed within a frame. Further improvements were made upon it subsequently, by the Chinese and the Japanese. It is believed that people proficient in using the Abacus can solve Mathematical problems the same or at even faster speeds than men using calculations to do the same problem.

The next pioneering contribution was made in 1614 A.D., by a Scottish mathematician named John Napier. He evolved the system of logarithms. By 1617 he had improved on his device which could perform multiplication and division as well. This was later known as NAPIER’S BONES and consisted of a set of 11 rods, which were further divided into 9 diagonal numbered parts. By manipulating the rods it was possible to perform calculations with 2 numbers.

The SLIDE RULE was invented just a few years later [1620] by William Oughtred. He used the principle of logarithms for division and multiplication. It has two marked rulers, one of which could be slid over the other and once properly aligned, would give the user the regarded product or quotient. The SLIDE RULE is an apt example of an "analog" device in which notations could be taken as continuous readings. This
is opposed to a digital device which operates one step at a time and works with distinct values.

A well known French philosopher and mathematician, Blaise Pascal, made a major breakthrough in 1642, by bringing forth a mechanical calculating device consisting of gears, dials and wheels. This gear driven machine was designed to add or subtract eight columns of numbers. The numbers were entered by dialling a series of numbered wheels, where the movement of the wheels started at 9 and moved to 0. An automatic carry over system was accomplished by rotating the adjacent wheel by one digit.

In 1694 Gottfried von Leibnitz, a German Mathematician, developed a calculating machine that was based on the same principal as that of Pascal's. The only added feature was a system of shift mechanism, operating through a series of sliders. This machine would do true multiplication and division and not as repeated additions and subtractions, as was present in Pascal's machine. However, its reliability and accuracy remained questionable since the technology of the times did not permit precision manufacturing. The calculating devices mentioned so far, were relatively primitive, slow and tedious to operate. This is in comparison with the subsequently developments in the 19th and 20th centuries, which finally arrived at the highly sophisticated computers of today. Apart from formidable breakthrough in technology, great advancements were made in the sphere of
information storage methods, programming, electronics and principles of logic and design.

It was in the early 1880's that a French textile manufacturer devised an automatic mechanical method of controlling weaving looms to create intricate and complex patterned woven cloth. He initiated the storage of information on a system of PUNCHED CARDS. The punched cards ['with holes' or 'without holes'] were secured tightly alongside each other in a sequential manner. These then passed over the loom mechanism which detected the,

"absence of hold" - leading to the warp thread being raised

"presence of hold" - leading to the warp thread not being raised.

This basic principal of one or the other of two states is the fundamental basis of the binary coding system being used even in computers today. It is noted however, that the first use of binary codes for numerical representations had been initiated way back in 1623, by Francis Bacon.

A pioneering contribution to the development of the mechanical computer was made in 1822, by an English professor of Mathematics, at the Cambridge University. Charles Babbage's main aim was to devise a machine that would store and read data or information prior to working out the defined process. This first machine came to be know as the DIFFERE-
The engine which operated on the principal that, "...the level difference between the values computed for a formula, remains the same". Babbage improved on the Difference Engine and designed a more sophisticated and larger calculating machine in 1834. This machine which was capable of working on some form of charge and calculating up to 20 decimals at about 60 additions per minute was known as the Analytical Engine. Unfortunately for Babbage, due to financial constraints and inadequate technological advancements [electricity was discovered only in the 1840s], both his devices remained unfinished. He however initiated the first notions of inputting data via a device and the storage of data and information prior to the process. It is for this pioneering effort that he is known as the Father of Computers.

Lady Ada Lovelace, Lord Byron's daughter, is famous as the First programmer, for having devised a suitable use of the Binary Number system for programs and data to be fed into the Analytical Computer. The actual application of the selection of alternative choices and its link with computer development came from George Boole. His theoretical development for representing and manipulating logical evaluations in terms of true or false, formed the basis of "computer Logic" and in being applied to the algebraic system came to be known as BOOLEAN ALGEBRA. Dr. Herman Hollerith proposed a mechanized solution to the problem by utilizing the system of punched cards. By 1889 he had devised the card punching and card reading machines or tabulators. In using this new
method for the 1890 census, the counting was complicate in only 3 years and that too for a larger population. His ideas were further developed and Hollerith started his own company. The computing Tabulating Recording company which is better known today as one of the largest manufactures of computers viz, IBM or International Business Machine corporation. At the same time, macro developments were taking place in the areas of recording devices. Valdemar Poulson devised the method of tapes and drums coated with thin films of magnetic material. This is regarded as the forerunner of the present day magnetic media cassettes tapes, video tapes etc.

A major technologic breakthrough came in 1906 when lead forest invented amplification and switching of electrical signals or pulses, without the movement of any mechanical or electrical part. This function that was performed though the material and technology used now is for more sophisticated and advanced. In 1938 Cloyd Shannon further exploited De Forest idea to work out Integrated Circuits for the logic dandy arithmetic processes done by computers. He also showed how Boolean Algebra could be applied to practical problems of circuitry. Prior to this in 1937, Alan Turing had shown how the process of computing solutions to given problems could be reduced to certain logical and conscious steps. It was between 1937-1944 that Howled Aiken, with the support of IBM built the first automatic electro mechanical computer, capable of performing arithmetic and logical opera-
tions by a series of electrically driven mechanical relays and switches. This machine, named Mark-I was very reliable and is regarded by some as the finished dream of Charles Babbage with respect to his Analytical Engine.

