CSC 101 - Introduction to Computer Science

Course Note

What is Computer

Computer is an electronic device that is designed to work with Information. The term computer is derived from the Latin term 'computare', this means to calculate or programmable machine. Computer cannot do anything without a Program. It represents the decimal numbers through a string of binary digits. The Word 'Computer' usually refers to the Centre Processor Unit plus Internal memory. Charles Babbage is called the "Grand Father" of the computer. The First mechanical computer designed by Charles Babbage was called Analytical Engine. It uses read-only memory in the form of punch cards. Computer is an advanced electronic device that takes raw data as input from the user and processes these data under the control of set of instructions (called program) and gives the result (output) and saves output for the future use. It can process both numerical and non-numerical (arithmetic and logical) calculations.

Digital Computer Definition

The basic components of a modern digital computer are: Input Device, Output Device, Central Processor Unit (CPU), mass storage device and memory. A Typical modern computer uses Large Scale Integration (LSI) Chips. Four functions of computer are to accept data (input), process data (processing), produce output and store the results. Input is the raw information entered into a computer from the input devices. It is the collection of letters, numbers, images and so on. Process is the operation of data as per given instruction. It is totally internal process of the computer system. Output, also known as the result, is the processed data given by computer after data processing. Results can be saved in the storage devices for future use. Basic characteristics of computer are:

1. Speed: Computer can work very fast. It takes only few seconds for calculations that we take hours to complete. You will be surprised to know that computer can perform millions (1,000,000) of instructions and even more per second. Therefore, we determine the speed of computer in terms of microsecond (10-6 part of a second) or nanosecond (10 to the power -9 part of a second). From this you can imagine how fast your computer performs work.

2. Accuracy: The degree of accuracy of computer is very high and every calculation is performed with the same accuracy. The accuracy level is determined on the basis of design of computer. The errors in computer are due to human and inaccurate data.

3. Diligence: A computer is free from tiredness, lack of concentration, fatigue, etc. It can work for hours without creating any error. If millions of calculations are to be performed, a computer will perform every calculation with the same accuracy. Due to this capability it overpowers human being in routine type of work.

4. Versatility: It means the capacity to perform completely different type of work. You may use your computer to prepare payroll slips. Next moment you may use it for inventory management or to prepare electric bills.

5. Power of Remembering: Computer has the power of storing any amount of information or data. Any information can be stored and recalled as long as you require it, for any numbers of years. It depends entirely upon you how much data you want to store in a computer and when to lose or retrieve these data.

6. No IQ: Computer is a dumb machine and it cannot do any work without instruction from the user. It performs the instructions at tremendous speed and with accuracy. The user decides what to do and in what sequence. So a computer cannot take decision independent of the user.

7. No Feeling: It does not have feelings or emotion, taste, knowledge and experience. Thus it does not get tired even after long hours of work. It does not distinguish between users.

8. Storage: The Computer has an in-built memory where it can store a large amount of data. You can also store data in secondary storage devices such as floppies, which can be kept outside your computer and can be carried to other computers.

Computer and its Various Components

A computer can process data, pictures, sound and graphics. They can solve highly complicated problems quickly and accurately. A computer performs basically five major computer operations or functions irrespective of their size and make. It accepts data or instructions by way of input, stores data, process data as required by the user, gives results in the form of output and controls all operations inside a computer.

Input: This is the process of entering data and programs in to the computer system. Computer like any other electronic machine takes as inputs raw data, performs some processing and gives out processed data. Therefore, the input unit of the computer takes data from us in an organized manner for processing.

Storage: The process of saving data and instructions permanently is known as storage. Data has to be fed into the system before the actual processing starts. It is because the processing speed of Central Processing Unit (CPU) is so fast that the data has to be provided to CPU with the same speed. Therefore the data is first stored in the storage unit for faster access and processing. This storage unit or the primary storage of the computer system is designed to do the above functionality. It provides space for storing data and instructions. The function of the storage unit is to store all data and instructions before and after processing. It also stores intermediate results of processing.

Processing: The task of performing operations like arithmetic and logical operations is called processing. The Central Processing Unit (CPU) takes data and instructions from the storage unit and makes all sorts of calculations based on the instructions given and the type of data provided. It is then sent back to the storage unit.

Output: This is the process of producing results from the data for getting useful information. Similarly, the output produced by the computer after processing must also be kept somewhere inside the computer before being presented in human readable form. The output is also stored inside the computer for further processing.

Control: This determines manner of how instructions are executed as well as how the operations are performed. Controlling of all operations like input, processing and output are performed by control unit. It takes care of step by step processing of all operations inside the computer.

COMPUTER FUNCTIONAL UNITS

The computer system is divided into three separate units for its operation. They are:

a. Arithmetic logical unit b. Control unit. c. Central processing unit.

