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Class Notes

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PPS: UNIT-1

Introduction to Components of a Computer System

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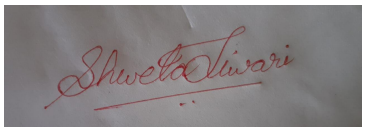

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TOPIC On : UNIT-1: Introduction to Computer Fundamentals (Part-1)

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By SHWETA TIWARI
Under On: Introduction to Components of a Computer System

PREPARED FOR
Engineering Students
All Engineering College

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TOPIC On : UNIT-1: Introduction to Computer Fundamentals (Part-1)

UNIT-1: Introduction to Computer Fundamentals

I. Introduction

Computing machines have been around for a long time, hundreds of years. The Chinese abacus, the calculators with gears and wheels and the first analog computers are all examples of computing machinery; in some cases quite complex, that predates the introduction of digital computing systems. The computing machines that we're interested in came about in the 1940s because World War II artillery needed a more accurate way to calculate the trajectories of the shells fired from battleships. **Today**, the primary reason that computers have become so pervasive is the advances made in integrated circuit manufacturing technology. The modern computer has become faster and more powerful but the basic architecture of a computing machine has essentially stayed the same for many years.

Most of us use computers for a variety of tasks, from serious scientific computations to entertainment.

The computer system can be divided into:

- **Computer hardware**.
- **Computer software**.

Computer hardware represents the physical and tangible components of a computer,

i.e. the components that can be seen and

touched. Examples of Hardware are the

following –

- **Input devices** – keyboard, mouse, etc.
- **Output devices** – printer, monitor, etc.
- **Secondary storage devices** – Hard disk, CD, DVD, etc.
- **Internal components** – CPU, motherboard, RAM, etc.

Computer Software is a set of programs, which is designed to perform a well-defined function. A program is a sequence of instructions written to solve a particular problem.

There are two types of software –

- **System Software.**
- **Application Software.**

System Software

The system software is a collection of programs designed to operate, control, and extend the processing capabilities of the computer itself. System software is generally prepared by the computer manufacturers. These software products consist of programs written in low-level languages, which interact

with the hardware at a very basic level. System software serves as the interface between the hardware and the end users.

Some examples of system software are Operating System, Compilers, Interpreter, Assemblers, etc.

Application Software

Application software products are designed to satisfy a particular need of a particular environment. All software applications prepared in the computer lab can come under the category of Application software.

Application software may consist of a single program, such as Microsoft's notepad for writing and editing a simple text. It may also consist of a collection of programs, often called a software package, which work together to accomplish a task, such as a spreadsheet package.

Examples of Application software are the following:

- Payroll Software
- Student Record Software
- Inventory Management Software
- Income Tax Software
- Railways Reservation Software
- Microsoft Office Suite Software
- Microsoft Word
- Microsoft Excel
- Microsoft PowerPoint

Relationship between Hardware and Software

- Hardware and software are mutually dependent on each other. Both of them must work together to make a computer produce a useful output.
- Software cannot be utilized without supporting hardware.
- Hardware without a set of programs to operate upon cannot be utilized and is useless.
- To get a particular job done on the computer, relevant software should be loaded into the hardware.
- Hardware is a one-time expense.
- Software development is very expensive and is a continuing expense.
- Different software applications can be loaded on hardware to run different jobs.
- Software acts as an interface between the user and the hardware.
- If the hardware is the 'heart' of a computer system, then the software is its 'soul'. Both are complementary to each other.

Computer architecture deals with the functional behavior of a computer system as viewed by a programmer. This view includes aspects such as the sizes of data types (*e.g.* using 16 binary digits to represent an integer), and the types of operations that are supported (like addition and subtraction). Also deals with the selection of the basic functional units such as the processor and memory, and how they should be interconnected into a computer system.

Computer organization is concerned with how the various hardware components operate and how they are interconnected to implement the architectural specifications.

Computer organization deals with structural relationships that are not visible

to the programmer, such as interfaces to peripheral devices and the technology used for the memory.

Computers are complex systems. How do we manage the complexity of these systems? We can get clues from looking at how we manage complex systems in life. Think of how a large corporation is managed. We use a hierarchical structure to simplify the management: president at the top and employees at the bottom. Each level of management filters out unnecessary details into the lower levels and presents only an abstracted version to the higher-level management. This is what we refer to as abstraction.
Different people view computer systems differently depending on the type of their interaction. We use the concept of abstraction to look at only the details that are necessary from a particular viewpoint. For example, if you are a computer architect, you are interested in the internal details that do not interest a normal user of the system. One can look at computer systems from several different perspectives.
We have already talked about the user's view.
We concentrate on the following views: (i) a programmer's view, (ii) an architect's view, and (iii) an implementer's view.

i. A ***programmer's view*** of a computer system depends on the type and level of language she intends to use. From the programmer's viewpoint, there exists a hierarchy from low-level languages to high-level languages.

ii. A ***computer architect*** looks at the design aspect from a high level. Uses higher- level building blocks to optimize the overall system performance. A computer architect is much like an architect who designs buildings. For example, when designing a building, the building architect is not concerned with designing the elevator; as far as the architect is concerned, the elevator is a building block someone else designs. Similarly, a computer architect does not focus on low-level issues. From ***the architect's viewpoint***, a computer system consists of three main components: *a processor or central processing unit (CPU)*, *a memory unit*, and *input/output (I/O)*

devices.

iii. ***Implementers*** are responsible for implementing the designs produced by computer architects. This group works at the digital logic level. At this level, logic gates and other hardware circuits are used to implement the various functional units.

II. The generations of computers.

This section traces the history of computers from their ***mechanical*** era. Our treatment is very brief.

1- The first generation.

