BACHELOR OF ARTS

CSB-1101

FUNDAMENTALS OF COMPUTER SYSTEM AND AUTOMATION

CENTRE FOR DISTANCE AND ONLINE EDUCATION

MANGALAYATAN
UNIVERSITY
ALIGARH
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BACHOLOR'S OF ARTS (B.A.)

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Block I: Introduction To Computer & Storage Devices

Unit 1: Brief history of development of computers, computer system concept, characteristics, capabilities and limitations, types of computers.

Unit 2: BIOS, Software, Hardware, Firmware, Booting files & Directory system. Data, information and their need, Levels of information, Quality of information, Comparison of manual & electronic storage of data,

Unit 3: Organization of data as file, Use of information in data processing systems, various data processing methods.

Unit 4: Primary Storage: Storage locations and addresses, storage capacity, RAM, ROM, PROM, EPROM, Cache memory.

Unit 5: Secondary Storage: Sequential & Direct Access devices, Punched paper devices Magnetic tape, Magnetic Disk, Floppy Disk, Optical Disk, Magnetic Bubble Memory.

Block II: Input-Output, Operating System & Office

Unit 6: Input-Output devices: Keyboard, Pointing Devices: Mouse Trackball, Touch pad, Track point, Joystick, Touch Screen, Scanner, Barcode Reader, Optical Mark Reader.

Unit 7: Basic Elements, Functions and Types of Operating System, Serial Processing, Multi-Programmed, Batch System.

Unit 8: Time Sharing Systems, System Components, Operating System Services, Interrupts, Interrupt Processing,

Unit 9: MS-Office, Introduction to MS-Word menus shortcuts, create a word document, opening a file-saving, editing text documents, cut, copy, paste, formatting a document, alignments, font styles, indents. Creating tables – merging, splitting, drawing-shapes, picture tools, mail merge, spell check.

Unit 10: MS-Excel, Introduction, working spread sheets, formatting spread sheets, creating charts, formula usage.

UNIT 1 BASIC DEVELOPMENT OF COMPUTER SYSTEM & CAPABILITIES

Structure

1.0 INTRODUCTION

This unit introduces you to a computer programmable device created to autonomously

execute arithmetically and logically to the procedures sequentially based on user-provided input, ultimately producing the desired output after processing. Computer components can be broadly categorized into two main groups: hardware and software. Hardware states to the corporal machine and its associated peripherals, including items like the monitor, keyboard, and mouse. On the other hand, the software comprises a collection of programs which utilizes the hardware to perform out and assortment duties.

1.1   OBJECTIVES

After completing this unit, you will have gained the following abilities:

- Acquaint yourself with the fundamental characteristics of computers.
- Recognize and identify the basic components that make 55 up a computer system.
- Explain the significance of various units within a computer system.
- Distinguish between system software and application software, understanding their respective roles and functions.
- Elaborate on the importance of the operating system and how it manages computer resources and facilitates user interactions.
- Become familiar with the concept of open-source software and its implications.
- Develop an appreciation for the importance of computer security, recognizing the need to protect digital information and systems from potential threats.

1.2   INTRODUCTION TO COMPUTERS

A computer is an electrical device that can accept, store, process, and generate data. It is a flexible machine that can do a broad range of activities, from simple computations to complicated computations and automated operations. Computers are made up of both software and hardware. The main processing unit (CPU), retention, memory devices, input/output devices and different peripherals are all examples of hardware. The operating system and applications are examples of software components.

In the nineteenth century, mechanical machinery such as the analytical engine and compilation machines gave rise to computer technology. Modern computers as we understand them now first appeared in the mid-twentieth century as a consequence of technological advances like transistors and incorporated circuits. Computers are now employed in a variety of industries such as education, banking, medical care, and entertainment. They have a huge influence on how we live, work, and interact. Furthermore, computers cleared the way for a new age of game-changing technology, like internet access, cloud services, and handheld gadgets, which have revolutionized our everyday lives even further. A computer, in essence, is a technological device that

transforms raw data into helpful data. It processes input by user-provided instructions and swiftly produces the desired output.

Computers excel at performing the following functions:

- Accepting data
- Storing data
- Processing data as specified
- Retrieving stored data when needed
- Presenting results in the desired format.

1.3   ORIGINS OF COMPUTER

The source of computers could be the laborious exertions of people to tally huge records. There procedure of numeration large numbers engendered numerous system structures of counting such assumptions likely a Babylonian system of enumeration and the Greek structure of enumeration. Moreover, the Roman arrangement of counting and Indian arrangement of reckoning. Out of them all the Indian structure of counting has been acknowledged and followed by the whole world. It is the origin of the current decimal arrangement of counting 0-9.