Arithmetic Logical Unit (ALU)

After the entering of data through the input device, it is stored in the primary storage unit. The actual processing of the data and instruction are performed by the ALU. The major operations performed by the ALU are addition, subtraction, multiplication, division, logic and comparison. Data is transferred to ALU from storage unit when required. After processing the output is returned back to storage unit for further processing or storage.

Control Unit (CU)

The next component of computer is the Control Unit, which acts like the supervisor seeing that things are done in proper fashion. Control Unit is responsible for co-ordinating various operations using time signal. It determines the sequence in which computer programs and instructions are executed. It oversees the processing of programs stored in the main memory, interpretation of the instructions and issuing of signals for other units of the computer to execute them. It also acts as a switch board operator when several users access the computer simultaneously, thereby coordinating the activities of computer's peripheral equipment as they perform the input and output operations.

Central Processing Unit (CPU)

The ALU and the CU of a computer system are jointly known as the central processing unit. You may call CPU as the brain of any computer system. It is just like brain that takes all major decisions, makes all sorts of calculations and directs different parts of the computer functions by activating and controlling the operations. Everything computer does is controlled by the CPU and is sometimes referred to simply as the central processor or Nerve Centre or heart, but more commonly called processor.

In terms of computing power, the CPU is the most important element of a computer system. It adds and compares its data in CPU chip. A CPU or Processors of all computers, whether micro, mini or mainframe must have three elements or parts, namely primary storage, arithmetic logic unit (ALU) and control unit. Control Unit (CU) decodes the program instruction. CPU chip used in a computer is partially made out of Silica. On other words silicon chip used for data processing are called Micro

Processor.

Central processing unit (CPU) is the central component of the PC. Sometimes it is called as processor. It is the brain that runs the show inside the PC. All work that is done on a computer is performed directly or indirectly by the processor. Obviously, it is one of the most important components of the PC.

Performance: The processor is probably the most important single determinant of system performance in the PC. While other components also play a key role in determining performance, the processor's capabilities dictate the maximum performance of a system. The other devices only allow the processor to reach its full potential.

Software Support: Newer, faster processors enable the use of the latest software. In addition, new processors such as the Pentium with MMX Technology, enable the use of specialized software not usable on earlier machines.

Reliability and Stability: The quality of the processor is one factor that determines how reliably your system will run. While most processors are very dependable, some are not. This also depends to some extent on the age of the processor and how much energy it consumes.

Energy Consumption and Cooling: Originally processors consumed relatively little power compared to other system devices. Newer processors can consume a great deal of power. Power consumption has an impact on everything from cooling method selection to overall system reliability.

Motherboard Support: The processor that decides to use in your system will be a major determining factor in what sort of chipset we must use, and hence what motherboard you buy. The motherboard in turn dictates many facets of the system's capabilities and performance.

Uses of Computer

Computer is used in the following areas:

Education: Getting the right kind of information is a major challenge as is getting information to make sense. College students spend an average of 5-6 hours a week on the internet. Research shows that computers can significantly enhance performance in learning. Students exposed to the internet say they think the web has helped them improve the quality of their academic research and of their written work. One revolution in education is the advent of distance learning. This offers a variety of internet and video-based online courses.

Health and Medicine: Computer technology is radically changing the tools of medicine. All medical information can now be digitized. Software is now able to compute the risk of a disease. Mental health researchers are using computers to screen troubled teenagers in need of psychotherapy. A patient paralyzed by a stroke has received an implant that allows communication between his brain and a computer; as a result, he can move a cursor across a screen by brainpower and convey simple messages.

Science: Scientists have long been users of it. A new adventure among scientists is the idea of a "collaboratory", an internet based collaborative laboratory, in which researchers all over the world can work easily together even at a distance. An example is space physics where space physicists are allowed to band together to measure the earth's ionosphere from instruments on four parts of the world.

Business: Business clearly sees the internet as a way to enhance productivity and competitiveness. Some areas of business that are undergoing rapid changes are sales and marketing, retailing, banking, stock trading, etc. Sales representatives not only need to be better educated and more knowledgeable about their customer's businesses, but also must be comfortable with computer technology. The internet has become a popular marketing tool. The world of cybercash has come to banking - not only smart cards but internet banking, electronic deposit, bill paying, online stock and bond trading, etc.

Recreation and Entertainment: Our entertainment and pleasure-time have also been affected by computerization. In movies, computer generated graphics give freedom to designers so that special effects and even imaginary characters can play a part in making movies, videos, and commercials. In sports, computers compile statistics, sell tickets, create training programs and diets for athletes, and suggest game plan strategies based on the competitor's past performance. In restaurants, almost everyone has eaten food where the clerk enters an order by indicating choices on a rather unusual looking cash register; the device directly enters the actual data into a computer, and calculates the cost and then prints a receipt.