During the IIInd world war the need to calculate the artillery firing table, led to the invention, in 1946, of the first electronic digital computer viz. ENIAC i.e. the Electronic Numerical Integration and Calculator. Other machines which were its contemporaries were the Z3 & Z4 produced by a German, Konrad Zuse [1941] the CLOSSUS in Britain [1943] EDVAC [Electronic Delayed storage Automatic computer -1949] and the UNIVAC I [Universal Automatic computer 1952] From 1946 onwards, the development of computers occurred at a very fast pace, especially with the emergence and the development of Electronic Digital Computers which would be much faster and have greater storage than their predecessors. A very effective and informative lecture was delivered by John Von Neuman in 1946 this famous Neuman Report outline the basic requirements for the design of modern digital computers. These relate to the binary coding scheme for data choice of dares and use of input output devices for feeding in data and retrieving information.

This list of prominent contributions to the evolution of the computer does not, however, account for all the Kanor developments that took place. Each of these contributions, though individually unrelated, were significantly relevant
Computers Through the Generations

Intensive research and countless experiments on computers led to the sophistication, versatility and reduced costs of what had once been expensive and huge machines capable of limited functions. These developments were significant enough to arouse man's interest worldover and there was a more intensive strive to evolve the best. The evolution of the modern computer can be viewed in specific "generations".

First Generation

The characteristics of first generation are as follows.
(a) The electronic circuitry was based on thermionic valves and Vacuum Tubes.
(b) The speed was limited to the mill seconds range.
(c) The internal storage used primitive devices and had a maximum capacity of 20,000 positions.
(d) It used the Binary coding scheme as a communication language with the machine i.e. the machine language interpretation of the presence of an electrical pulse as "1" and the absence of it as "0".

Examples
ENIAC, EDVAC, EDSAC, ACE, LEQ [Lyons Electronic office 1951, the first commercial computer] and the IBM 850.

Second Generation
The characteristics of second generation are as follows.
(a) Electronic circuitry of valves and vacuum tubes is replaced by Transistors.
(b) An increase in operating speeds up to the microseconds range.
(c) An increase in storage capacity to accommodate as much as 100,000 characters.
(d) The communicative languages in the early stages were of the assembly language kind requiring translator-programs, which were specific to each model. The later stages saw a marked improvement in this field with the introduction and wide acceptance of the first high level language viz. FORTRANS (1957).

Examples
IBM 1400 and IBM 7000 series, Control Data 3600, General Electric 635, LEO Mark III, ATLAS.

Third Generation

The major characteristics of third generation are as follows.
(a) The electronic circuits was based on miniature, Integrated Circuits on silicon chips, which although small, contained the equivalent of a large number of transistors. These utilized miniprocesor in their internal design.
(b) The operating speed improved to near about the nano seconds range.
(c) The internal storage increased to a capacity that could accommodate up to one half million characters.

(d) A greater development of high level languages took place COBOL (Common Business Oriented Language), BASIC (Beginners All purpose Symbolic Instruction Code).

Examples

IBM system/360, ICL 1900 series, PDP II, and the DATA GENERAL range of computers.

Fourth Generation

The major features of forth generation are as follows.

(a) The technology used for their circuitry was so specialized and miniaturist that hundreds of ICs could be etched on a chip, the size of a pinhead.

(b) The operating speed improved to between the neno and pico seconds ranges.

(c) The internal storage capacity increased to the range of one million positions.

(d) A further refinement of High Level Languages and the introduction of special software for managing large data bases occurred.

Examples

IBM 370 series, Honeywell 6080 series, the APPLE etc.

Fifth Generation

The development of these machines is the topic of the day
where the improved and added features include the incorporation of Very Large Scale Integrated Circuitry, (VLSIC) the development of Artificial Intelligence to make the computer take decision almost like a human being, speech synthesizers as well as the use of video disks and tapes for external storage media. It is predicted that the world is moving towards the development of what one can call 'Super Large Scale Integration' which in turn will compliment and improve on speed, miniaturization and cost reduction. The circuitry on the LSI chips will themselves become programmable and the use of micro computers in home and work environment will result in a number of conveniences. Office and factory automation will reduce manual jobs and in turn open up more challenging job opportunistic.

According to Lan Scales² (1987 p. 276):

"Portable computer: A device that can be transported as a single unit and thus contains the display unit, disk drives, and other essential peripheral equipment in the same case."

The process of evolution is synonymous with "technological advancements" and modernization. While the technological of computers is itself taking the same path, it in turn, is being applied to speed up the process in wider perspective. What the nature of these machines will be 50 years hence, is anybody's guess. Perhaps it is something that we have not even visualized, just as man in the 1950s had not even dreamt of handling a machine as compact, as efficient
The portable desktop of the future: NEC's luggable computer, the PC-9801T Model F5, has a TFT color display. The system is designed so it can easily be stowed away or moved.
and as sophisticated as the one we see today.

2.2 **TYPES OF COMPUTER & CHARACTER**

The types of computer - Analog, Digital and Hybrid, are as follows.

2.2.1 Analog Computer

Analog devices are those devices in which the representation of a smoothly changing physical variable (e.g. temperature) is by the continuous changes in another physical variables (e.g. mercury in a thermometer). Analog computer is one in which continuous physical variables such as the movement of gear's or the magnitude of voltage is what represents data. These were in wide use in earlier times and still find application in a number of fields today. A common use of this can be seen on watches and clocks that have the hour and minutes hands.

Thus Analog a representation of numeric quantity which use continuously changing physical quantities as a reference e.g. sound is a wave the level of which can be increased or decreased idetitely. Also mechanical components the physical variables become for example angular rotations and linear displacement.

2.2.2 Digital Computer

Digital, refers to the use of discrete signals for repre-
senting data in the form of numbers or characters. Most forms of digital representation in data processing has been done on the basic of binary numbers sets of binary digits grouped together to represent numbers in some other random when required. A computer that is able to process information expressed as combinations of data that are represented by separate individual units sequences of binary "0" code and 1's has been indicated within the computer as either the present or absent of voltage (on or off). These computer are used in large number of applications like preparation of bills / vouchers, ledgers, solvings complex etc. The majority of the computer used now a days are digital. There are four types of digital computers.

