COMPUTER COURSE FOR DATABASE MANAGERS

ROORKEE

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(UNDER WORLD BANK AIDED HYDROLOGY PROJECT)

MODULE - 1

FUNDAMENTALS OF COMPUTER HARDWARE

by

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FUNDAMENTALS OF COMPUTER HARDWARE

1.0 INTRODUCTION

The development of water resources of the country to meet growing demands of rising population is a challenging task. Hydrological investigations and analysis form an essential component for investigations, planning, design, construction and operation of water resources projects. The developments of system approach, electronic instrumentation and advent of high speed computers have led to significant progress in modelling and simulation of complex hydrologic processes. Computers are used because they are reliable and fast. Computers of different sizes and configurations with their capabilities for rapid processing and objective analysis of data have made it possible to develop data collection, communication and processing systems.

Application of a computer for hydrology can be grouped into following types :

- Ordinary computations, like statistical computations, rainfall runoff correlation by different methods, unit hydrograph studies, reservoir sedimentation studies, design flood and water availability computations.

- Intense computations, like calibration of parametric models, multiple reservoir optimization etc.

- Graphics : Hydrology involves lot of plotting work and graphics can be considered as a task by itself.

- Data Storage and Retrieval : Magnetic media is ideally suited for storage, processing and retrieval of large volumes of data.

- Office Automation : Like word processing, networking, electronic mail, database management system etc.

1.1 What is a Computer ?

A computer is made up of electronic and electro-mechanical devices. To understand what is a computer, it is better to learn what it can do.

Computer transforms data in to information through an information processing

cycle made up of input, processing, storage, and output. A Computer can only accept data in computer-readable form. Data in this form can be captured quickly and accurately and are available for further computer-based information processing. While processing data, computer needs detailed instructions to perform arithmetic, text manipulation and logic operations. Problems of higher complexity can be tackled in shorter periods through the use of computers.

A computer has two main components : Hardware and software.

1.2 Hardware

The commonly used term for computer devices is hardware. The four categories of hardware components are central processing unit, memory, input devices, output devices. Hardware is useless without software. Hardware and software used as a single unit make up computer system.

1.3 Software

A working machine requires an extensive set of instructions to control its operations. They are collectively known as software. The instructions which control what a computer does in response to command of a user are normally handled in two sets. One set of instructions controls the system under which the computer operates fixing the detailed movement and handling of information. This set is called the operating system. The second set, known as the application software, allows the user to call up instructions which support a given tasks rather than to the operation of the computer.

The programming languages serve as the means by which a programmer communicates with a computer system. Three levels of programming language are in common use : machine language, assembly languages and high-level languages.

As most programs are not coded in machine language, they are translated into machine language by systems software. The initial version of a program is called to the source code and the translated version is called the object code. With assembly languages, an assembler performs the translation. With high-level languages, compilers or interpreters perform the translation. A compiler translates a program all at once. An interpreter translates a program one statement at a time and then executes it prior to translating the next statement.

Assembly languages which were developed to reduce the errors of machine language programs, are a more readable form of machine language programs, High-level languages have more powerful commands that are 'problem-oriented' rather than 'machine-oriented'. However, programmers lose some control over the manner in which processing occurs as they make use of each higher level of programming language.

Every programming language is designed to achieve certain goals. These goals represent the design features of the language. The design features are particularly useful in comparing the strengths and weaknesses of different programming languages.

The four most popular high level languages used for programming are FORTRAN, BASIC, C and PASCAL. FORTRAN is primarily used for scientific and engineering problem solving. BASIC is a general-purpose programming language that is very easy to learn and C is a very powerful, but also more complex general purpose programming language. PASCAL is a general purpose programming language that offers very sophisticated control and data structures.

2.0 CENTRAL PROCESSING UNIT

The most important hardware component of a computer system is the central processing unit (CPU). It directs and coordinates all the processing. It controls the transfer of data and performs basic operations. The operations performed by the CPU are controlled by instructions in the form of a computer program.