1.3.1 **Abacus**

The "abacus" was invented over 500 centuries before in China nearly in 3000 B.C. The term abacus refers to a calculating panel. The "abacus" is possibly regarded as the earliest computer, and it has been utilized for fundamental arithmetic operations by numerous cultures from ancient times. The abacus, which is also referred as a numeration frame, device for calculating mathematical operations. Vertical wires within seven beads on every single wire make up the frame of the Chinese abacus.
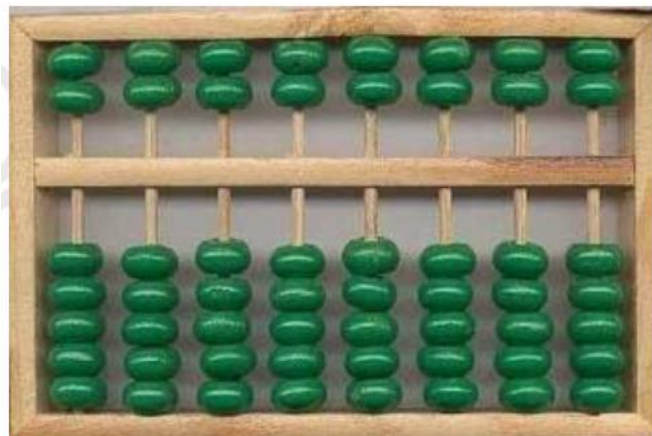
The earth and heaven beads are commonly referred as the horizontal separator that divides

the leading two beads off the bottom five. The beads are manipulated on the rack to perform mathematical computations based on their positional weight. In the present day, young children are taught how to calculate using abacuses. Calculations are possibly performed equally quickly by a proficient abacus operator as a pocket calculator.

1.3.2 Napier's Bones

Inventing logarithms was John Napier's greatest accomplishment as a math scholar. He could simplify any multiplication issue by using logarithmic functions. A mechanical method for multiplication was invented by John Napier in A.D. 1617 Napier's bones were the name given by the gadget. A group of eleven rods arranged side by side is what constitutes his 'bones' and can be used by creating numerous products and quotients. Because of their ivory composition, the rods were referred as 'bones'.

1.3.3 Pascal's Calculator

The first calculator was created by Blaise Pascal, a French mathematician. He built a machine capable of performing integer addition and subtraction when he was 19. To operate the machinery, a sequence of wheels, shifts, and cylinders were dialed in.

1.3.4 Leibniz's Dividing and Multiplying Machine

Similarly Pascal and Gottfried Leibniz was the seventeenth-century inventor who

predictable the structural value of technologies along with it was built nearly in 1673 a machine-driven tool which can do scientific computations while also saving labour.

1.3.5 Engine of Difference

Charles Babbage, a professor of mathematics in English, took the initial step towards creating computers. Early on, he discovered that all mathematical computations can be broken down into basic operations that are then continually reaffirmed, and that these processes may be carried out by an automated machine. In 1820s, Charles Babbage began working on 'Difference Engine', but after a decade, he shifted his focus to the 'Analytical Engine', which was ultimately the precursor to the computer.

Babbage's outline of the primary components of a modern general-purpose computer was founded on the finite difference method. Division and Multiplication are eliminated by using arithmetical addition, which makes it easier to implement mechanically. The computer industry refers to Charles Babbage as its father.
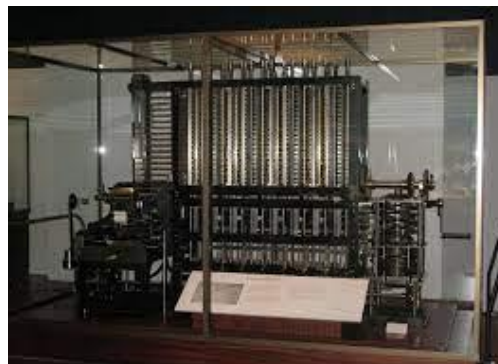
1.3.6 Analytical Engine

This engine indicates the change of calculating arithmetical numbers to computing general-purpose data. The advancement of it was only possible by Charles Babbage's contributions. This machine was designed on the belief that there is a constant difference between values for certain formulas. There are several important components in the Analytical Engine,

current digital computers that has been created.

Both the 'Store' (memory) and 'Mill' (processor) were utilized in the engine to store values and moderate results, and both were separated for performing arithmetical processes. The internal merchandise of four arithmetic functions is sufficient for undeviating division and multiplication. Controlled branching, looping (version), microprogramming, batch processing, grasping, and polling were among the functions it could accomplish. During the electronic age, the logical structure of the Analytical Engine's logical structure was nearly identical to that of the reigning supreme in computer design.
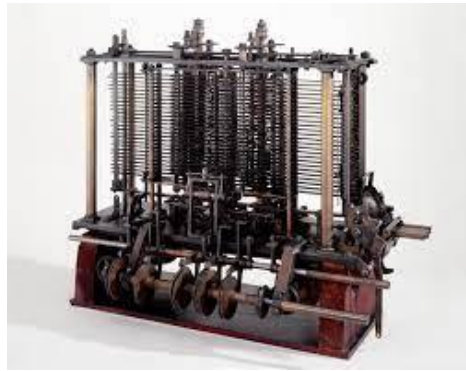
1.4   FUNDAMENTALS OF COMPUTER SYSTEM

Numerous input devices are used by a computer to receive input. The computer executes the various actions requested after getting the entered data by the user. At the end, the computer produces the outcome of the processed data via various output devices. As a result, a computer is the data-processing device. This section will explain computers, their history, and explanations of their numerous components, programs, and contemporary technology platforms.

1.4.1 Define Computer

All the necessary hardware and software components to enable user functionality are present in a computer, making it a fundamental and operational system. The electronic device is a device that takes input data, processes it according to pre-established instructions, and then displays the results on the screen. That CPU, which is also referred as the Main Processing Unit, handles the core computer processing and acts as the system's brain. An electrical circuit executes computer programs, which are makeup of instructions.