Manframe computes

The term MANFRAME computers refers to medium to large size computer systems designed for large scale data processing i.e. handling very large amount of raw facts and being able to cope with a variety of operations. The characteristic features of such systems are as following.

1 They support a wide range of high speed input/output terminals, with backing storages capable of storing large volumes of information (disk pack and magnetic tapes).

2 They have a very large and fast central processing unit.

3 They are usually a centralized services department.
4 They required strike environmental conditioning of air (conditioning), dust and temperature control.

5 They are usually centralized systems that support remote satellite computers and terminals. They are very expensive to set up and are suitable in only those areas that involve large volumes of data processing.

Examples
ICL 2700, IBM 360 & 370 IBM 370 series, DEC 10 etc.

Minicomputers

Minicomputers are as their name denotes a smaller version of the peripheral devices are on a much smaller scale. These systems are on a much smaller in size. The characteristic features of such systems are as following.

1 Hardware units being smaller in size.
2 A lesser memory capacity.
3 Smaller range of input/output interfaces. Floppies insisted of disk packs.
4 Smaller range of input/output interface. They usually have a slower operation speed.
5 They do not require as strict an environmental control as the former, and in general they are less expensive to install.

Examples
Digital PDP 11, VAX range and Data General range.

Microcomputers
Microcomputer are the result of technological advancements in the sphere of miniaturizing computers make them more accessible to the direct user. The two highly obvious features in them is their reduced cost and size, which today can be comfortably afforded and installed on a desk top. The fundamental building block of a microcomputer is the silicon chip called a microprocessor which occupies a very little space, the entire components configuration of a memory and a central processing unit. The characteristic features of such systems are as following.

1. Microcomputers are the smallest in computer systems and tend to be slower. They are seen interfaced with additional peripheral units.
2. It can store large volumes of data.
3. Mostly use a keyboard as a general input device and incorporate a visual display on which output may be displayed.
4. They are usually directly linked with small printers of the teletype, daisy wheel and matrix type to enable the retrieval of quick hard copies of information.
5. Support backing storage of a much smaller scale they usually use floppy disk and Winchester disks.

Examples

COMMODORE PET, APPLE, SUPERBRAIN, IBM PC etc.

Super Computers

A super computer can be defined as a very large computer
which has the speed of operation of more than 20 M flops or 20 millions of floating point operations per second. These computers are used for scientific and technological research. Defence is another area which is largely making use of the super computers. These computers function very differently when compared to the ordinary computers. Moreover, since they have a tremendous processing power, the design of these computers is changed considerably.

Examples

CRAY-1, Distributed Array Processor of ICL etc.

2.2.3 Hybrid computers

Hybrid computer are computer with combined features of both digital and analog type. The operate by counting as well as by measuring. In other words the output can be either in the form of discrete numbers or required units of measurements.

2.2.4 Type of character

Letters : A B C D E F G H I J K L M N O P Q R S T
          U V W X Y Z

Digits :  0 1 2 3 4 5 6 7 8 9

Maths Operators : + as in A + B
                 - as in C-D
                 * Multiply as in 3*4
                 / Divide as in 4/5
                 ^ to the power of as in 5^2
<table>
<thead>
<tr>
<th>Bracket</th>
<th>( ) indicate do this first as in (M*L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space</td>
<td>as in GO TO (for GOTO)</td>
</tr>
<tr>
<td>Point</td>
<td>. for the decimal point as 3.14</td>
</tr>
<tr>
<td>Comma</td>
<td>, used in lists such as PRINT M$, L$</td>
</tr>
<tr>
<td>Semi-colon</td>
<td>; used in statements to indicate</td>
</tr>
<tr>
<td></td>
<td>PRINT next item in next position</td>
</tr>
<tr>
<td>Assigning</td>
<td>= M = L+J means put the value of L+J</td>
</tr>
<tr>
<td></td>
<td>to M</td>
</tr>
<tr>
<td>Comparing</td>
<td>&lt; less than as in 5 &lt; 8</td>
</tr>
<tr>
<td></td>
<td>&gt; greater than as in 8 &gt; 5</td>
</tr>
<tr>
<td>Quotes</td>
<td>&quot;&quot; used to surround a string that is to</td>
</tr>
<tr>
<td></td>
<td>be printed</td>
</tr>
<tr>
<td></td>
<td>e.g. 10 PRINT &quot;MUKESH&quot;</td>
</tr>
<tr>
<td>Strings</td>
<td>$ used to store a string variable as in</td>
</tr>
<tr>
<td></td>
<td>M$ = &quot;JUGESH&quot;</td>
</tr>
</tbody>
</table>

**Extension of a statement**: used to extend a statement as

10 PRINT "LATTA" : GOTO 20

**Other Characters**

recognized by

some versions : `, ~ , @ , # , % , & , , , , !, !, ?

### 2.3 LANGUAGE OF COMPUTER

An intermediate step that helps humans to communicate with a computer Arbitrary synatax and vocabulary are used to efficiently express particular relationships and to solve
specific types of problem. What we communicate to the machine or computer, are data and instructions (INPUT) and what the machine communicates to us is the solution of result (OUTPUT). The languages of computer are as following.

- BASIC
- FROTRAN
- LOGO
- COBOL
- ALGOL
- CPM
- FORTAN
- LOGO
- FORTH
- LISP
- PROLOG
- APT
- PASCAL
- APL
- DBASE I
- CORL66
- RPG
- DBASE II
- SNOBOL
- JOSS
- DBASE III
- FOXPLUS
- PL/1
- DBASE IV PLUS
- FOXPRO
- LOTUS 1-2-3
- C

There are three types of main languages of computer, i.e. Machine language, Assembly language and High level language.

**Machine language**

Programs writing in machine language proves to be a very tedious task, since it involves instructions and data in binary code i.e in combinations of 0's and 1's. Now a days, most of the programs are written in high level languages, as machine language as the following problems.