Government: Various departments of the Government use computer for their planning, control and law enforcement activities. To name a few - Traffic, Tourism, Information & Broadcasting, Education, Aviation and many others.

Defence: There are many uses of computers in Defence such as controlling UAV or unmanned air-crafts, use on Intercontinental Ballistic Missiles (ICBMs) that use GPS and Computers to help the missile get to the target, computers used to track incoming missiles and help slew weapons systems onto the incoming target to destroy them, computers used in helping the military find out where all their assets are (Situational Awareness) and in Communications/Battle Management Systems, computers used in the logistic and ordering functions of getting equipments to and around the battlefield, computers used in tanks and planes and ships to target enemy forces, help run the platform and more recently to help diagnose any problems with the platforms, and computers help design and test new systems.

Impact of Computers on Society

During the last decade computers have become an integral part of our daily lives. There is hardly any activity which does not make use of computers at some stage or the other. Even when someone on a holiday wishes to call a friend using his/her cell phone, he/she is using computers indirectly as messages are handled and directed by them. Similarly, on any given day, even if we are not directly working on computers on our desks, we make use of computers many times while using a mobile or a land line phone, purchasing from a modern outlet, and other such activities. Facilities such as e-mail

and web have become the life-line of our modern society as well as of the world of business.

Almost all the normal activities in present day society are controlled by computers including the functioning of offices, factories, research and development laboratories, along with development in the fields of teaching, sports, telecommunication, entertainment, etc. Activities that are closely linked with the developments in computer systems include weather forecasts, developments in science and technology, outer-space exploration, breakthroughs in medical sciences, and so on.

The term 'computer system' includes both the hardware and software. The hardware of a system consists of the physical components that are connected together to function as a computer. The working and functioning of a computer is governed by the software. All computers operate by carrying out the instructions contained in operating systems and other programs which comprise the software. The last decade has seen rapid development in computer hardware as well as software systems. As a result, the speed with which the present-day computers carry out instructions has increased tremendously. For instance, super computers are capable of carrying out trillions of instructions per second. At the same time, the costs of operations have reduced to a large extent. This has made it possible for a common man to possess a computer at home or office or shop in the form of a desktop or carry with him/her in the form of a laptop or a notebook while travelling.

CLASSIFICATION OF COMPUTERS

Computing machines can be classified in many ways depending on their purpose, baseline technology, usage, capacity or size, the era in which they were used, their basic operating principle and the kinds of data they process.

Classification by Purpose

General purpose computers are designed to perform a range of tasks. They have the ability to store numerous programs, but lack in speed and efficiency. Specific purpose computers are designed to handle a specific problem or to perform a specific task. A set of instructions is built into the machine.

Classification by Technology

This classification is a historical one and it is based on what performs the computer operation, or the technology behind the computing skill. Before the advent of any kind of computing device at all, human beings performed computation by themselves. This involved the use of fingers, toes and any other part of the body. Wood became a computing device when it was first used to design the Abacus. Electromechanical devices as differential analyzers were present in the early machines of Zuse, Aiken, Stibitz and many others. Electronic elements were equally used in the Colossus, ABC, ENIAC, and the stored program computers.

Classification by Capacity

Computers can be classified according to their capacity. The term 'capacity' refers to the volume of work or the data processing capability a computer can handle. Their performance is determined by the amount of data that can be stored in memory, speed of internal operation of the computer,

number and type of peripheral devices, amount and type of software available for use with the computer.

MICROCOMPUTERS

The microcomputer is a digital computer system that is controlled by a stored program that uses a microprocessor, a programmable read-only memory (ROM) and a random-access memory (RAM). The ROM defines the instructions to be executed by the computer while RAM is the functional equivalent of computer memory. A Microcomputer has the lowest level capacity and memories that are generally made of semiconductors fabricated on silicon chips. Large-scale production of silicon chips began in 1971 and this has been of great use in the production of microcomputers. The Apple IIe, the Radio Shack TRS-80, and the Genie III are examples of microcomputers and are essentially fourth generation devices. Microcomputers have from 4k to 64k storage location and are capable of handling small, single-business application such as sales analysis, inventory, billing and payroll.

MINICOMPUTERS

In the 1960s, the growing demand for a smaller stand-alone machine brought about the manufacture of the minicomputer, to handle tasks that large computers could not perform economically. Minicomputer systems provide faster operating speeds and larger storage capacities than microcomputer systems. Operating systems developed for minicomputer systems generally support both multiprogramming and virtual storage. This means that many programs can be run concurrently. This type of computer system is very flexible and can be expanded to meet the needs of users. Minicomputers usually have from 8k to 256k memory storage location. The PDP-8, the IBM systems 3 and the Honeywell 200 and 1200 computer are typical examples of minicomputers.

