Computer Programming

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Subject and Teacher

- **Subject Name:** Computer Programming
- **Subject Code:** CS 1093
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Text Book

1. Programming in ANSI C (8th Edition) by E. Balagurusamy
2. Y. Kanetker,Let Us C, 16thEdition, BPB Publications, 2018.

Reference Book

- The C Programming Language by Brian Kernighan and Dennis Ritchie (Second Edition)
- B. Gottfried,Schaum’s Outline of Programming with C, 3rdEdition, McGraw-Hill, 2017

What is a computer?

It is an electronic device

- Receives input data
- Stores data
- Processes data as per user instructions
- Provides output in desired format

Desktop PC

Laptop

Characteristics of Computer: Speed, Accuracy, Reliability, Versatility, Storage Capacity.
Limitations : Computers have no intelligence, Regular electric supply is necessary

Smart Phone

USE of COMPUTERS

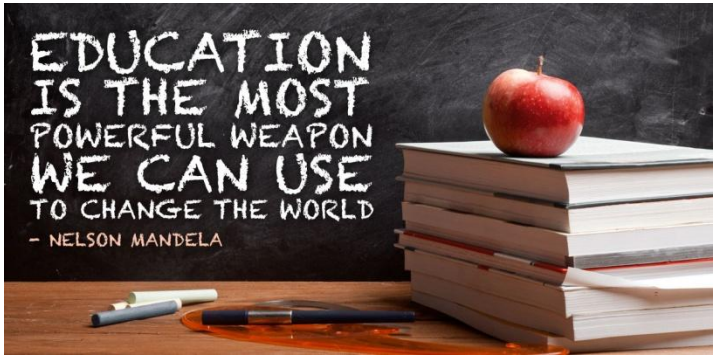
- **Business**
  - Payroll calculations
  - Budgeting
  - Sales analysis
  - Financial forecasting
  - Managing employee database
  - Maintenance of stocks, etc

- **Banking**
  - Payroll calculations
  - Budgeting
  - Sales analysis
  - Financial forecasting
  - Managing employee database
  - Maintenance of stocks, etc

USE of COMPUTERS

- **Insurance**
  - Payroll Procedure to continue with policies
  - Starting date of the policies
  - Next due installment of a policy
  - Maturity date
  - Interests due
  - Survival benefits
  - Bonus

- **Education**
  - Keep students' records
  - Computer based learning
  - Admission process
  - Placement centre



USE of COMPUTERS

- **Health care**
  - Diagnostic system
  - Patient monitoring system
  - Hospital administration
  - Pharma information system

- **Engineering design**
  - Structural engineering
  - Architectural engineering
  - Industrial engineering

USE of COMPUTERS

- **Military**
  - Missile Control
  - Military Communication
  - Military Operation and Planning
  - Smart Weapons

- **Communication and social media**
  - Email
  - Facebook
  - Twitter
  - Video conferencing
  - whatsapp

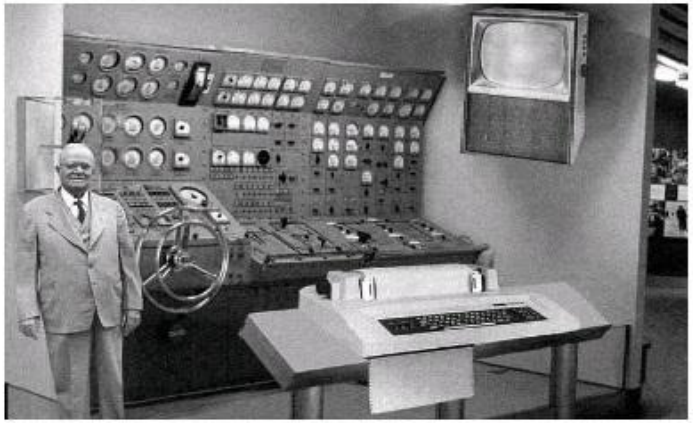
USE of COMPUTERS

- **Government services**
  - Budgets
  - Sales tax department
  - Income tax department
  - Computation of male/female ratio
  - Computerization of voters lists
  - Computerization of PAN card
  - Weather forecasting