1. Since the operations or function codes are in the form of binary numbers, they have to memorized, which is a very difficult task.

2. The entire process i.e. developing, testing and debug-
ging a program, is a very lengthy procedure.

These codes are transferred to the ALU where the actual operation takes place. We shall not go into the details of the actual procedure, from this example we can say about the complexity involved in programming machine language.

Assembly language

These are called low level languages. Machine code is a representation (in binary form) of the sequences of on/off electrical signals that drive the computer. Assembly language is a representation of machine code using decimal numbers and algebraic symbols to make it easier for people to understand and to reduce the probability of writing bugs into programs. These languages are aligned towards the computer's structure and not towards any particular type of problem. Assembly language could usefully be studied in the context of study of the computer's structure and operation.

The machine codes or binary codes were replaced by MNEMONIC codes, which are nothing but codes with names that have been acquired from the meaning of the function. For example, STA stands for and had been derived from Store Accumulator. This leads to reduction in timetable and effort as well as the elimination of the difficulty in memorizing the relevant binary codes.

High level language
High level languages are the source language or compiler languages and they are procedure oriented languages and reflect the procedures which are to be adopted. Below we have given some of the High level languages.

<table>
<thead>
<tr>
<th>Language</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASIC</td>
<td>Beginners All Purpose Symbolic Instruction Code</td>
</tr>
<tr>
<td>FORTRAN</td>
<td>Formula Translation Language</td>
</tr>
<tr>
<td>COBOL</td>
<td>Common Business Oriented Language</td>
</tr>
<tr>
<td>PL/1</td>
<td>Programming Language -1</td>
</tr>
<tr>
<td>ALGOL</td>
<td>Algorithmic Languages</td>
</tr>
<tr>
<td>MAD</td>
<td>Nasighan Algorithmic Decoder</td>
</tr>
<tr>
<td>WATFOR</td>
<td>Waterloo FORTRAN</td>
</tr>
</tbody>
</table>

Apart from these are some more high level languages, namely ADA (names after Augusta, ADA Byron of 19th century, PASCAL (names after the French scientist Blaise Pascal) etc.

2.4 GENERAL SYSTEM OF COMPUTERS

The computers depending on their circuit or hardware design vary in size, speed, and capacity. The general system of computers are Input, Memory, Control, Arithmetic, and Output unit. These units may assume varying forms in different computers. Also, some computers may have several different types of the same unit. We shall now briefly study the function of each of these units and the working of the computer.

2.4.1 Input Unit
Fig. 2
GENERAL SYSTEM OF COMPUTER

Central Processing Unit

MEMORY UNIT

INPUT DEVICE

CONTROL UNIT

ARITH. & LOGIC UNIT

OUTPUT DEVICE
The input unit is the means by which the user communicates data to the computer. This data is prepared, in a coded form, on an input medium and is read and translated by an input device into a form to which the computer can respond. The input may consist of one or more input devices. Some of the many different kinds of input media and devices generally used for feeding data into a computer are Punched card, Punched paper tape, Magnetic tape, Magnetic ink character reader, Optical character reader, Console typewriter, Cathode ray tube, Light pen, Touchpad, Joysticks, Voice input, Paddle and Mouse etc.

Punched Card

The punched card is one of the most useful and commonly employed media for communicating with the computer. The standard punched card has 80 columns, each consisting of 12 punching positions. Data is recorded on it by punching rectangular holes in the columns. This is normally done by using a keypunch which is similar to a typewriter pressing a key codes the character and punches the corresponding holes into the selected column of the card. Punched cards are read with the help of a card reader, an input device, which has a reading speed of 300-1600 cards per minute.

Punched Paper Tape

The punched paper tape is a continuous strip of paper.
Each character is represented on it by a code made up of a combination of circular holes punched across the width of the tape. The input device for reading punched paper type, viz., paper tape reader, has a reading speed of 100-1000 character per second.

Magnetic Tape

The magnetic tape used in computers is similar to that in audio tape recorders. It is made of thin plastic, coated with minute particulars of iron oxide which can be magnetized (polarized) in either of two directions. One polarity is used to represent binary bit '1', and the other, binary bit '0'. Each character on magnetic tape is represented as a column of binary bits, in a code similar to that used on paper tape. Reels of magnetic tape are mounted on devices known as magnetic tape drive. This device can not only read the data from the tape but can also write on it. The rate of information transfer to and from the magnetic tape is 5000-240,000 characters per second.

Magnetic Ink Character Reader

A high speed input device, the magnetic ink character reader picks up the directly from the source document. The reading heads of this device produce electrical signals when magnetically recorded characters are passed beneath them. These signals are analyzed by special circuits to determines the character sensed. Such characters are then transmitted, in groups to the memory unit.
Figure: 3

Example of a punched card.

Punched seven-track paper tape.
acter reader is widely used by the banking industry to process cheques and deposits. Its normal speed per minute is 75-1600 cheque cards or paper documents, each carrying not more than one printed line.

Optical Character Reader

An input device, the Optical Character Reader (OCR) is designed to read numeric and alphabetic characters from printed documents produced by typewriters, cash registers, line printers, and imprinting mechanisms of various types. It reads a line of printed characters and converts each into an electrical which, when analyzed, identifies the characters. The optical character reader is used in turn around documentation, such as processing of gift coupons and puzzle solutions. Its use has reduced, and in many cases eliminated, the reading speed of this device is generally 100-500 characters per second.

Console Typewriter

Console Typewriter is similar to an electric typewriter but contains, in addition, a serious of switches, special keys, and lights. The operator can use it for entering the instructions into the control unit and for monitoring the computer. The console typewriter also allows the computer to print and communicate information about a program inside the computer, e.g. error message and completion or operation. This device has a relatively low speed of operation, vis.
10.20 characters per second.