MEDIUM-SIZE COMPUTERS

Medium-size computer systems provide faster operating speeds and larger storage capacities than minicomputer systems. They support large number of high-speed input/output devices and several disk drives can be used to provide online access to large data files as required for direct access processing and their operating systems also support both multiprogramming and virtual storage. This allows the running of variety of programs concurrently. A medium-size computer can support a management information system and can therefore serve the needs of a large bank, insurance company or university. They usually have memory sizes ranging from 32k to 512k. The IBM System 370, Burroughs 3500 System and NCR Century 200 system are examples of medium-size computers.

LARGE COMPUTERS

Large computers are next to Super Computers and have bigger capacity than the Medium-size computers. They usually contain full control systems with minimal operator intervention. Large computer system ranges from single-processing configurations to nationwide computer-based networks involving general large computers. Large computers have storage capacities from 512k to 8192k, and these computers have internal operating speeds measured in terms of nanosecond.

Large computers are usually used in government agencies, large corporations and computer services organizations.

SUPERCOMPUTERS

The supercomputers are the biggest and fastest machines today and they are used when billion or even trillions of calculations are required. These machines are applied in nuclear weapon development, accurate weather forecasting and as host processors for local computer and time sharing networks. Super computers have capabilities far beyond even the traditional large-scale systems. Their speed ranges from 100 million-instruction-per-second to well over three billion.

Classification On the basis of Size

Super Computer: The fastest and most powerful type of computer. Supercomputers are very expensive and are employed for specialized applications that require immense amounts of mathematical calculations. For example, weather forecasting requires a supercomputer. Other uses of supercomputers include animated graphics, fluid dynamic calculations, nuclear energy research, and petroleum exploration.

Mainframe Computer: A very large and expensive computer capable of supporting hundreds, or even thousands, of users simultaneously. In the hierarchy that starts with a simple microprocessor at the bottom and moves to supercomputers at the top, mainframes are just below supercomputers. In some ways, mainframes are more powerful than supercomputers because they support more simultaneous programs. But supercomputers can execute a single program faster than a mainframe.

Mini Computer: A midsized computer. In size and power, minicomputers lie between workstations and mainframes. In general, a minicomputer is a multiprocessing system capable of supporting from 4 to about 200 users simultaneously.

Micro Computer or Personal Computer: Micro or personal computers include Desktop Computer (a personal or micro-mini computer sufficient to fit on a desk), Laptop Computer (a portable computer complete with an integrated screen and keyboard, generally smaller in size than a desktop computer and larger than a notebook computer), Palmtop Computer/Digital Diary/Notebook/PDAs (a hand-sized computer with no keyboard but the screen serves both as an input and output device).

Workstations: A terminal or desktop computer in a network. In this context, workstation is just a generic term for a user's machine (client machine) in contrast to a "server" or "mainframe."

Classification by basic operating principle

Using this classification technique, computers are divided into Analog, Digital and Hybrid systems.

Analog Computers: These are computers were well known in the 1940s although they are now uncommon. An analog computer accepts inputs which vary with respect to time and are directly applied to various devices which performs the computing operations of additions, subtraction, multiplication, division, integration and function generation. Numbers to be used in some calculation were represented by physical quantities - such as electrical voltages.

Digital Computers: Digital computers represent information discretely and use a binary (two-step) system that represents each piece of information as a series of zeroes and ones for calculation. They are designed to process data in numerical form and manipulate them more easily with their circuits performing directly the mathematical operations of addition, subtraction, multiplication, and division.

Hybrid Computers: These are machines that can work as both analog and digital computers. During the period from the early 1960s to the early 1970s, electronic analog computers were increasingly combined with a digital computer in hybrid systems. The idea was to combine the easy programmability of a general purpose digital computer with the ability of a large electronic analog computer to solve substantial, complex problems, notably large sets of nonlinear differential equations, or to simulate challenging spaceflights and "person-in-the-loop" situations in real time.

THE COMPUTER EVOLUTION

The computer evolution is indeed an interesting topic. Each generation of computer is characterized by a major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper, more powerful and more efficient and reliable devices.

The Mechanical Era (1623-1945)

Trying to use machines to solve mathematical problems can be traced to the early 17th century. Wilhelm Schickhard, Blaise Pascal, and Gottfried Leibnitz were among mathematicians who designed and implemented calculators that were capable of addition, subtraction, multiplication, and division. The first multi-purpose or programmable computing device was probably Charles Babbage's Difference Engine, which was begun in 1823 but never completed. In 1842, Babbage designed a more ambitious machine, called the Analytical Engine but unfortunately it also was only partially completed. Babbage, together with Ada Lovelace recognized several important programming techniques, including conditional branches, iterative loops and index variables. The US Census Bureau was one of the first organizations to use the mechanical computers which used punch-card equipment designed by Herman Hollerith to tabulate data for the 1890 census. In 1911 Hollerith's company merged with a competitor to found the corporation which in 1924 became International Business Machines (IBM).