Generation of computers

Gen #	Technology	Operating System	Year of Introduction	Specific Computers
1	Vacuum Tube	None	1945	Mark1
2	Transistor	None	1956	IBM 1401, ICL 1901, B5000, MINSK-2
3	SSI and MSI (circuit based)	Yes	1964	IBM S/360/370, UNIVAC 1100, HP 2100A, HP 9810
4	LSI and VLSI (micro processor based)	Yes	1971	ICL 2900, HP 9845A, VAX 11/780, ALTAIR 8800, IBM PC
5	Hardware Abstraction Layer(HAL)	Yes	Present and beyond	

FIVE generations of computers



First Generation

Second Generation

Third Generation

Fourth Generation

Fifth Generation

Components of Computer System

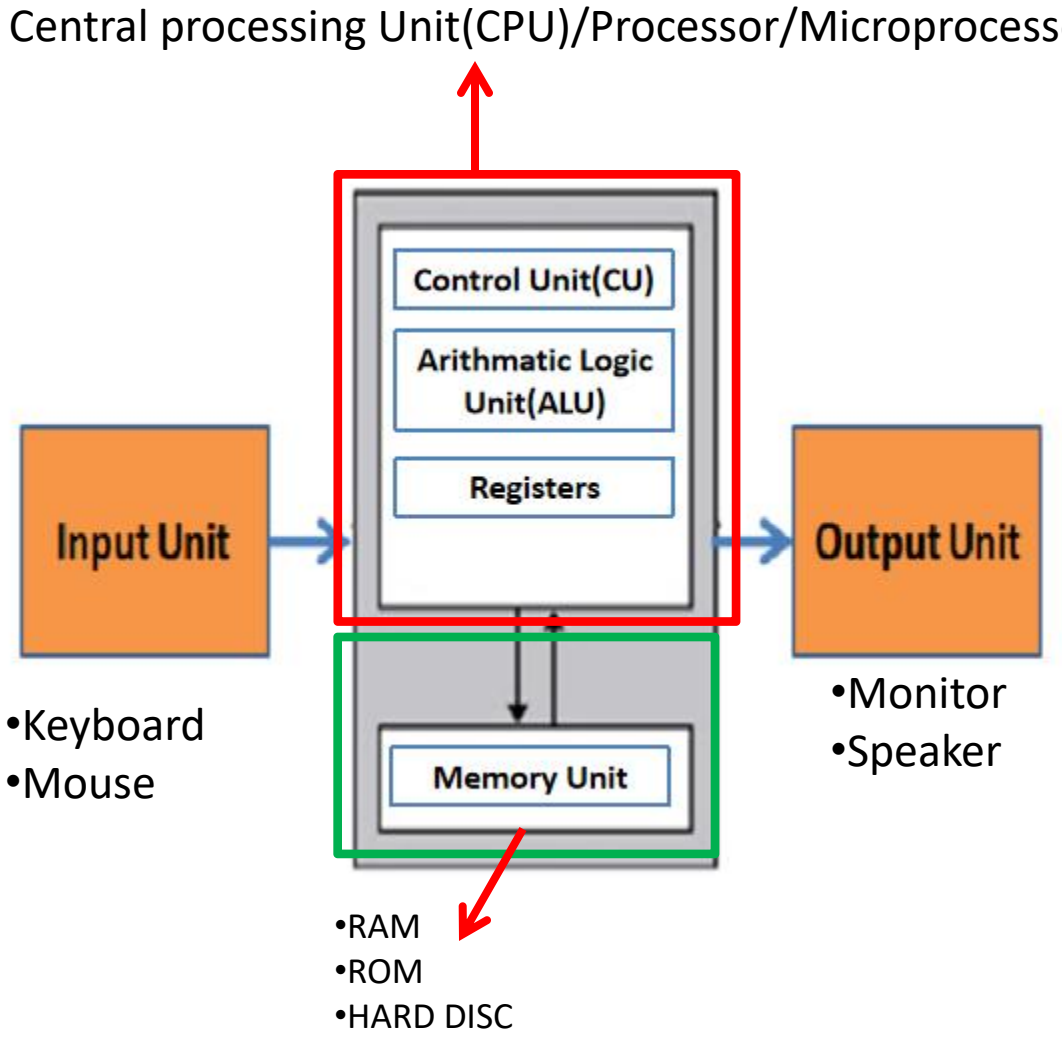


Fig-1: Block Diagram of a Computer System

Components of Computer System

- **Input Unit** − Devices like keyboard and mouse that are used to input data and instructions to the computer are called input unit.
- **Output Unit** − Devices like printer and visual display unit that are used to provide information to the user in desired format are called output unit.
- **Control Unit** − As the name suggests, this unit controls all the functions of the computer. All devices or parts of computer interact through the control unit.
- **Arithmetic Logic Unit** − This is the brain of the computer where all arithmetic operations and logical operations take place.
- **Registers**
  - High speed storage devices
  - Serves some special purpose , like IR – instruction register holds current instructions being executed
- **Memory** − All input data, and instructions are stored in the memory. Memory is of two types – **primary memory** and **secondary memory**.