*There are many key components that make up the block diagram of a computer.*
The Arithmetical and Logical Unit in charge of carrying out calculations and making decisions with logical and arithmetical expressions.

Control Unit (CU): The timing and control unit supervises and manages the overall operations conducted within the computer system, ensuring that they occur in a coordinated and controlled manner.

Registers: Registers are tiny, high-speed memory units embedded within the CPU. They are responsible for storing the current data and instructions being processed by the CPU.

Memory Unit: This unit serves as the storage component of the computer system, responsible for storing program statements and data, both temporarily and long-term.

Input and Output Unit: The input and output unit is responsible for sending and receiving data, allowing the computer to interact with external devices and presenting information to the user, typically through a display.
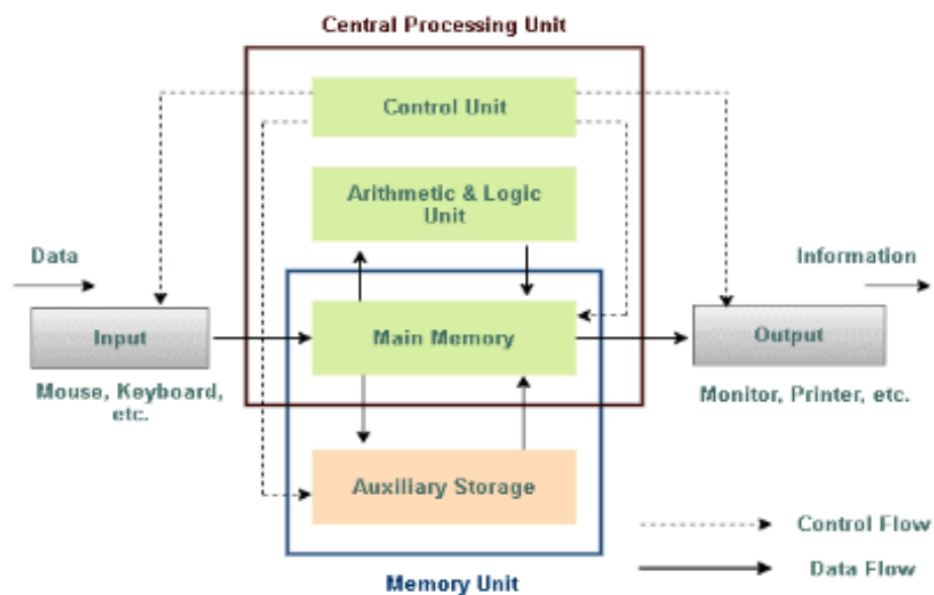
1.4.2 Characteristics of Computer

Information that is unprocessed is handled by a computer, which is a rapid electrical device that conducts computation and logic and creates outputs. Computers have been integrated into almost every aspect of our lives in the modern era, with applications that span various fields. In computing, different attributes can be present in computer systems depending on their size, capacity, and specifications. Computers have several essential traits that can be broadly categorized into their key characteristics. Let's discuss the qualities of computers.

Speed: Computers excel in the realm of mathematical calculations, outpacing humans in both speed and accuracy. Their ability to process millions (1,000,000) instructions per second, accomplishing operations in just a few microseconds and nanoseconds is remarkable. Computers are indispensable time-saving devices because they quickly

complete many calculations and tasks within seconds, which would otherwise take humans hours to solve. Gigahertz (GHz) and Megahertz (MHz) are commonly used to measure the speed of a computer, which quantifies how quickly it can execute instructions and operations.

Diligence: Humans are limited in their capacity to work continuously for extended hours without the need for rest, while computers exhibit an inherent advantage in their tireless operation. The capacity of computers to perform millions of calculations per second with absolute precision is remarkable, and they do so without any need for breaks. They operate without fatigue or lapses in concentration while completing an extensive array of tasks and calculations with consistency and accuracy. Furthermore, their memory capacity is much greater than that of humans, which further enhances their capacity to handle and process information efficiently.

Reliability: Computers are known for their reliability. When given the same input, they consistently produce the same output without any deviation. The output is completely dependent on the input given. The output will be unchanged if the input stays constant, in other words. Computers are highly consistent and produce identical results for identical sets of data. The computer ensures that the output is consistent and reliable, regardless of the input being provided once or multiple times.

Automation: The world is rapidly advancing towards technology based on Artificial Intelligence (AI). Once they are programmed with specific instructions, computers equipped with AI can carry out tasks autonomously. The need for thousands of human workers in various processes can be replaced by this automation feature. The use of programs, scripts, batch processing, streamlining, and expediting a wide range of tasks and operations is a common way to achieve automation in computing.

Versatility: Versatility is a key attribute of computers, signifying their ability to perform a diverse range of tasks with consistent accuracy and efficiency. The versatility of computers lies in their ability to handle multiple tasks simultaneously. While listening to music, it's possible to work on a project with software like PowerPoint and WordPad, or engage in tasks such as website design. Computers are indispensable for various applications in our daily lives due to their adaptability and multitasking capability.

Memory: Computers possess the capability to store an extensive number of records, and these records can be accessed with absolute precision. The memory storage capacity of a computer is typically measured in units such as Bytes, Kilobytes (KB), Megabytes (MB), Gigabytes (GB), and Terabytes (TB), reflecting the vast amount of data they can handle.