The memory of a computer is of two types : primary memory and secondary memory.

3.0 PRIMARY MEMORY

All computers have an internal memory that functions as a working space for holding programs and data. Every part of this internal memory is equally accessible to the CPU and for this reason it is known as Random Access Memory (RAM). The capacity of the RAM is measured in bytes, one byte being composed of 8 bits of binary code. Depending on their power PCs have a RAM capacity between 640 kilo bytes (1 KB = 1024 bytes) and 64 Mega bytes (1MB = 1024 X 1024 bytes).

Primary memory provides temporary storage for data and programs. It is

cleared when the computer is switched off or reset. It is relatively expensive and cannot be used to permanently store data and programs. For this purpose, secondary storage devices are used.

4.0 SECONDARY MEMORY

Secondary memory uses magnetic recording techniques that retain the data when the power to the computer is turned off. The most popular secondary storage devices are magnetic tape and magnetic disk, both of which can store data in a physically compact form. Compared to tape, much faster access time is possible with magnetic disks. The storage capacity of a disk depends on the number of tracks per surface, the bit density, and the number of recording surfaces. The speed with which data can be found and retrieved depends on access time. Access time is the amount of time it takes from the point of requesting data until the data are retrieved. The disks may take the form of either a fixed (hard) disk fitted inside the computer, or flexible (floppy) diskettes.

Hard disks have a relatively large capacity. They are rigid aluminum platters coated with a magnetic oxide. They come in a variety of sizes and the significantly different storage capacities and can be further categorized in terms of being fixed or removable.

Diskettes have a much smaller capacity and are available in various sizes and capacities. The most common are 5.25" diskettes with 360 KB or 1.2 MB capacity and 3.5" diskettes with 720 KB or 1.44 MB capacity. They are made of a flexible Mylar plastic coated with a thin layer of metallic oxide particles. Diskettes also come in several sizes, and all are designed to be removable.

Magnetic tapes are thin plastic tapes coated with magnetic material. They come in three forms reel-to-reel, cartridge, and cassette. All magnetic tapes work in a similar fashion, very much like audio cassettes. The storage capacity of a tape is determined by the number of bits per inch that can be recorded, the length of the tape and the blocking factor.

Most data and programs are stored on secondary storage.

5.0 INPUT & OUTPUT DEVICES

Input and output (I/O) devices move data into and out of the computer's

processor. The most common input as well as output device is a terminal, also called a video display unit (VDU). Diskette drives and magnetic tape drives are also used as I/O devices. Common output devices include the CRT screen, printers, and plotters. Hard copy, a permanent copy, of computer outputs is produced by printers and plotters. The additional I/O devices are mouse, an alternative to keyboard for defining instructions and digitizer.

6.0 SEMICONDUCTOR DEVICES

A basic building block of modern computer circuitry is the semiconductor chip. These chips are composed of thousands of transistors, which are electronic components that function as semiconductors. A semiconductor is a solid-state device that can be made to conduct electricity under certain conditions and act as an insulator inhibiting electrical flow at other times. These chips are used for the CPU, for primary memory, and for interface devices. Interface devices are used to coordinate the flow of electrical signals between CPU and hardware units.

Primary memory chips are designed as RAM or ROM. RAM stands for Random Access Memory, which means that instructions or data can be read from this memory or written into it. Thus, RAM is sometimes referred to as read/write memory. The types of RAM chips, most commonly used today, are volatile, meaning that the memory contents will be lost when the electrical power is turned off.

ROM, or Read Only Memory, can only be used to read permanently loaded instructions or data. Software stored in ROM hardware is called firmware. ROM uses storage technology that is nonvolatile, and thus is not affected by loss of power. Erasable Programmable ROM or EPROM chips have been developed in which ultraviolet light can be used to erase the information stored on the chip. EEPROM or Electrically Erasable Programmable ROM chips can be used in situations where selected bytes of information need to be changed electronically.

