LABORATORY MANUAL

18CPL17/27-C PROGRAMMING LABORATORY

2019-20

DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING
ATRIA INSTITUTE OF TECHNOLOGY
Adjacent to Bangalore Baptist Hospital
Hebbal, Bengaluru-560024

C PROGRAMMING LABORATORY

Semester	**: I/II**	**CIE Marks**	**: 40**
Course Code	**: 18CPL17/27**	**SEE Marks**	**: 60**
Teaching Hours/week	**: 0:0:2**	**Exam**	**: 03**
	Credits : 01		

Laboratory Programs:

1. Familiarization with computer hardware and programming environment, concept of naming the program files, storing, compilation, execution and debugging, taking any simple C- code.

PART A

2. Develop a program to solve simple computational problems using arithmetic expressions and use of each operator leading to simulation of a commercial calculator. (No built-in math function)

3. Develop a program to compute the roots of a quadratic equation by accepting the coefficients. Print appropriate messages.

4. Develop a program to find the reverse of a positive integer and check for palindrome or not. Display appropriate messages.

5. An electricity board charges the following rates for the use of electricity: for the first 200 units 80 paise per unit: for the next 100 units 90 paise per unit: beyond 300 units Rs 1 per unit. All users are charged a minimum of Rs. 100 as meter charge. If the total amount is more than Rs 400, then an additional surcharge of 15% of total amount is charged. Write a program to read the name of the user, number of units consumed and print out the charges.

6. Introduce 1D Array manipulation and implement Binary search.

7. Implement using functions to check whether the given number is prime and display appropriate messages. (No built-in math function)

PART B

8. Develop a program to introduce 2D Array manipulation and implement Matrix multiplication and ensure the rules of multiplication are checked.

9. Develop a Program to compute Sin(x) using Taylor series approximation. Compare your result with the built- in Library function. Print both the results with appropriate messages.

10. Write functions to implement string operations such as compare, concatenate, string length. Convince the parameter passing techniques.

11. Develop a program to sort the given set ofN numbers using Bubble sort.

12. Develop a program to find the square root of a given number N and execute for all possible inputs with appropriate messages. Note: Don't use library function sqrt(n).

13. Implement structures to read, write and compute average- marks and the students scoring above and below the average marks for a class of N students.

14. Develop a program using pointers to compute the sum, mean and standard deviation of all elements stored in an array of n real numbers.

15. Implement Recursive functions for Binary to Decimal Conversion.

Laboratory Outcomes:

The student should be able to:

- Write algorithms, flowcharts and program for simple problems.
- Correct syntax and logical errors to execute a program.
- Write iterative and wherever possible recursive programs.
- Demonstrate use of functions, arrays, strings, structures and pointers in problem solving.

Conduct of Practical Examination:

- All laboratory experiments, **excluding the first**, are to be included for practical examination.
- Experiment distribution

  *For questions having only one part: Students are allowed to pick one experiment from the lot and are given equal opportunity.
  *For questions having part A and B: Students are allowed to pick one experiment from part A and one experiment from part B and are given equal opportunity.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks
- Change of experiment is allowed only once and marks allotted for procedure part to be made zero.
- Marks Distribution (Subjected to change in accordance with university regulations)
  a) For questions having only one part — Procedure + Execution + Viva-Voce: 15+70+15 =100 Marks
  b) For questions having part A and B
     i. PartA— Procedure + Execution + Viva = 4 + 21 + 5 = 30 Marks
     ii. Part B —Procedure + Execution + Viva =10 + 49+ 11= 70 Marks

INTRODUCTION

Description about Functional block diagram of Computer:

A computer is an electronic device, which mainly performs the four functions as **reading**, **processing**, **displaying** and **storing** on data. These functions of a computer system can be carried out by using the three main units namely input unit, system unit and output unit. The block diagram of a computer system is as follows:

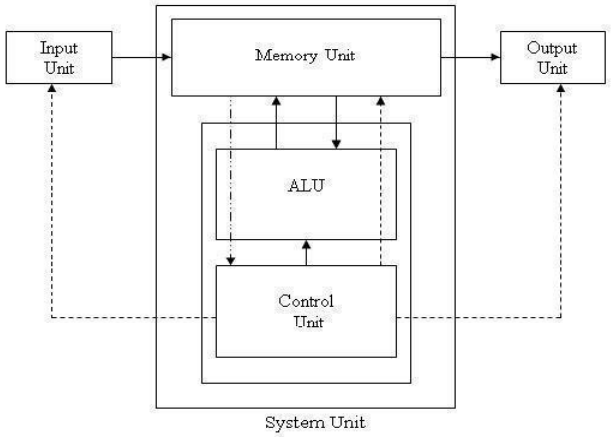


Fig 1: Block Diagram of a Computer

Notations:

- Data and Results flow ——————
- Control instructions to other units from control unit - - - - - - - - - - - - - - - - -
- Instructions from memory unit to control unit — · · — · · — · · — · · —

System or Central Processing Unit (CPU): is commonly known as "processor" that executes the instructions of a computer program. It has Control Unit (CU) and Arithmetic & Logical Unit (ALU). These two units perform the basic arithmetic, logical, and input/output operations.

a) Input unit: is used to enter data and information into a computer. The devices like keyboard, mouse and scanner are commonly used input devices.

- A keyboard is used to enter alphanumeric characters and symbols.
- The mouse is used to pick or select a command from the monitor screen.
- A scanner is used to scan an image or read a barcode and so on.

b) Arithmetic and Logic Unit (ALU): is a digital circuit that perform arithmetic (Add, Sub, Multiplication, Division) and logical (AND, OR, NOT) operations. It helps in fast computation of scientific calculations on floating-point number.

c) Control unit (CU): is the circuitry that controls the flow of information through the processor and coordinates the activities of the other units within the processor.

Functions of Control unit

Accessing data & instructions from memory unit.
Interpreting instructions
Controlling input and output units

Overall supervision of a Computer system

d) Memory Unit (MU): is the unit where all the input data and results are stored either temporarily or permanently. The CPU memory is also called as memory register. The memory of a computer has two types:

a. Main Memory / Primary Memory units

i. Random Access Memory (RAM)

ii. Read Only Memory (ROM)

b. Secondary Memory / Auxiliary Memory

e) Output Unit: It is used to display or print results from a computer. Monitor, printer and plotters are commonly used output devices.

f) Bus: A bus is a collection of wires that carries data/Instructions. It connects physical components such as cables, printed circuits, CPU, Memory, Peripherals etc., for sharing of Information and communication with one another. The purpose of buses is to reduce the number of "pathways" needed for communication between the components, by carrying out all communications over a single data channel.

Types of Buses:

1. **System Buses:** The system buses are used to transfer the data and instructions between Main memory (Random Access Memory) and CPU. These are classified into following three types.

Data Bus	Address Bus	Control Bus
It is used to transfer the data between Processor, Memory and I/O devices	It is used to transfer the addresses of data and Instructions stored in memory.	It is used to transfer the control signals between CPU, Memory and I/O devices.
Bidirectional in nature	Unidirectional in nature	Unidirectional or Bidirectional in nature

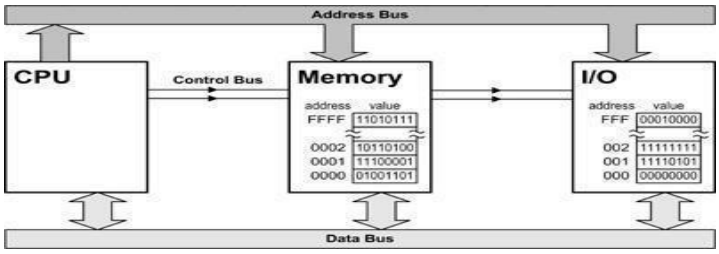


Fig 2: Types of Buses

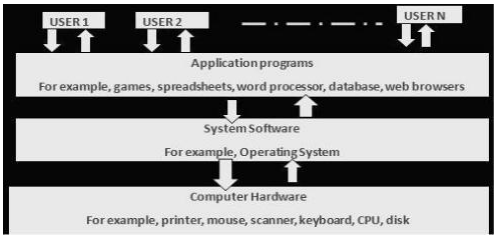
2. **I/O Buses:** The buses which are used to connect all I/O devices with CPU and Memory are called I/O buses. These are classified into following three types.