Primary memory is a built-in memory in a computer that plays a crucial role in data storage and retrieval.

Accuracy: When a computer undertakes a computation or operation, the likelihood of errors occurring is minimal. Computer system errors are often caused by humans entering incorrect or flawed data. Their reputation for accuracy and efficiency is attributed to computers' ability to conduct an array of operations and calculations swiftly and with a high degree of precision.

1.4.3   Computer Organisation

There is a range of computers available in various sizes, shapes, and weights. Different types of jobs are performed by them due to their size and shape. They can be categorized in different ways. Computer architects who are qualified and meet specific requirements are responsible for designing the computers. Computers used in hospitals and homes have different sizes and shapes. In the sections following, there is going to be a discussion about the many computer classifications. The capacity of an advance computer is determined by its ability to handle work or data processing. These are criteria's that are utilized to assess their performance:

1. The amount of information which can be stored in memory.

2. The computer's internal operations are at a fast pace

3. The quantity and variety of peripheral devices.

4. The computer has various software alternatives from which to pick.

The physical size of computers in the past had a significant impact on their capacity: greater the size, the higher in volume. The ratio in computer terminology, dimensions and rate of operation is currently in proportion. Recent technology has led to the production of smaller machines, which allows for the packaging of similar speed and versatility packaged in a lesser footprint.

Micro Computers: The advent of mass-produced silicon chips since 1971 marked a transformative era in technology, enabling the integration of computational capabilities into diverse machines. Microcomputers powered by silicon chips underwent large-scale integration, revolutionizing their functionality. Remarkably, these chips condensed computing power into minuscule proportions—a microprocessor fitting through the eye of a needle became a testament to this advancement. Silicon chip fabrication became integral to the development of microcomputer memories, utilizing semiconductors. These microcomputers functioned through a combination of microprocessors, programmable ROM, and RAM, orchestrating stored program control in digital computer systems. Today,

these microcomputers, colloquially known as personal computers or PCs, have become ubiquitous, offering small, cost-effective solutions for personal and professional use in homes and offices.

Mini Computers: The technological strides made in the 1960s ushered in an era where manufacturers could cater to the rising demand for standalone machines like the minicomputer, filling the void for tasks that larger computers couldn't economically handle. These systems, often dubbed as small mainframe computers, boasted superior operating speeds and expanded storage capacities compared to their microcomputer counterparts. With the prowess to support numerous high-speed input/output devices, minicomputers integrated multiple desktop drives, facilitating direct processing of extensive data files. Operating systems tailored for minicomputer systems embraced multiprogramming and virtual storage, enabling the concurrent execution of multiple programs. Their innate flexibility allowed these systems to adapt and cater to diverse user needs. Despite not matching the raw power of medium or large-sized computers, minicomputers retained their relevance, offering a balance between capability and size, proving to be an adaptable solution.

Medium-size Computers: Medium-sized computers offer enhanced operational speeds and expanded storage capacities surpassing those of smaller computer systems. In contrast to small computer systems, medium-sized counterparts excel in delivering larger storage capacities and swifter operational speeds. The augmentation of a computer's data processing capabilities through the inclusion of supplementary devices, like additional memory and peripherals, characterizes its expandability.

Large Computers: These computers epitomize unparalleled flexibility and speed, often featuring control systems demanding minimal operator intervention. The spectrum of large computer systems is vast, spanning from singular processing setups to expansive nationwide computer networks integrating large-scale machines. Internal operating speeds of large computers are measured in nanoseconds, distinguishing their rapidity, whereas smaller computers' speeds are measured in microseconds, indicating a relative differentiation in processing velocity.

Mainframe Computers: Mainframes represent colossal, multi-user systems engineered to handle millions of instructions per second and possess the capability to access vast volumes of data. They are favored by major hospitals, airline reservation systems, and large corporations due to their prowess in managing extensive data sets. With a mainframe, users can centralize storage for copious amounts of information, enabling access and processing from multiple computers dispersed across different locations.

However, individuals seeking to acquire a mainframe for personal use often find it prohibitively expensive and financially unfeasible. The cost and scale of these systems typically place them beyond the reach of individual buyers. Within the realm of computer families, mainframes rank as the second largest both in terms of capability and physical size.

Super Computers: Supercomputers stand as the pinnacle of computational power today, essential for handling immense volumes of data and unraveling complex patterns in various scientific domains. These machines play a pivotal role in critical applications such as nuclear weaponry development and precise weather forecasting. Their prowess lies in processing vast amounts of scientific data, enabling tasks like molecular modeling, climate research, weather prediction, quantum physics, and sophisticated physical simulations. With the capability to execute hundreds of millions to trillions of instructions per second, supercomputers are highly coveted, particularly by governments for their computational capabilities in diverse fields. They serve as indispensable tools for industries, aiding in product design and even finding application in the realm of animation.

Among notable examples, India's Center for Development of Advanced Computing (C-DAC) has engineered the PARAM supercomputer series, showcasing impressive processing speeds reaching up to a staggering 1 trillion instructions per second. These supercomputers epitomize the cutting edge of computational technology, enabling leaps forward in scientific research, industrial innovation, and computational intensity across numerous sectors.