First Generation (1946-1954)

In 1946 there was no 'best' way of storing instructions and data in a computer memory. There were four competing technologies for providing computer memory: electrostatic storage tubes, acoustic delay lines (mercury or nickel), magnetic drums (and disks), and magnetic core storage. The digital computers using electronic valves (Vacuum tubes) are known as first generation computers. The high cost of vacuum tubes prevented their use for main memory. The vacuum tube consumes a lot of power. The Vacuum tube was developed by Lee DeForest in 1908. These computers were large in size and writing programs on them was difficult.

Mark I: The IBM Automatic Sequence Controlled Calculator (ASCC), called the Mark I by Harvard University, was an electro-mechanical computer. Mark I is the first machine to successfully perform a

long series of arithmetic and logical operations. Mark I computer which was built as a partnership between Harvard and IBM in 1944. This was the first programmable digital computer made in the U.S. The machine weighed 5 tons, incorporated 500 miles of wire, was 8 feet tall and 51 feet long, and had a 50 ft rotating shaft running its length, turned by a 5 horsepower electric motor.

ENIAC: It was the first general-purpose electronic computer built in 1946 at University of Pennsylvania, USA by John Mauchly and J. Presper Eckert. It was named Electronic Numerical Integrator and Calculator (ENIAC). ENIAC contained 17,468 vacuum tubes, 7,200 crystal diodes, 1,500 relays, 70,000 resistors, 10,000 capacitors and around 5 million hand-soldered joints. It weighed more than 30 short tons, was roughly 8 by 3 by 100 feet, took up 1800 square feet, and consumed 150 kW of power.

EDVAC: It stands for Electronic Discrete Variable Automatic Computer and was developed in 1950. It was to be a vast improvement upon ENIAC, it was binary rather than decimal, and was a stored program computer. The concept of storing data and instructions inside the computer was introduced here. This allowed much faster operation since the computer had rapid access to both data and instructions.

EDSAC: It stands for Electronic Delay Storage Automatic Computer and was developed by M.V. Wilkes at Cambridge University in 1949. The EDSAC won the race as the first stored-program computer beating the United States' EDVAC by two months. EDSAC is the first computer used to store a program.

UNIVAC-1: Eckert and Mauchly produced it in 1951. It was the first commercial computer produced in the United States. The machine was 25 feet by 50 feet in length, contained 5,600 tubes, 18,000 crystal diodes, and 300 relays. It utilized serial circuitry, 2.25 MHz bit rate, and had an internal storage capacity of 1,000 words or 12,000 characters.

Limitations of First Generation Computer: They used valves or vacuum tubes as their main electronic component. They were large in size, slow in processing and had less storage capacity. They consumed lots of electricity and produced lots of heat. Their computing capabilities were limited. They were not so accurate and reliable. They used machine level language for programming. They were very expensive. Example: ENIAC, UNIVAC, IBM 650 and so on.

Second Generation (1955-1964)

The second-generation computer used transistors for CPU components and ferrite cores for main memory and magnetic disks for secondary memory. They used high-level languages such as FORTRAN (1956), ALGOL (1960) and COBOL (1960-1961). Around 1955 a device called Transistor replaced the bulky Vacuum tubes in the first generation computer. Transistors are smaller than Vacuum tubes and have higher operating speed. They have no filament and require no heating. Manufacturing cost was also very low. Thus the size of the computer got reduced considerably.

Features: Transistors were used instead of Vacuum Tube. Processing speed is faster than First Generation Computers (Micro Second). Smaller in Size (51 square feet). The input and output devices were faster. Example: IBM 1400 and 7000 Series, Control Data 3600 etc.

Third Generation (1964-1977)

This began with the development of a small chip consisting of 300 or more transistors. These ICs are popularly known as Chips. A single IC has many transistors, registers and capacitors built on a single thin slice of silicon. Some of the computers developed during this period were IBM-360, ICL-1900, IBM-370, and VAX-750. Higher level language such as BASIC (Beginners All purpose Symbolic Instruction Code) was developed during this period. Computers of this generation were small in size, low cost, large memory and processing speed is very high.

Features: They used Integrated Circuit (IC) chips in place of the transistors. Semi conductor memory devices were used. The size was greatly reduced, the speed of processing was high, they were more accurate and reliable. Large Scale Integration (LSI) and Very Large Scale Integration (VLSI) were also developed. The mini computers were introduced in this generation. They used high level language for programming. Example: IBM 360, IBM 370 etc.