A CPU that has been implemented on a single silicon chip is called a microprocessor. Microprocessor chips use many different internal designs, and the chips vary in appearance and capability. One of the specific ways in which they vary is in dataword length. This refers to the number of bits of data that can be retrieved from memory each machine cycle.

Computers differ in their computing power. This can be measured in a number

of ways, such as the number of instructions that can be processed in a given time period. Other indicators of computer power are the dataword length and the size of primary memory.

7.0 PERSONAL COMPUTER (PC)

The PC family of computers are a powerful tool, not only for mathematical computation but also for information processing. The introduction of PCs and the exponential growth of chip technology has remarkably increased the data processing and computational speed. The PC is a versatile tool used in many areas of hydrology by improving management of water resources through automatic data collection devices, use of simulation and optimization for planning and use of real time forecasting techniques for operation of projects.

Before the advent of PC, earlier systems required more space. The room in which they were housed required temperature and humidity control, beside being dust free. Only limited persons were allowed to enter in computer room. The users had to give information on punch cards or on magnetic tapes to computer center for processing. Against this, PCs occupy less space and can work in normal room environment. Hence PCs are becoming popular and are user friendly.

A PC essentially consists three units :

- Central Processing Unit, typically housed in a rectangular box.
- Video Display Unit (VDU) or display screen
- Keyboard

The keyboard provides the facility to enter commands or information to the computer and the screen to display the response to these commands.

The first PC was released by IBM in 1981 and used Intel 8088 microprocessor as its CPU. This CPU has a 16-bit internal architecture but communication with external devices is in 8-bit mode. Initially a typical PC had a RAM of 256 KB and two floppy drives. The next in series, PC XT (XT stands for extra) also used Intel 8088 CPU with RAM size of 640 KB and one floppy drive was replaced by a hard disk of 20 MB capacity. Next improvement was use of Intel 80286 CPU which is fully 16 bit, internally as well as externally. The model was given the name PC/AT (AT stands for Advanced Technology). 80286 was followed by 80386, 80486 and Pentium PCs.

8.0 USEFUL HINTS REGARDING USE OF PCs

- Avoid excessive heat i.e. the PC should be kept atleast one foot away from the wall.

- Don't move the PC while it's is power ON. Movement of any kind could cause severe damage to the hard disk and could result in it's failure.

- Don't shift the PC without parking the hard disk. Use disk parking utilities like Diskpark, Pctools or Shutdown etc. for parking the hard disk.

- Don't switch the PC ON and OFF frequently. If you switch it OFF wait for at least 30 seconds before turning it ON again. While switching OFF the PC follow the sequence given below:
  - Switch OFF the computer from the switch provided on the back side of the CPU.
  - Switch off the monitor from the switch provided on it's backside.
  - Switch OFF your CVT.
  - Switch OFF the main power point.

- PC/AT with printer requires CVT with 1 KVA rating. Please check whether the CVT is adequate or not.

- Keep the printer and keyboard covered while not in use in order to prevent the dust, which makes the mechnical parts wear very soon.

- Do not run diagnostic softwares like Disk Manager, QAPLUS etc. unless you are completely familier with it. It may permanently damage the disk.

- Do not attempt low level formatting on the hard disk. Specially the PC-AT/386 users should not format their hard disk on their own, as these HDDs do not require it and may become useless once it is done.

- If any part of the PC/Printer like printer knobs are broken don't throw it away. It may be required by the service engineer to replace it.

- Avoid using PC during sudden temperature or humidity changes which could

lead to condensation on the components. If you change the environment wait a half an hour before the power ON.

- Avoid keeping a PC on vibrating surfaces, which could loosen connections.

- Avoid dust. dirt, smoke and humidity (the direct path of a desert cooler). They damage keyboards, floppy drives and other components. Dusty floppy drives can destroy the floppies in seconds.

- In case of any problem call the service engineer instead of trying to fix it yourself.