Cathode Ray Tube

More recently, input to the computer has also been made possible by means of a cathode ray tube (CRT) which is similar in arrangement and operation to a television picture tube. This process makes use of electronics pointers or light pens to quickly add to the memory unit, or erase, or alter any data/solution displayed on the CRT. Such a method of input has equipped all types of designer, engineers, statisticians, and managers will not only an important tool but also an extremely useful aid.

Light Pen

A pen-like wand that is attached to a CRT screen by a wire and that can be used to select options from a menu or draw lines and figures.

A pen-shaped device which, when hooked up to a computer allows you to 'draw' pictures on the screen. Light pens effectively turn the TV screen or monitor into a piece of electronic paper on which you can draw whatever you like. The software that often comes with light pens, lets you choose different thicknesses for the lines you draw, different colours, as well as draw easily some pre-defined shapes (squares, triangles and circles).

Touch Pad
### Storage Formats

<table>
<thead>
<tr>
<th>Floppy disks or diskettes</th>
<th>Size</th>
<th>Physical characteristics</th>
<th>Storage capacity</th>
<th>Machines using</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8&quot; diameter</td>
<td>thin, flexible paper case</td>
<td>800 K</td>
<td>not commonly used for instructional purposes</td>
</tr>
<tr>
<td></td>
<td>5½&quot; diameter</td>
<td>thin, flexible paper case</td>
<td>single-sided, double-density, approx. 140 K double-sided, double-density, 340 to 360 K double-sided, high density, 1 to 2 megabytes</td>
<td>commonly used with Apple II series, most PCs, and PC compatibles</td>
</tr>
<tr>
<td></td>
<td>3½&quot; diameter</td>
<td>stiff plastic case</td>
<td>single-sided 400 K double-sided 700 to 800 K double-sided, high density 1.4 megabytes</td>
<td>commonly used with Macintosh, Amiga, Atari ST, IBM PS-2 series, and some PC compatibles</td>
</tr>
</tbody>
</table>

**Hard disks**

| Varies—usually 5½" or 3½" | metal or metal-coated platters internal or external to the computer | 20 to 40 megabytes most common up to 360 megabytes available for some machines | available for all personal computers |

---

*Figure: 4*

The most common types of computer disks
A computer input device consisting of a flat pad with a special pen and an electronically sensitive grid. The major advantage of the touch pad is low resolution: obviously the finger is too thick to select accurately between symbols packed so closely as to use all 30 rows and 80 columns of a screen.

Joystick

An input device commonly used with microcomputer and often designed in the shape of handles. The joystick swivels in 360-degree arcs, thereby enabling users to control screen figures.

Voice Input

A method of input that allows the user to speak into a microphone attached to a digitizer. And also an alternative input device that lets you give commands or send information to a computer by talking to it.

Paddle

A paddle has a knob which can be rotated to send a varying electrical signal to the computer. The paddle handler is usually designed to display a short line on the screen, and to move it around in response to the rotation of the knob. The line in question often represents a tennis racquet or other sporting implement, and this has given rise to the general term 'paddle' for both the screen line and its
controller.

Mouse

According to David Woodhouse (1986 p.224):

A mouse is a small box with wheels or track balls underneath. Rolling a mouse across a desk or other flat surface causes the cursor to move across the screen in the corresponding direction. In practice, these devices normally come with a basic handler, and the provision for the user to extend it to determine just how the button signals will be interpreted.

2.4.2 Memory Unit

The memory unit stores instructions, data, and intermediate results. It supplies, when required, the stored information to other units of the computer. The memory unit may have one or more memory devices of the following two categories:

1. Internal storage
2. Auxiliary storage

The primary memory is the internal storage within the computer that stores the unprocessed and processed data as well as the program instructions. It is primary since it is the only memory from which the computer can access information directly and process it. It is of a limited capacity and is measured in terms of kilo bytes. The information stored in this memory is thus limited. The PRIMARY MEMORY is further divided into 2 distinct parts viz:
* ROM : Read Only Memory
* RAM : Random Access Memory.

The Rom, as the name suggests, is that part of the memory which is only 'read' by the computer. The Ram is that part of the memory, whose 'bytes' or memory locations are open and accessible to the user. If the computer is switched off, the Rom instructions still remain but the information stored on the RAM gets wiped out.

2.4.3 Control Unit

The Control Unit is the nerve centre of the C.P.U. This unit does a number of supervisory functions.

1. It directs the flow of the INPUT from the input device to the primary memory.
2. Accordingly it directs the flow of the raw data to the A.L.U. to be processed.
3. It interprets the instructions in the program.
4. It then redirects the processed data from the A.L.U. to the memory.
5. Finally it directs the flow of the meaningful information from the memory to the output device.

2.4.4 Arithmetic and Logic Unit

The A.L.U. (arithmetic and logic unit) is so named because it is actual process unit where Mathematical Manipulation, Logical and comparative analysis. Mathematical Manipulations are done simple arithmetic calculations involving addition, subtraction, multiplication and division. Log-
ical and comparative analysis are also made comparisons, e.g. 2 number and determining whether one is equal to or less than or greater than the other numbers.

The arithmetic unit, under commands from the control unit, receive information from the memory unit. In accordance with the basic rules deductive logic designed into its framework and the directions it receives from the control unit, the arithmetic unit first analyzes and rearranges the data, then carries out the sequences of arithmetic and logical operations to accomplish the defined job. Though very few rules of logic are built in, they enable us to perform long and complex sequences of operations by initially breaking these into simpler and basic ones, then representing these a requisite number of times.

2.4.5 Output Unit

The output unit receive the stored from the memory unit, converts it into a from the user can understand and, through the aid of one or more output devices, prints or produce it in the desired format. Some of the output devices generally used are Line Printer, Graph Plotter, Visual Display, Card Punch and Paper Tape Punch, Microfilm, Audio response, and Robots etc.