Fourth Generation

An IC containing about 100 components is called LSI (Large Scale Integration) and the one which has more than 1000 such components is called as VLSI (Very Large Scale Integration). It uses large scale Integrated Circuits (LSIC) built on a single silicon chip called microprocessors. Due to the development of microprocessor it is possible to place computer's central processing unit (CPU) on single chip. These computers are called microcomputers. The personal computer (PC) that you see in your school is a Fourth Generation Computer. Main memory used fast semiconductors chips up to 4 M bits size. Hard disks were used as secondary memory. Keyboards, dot matrix printers etc. were developed. OS such as MS-DOS, UNIX, Apple's Macintosh were available. Object oriented language, C++ etc were developed.

Features: They used Microprocessor (VLSI) as their main switching element. They are also called as micro computers or personal computers. Their size varies from desktop to laptop or palmtop. They have very high speed of processing; they are 100% accurate, reliable, diligent and versatile. They have very large storage capacity. Example: IBM PC, Apple-Macintosh etc.

Fifth Generation (1991 - continued)

The 5th generation computers use ULSI (Ultra-Large Scale Integration) chips. Millions of transistors are placed in a single IC in ULSI chips. 64 bit microprocessors have been developed during this period. Memory chips and flash memory up to 1 GB, hard disks up to 600 GB and optical disks up to 50 GB have been developed. The fifth generation digital computer will be Artificial intelligence.

The Active Players in Computer Technology

Hundreds of people from different parts of the world played prominent roles in the history of computer.

The American Participation: America indeed played big roles in the history of computer. John Atanasoff invented the Atanasoff-Berry Computer (ABC) which introduced electronic binary logic in

the late 1930s. Howard Aiken is regarded as one of the pioneers who introduced the computer age. The ENIAC (Electronic Numerical Integrator and Computer) was displayed to the public on February 14, 1946, at the Moore School of Electrical Engineering at the University of Pennsylvania.

The German Participation: Konrad Zuse is popularly recognized in Germany as the father of the computer and his Z1, a programmable automaton built from 1936 to 1938, is said to be the world's 'first programmable calculating machine'. He built the Z4, a relay computer with a mechanical memory of unique design, during the war years in Berlin. The Plankalkul is the first fully-fledged algorithmic programming language.

The British Participation: The Colossus was designed and constructed at the Post Office Research Laboratories at Dollis Hill in North London in 1943. Colossus was the world's first large electronic valve programmable logic calculator. The University of Manchester Small-Scale Experimental Machine, the 'Baby' first ran a stored program on June 21, 1948, thus claiming to be the first operational general purpose computer.

The Japanese Participation: In the second half of the 1950s, many experimental computers were designed and produced by Japanese national laboratories, universities and private companies. Between the periods of 1955 and 1959, computers like ETL-Mark 2, JUJIC, MUSASINO I, ETL-Mark-4, PC-1, ETL-Mark-4a, TAC, Handai-Computer and K-1 were built.

The African Participation: Philip Emeagwali, supercomputer and Internet pioneer, was born in 1954, in Nigeria, Africa. In 1989, he invented the formula that used 65,000 separate computer processors to perform 3.1 billion calculations per second. Emeagwali is regarded as one of the fathers of the internet because he invented an international network which is similar to, but predates that of the Internet. He also discovered mathematical equations that enable the petroleum industry to recover more oil. Emeagwali won the 1989 Gordon Bell Prize, computation's Nobel prize, for inventing a formula that lets computers perform the fastest computations, a work that led to the reinvention of supercomputers.

Computer System Components

CPU: This is the central processing unit, often called simply the processor, where the actual execution of a program takes place. Since only machine language programs can execute on a computer, the word program will usually mean a machine language program.

Memory: A program's data and machine instructions are stored here during the time the program is executing. Memory consists of cells called words, each of which is identifiable by its address. If the CPU fetches the contents of some word of memory, we say that the CPU reads that word. On the other hand, if the CPU stores a value into some word of memory, we say that it writes to that word. Ordinary memory is called RAM, for Random Access Memory. There is also ROM (Read-Only Memory), which as its name implies, can be read but not written.

I/O Devices: A typical computer system will have several input/output devices, possibly even hundreds of them. Typical examples are keyboards/monitor screens, floppy and fixed disks, CDROMs, modems, printers, mice and so on.

System Bus: A bus is a set of parallel wires (usually referred to as "lines"), used as communication between components. The system bus plays a central role - the CPU communicates with memory and I/O devices via the bus. The bus is broken down into three sub-buses:

Data Bus: As its name implies, this is used for sending data. When the CPU reads a memory word, the memory sends the contents of that word along the data bus to the CPU; when the CPU writes a value to a memory word, the value flows along the data bus in the opposite direction.

Address Bus: When the CPU wants to read or write a certain word of memory, it needs to have some mechanism with which to tell memory which words it wants to read or write. This is the role of the address bus.