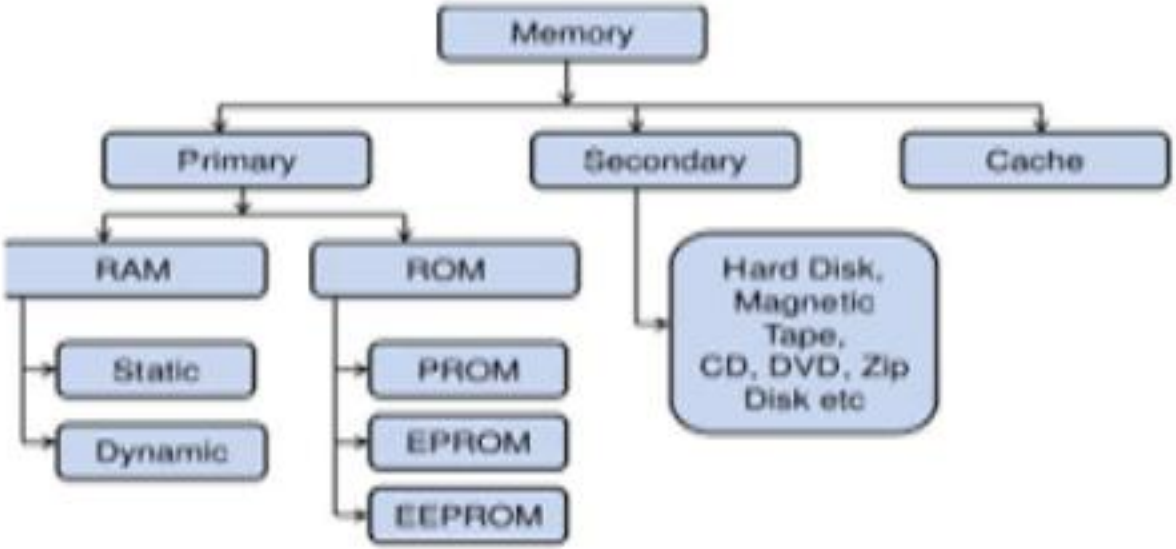
Arithmetic and Logical Operations

- **Arithmetic operations** – addition, subtraction, differentials, square root, etc.
- **Logical operations** – comparison operations like greater than, less than, equal to, opposite, etc.

Memory unit

- It is used to **store data and instructions**. Computer memory is the storage space in the computer, where data is to be processed and instructions required for processing are stored.
- The memory is divided into large number of small parts called cells. Each location or cell has a unique address,