1.5   GENERATIONS OF COMPUTER

Today's modern technology is a result of the evolution of computers that began in the 16th century. Over the years, the computer we use today has also undergone rapid changes. During this time period, computers went through five distinct phases known as Generations of Computers. The processing and capabilities of a new generation of computers are superior to their predecessors, and they also have different looks and sizes. The use of switching circuits determines the distinction between phases. These Generations are:

- Computers that were first generation from 1940-1956.
- Second Generation of Computer was from 1956 to 1963.
- Third Generation of Computer which ran from 1964 to 1971.
- Computers that have been in existence since 1971.
- Present-day and beyond the Fifth generation computers.

1.5.1   First Generation (1940-1956)

First-generation computers are distinguished by the use of vacuum tubes. In a fragile glass device called a vacuum tube, filaments were utilized as a source of electronics. By controlling and amplifying electronic signals, it can be done. The use of these vacuum tubes allowed for calculation, storage, and control. J. built the first electronic computer that was programmed for general purpose, which is known as the Electronic Numerical Integrator and Computer (ENIAC). Presper Eckert and John V. Mauchly is a student at the University of Pennsylvania. The ENIAC was a 30-foot long and 30 tons-long machine that contained 18,000 vacuum tubes, 70,000 registers, 10,000 capacitors, and a need for 150,000 watts of electricity. First-generation computers were too bulky in size which required a large room for installation and they used to emit large amounts of heat, so air-conditioning was a must for the proper working of computers. A compiler is responsible for translating programs written in high-level programming languages into assembly or machine language. An assembler, which is also known as an assembly language compiler, is a program that converts assembly language programs into machine language.

Von Neumann designed the Electronic Discrete Variable Automatic Computer (EDVAC) before the completion of ENIAC, which can hold both stored programs and data. Both data and instructions were quickly accessed by the computer, resulting in a much faster operation. The storage of instructions allowed computers to make logical decisions internally, which was also advantageous. Eckert and Mauchly designed the Universal Automatic Computer (UNIVAC) in 1952, which was regarded as the first computer in the world that was highly profitable.

Examples: ENIAC, EDVAC, UNIVAC-1

1.5.2 Second Generation (1956-1963)

Solid-state elements (transistors and diodes) with magnetic core memory were the foundations of the second version of computers. The transistor is comprised of material called semiconductors and has the ability to magnify a signal as well as open or close an integrated circuit. Bell Labs created transistors, which are used in all digital circuits, especially computers. Transistors superseded the cumbersome electric tubes in the first-generation computer. Transistors are similar to vacuum tubes, except that electrons are transmitted via solid materials rather than a vacuum. Transistors composed of semiconducting material regulated the transmission of electricity across the circuit. At the exact same time, they may enable computers to grow smaller, stronger, and quicker. They are less costly than vacuum tubes, use less electricity, and produce less heat. Production expenses were also kept to a minimum.

The computer's central processing unit (CPU), retention, programming syntax, and input and output devices were all developed during the second generation. By transitioning from

enigmatic binary machine syntax to figurative, or assembly, languages in the 2nd generation's devices, developers were able to define commands in words. These were the first systems to store programs in memory, and they switched from magnetic drum technique to magnetic core architecture. Throughout the second generation, programming languages with high levels such as FORTRAN (1956), ALGOL (1958), and COBOL (1959) were developed.

Examples: PDP-8, IBM1400 series, IBM 1620, IBM 7090, CDC 3600

1.5.3   **Third Generation (1964-1971)**

In 1964, third-generation computers were introduced. The shrinking and positioning of transistors on silicon chips, also called semiconductors, substantially enhanced the effectiveness and productivity of computers. They made use of Integrated Circuits (ICs). The invention of integrated circuits was a watershed moment in the history of computers and technology. These integrated circuits are commonly referred to as chips.

Because of the atomic structure of silicon, it is an excellent semiconductor element, and it is used as a fundamental material in the manufacture of computer chips, semiconductors, diodes made of silicon, as well as other electrical circuits and switching equipment. Silicon may be infused or combined with other elements to change its conductive characteristics, such as boron, phosphorous, even arsenic. A typical chip measuring less than 14 square inches can include millions of electrical components, including transistors. Many chips are held in computers via electronic panels that are called printed circuit boards. There are several sorts of chips. CPU chips (which are also referred to as microprocessors) can process a full system, although memory chips can only store blank memory.

A single integrated circuit (IC) is made up of several transistors, records, and resistors that are built on just a single thin sheet of silicon. Small-scale inclusion (SSI) and medium-scale insertion (MSI) are two approaches of developing integrated circuits. Core memory was replaced by the development of multilevel printed circuitry and the substitute of quicker, solid-state memories for core memory. IC technology was additionally referred to as microelectronics technology due to its ability to incorporate numerous circuits onto a single chip.

Machines of this generation are tiny in size, low in cost, have a large amount of memory, and have extremely rapid processing speeds. More advanced languages that include Basic (Beginners All-purpose Symbolic Instruction Code) were created during this time period. The most significant benefits of this generation comprised solid-state circuitry, enhanced secondary storage devices, along with new input/output devices. The additional circuitry boosted the computer's speed. Mini computers were developed as well during this age. NCR 395, B6500, and IBM 360,370 are a few examples. Arithmetic and logical processes

might now be completed in microseconds or possibly nanoseconds.