The period of the first generation was from 1946-1959. The computers of the first generation used vacuum tubes as the basic components for memory and circuitry for CPU (Central Processing Unit). These tubes, like electric bulbs, produced a lot of heat and the installations used to fuse frequently. Therefore, they were very expensive and only large organizations were able to afford it.

In this generation, mainly batch processing operating system was used. Punch cards, paper tape, and magnetic tape was used as input and output devices. The computers in this generation used machine code as the programming language.

2- The second generation.

The period of the second generation was from 1959-1965. In this generation, transistors were used that were cheaper, consumed less power, more compact in size, more reliable and faster than the first generation machines made of vacuum tubes. In this generation, magnetic cores were used as the primary memory and magnetic tape and magnetic disks as secondary storage devices.

In this generation, assembly language and high-level programming languages like FORTRAN, COBOL were used. The computers used batch processing and multiprogramming operating system.

3- The third generation.

The period of third generation was from 1965-1971. The computers of third generation used Integrated Circuits (ICs) in place of transistors. A single IC has many transistors, resistors, and capacitors along with the associated circuitry.

The IC was invented by Jack Kilby. This development made computers smaller in size, reliable, and efficient. In this generation remote processing, time-sharing, multiprogramming operating system were used. High-level

languages (FORTRAN- II TO IV, COBOL, PASCAL PL/1, BASIC, ALGOL-68 etc.) were used during this generation.

4- The fourth generation.

The period of fourth generation was from 1971-1980. Computers of the fourth generation used Very Large Scale Integrated (VLSI) circuits. VLSI circuits having about 5000 transistors and other circuit elements with their associated circuits on a single chip made it possible to have microcomputers of fourth generation.

Fourth generation computers became more powerful, compact, reliable, and affordable. As a result, it gave rise to the Personal Computer (PC) revolution. In this generation, time sharing, real time networks, and distributed operating systems were used. All the high-level languages like C, C++, DBASE etc., were used in this generation.

5- The fifth generation.

The period of fifth generation is 1980-till date. In the fifth generation, VLSI technology became ULSI (Ultra Large Scale Integration) technology, resulting in the production of microprocessor chips having ten million electronic components.

This generation is based on ***parallel processing hardware*** and AI (Artificial Intelligence) software. AI is an emerging branch in computer science, which interprets the means and method of making computers think like human beings. All the high-level languages like C and C++, Java, .Net etc., are used in this generation.

III. Operating System:

An operating system is a program that acts as an intermediary between a user of a computer and the computer hardware. The purpose of an operating system is to provide an environment in which a user can execute programs. The primary goal of an operating system is thus to make the computer system convenient to use. A secondary goal is to use the computer hardware in an efficient manner. An operating system is an important part of almost every computer system.

A computer system can be divided roughly into four components: *the hardware, the operating system, the applications programs, and the users*.

IV. Computer Classification:

1. Analog Computers

Analog Computer is a computing device that works on a continuous range of values. The results given by the analog computers will only be approximate since they deal with quantities that vary continuously. It generally deals with physical variables such as voltage, pressure, temperature, speed, etc.

2. Digital Computers

Digital computer operates on digital data such as numbers. It uses a binary number system in which there are only two digits 0 and 1. Each one is called a bit. The digital computer is designed using digital circuits in which there are two levels for an input or output signal. These two levels are known as logic 0 and logic 1. Digital Computers can give more accurate and faster results. Digital computers are well suited for solving complex problems in engineering and technology. Hence digital computers have an increasing use in the field of design, research and data processing.

V. Computer Classification by size:

There are many computers which are different from each other in various aspects. Classification of computers is given below. Classes by size:

i. ***Microcomputers:*** These computers use a microprocessor chip and this chip is used instead of CPU means that this microprocessor chip works as a CPU. These computers are also called personal computers. Two major types of these computers are laptop or Desktop computers. Only one user uses these computers at times, that's why they are also known as personal computers.

ii. ***Mini Computers:*** These are powerful computers. These computers came into existence in the 1960s at that time mainframe computers were very costly. Mini computers were available at cheap prices, so users started using them.

iii. ***Mainframe Computer:*** It is a very powerful and large computer. You can get an idea of its power as it can handle processing of many users at a time. Terminals are used to connect a user to this computer and users submit their task through the mainframe. Terminal is a device which has a keyboard and a screen. By using terminal users put inputs into the computer and get the output through the screen.

iv. ***Supercomputers:*** As the name "super computer" specifies that these are more powerful computers than mainframes. Actually, when we optimize a mainframe computer then we get a super computer.

VI. Computer Classification by function:

1. **Servers**

   Server usually refers to a computer that is dedicated to provide a service. For example, a computer dedicated to a database may be called a "database server". "File servers" manage a large collection of computer files. "Web servers" process web pages and web applications. Many smaller servers are actually personal computers that have been dedicated to provide services for other computers.

2. **Workstations**

   Workstations are computers that are intended to serve one user and may contain special hardware enhancements not found on a personal computer.

3. **Information appliances**

   Information appliances are computers specially designed to perform a specific user-friendly function —such as playing music, photography, or editing text. The term is most commonly applied to mobile devices, though there are also portable and desktop devices of this class.

4. **Embedded computers**

   Embedded computers are computers that are a part of a machine or device. Embedded computers generally execute a program that is stored in non-volatile memory and is only intended to operate a specific machine or device. Embedded computers are very common. Embedded computers are typically required to operate continuously without being reset or rebooted, and once employed in their task the software usually cannot be modified. An automobile may contain a number of embedded computers; however, a washing machine and a DVD player would contain only one. The central processing units (CPUs) used in embedded computers are often sufficient only for the computational requirements of the specific application and may be slower and cheaper than CPUs found in a personal computer.