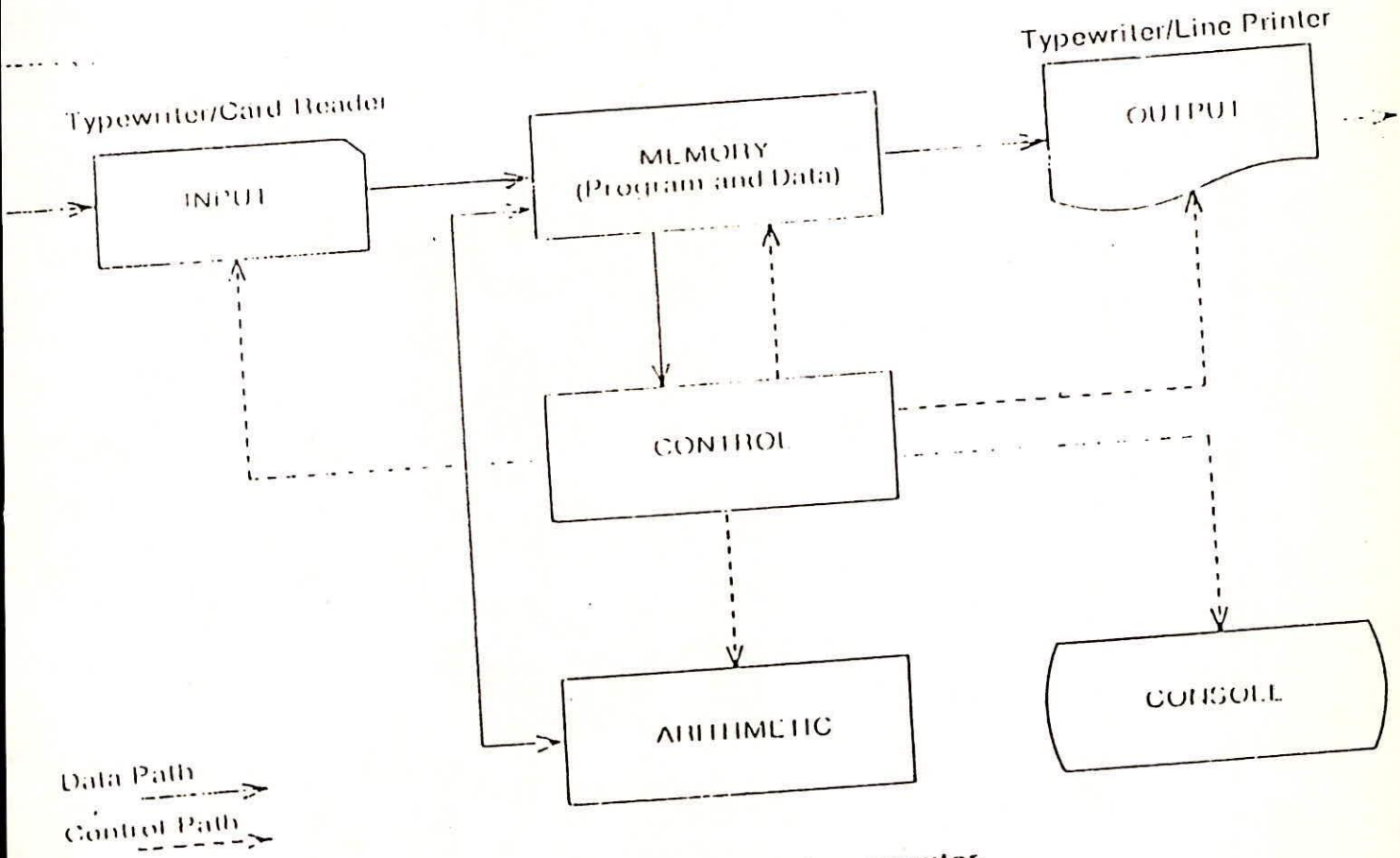

Fig. 1.1. Block diagram of a computer.