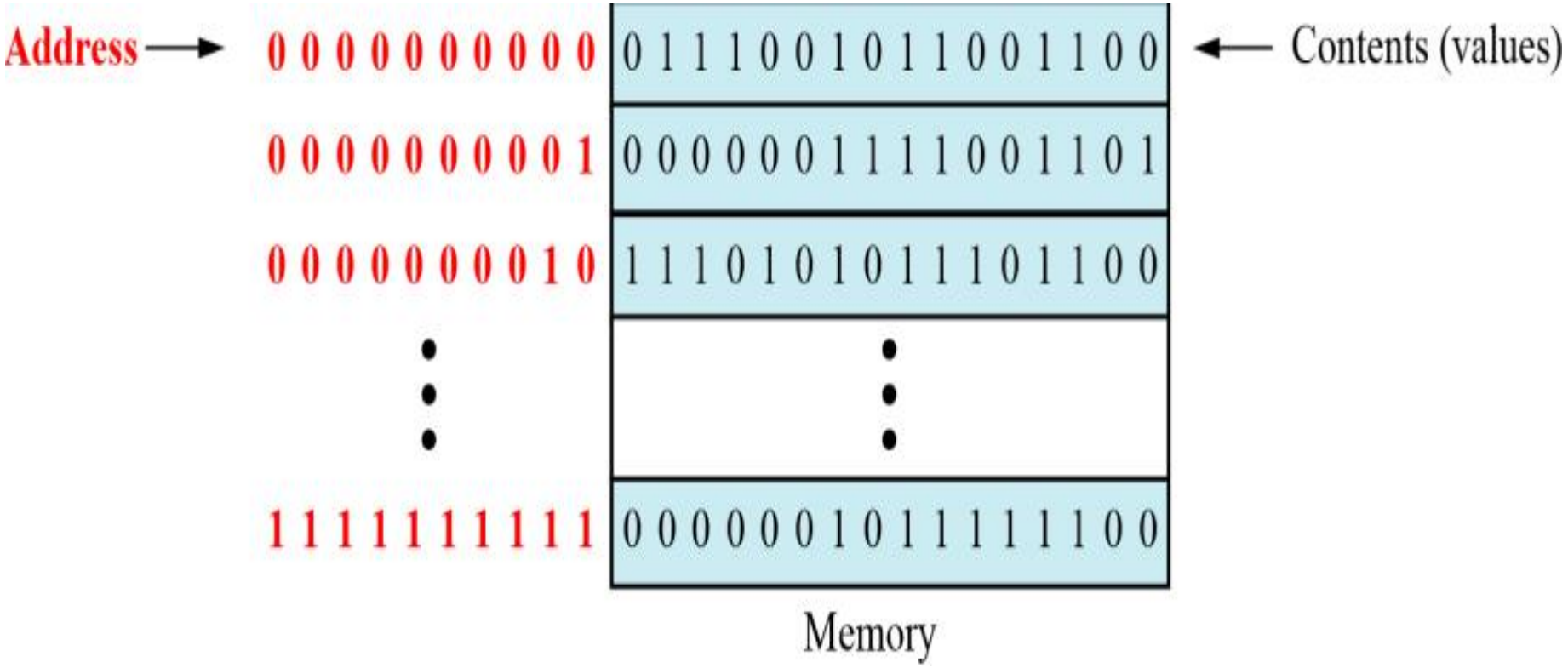
Computer Memory



- ✓ Primary memory can be accessed directly by the CPU and is volatile.
- ✓ Secondary memory is not directly accessible by the CPU and is non-volatile

- •RAM: Random Access Memory
- •ROM: Read Only Memory
- •PROM: Programmable ROM
- •EPROM: Erasable Programmable ROM
- •Electrically Erasable Programmable ROM

Main Memory


Address
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 1
0 0 0 0 0 0 0 0 0 1 0
1 1 1 1 1 1 1 1 1 1 1
0 1 1 1 0 0 1 0 1 1 0 0 1 1 0 0
0 0 0 0 0 0 1 1 1 1 0 0 1 1 0 1
1 1 1 0 1 0 1 0 1 1 1 0 1 1 0 0
0 0 0 0 0 0 1 0 1 1 1 1 1 1 0 0
Contents (values)
Memory

Memory Units

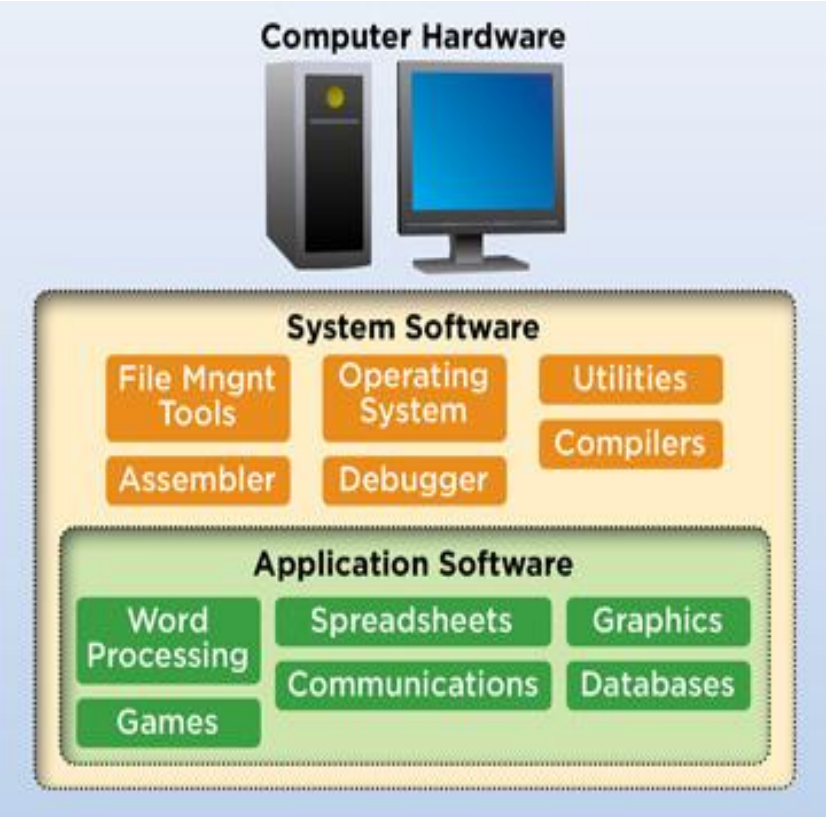
S.No.	Unit & Description
1	**Kilobyte (KB)** 1 KB = 1024 Bytes = 2^{10} Bytes = 10^{3} Bytes
2	**Megabyte (MB)** 1 MB = 1024 KB = 2^{10} KB = 10^{6} Bytes
3	**GigaByte (GB)** 1 GB = 1024 MB = 2^{10} MB = 10^{9} Bytes
4	**TeraByte (TB)** 1 TB =1024 GB = 2^{10} GB = 10^{12} Bytes
5	**PetaByte (PB)** 1 PB = 1024 TB = 2^{10} TB = 10^{15} Bytes
6	**ExaByte (EB)** 1 PB = 1024 PB = 2^{10} PB = 10^{18} Bytes
7	**YottaByte (YB)** 1 PB = 1024 EB = 2^{10} EB = 10^{21} Bytes