Control Bus: How will the memory know whether the CPU wants to read or write? This is one of the functions of the control bus. For example, the control bus in typical PCs includes lines named MEMR and MEMW, for "memory read" and "memory write."

CPU Components

The ALU (Arithmetic and Logic Unit) does arithmetic operations, such as addition, subtraction, multiplication and division, and also several logical operations. The ALU does not store anything. Values are input to the ALU, and results are then output from it.

Registers are storage cells similar in function to memory words. The number of bits in a register is typically the same as that for memory words. Some important registers include:

PC (Program Counter): contains the address of the currently executing instruction. SP (Stack Pointer): contains the address of the "top" of a certain memory region called the stack. XR (Index Register): helps programs access arrays. PS (Processor Status): contains miscellaneous pieces of information, including the condition codes. DRs (Data Registers): usually used as "fast memory," i.e. as temporary places to store data to which we need quick access. MAR (Memory Address Register): used as the CPU's connection to the address bus. MDR (Memory Data Register): used as the CPU's connection to the data bus. IR (Instruction Register): when the CPU is ready to start execution of a new instruction, it fetches the instruction from memory.

PROGRAMMING METHODOLOGY AND ALGORITHM

Programming languages are languages through which we can instruct the computer to carry out some processes or tasks. They are also designed to communicate ideas about algorithms between human beings and computers. A program is a set of codes that instructs the computer to carry out some processes. Programming is the process of writing programs.

LEVELS OF PROGRAMMING LANGUAGES

Programs and programming languages have been in existence since the invention of computers, and there are three levels of programming languages.

Machine Language: Machine language is a set binary coded instruction, which consists of zeros (0) and ones (1). Machine language is peculiar to each type of computer. The first generation of computers was coded in machine language that was specific to each model of computer. Some of the shortcomings of the machine language were: Coding in machine language was a very tedious and boring job; Machine language was not user-friendly; Debugging any set of codes is a very difficult task. The major advantage of machine language is that it requires no translation since it is already in machine language and is therefore faster to execute.

Low Level Language: This is a level of programming language which is different from the machine language. That is, the instructions are not entirely in binary coded form. It also consists of some symbolic codes, which are easier to remember than machine codes. In assembly language, memory addresses are referenced by symbols rather than addresses in machine language. Low level programming language is also called assembly language, because it makes use of an assembler to translate codes into machine language. The disadvantages of assembly language are that it is specific to particular machines and it requires a translator called an assembler. The major advantage of the assembly language is that programs written in it are easier to read and more user friendly than those written in machine language.

High Level Language: This programming language consists of English-like codes. High-level language is independent of the computer because the programmer only needs to pay attention to the steps or procedures involved in solving the problem. Some advantages of high-level language: It is more user friendly, that is, easy to learn and write; It is very portable, that is, it can be used on almost any computer; It saves much time and effort when used compared to any other programming level language; Codes written in this language can easily be debugged.

FEATURES OF PROGRAMMING LANGUAGES

There are some conventional features which a programming language must possess: It must have syntactic rules for forming statements; It must have a vocabulary that consists of letters of the alphabet; It must have a language structure, which consists of keywords, expressions and statements; It may require a translator before it can be understood by a computer; Programming languages are written and processed by the computer for the purpose of communicating data between the human being and the computer.

PROGRAMMING METHODOLOGIES AND APPLICATION DOMAIN

Procedural Programming: A procedural program is a series of steps, each of which performs a calculation, retrieves input, or produces output. Concepts like assignments, loops, sequences and conditional statements are the building blocks of procedural programming. Major procedural programming languages are COBOL, FORTRAN, C, AND C++.

Object-Oriented (OO) Programming: The OO program is a collection of objects that interact with each other by passing messages that transform their state. The fundamental building blocks of OO programming are object modelling, classification and inheritance. Major object-oriented languages are C++, Java etc.

Functional Programming: A functional program is a collection of mathematical functions, each with an input (domain) and a result (range). Interaction and combination of functions is carried out by functional compositions, conditionals and recursion. Major functional programming languages are Lisp, Scheme, Haskell, and ML.

Logic (Declarative) Programming: A logic programme is a collection of logical declarations about what outcome a function should accomplish rather than how that outcome should be accomplished. The major logic programming language is Prolog.

Event Driven Programming: An event driven program is a continuous loop that responds to events that are generated in an unpredictable order. These events originate from user actions on the screen (mouse clicks or keystrokes, for example), or else from other sources (like readings from sensors on a robot). Major event-driven programming languages include Visual Basic and Java.

Concurrent Programming: A concurrent program is a collection of cooperating processes, sharing information with each other from time to time but generally operating asynchronously. Concurrent programming languages include SR, Linda, and High performance FORTRAN.

APPLICATION AREAS

Scientific Computing: It is concerned with making complex calculations very fast and very accurately. The calculations are defined by mathematical models, which represent scientific phenomena. Examples of scientific programming languages include Fortran 90, C, and High Performance Fortran.