1.5.4   Fourth Generation (1971-Present)

The use of large scale integration (LSI) in the design of computing parts resulted in the introduction of fourth-generation computers in 1971. LSI circuits are created on a silicon device known as a microprocessor. A microprocessor has the circuitry required to execute arithmetic, logic, and control operations on a single chip. Because of microprocessors, the fourth generation has higher computation capability than equivalent-sized third-generation computers. The advancement of microprocessors has allowed the central processing unit (CPU) of a computer to be housed on just one semiconductor. These machines are known as microcomputers. LSI circuits were widely superseded with VLSI circuits in the past. What used to take up an entire room in the first generation may now fit in the palm of your hand. The Intel 4004 microprocessor, designed in 1971, integrated all the parts of a computer, from the main processing unit and storage to the input/output controllers.

The key advancements of this generation were microelectronics and other computer technologies like as multiprocessing, multiprogramming, time-sharing, fast operation, and cloud storage. During this time, high-speed vector processors altered the high-performance computing paradigm. Microcomputers and workstations were installed in the majority of time-shared mainframe systems. As a result, the computer that used to take up a lot of room may now be placed on a table. The personal computer is a fourth-generation computer. Throughout this time period, networks of computers evolved.

Examples: Apple II, Alter 8800

1.5.5   Fifth Generation (Present-Beyond)

Despite being in the early stages of research, fifth-generation computers powered by artificial intelligence have already been employed for some applications such as speech recognition. AI is a branch of computer science which is focused on teaching robots to act like humans and giving them the ability to make their own judgments. At the moment, computers cannot fully display artificial intelligence (i.e., they cannot replicate human actions). The gaming industry has seen the most improvements. The greatest computer chess systems can currently defeat humans. Artificial neural networks are the most rapidly expanding branch of computational intelligence, and they are proven to be useful in a variety of applications such as speech recognition and processing of natural languages. Because AI languages are usually used for AI applications, they are often referred to as programming languages. LISP and Prolog are the two most common. Computers in the fifth generation are highly fast. In the research and development of fifth-generation computers, parallel processing became the major focus of developers. Until now, parallelism had been restricted to pipeline construction and vector computations. This

generation saw the introduction of machines with hundreds of processors, allowing them to operate on various sections of a single program. The creation of increasingly powerful computing devices is still continuing. It is projected that a computer of this type would be able to speak with its user in natural spoken language, maintain large knowledge libraries, search through these databases quickly, make intelligent judgments, and generate logical conclusions.

1.6   Integrated Circuits

In today's environment, incorporated circuits (semiconductor devices having several transistors integrated into a single physical component) are common. An electrical circuit has thousands or millions of linked components such as diodes, transistors, and other semiconductor devices and resistors. They are commonly referred to as ICs. These can be discovered on computers in a variety of places. For example, most individuals have probably heard of a microprocessor. The microprocessor, known as an incorporated circuit that processes all of the data in the computer.
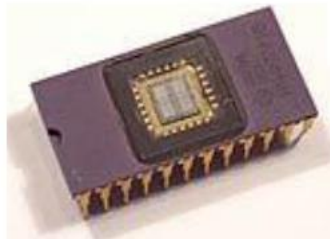
It keeps track of which keys are pushed and when the mouse is moved. Numbers are counted, and applications, games, and the computer's operating system are run. The initial integrated circuits (ICs) were designed on small-scale inclusion (SSI) transistors with approximately 10 devices per circuit (or "chip"), which expanded to the usage of medium-scale integrated (MSI) circuits with up to 100 devices per chip. Integrated circuits are found in almost every contemporary electrical equipment, including automobiles, television sets, CD players, cellular phones, and so on. The key benefits associated with integrated circuits are lower prices, higher reliability, and less requirement for space.

1.6.1   Electric Circuits

The integrated circuit is just a sophisticated electrical circuit. An electric circuit is made up of several electrical elements that are linked through different ways, such as transistors, resistors, capacitors, and diodes. Electrons can flow indefinitely via an ongoing network of

conductive substance. When a circuit is interrupted, continuous electron flow is impossible because the conductive parts no longer form a full route. The transistor functions as a switch. It has the ability to turn on or off energy as well as enhance current. It is used to store information in computers.

By regulating the flow of electricity via the resistor, we may regulate the amount of current that is permitted to pass. Resistors, among other things, can be used to adjust the loudness of television sets or radios.

The capacitor collects electricity and quickly releases it. When specific circumstances are satisfied, the diode prevents electricity from passing and only enables it to pass when those requirements change. When a fractured light beam activates a photocell, the diode blocks the flow of electricity.

1.6.2 **Transistor Vs. Vacuum Tube**

The transistor is fundamental to the creation of contemporary computers. Before the transistor, engineers utilized vacuum tubes. The vacuum tube, like the transistor, can turn electricity on or off or magnify a current. So, why did the vacuum tube give way to the transistor? There are various causes for this. The behaviour and look of a vacuum tube are quite similar to those of a light bulb; it creates an abundance of heat and eventually burns out. Furthermore, in comparison to the transistor, it is sluggish, large, and unwieldy. When engineers attempted to design sophisticated circuits, the vacuum tube's limits became clear. The first digital computer, the ENIAC, was a gigantic machine that measured over thirty tons and consumed 200 kilowatts of energy. Due to the constant burning out of approximately 18,000 vacuum tubes, it became very unreliable. The transistor's invention in 1947 was seen as a revolutionary invention. The vacuum tube was quickly replaced thanks to its small, fast, reliable, and effective nature.