PCI Bus	ISA Bus	USB Bus
PCI stands for ***Peripheral Component Interconnect***	ISA stands for ***Industry Standard Architecture***	USB stands for ***Universal Serial Bus***
The motherboard will be having 3 or 4 PCI connectors, so that we can insert various chips.	This is simple and slowest bus used in IBM PCs	It helps to connect various I/O devices like keyboard, mouse, pen drives, printer, etc.
Fastest and presently more powerful bus	Oldest, simplest and slowest Bus	Newest and widely used bus

Main Board or Mother Board: Mother Board is a set of Integrated Chips (**ICs**) which are designed to work together. It controls the flow of data/instructions within our computer. It is the main board on which other hardware components are connected to enable the computer system to work as an integrated unit. It consists of sockets, slots, power connectors and bus.

Chip sets: Chip set is the set of integrated chips that are designed to work together. These set of chips controls the flow of information on computer. The chips may be controllers for memory, cache, hard drive, key board and peripherals.

Operating System and its types: An Operating System (OS) is system software that **controls** and **supervCSEs** the **hardware components** of a computer system and it provides the services to computer users. Also called as ***Resource Manager*** that manages the resources such as CPU, Memory, I/O devices, Job/Task/Process etc., a computer cannot run without it. The major functions of OS includes: ***CPU Management, Memory Management, File Management, Device Management, Process/Task/Job Management and Security Management.***



The primary goal of an OS is to make the computer system c*onvenient and efficient to use.* An OS ensures that the system resources (such as CPU, memory, I/O devices, etc) are utilized efficiently. For example, there may be many programs residing in the main memory. Therefore, the system needs to determine which programs are active and which need to wait for some I/O operation.

Some of the examples of Operating Systems:

Windows –XP is an O.S. is used for Personal Computers (PCs) Unix and XENIX are the OSs used for multi-user computers. Windows 7, Windows 8, Macintosh OS, Fedora, and Android, etc.

Types of Operating Systems: The operating systems are classified into 7 types based on their capability and usage.

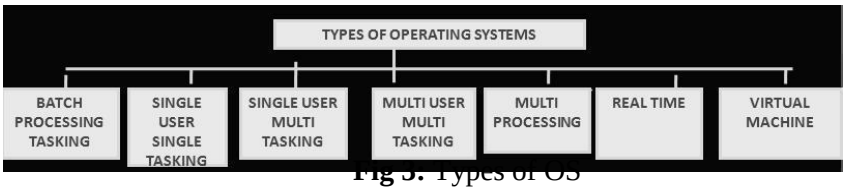


Fig 3: Types of OS

Batch Processing Tasking OS: The data is collected into a group called batch and provides only one batch (one after another) of jobs as input to the computer system at a time. The jobs in a batch are processed on first come first serve basis. In this type, the process takes place at specified time intervals i.e. weekly or monthly without user interaction. E.g. Punch cards were using to store the data in batch processing and in payroll preparation in a business batch processing was helpful.

Single user and single tasking OS: The OS that allows only one program to execute at a time is called single user single tasking operating system. Using this operating system user can do only one task at a time. **E.g.** DOS (Disk Operating System).

Single user and multi tasking OS: The OS that allows a single use to perform more than one task at a time is called single user multi tasking operating system. While working with the Ms-Word user can perform other work like print a document, listen music.**E.g.** Windows-XP, Windows Vista, Windows – 7, etc.

Multi user and multitasking OS: The O.S. that allows two or more users to use a main computer system to do more than one task is called multiuser and multitasking operating system.**E.g.** UNIX is a multiuser and multitasking operating system.

Multiprocessing OS: The OS that allows multiple programs to be executed by multiple CPUs

(Processors) is called multiprocessing operating system. Super and main frame computers have more than one CPU and multiprocessing operating system.

Real Time Operating System (RTOS): The OS that is used for real time applications and to carry out certain calculations within the specified time constraint. This OS is used in applications such as mobile phones, supporting systems in hospitals, nuclear power plants, oil refining, chemical processing, environmental applications and air-traffic control systems, disaster management etc.,

Virtual machine OS: Allows several users of a computer system to operate as if each has the only terminal attached to the computer.