Line printer

A popular output device, the line printer provides a printed copy of the result and program listing which are easy to read and convenient for subsequent reference. The impact
type of line printer which is often used can print 300-1400 lines per minute, each line consisting of 96, 120, 132, 144 or 160 character positions.

Some printers have whole print characters. Some, however, have a matrix of wires, each of which can print a dot on the paper. These are called dot-matrix printers. According to Lan Scales:

**LASER PRINTER:**
A printer that uses a laser beam to write dot matrix characters on specially treated computer paper. The laser printer offers higher resolution than many other forms of printing, and is much quicker like the electrosensitive printer, the laser printer `burns` rather than `inks` its messages on to paper.

**Graph Plotter**
A graph plotter is useful when a graphic or pictorial representation of the result is more meaningful and easier to interpret and use than an extensive alphabetic, numeric, or alphanumeric listing. A common form of this device makes use of a pen which moves on a graph paper, at a speed of 600-18,000 steps per minute.

**Visual Display Unit**
The visual display unit is used when the output information is to be displayed on the CRT. For example, it may be used to display data graphs and all types of designs to a viewing manager, engineer, or scientist. This device provides almost instantaneous response and can display 250 to 10,000 characters per second.
The EPL 5200 Laser Printer sets new standards with its superb print quality, speed and versatility.

- Resolution Improvement Technology (RIT) for smoother, sharper output.
- Micro Art Printing for blacker blacks.
- Fast 6 pages per minute throughput.
- First print time of < 20 seconds.
- Multiple emulations - PCL 5, FX, LQ and Epson GL - 2.
- Shareable with upto 3 users.
- User friendly with small foot print
- Original Adobe Postscript upgrade with Intelligent Emulation Sensing (IES)
- 6000 page long life Toner cartridge.
Card Punch and Paper Tape Punch

When output information is to be recorded on cards or paper tape for use as input data, either a card punch or a paper tape punch may be used. The card punch has a set of punches which, according to the instructions it receives, mechanically punch holes on a blank card. Once this operation is over, the card punch punches at a slow speed, viz., 100-500 cards per minute. In a paper tape punch the punch, the punching operation is similar to that in a card punch except that only one character at a time is punched. Therefore its punching speed is only 20-500 character per second.

Microfilm

The computer output microfilm device is very expensive and specially made for extensive computer users. Information stored on magnetic tapes is made into miniature images on the microfilm. The information is displayed as characters on the VDU and by using a photographic methods, it is recorded on to a film, usually 16-35 mm roll film. Drawings, picture and narrative text, on a full display (equivalent to a page of line punch output), is recorded as a single frame. A special readed of recording is 25-50 times faster than the average line printer.

Audio Response Unit

Transient information, or any information that needs to be converted only once, could be utilised in such a manner
that the OUTPUT can be retrieved by an AUDIO RESPONSE UNIT. Here, the messages have to be composed and transmitted in coded over telephone lines through a Voice Input system or by using a keyboard for input. The response is assembled from per recorded words and phrases after the input is analysed, and the response delivered clearly and more slowly than human verbal relies.

2.5 CHARACTERISTICS OF COMPUTERS

The major characteristics that make the computer such a powerful machine can be enumerated as Speed, Storage, Accuracy and Scientific approach, Versatility, Ability to Operate Automatically, Diligence etc. Let us look at each of these characteristics briefly.

Speed

The computer was invented as high speed calculator. This has led to many scientific projects which were previously impossible. The control of the moon landing would not have been feasible without computers, and neither would today's more scientific approach to weather prediction, if we want tomorrow's forecast today (and not in six months time). A powerful computer is capable of adding together two 18 digit number in 300 to 400 non records (i.e. about 3 million calculations per second).

The computer's speed at performing a single operation can
be measured in terms of Milliseconds to Picoseconds.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milliseconds</td>
<td>A thousandth of a second</td>
</tr>
<tr>
<td>Microseconds</td>
<td>A millionth of a second</td>
</tr>
<tr>
<td>Nanoseconds</td>
<td>A thousand millionth of a second</td>
</tr>
<tr>
<td>Picoseconds</td>
<td>A million millionth of a second</td>
</tr>
</tbody>
</table>

Storage

The speed with which computers can process large quantities of information has led to the generation of new information on a vast scale, in other words, the computer has compounded the information "explosion". How can people cope with it? We can't but computers can. In computers, the internal memory of the CPU is only large enough to retain a certain amount of information (i.e. it is finite). It is, therefore, impossible to store inside the computer records, for example, of every premium Bond and the names and addresses of their owners. All of this data is stored outside of the memory of the CPU, on auxiliary (or) secondary storage devices. "Small sections to the total data can be accessed (got at) very quickly by the C. P. U. and brought into the main, internal memory, as and when required for processing. The internal memory (in the CPU) is built up in 1K OR k modules, where K equals 1024 storage locations. Computers come in many size. Many small microcomputers have an 8K store whilst "super computers", such as the CDC CYBER 205 may have up to 1024K store (i.e., 1024 * 1024 locations).
Accuracy

The computer's accuracy is consistently high, errors in the machinery can occur but, due to increased efficiency in error detecting techniques, these seldom lead to false results. Almost without exception, the errors in computing are due to human rather than to technological weakness i.e., to imprecise thinking by the programmer, or to inaccurate data, or to poorly designed systems.

Versatility

Computers seem capable of performing almost any task, provided that the task can be reduced to a series of logical steps. For example, a task such as preparing a payroll or controlling the flow of traffic can be broken down into a logical sequence of operations, whereas comparing the tones of a Turner with a Vermeer cannot.