1.7   TECHNOLOGY CLASSIFICATION

Two forms of computer processing are fundamentally similar. Each is made feasible by a distinct type of circuitry and serves a different purpose.

Analogue computers get their name from the term **"analog"** which means "similar." An analog signal is a constant electrical signal with an amplitude that can vary across a wide range. It has an endless number of possible values. Analogue computers cope with constantly changing amounts. They simply provide approximations. These computers give an analogue or simulation of the thing or system they represent.

Supercomputers offer particular advantages in tackling challenges concerning dynamic connections within time-varying systems. They excel in depicting altered relationships

through graphical outputs derived from analog computation. This capability stems from their responsiveness to shifts in electrical voltages, which directly correspond to changes in variable quantities. This unique attribute enables the creation of visual representations that vividly illustrate the evolving nature of these systems, providing invaluable insights into their complex dynamics and evolving interconnections.
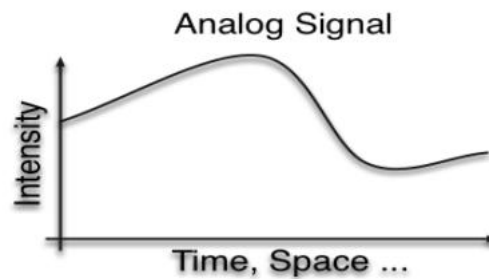
Digital Computers: It is a computerized counting machine. It counts discrete values that are different and distinct from continuous quantities that may be obtained from an analog computer. The electrical signal, which is a fixed-time signal, has a definite number of levels. It can only take one of two values: 0 or 1. Digital technology encodes information into discrete signal states, whereas analog technology employs continuous signals. The usage of digital computers can improve company information management and accuracy. A digital computer's fundamental operation is addition. It can aggregate the sums of additional issues and execute a single computation in a fraction of a millisecond. Reasoning operations, input information editing, and fast connectivity printing are examples of logical activities that can be conducted by a computer with digital capabilities, which can store data indefinitely. Digital systems provide advantages such as flexible processing, flexibility of architecture, precision and accuracy, ease of use, easy data archiving, fewer noise, and so on.

Although both analogous and digital devices are extensively used and approved in numerous sectors, manufacturers must endeavor to build a computer which integrates the greatest aspects of both types. This special-purpose machine is known as a hybrid computer because it combines the analog computer's measuring skills with the digital computer's logical and control capabilities. It provides an efficient and cost-effective approach of

solving specific sorts of issues in the fields of science and engineering. Some Hybrid machines have specialized equipment for converting analog levels to digital impulses and vice versa.

1.8   COMPUTER APPLICATIONS

Computers have become integral across diverse domains in the modern world. They serve crucial roles in numerous areas, showcasing their versatility and impact:

Scientific, Engineering and Research: In scientific research and engineering, computers are indispensable. They facilitate complex experiments, intricate mathematical computations, and weather forecasting. Moreover, Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) are pivotal in crafting robotics, automobiles, and automated control systems.

Business: Business and industry heavily rely on computers for essential functions. Tasks like recordkeeping, budgeting, inventory management, payroll, and accounts find efficiency through computer systems. Large-scale database administration empowers sectors like banking and travel reservations, handling vast amounts of data seamlessly.

Medicine: Healthcare experiences a transformative effect due to computer integration. Automated systems monitor patient vital signs, aiding in quicker and more precise diagnoses. Medical research benefits significantly from extensive computer usage.

Information: The information age is driven by computers, powering television, satellite communication, the Internet, and expansive networks that connect the world.

Education: Education has undergone a paradigm shift with computers. They foster critical thinking skills in students, enabling problem-solving abilities. Digital resources like CDs covering diverse subjects, online training programs, and easily accessible digital encyclopedias, dictionaries, and novels enhance learning experiences. Additionally, computers stimulate innovation in various creative domains such as painting, illustrating, music, and more, fostering effective development.

Games and Entertainment: Computers, therefore, have become indispensable tools in numerous facets of modern life, enhancing efficiency, innovation, and connectivity across various fields.

1.9   COMPUTER LIMITATIONS

While computers excel in speed, memory, and precision, they do have inherent limitations that distinguish them from human capabilities.

Programmed and Supervised by Humans: Fundamentally, computers are reliant on human-created instructions, encapsulated in software. Any flaws or inaccuracies in these instructions can lead to improper functioning. Additionally, when faced with unexpected or inadequate data, unsupervised computers may struggle to perform optimally.

No Intelligence: Despite their superior speed, accuracy, and adaptability, computers lack human-like intelligence. They operate solely based on instructions and cannot autonomously execute tasks or make decisions.

Self Care: Unlike humans, computers cannot self-care; they necessitate human intervention and oversight for maintenance and operation.

Emotionless: Emotions and feelings are beyond the realm of computers. They lack the capability to experience emotions or form relationships, functioning merely as devices that execute predefined instructions.

Thinking: While the concept of artificial intelligence implies thinking capabilities in computers, this is contingent upon the instructions provided by humans. Computers cannot independently generate thoughts or ideas.