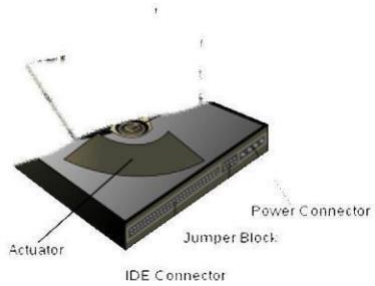
Random Access Memory (RAM): RAM is basically main memory of the computer**.** RAM is a semiconductor memory made up of small memory chips that form a memory module. These modules are installed in the RAM slots on the motherboard of computer. Every time you open a program, it gets loaded from the hard drive into the RAM. This is because reading data from the RAM is much faster than reading data from the hard drive.

Synchronous Dynamic Random Access Memory (SDRAM): It is an improvement to standard DRAM because it retrieves data alternately between two sets of memory. This eliminates the delay caused when one bank of memory addresses is shut down while another is prepared for reading. It is called "Synchronous" DRAM because the memory is synchronized with the clock speed that the computer's CPU bus speed is optimized for. The faster the bus speed, the faster the SDRAM can be. SDRAM speed is measured in Megahertz.

FLASH memory: Flash memory is a type of Electrically Erasable Programmable Read-Only Memory (EEPROM). The name comes from how the memory is designed -- a section of memory cells can be erased in a single action or in a "flash." Flash memory cards used for digital cameras, cellular phones, networking hardware, and PC cards.

Hard disks: Hard disk is prime unit of storage of the computer. Huge amount of data can be stored and accessed in few millCSEconds. The hard disk consists of more number of disks arranged in the cylindrical order, one above another on a spindle.

The read/write heads are attached to single access mechanism so that they cannot move independently. All read/write heads are moved together to position that heads on the required track. The hard disks available today ranges from 200 GB to 2TB and so on. The present day hard disk ranges from 3600 rpm to more than 10000 rpm and so on.



Advantages: High storage capacity, high data accessing rate and permanent storage medium.

Disadvantages: It is not portable.

Optical media: An optical storage media is kind of storage, which is coated with thin metal on which bits are stored. The data can be stored in to optical storage media or read form the optical storage media.

The devices which perform read or write operation on optical storage media are called optical storage media. The laser technology is used to read the data or write the data on

optical storage devices.

Examples: CD-ROM, DVD etc.

Compact Disc Read-Only-Memory (CD-ROM): It is a type of optical disc that uses laser technology to read and write data on the disc. The information stored on CDROM becomes permanent and cannot be altered. This means that the stored information can only be read for processing**.**

A CD-ROM uses the round shaped optical disk to store data, applications, games and audio files. It can store up to 700 MB of data. It has become integral part of every organization due to its features like reliability, reasonable, storage capacity and easy to use of carry.

CD-Drive will be with motor to rotate the disks to perform read and write operations. A CD-drive will

consists of the components like Disc drive, disk drive motor, laser pick up assembly tracking drive and tracking motor and so on.

Compact Disk Recordable (CD-R): The CD-R allows you to create your own CD.CD-R drives have the ability to create CDs but they can write data on the disk only once.CD-R technology also called as Write Once-Read much (WORM) technology. Laser technology is used to write the data on the compact disk.CD-R drives come in IDE, SCSI and USB models.

Compact Disc Rewritable (CD-RW): CD-RW is an erasable optical disk which is used to write data multiple times on a disk, CD-RW disks are good for data backup, data archiving or data distribution on CDs. The disk normally holds 700MB of data. Technology to write data multiple times on a CD was known as the Phase change Dual (PD) technology. The reflective properties of a CD-RW are different than regular CD-ROM disks.

Disk or Digital Versatile Disc (DVD-ROM): A DVD is a small optical disk having high density medium and capable of storing a full-length movie on a single disk. The high density is achieved by using both sides of the disk, special data-compression technology, and extremely small tracks to store the data.

Advantages: Storage capacity is more compared to CDs.

Flash Drives (Pen drives): USB flash drives are removable, rewritable, and physically much smaller drives weighing even less than 30 g. A flash drive consists of a small printed circuit board carrying the circuit elements and a USB connector, insulated electrically and protected inside a plastic, metal, or rubberized case which can be carried in a pocket or on a key chain.