Automation

A computer is much more than an adding machine, calculator or check-out till, all of which require human operations to press the necessary keys for the operations to be performed. Once a programme is in the computer's memory, the individual instructions are then transferred, one after the other, to the control unit for execution. The CPU follows these instructions ('do this', 'do that', 'do the other', etc.) until it meets a last instruction which says 'stop program.
Diligence

Being a machine, a computer does not suffer from the human traits of tiredness and lack of concentration. If 3 million calculations have to be performed, it will perform the 3 millionth with exactly the same accuracy and speed as the first. This factor may cause those whose jobs are highly repetitive to regard the computer as a threat. But to those who rely on a continuous standard of output, e.g. quality control in the refining of oil and other chemical processes, the computer will be seen as a considerable help.

2.6 USE OF COMPUTER

The use of computer are Education, Scientific Research Meteorology, Space Technology, Engineering, Communications, Medical, Industrial and Business etc.

Education

The use of computers in schools has expanded rapidly and their presence is recognised all over as an important tool for the improvement of teaching-learning strategies in schools. The computer will be used to improve the teaching of subjects such as Physics, Mathematics, Environmental Science etc. The computer should be used to provide information and motivate learning through the use of animation and graphics. The intention is not to replace/displace the teachers but to
enhance the ability of the teachers to educate more effectively.

According to NCERT Computer CLASS Project5 (1990 p. 105): Computers are used to help the students to learn, when used for this purpose, we call it Computer Assisted instruction (CAI). Programs are created to assist both the teacher and the students. A student, for example, could use the machine and practice Maths, Spellings, Science of Comprehension. He might use the computer to revise his literature course, or the teacher might use it in the literature classes to do a mathematic study of some aspect of the book. The different approaches in CAI programs are Drill and Practice, Dialogue, Simulation, Educational Game Approach, Problem Solving and Discovery Learning etc.

Drill and Practice

This approach promotes acquisition of knowledge or skill through repetitive practice. The LENSES package is an example of such activity which reinforces the relationship between different parameters controlling the formation of an image when an object is placed in front of a lens.

Dialogue

This approach consists of emulating the interaction process between teacher and learner. The dialogue approach can be further classified into the following two categories:

1. The tutorial approach consists of making available
curricular material to a learner in the form of several modules-each is addressed to a specific concept. In this approach the computer controls the process of learning.

2 The enquiry approach is the same as the tutorial in several aspects except that the computer analyses the responses of the learner and gives him the required information for proceeding towards the goal of learning. In this approach, the learner controls the dialogue.

Simulation

Simulation is used as a controlled representation of real world phenomena. It is useful in instructional situations wherein real world experiences are either not available, or are expensive, or involve an element of risk. Task performance simulation is designed to assist the learner in acquisition of skills related to the successful completion of a specific task. System modelling simulation is used to assist the learner in acquisition of information leading to development of insight and understanding about the system. Experience simulation is useful in exposing the learner to ideas and experiences otherwise not available. This helps a learner to gain an intellectual appreciation of real experiences.
Educational Game Approach

The game approach is usually found to facilitate rapid learning and longer retention because the learners are better motivated. A game may be defined as a goal-oriented activity to be completed by the skilful application of a set of rules. For example, ENGLISH SPELLING, BATBALL and NUMBER etc.

Problem Solving

The problem solving approach can be fruitfully employed to exploit speedy processing of the information capability of the computer. The packages using this approach are REKHA, PLOTTING GRAPH, and PROBLEM SOLUTION etc.

Discovery Learning

Discovery learning places a learner in structured environments and makes available different modes of exploring, analysing and mastering new concepts and principles. The package MALTHUS exposes learners to situations relating to availability of natural resources as a consequence of population growth when he chooses different values of parameters.

Scientific Research

Almost every branch of science and engineering has benefited from computer development. Elementary patical Phydics is one field of study which has been broadened considerably.
Molecular biology is another, resulting in spectacular progress in our understanding of the structure of living matter. Because of the immensity of some of the research problems, huge computer complexes are sometimes needed.

Meteorology

Meteorology, as a science, is relatively young and, with assistance, it has become much more of an exact science. The problem with meteorology has always been to obtain sufficient data, and to analyse that data quickly enough so that predictions can be made. Weather is observed and data collected by human observers working at land stations and on weather ships, and by automatic weather stations on land and sea. Data is also recorded at different levels of atmosphere. The computer system is also able to analyse vast quantities of past measurements to test for weather patterns and, based partly on these results, long-range forecasts can be made.

Space Technology

The development of space technology which culminated in the first moon landing was only possible because of the calculating powers and speed of the computer. Computers were used at the design stage of the project and in all phases of development right through to flight control. For example, they monitored and helped to control the proper functioning of all the equipment; they helped determine the
routes and kept surveillance during the flight; they plotted courses of action when unforeseen events occurred; and, finally, they processed information relayed from the space vehicles. Computer-linked space satellites provide previously unavailable about the universe around us.

Engineering Design

Computers can help in calculating that all parts of a proposed design are satisfactory as well as assisting directly in the design. If modifications are necessary and further calculations are required, the computer can evaluate the alternatives more quickly and more accurately than would otherwise be possible. This means a great saving in time and elimination of technical faults and human error, before a design is further developed.

The application of computers to design is known as CAD (Computer-aided Design) and, where it applies specifically to engineering, it is often referred to as CAE (Computer-aided Engineering). CAD/CAE software typically needs to be able to contend with all these tasks as well as handling all the calculations that are involved in proving a design.

Communications

Air traffic control, which is responsible for organizing the safe movement of our crowded airlines, depends on a significant amount of computer support. Computer-controlled seat reservation brings benefit to customers and to the
airlines. Computerized telephone exchanges handle an ever-increasing volume of calls. By way of satellites, calls, S.T.D., FAX and Computer network calls also be transmitted at faster speeds than through conventional networks.

Medical

The computer being used increasingly in hospital administration. In intensive care unit, a computer can be used to monitor a patient's condition. The computer may assist in medical diagnosis, for example programmes exist which can carry out electro-cardiogram analysis to determine both normal and abnormal heart conditions. The computer has an important part to play in medical research and in teaching doctors and nursing staff.