Retrieval of Memory: Moreover, the linear nature of data processing in computers differs vastly from the spontaneous, non-linear nature of human thought processes. The human mind's capacity to process information dynamically sets it apart from the computational abilities of machines.

1.10 CONCLUSION

This comprehensive resource delves into the fundamental concepts, components, and principles of computers in the contemporary digital landscape. It serves as an essential guide for individuals seeking a lucid comprehension of computer operations, encompassing hardware and software intricacies, data representation, programming, and tracing the historical evolution while exploring future trends. With a deliberate approach to cater to both novices and individuals with preliminary knowledge, this content is adept for students, professionals, and anyone keen on grasping the core aspects of computing. Its primary aim is to furnish a valuable tool for beginners venturing into computer science and also for those aiming to establish a robust understanding of computer basics.

1.11 UNIT-BASED QUESTIONS / ANSWERS

Qus.1. What is the brief history of the development of computers?

Ans. The development of computers began in the early 19th century with Charles Babbage's design of the Analytical Engine, considered the first mechanical computer. In the mid-20th century, the advent of electronic computers marked significant progress, with the ENIAC (1945) being one of the first general-purpose electronic computers. The 1950s and 1960s saw the development of transistors and integrated circuits, which revolutionized computing. The personal computer (PC) era began in the 1970s with machines like the Altair 8800 and later the IBM PC in 1981. The rapid advancement in microprocessor technology in the following decades led to the powerful and compact computers we use today.

Qus.2. What is the concept of a computer system?

Ans. A computer system is a combination of hardware and software components that work together to perform computational tasks. The hardware includes the physical components

like the CPU, memory, storage devices, and peripheral devices. The software includes the operating system, which manages hardware resources, and application programs that provide functionality to the user. The system operates through input, processing, storage, and output stages, where data is entered, processed, stored, and then outputted as information.

Qus.3. What are the key characteristics of a computer system?

Ans. Key characteristics of a computer system include speed, accuracy, reliability, and versatility. Computers can perform complex calculations and process large amounts of data at incredible speeds. They operate with a high degree of accuracy, as errors are usually due to human input or software bugs rather than hardware malfunctions. Reliability is another crucial feature, as computers can run continuously for long periods without failure. Versatility refers to the ability to perform a wide range of tasks, from simple calculations to complex simulations.

Qus.4. What are the main capabilities of computers?

Ans. Computers have several main capabilities, including data processing, storage, and retrieval. They can execute complex algorithms to solve mathematical problems, analyze large datasets to find patterns, and simulate physical systems. Computers are also capable of multitasking, running multiple applications simultaneously. Additionally, they enable communication over networks, support multimedia creation and playback, and provide platforms for software development and automation of various tasks.

Qus.5. What are the limitations of computers?

Ans. Despite their capabilities, computers have several limitations. They lack the ability to think and reason like humans, as they operate strictly according to their programming. Computers are also dependent on the quality of their input; erroneous data can lead to incorrect outputs. They require significant power and cooling resources, especially high-performance systems. Additionally, computers are susceptible to hardware failures and cybersecurity threats, which can compromise data integrity and system functionality.

Qus.6. What are the different types of computers?

Ans. Computers can be classified into several types based on their size, power, and purpose. Personal computers (PCs) are designed for individual use, while workstations are more powerful and used for professional tasks. Servers provide services to other computers over a network. Mainframes and supercomputers are large, powerful machines used by large organizations for bulk data processing and complex computations. Embedded systems are specialized computers integrated into other devices, such as appliances and vehicles, to perform specific tasks.

Qus.7. How did the transition from mechanical to electronic computers occur?

Ans. The transition from mechanical to electronic computers occurred in the mid-20th century. Mechanical computers, like Babbage's Analytical Engine, used gears and levers to perform calculations. The invention of vacuum tubes enabled the development of the first electronic computers, such as the ENIAC. Vacuum tubes were later replaced by transistors in the 1950s, leading to smaller, more reliable machines. The development of integrated circuits in the 1960s further miniaturized electronic components, paving the way for modern computers.

Qus.8. What role did the invention of the microprocessor play in computer development?

Ans. The invention of the microprocessor in the early 1970s revolutionized computer

development. A microprocessor integrates the functions of a computer's central processing unit (CPU) onto a single chip, drastically reducing the size and cost of computers. This innovation led to the creation of personal computers and enabled the proliferation of computing into homes and small businesses. Microprocessors continue to evolve, powering a wide range of devices from smart phones to supercomputers.

Qus.9. How do modern computers differ from early computers?

Ans. Modern computers differ significantly from early computers in terms of size, speed, storage capacity, and functionality. Early computers were large, room-sized machines that required significant power and cooling resources. They performed relatively simple calculations at slow speeds and had limited memory and storage capacity. In contrast, modern computers are compact, extremely fast, and have vast storage capabilities. They support a wide range of applications, from web browsing to artificial intelligence, and are an integral part of everyday life.

Qus.10. What is the significance of computer networking in modern computing?

Ans. Computer networking is crucial in modern computing as it enables the interconnection of multiple computers, allowing them to share resources and communicate with each other. Networking facilitates the exchange of data, access to remote resources, and collaborative work environments. The internet, the largest network of networks, has transformed how people access information, communicate, and conduct business. Networking also underpins cloud computing, where computing resources and services are provided over the internet, enabling scalable and flexible IT solutions.

1.12 FURTHER READINGS

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