Advantages

Data stored on flash drives is impervious to scratches and dust Mechanically very robust
Easily portable
Have higher data capacity than any other removable media. Compared to hard drives, flash drives use little power
Flash drives are small and light-weight devices
Flash drives can be used without installing device drivers.

Disadvantages

Can sustain only a limited number of write and erase cycles before the drive fails. Most flash drives do not have a write-protect mechanism

Flash drives are very small devices that can easily be misplaced, left behind, or otherwCSE lost. The cost per unit of storage in a flash drive is higher than that of hard disks

Keyboard: A keyboard is the primary input device used in all computers. Keyboard has a group of switches resembling the keys on an ordinary typewriter machine. Normally keyboard has around 101 keys. The keyboard includes key that allows us to type letters, numbers and various special symbols such as *, /, [, % etc.

Mouse: The mouse is the key input device to be used in a Graphical User Interface (GUI). The users can use mouse to handle the cursor pointer easily on the screen to perform various functions like opening a program or file.

With mouse, the users no longer need to memorize commands, which was earlier a necessity when working with text-based command line environment such as MS-DOS.

Advantages:

Easy to use; Cheap; Can be used to quickly place the cursor anywhere on the screen Helps to quickly and easily draw figures

Point and click capabilities makes it unnecessary to remember certain commands

Disadvantages:

Needs extra desk space to be placed and moved easily

The ball in the mechanical mouse needs to be cleaned very often for smooth movements

Printers: The printer is an output device, which is used to get hard copy of the text displayed on the screen. The printer is an external optional device that is connected to the computer system using cables. The printer driver software is required to make the printer working. The performance of a printer is measured in terms of Dots Per Inch (DPI) and Pages Per Minute (PPM) produced by the printer.

Plotters: A plotter is similar to printer that produces hard-copy output with high-quality color graphics. Plotters are generally more expensive than printers, ranging from about $1000 to $75000.

Problem Solving Techniques:

The process of working through details of a problem to reach a solution. There are three approaches to problem solving:

1. **Algorithm**
2. **Flowchart**
3. **Pseudo Code**

Algorithm: The algorithm is a ***step-by-step procedure*** to be followed in solving a problem. It provides a scheme to solve a particular problem in ***finite number of unambiguous steps***. It helps in implementing the solution of a problem using any of the *programming languages.*

In order to qualify as an algorithm, a sequence of instructions must possess the following characteristics:

Definiteness: Instructions must be ***precCSE*** *and* ***unambiguous*** i.e. each and every instruction should be clear and should have only one meaning.

Finiteness: Not even a single instruction must be ***repeated infinitely***. i.e., each instruction should be performed in finite time.

Termination: After the algorithm gets executed, the user should get the desired ***result***

Key features of an algorithm:

Any algorithm has a finite number of steps and some steps may involve decision making, repetition. Broadly speaking, an algorithm exhibits three key features that can be given as:

Sequence: Sequence means that each step of the algorithm is executed in the specified order.

Decision: Decision statements are used when the outcome of the process depends on some condition.

Repetition: Repetition which involves executing one or more steps for a number of times can be implemented using constructs like the while, do-while and for loops. These loops executed one or more steps until some condition is true.

Example: To compute the Area of Rectangle

ALGM: AREA_of_RECTANGLE [This algorithm takes length and breadth, the sides of the rectangle as input and computes the area of rectangle using the formula ***area=length * breadth***. Finally it prints the area of rectangle]

STEPS:

Step 1:[Initialize]

Start

Step 2: [Input the sides of Rectangle]

Read **length, breadth**

Step 3:[Compute the area of rectangle]

Area length*breadth

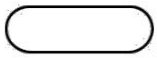
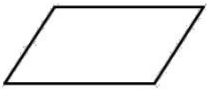
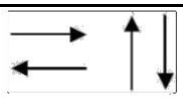
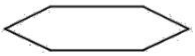
Step 4:[Display the Area**]**

Print **Area**

Step 5: [Finished]

Stop

Flowcharts: A flowchart is a graphical or symbolic representation of an algorithm. They are basically used to design and develop complex programs to help the users to visualize the logic of the program so that they can gain a better understanding of the program and find flaws, bottlenecks, and other less-obvious features within it. Basically, a flowchart depicts the "***flow***" of a program. The following table shows the symbols used in flowchart along with its descriptions.