Management Information System (MIS): Programs for use by institutions to manage their information systems are probably the most prolific in the world. These systems include an organisation's payroll system, online sales and marketing systems, inventory and manufacturing systems, and so forth. Traditionally, MIS have been developed in programming languages like COBOL, RPG, and SQL.

Artificial Intelligence: The artificial intelligence programming community has been active since the early 1960s. This community is concerned about developing programs that model human intelligent behaviour, logical deduction, and cognition. Examples of AI programming languages are prominent functional and logic programming languages like Prolog, CLP, ML, Lisp, Scheme and Haskell.

Systems: System programmers are those who design and maintain the basic software that runs systems - operating system components, networks software, programming language compilers and debuggers, virtual machines and interpreters, and so on. The primary example of a system programming language is C.

Web-centric: The most dynamic area of new programming community growth is the World Wide Web, which is the enabling vehicle for electronic commerce and a wide range of applications in academia, government, and industry. Programming languages that support Web-centric computing include Perl, Tcl/Tk, Visual Basic, and Java.

TRANSLATORS

A translator is a program that translates another program written in any programming language other than the machine language to an understandable set of codes for the computer and in so doing produces a program that may be executed on the computer.

Assembler: This is a program that converts programs written in assembly or low-level language to machine language.

Interpreters and Compilers: These consist of programs that convert programs in high level programming language into machine language. The major difference between interpreters and compilers is that a compiler converts the entire source program into object code before the entire program is executed while the interpreter translates the source instructions line by line.

Features of Translators: They exist to make programs understandable by the computer; There exist different translators for different levels and types of programming languages; Without them, the programs cannot be executed.

The Programming Environment

The Editor: An editor allows a program to be retrieved from the disk and amended as necessary. In order to type any program on the keyboard and save the program on a disk, it will be necessary to run a program called an editor.

The Compiler: This will translate a program written in high level language stored in a text mode on a disk to the program stored in a machine-oriented language on a disk.

The Linker/Loader: A linker/loader picks up the machine-oriented program and combines it with any necessary software (already in machine oriented form) to enable the program to be run. Before a compiled program can be run or executed by the computer, it must be converted into an executable form.

ALGORITHMS

Algorithm is a procedure through which we obtain the solution of a problem. In other words, a sequence of statements that, when executed one after the other, allow one to calculate the solution of the problem starting from the information provided as input.

An algorithm is characterized by: non ambiguity (the statements must be interpretable in a unique way by whom is executing them); executability (it must be possible to execute each statement in a finite amount of time given the available resources); finiteness (the execution of the algorithm must terminate in a finite amount of time for each possible set of input data).

COMPUTER PROBLEM SOLVING STRATEGIES

Computer problem strategies are the approaches adopted for obtaining satisfactory solution to a problem. The following are the major computer problems solving strategies:

Decomposition: The first step to solving any problem is to decompose the problem description. A good way to do this would be to perform syntactic analysis on the description. We can do this in four

steps: Identify all of the nouns in the sentence; Eliminate redundant or irrelevant information; Identify all of the verbs in the sentence; Link your inputs, processes, and output.

Flowcharting: The second step in solving our problem involves the use of flowcharting. Flowcharting is a graphical way of depicting a problem in terms of its inputs, outputs, and processes. Basic elements include: Oval (start/end of a program), Parallelogram (program input and output), Rectangle (processing), Diamond (condition/looping), and Uni-directional arrows (indicate the flow of program).

PseudoCode: The final step in analyzing a problem is to step from flowchart to pseudocode. Pseudocode involves writing down all of the major steps you will use in the program as depicted in your flowchart. This is similar to writing final statements in your programming language without needing to worry about program syntax. Common pseudocode commands include: Get (get information from the user), Display (display information for the user), Compute (perform an arithmetic operation), Store (store a piece of information for later use).

Computer program development stages/phases include: requirement and specification stage, design, coding/implementation, testing, and maintenance.

SUMMARY, CONCLUSION AND RECOMMENDATION

Researching, studying and writing on 'History of the Computer' has indeed been a fulfilling, but challenging task and has brought about greater appreciation of several work done by scientists of old, great developmental research carried out by more recent scientists and of course the impact all such innovations have made on the development of the human race. It has generated greater awareness of the need to study history of the computer as a means of knowing how to develop or improve on existing computer technology.

It is therefore strongly recommended that science and engineering students should develop greater interest in the history of their profession. The saying that 'there is nothing absolutely new under the sun' is indeed real because the same world resources but fresh ideas have been used over the years to improve on existing technologies.

Finally, it is hoped that this paper is found suitable as a good summary of 'the technological history and development of computer' and challenging to upcoming scientists and engineers to study the history of their profession.