Industrial Application

Several professional societies have been formed within the computer industry. These societies perform such tasks as distributing information to member education, encouraging student-chapter activities, raising money for scholarships, supporting state and federal legislation relating to computer, raising public awareness of important computer issues, and furthering professional goals.

Business application

A Business information system is a set of manual and/or computerized components for gathering, storing and process-
ing business data and for converting such data in to useful, decision oriented information.

2.7 COMPUTER IN EDUCATION

The learning process can be enriched in many subjects because of the scale and range of information which a computer data bank can provide. Use is increasingly being made of the computer as a resource in teaching and learning at all level of education. Instructional material can be prepared and stored within the computer system in the form of programs which are carefully structured to teach specific lesson. A student could then sit at a teletypewriter terminal or VDU and call in the program and participate in the lesson. This form of teaching aid has been used successfully to supplement more formal teaching methods and can be particularly useful remedial purposes. A program can be used by many students, thus freeing the teacher to spend time on more personal tuition.

In the National Policy on Education (1986) and its programme of Action (POA), emphasis has been laid on decentralised educational planning i.e. level education planning with district as its basic unit. But if we look at the available education allied statistics at district level, information are available only on few items. There is hardly any time series data which is a must for any meaningful planning. Secondly, whatever information is available at state or natio-
national level is a time large of about 7 to 8 years. The situation at the district level in this regard is more severe. At the national level, the district level latest information is available for the year 1977-78 and for few states for 1981-82. In order to reduce time lag in educational data and for proper dissemination of education information proper management information system (MIS) should be developed and computerised network should be established in all the 441 districts of the country. The EMIS at each district should be linked with the EMIS at state and national level so that the district level information could immediately reach at the state and national headquarters.

Recently Development of Education Ministry of Human Resource Development has started computerization of education statistics at the state level.

2.7.1 Algorithms and Flowcharts

Algorithms

An Algorithm is a set of instructions giving a step by step description of the various procedures to be followed to accomplish a particular task.

An algorithm is a stepwise and logical solution to a problem, taking into account all the possible alternatives.

An algorithm can derive following steeps.
1 It is a stepwise list of instructions.

2 It is manually done on paper with pen/pencil by the person.

3 It is easy to write since it is in a language that we use for our everyday communication.

Example

In a certain school, number of students attending the classes form Monday to Saturday was 200, 450, 555, 650, 525 and 530 respectively. What is the average attendance during the week?

Algorithm Steps

Step 1 Initialize the value of SUM and AVE by zero.
Step 2 Read the value of Monday to Saturday $X_1, X_2, X_3, X_4, X_5, X_6$.
Step 3 Read the value of total number of days "N".
Step 4 Add SUM to $X_1, X_2, X_3, X_4, X_5, X_6$.
Step 5 Divide SUM of present students by N and store resultant value in AVE.
Step 6 Print AVE.
Step 7 Stop

The flowchart of this example is shown in Appendix no.2.

Flowchart

According to Computer Dictionary®:
1. An exact prescription defining a computational process leveling from various initial data to the derived result.
2. A list of instructions specifying a sequence of operations which give the answer to any problem of a given type.
3. Any unambiguous plan, telling how to carry out a process in a finite number of steps, school of Mathematics.
5. Refers to a graphic representation of the sequences prepared to solve a problem.

Thus, flowchart is a diagram that uses symbols and interconnecting lines to show the logic and sequence of specific program operations (program flowchart) or a system of processing to achieve objectives (system flowchart).

2.7.2 Programme

Series of instructions that will cause a computer to process data. It may be in a high-level source form, which requires intermediate processing before the computer can execute it or it may be in an object form directly executable by the computer.

A program is a collection of certain statements of steps. These statements can be written in any language i.e. BASIC, COBOL, FORTRAN etc. There are various kinds of programmes
available, but we shall discuss system Programe and its components only. Its components are Compiler, Assembler, Monitor, Control Programme and Micro Processor. A Compiler is a program (Systems programme) which translates one programming language into another programming language. Whereas Source Program is a program which is not understood by machine and which needs further translation but Object Programs are understood by the machines and needs no further translation. Loader is a program which loads an Object program into computer memory.

There are various kinds of loader available. One of the important components of systems program is Operating System (OS). It is collection of various program which act as an interface between the user and the machine.

If result are unsatisfactory it may be because of incorrect input data, Algorithm (procedure) is incorrect, mistakes in logic or due to mal functioning of the system.

2.7.3 Data Processing And Files

Data Processing

"Data Processing" - A phenomenon that has come to play a vital role in modern life. DATA refers to the collection of unarranged facts and figures that need to be manipulated to give them a meaningful connotation. Data can originate in and are a record of any event, activity or situation. DATA AND INFORMATION: Data, as stated earlier, is merely a
collection of raw facts. Once manipulated and processed according to certain requirements, they form a desired output which serves some purpose. These resultant facts are known as "Information."

Data Processing refers to the summation of activities and operations involved in manipulating raw data to provide information. Major Electronic Data Processing components are those of Hardware, Software, Firmware, Liveware. Commonly used processing modes are those of batch processing, real time and time sharing.

File

A File is a collection of information that is recorded and maintained for further use. In data processing, files can be of 2 kinds viz; "Program files" (which-record and maintain program listings) and "Data files" (which-record and maintain a collection of related information).

\[
\text{Consist of} \quad \text{FILES} \rightarrow \text{RECORDS} \rightarrow \text{FIELDS} \rightarrow \text{CHARACTERS}
\]

FILE ORGANIZATION refers to the arrangement of data on a file of which the two commonly used ones are the sequential and Random files. The BASIC statements associated with file handling are as, OPEN "O", OPEN "I", OPEN "A", WRITE #, INPUT #, EOF, CLOSE # etc (for IBM Computers).