Symbol	Name	Description
	oval	Represents the terminal point
	Rectangle	Represents the process steps defined in algorithm
	Parallelogram	Indicate the reading Operation used for input/output or data or information from/to any device
	Diamond	Indicates the decisions (questions) and consequently branch points or the paths to be followed based on the result of the question
	Arrows	Shows the flowchart direction and connects the various flow chart symbols.
	Small circle	Shows the continuation from one point in the process flow to another.
	Hexagon	Represents Looping structures
	Process	Subroutine function

Advantages of Flowcharts:

A flowchart is a diagrammatic representation that illustrates the sequence of steps that must be performed to solve a problem. They are usually drawn in the early stages of formulating computer solutions to facilitate communication between programmers and business people.

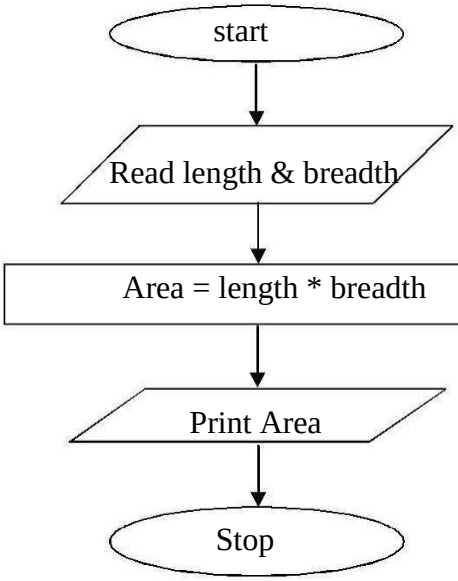
Flowcharts help programmers to understand the logic of complicated and lengthy problems. They help to analyze the problem in a more effective manner

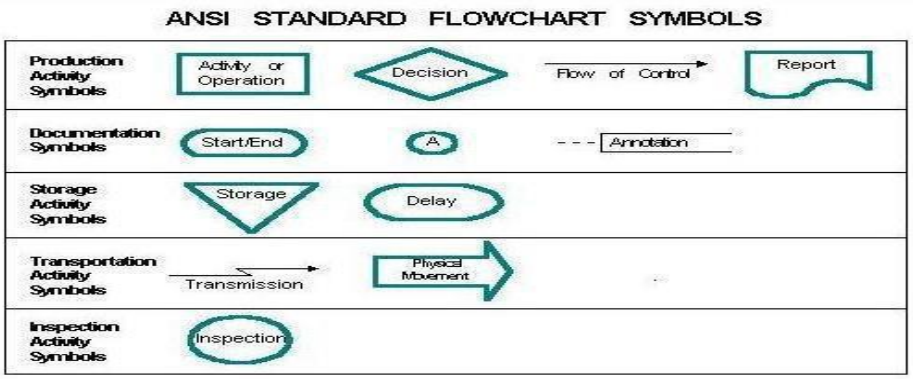
Flowchart can be used to debug programs that have error(s).

E.g.: To compute the Area of Rectangle

Limitations of using Flowcharts:

Drawing flowcharts is a laborious and a time consuming activity. Flowchart of a complex program becomes, complex and clumsy. At times, a little bit of alteration in the solution may require complete re-drawing of the flowchart Essentials of what is done may get lost in the technical details of how it is done. There are no well-defined standards that limits the details that must be incorporated in a flowchart





Pseudo code: It is a form of structured English that describes algorithms. It facilitates the designers to focus on the logic of the algorithm without getting bogged down by the details of language syntax. ***Pseudocode*** is a compact and informal high-level description of an algorithm that uses the structural conventions of a programming language. It is meant for human reading rather than machine reading, so it omits the details that are not essential for humans. Such details include keywords, variable declarations, system-specific code and subroutines. There are no standards defined for writing a ***pseudocode*** because it is not an executable program. Flowcharts can be considered as a graphical alternative to ***pseudocode***, but are more spacious on paper.

E.g.: To compute the area of Rectangle

Begin
Input length, breadth
Area=length*breadth
Print Area

End