- **Bit (Binary Digit):** 0 and 1
- **Nibble:** 4 bits
- **Byte:** 8 bits

Computer hardware and Software

- **Computer Hardware:** Any physical device used in your computer
- **Instruction**: Command to perform a task
- **Program:** Set of Instructions to perform some specific task
- **Software:** Set of instructions or programs used to operate computers and execute specific tasks
- **Programming:** Process of writing a set of instructions that tell a computer how to perform a task.

Software Types



- **System software:** It provides a platform for other softwares
- Used by the computer system to operate on hardware

  Example: OS, Device Driver
- **Application software:** Used by users to perform some specific task

  Example: Word, excel and PowerPoint

Operating System(OS)

- It is a system software that acts as an intermediary between a user of a computer and the computer hardware.
- **Operating system goals:**
  - Execute user programs and make solving user problems easier.
  - Make the computer system convenient to use.
- Use the computer hardware in an efficient manner.

Example:

- Windows XP/7/10
- Linux(Ubuntu/Fedora/Redhat)

Compiler

- Software that translates program written in a high-level language (e.g.,C, C++, Java) into machine-language which is understood by a computer's CPU

  Example: C compiler, C++ compiler, java Compiler

Interpreter

- **Interpreter** translates just one statement of the program at a time into machine code.
- **Compiler** scans the entire program and translates the whole of it into machine code at once.

Assembler

- Converts instructions written in assembly language into machine language

Editor

- Software used to edit text in a computer
- Example: notepad, notepad++

Editor and IDE

IDE — that's an integrated development environment, it is the piece of software that acts as text editor, debugger and compiler all in one.

Example:

Eclipse

NetBeans

CodeLite

Bloodshed Dev-C++

Code::Blocks

C-Free

Algorithm

- Algorithm is an ordered set of well defined instructions to perform some specific task in finite time.

Algorithm

- It is a **finite** **step-by-step** list of **well defined instructions** to solve a particular problem.
- It takes some value or some set of values as its input and produces some value or some set of values as its output.

Important features of an algorithm

- **Finiteness:** An algorithm must terminate after a finite or fixed number of steps.
- **Well Define:** Each step should be clearly and correctly defined i.e. the actions to be carried out should be specified unambiguously.
- **Effectiveness:** All operations used in the algorithm are basic and can be performed exactly in a fixed duration of time.
- **Input:** An algorithm has one or more input.
- **Output:** It produces one more output.

Different ways of stating algorithm

- **Step form :** statements to follow in steps
- **Pseudo Code :** English form with restricted vocabs
- **Flowchart**

Flowchart is graphically oriented representation with sequence, decision, repetition actions

Simple Algorithm : in steps

Step 1: Start

Step 2: Create a variable to receive the user's email address

Step 3: Clear the variable in case it's not empty

Step 4: Ask the user for an email address

Step 5: Store the response in the variable

Step 6: Check the stored response to see if it is a valid email address

Step 7: Not valid? Go back to Step 3.

Step 8: End

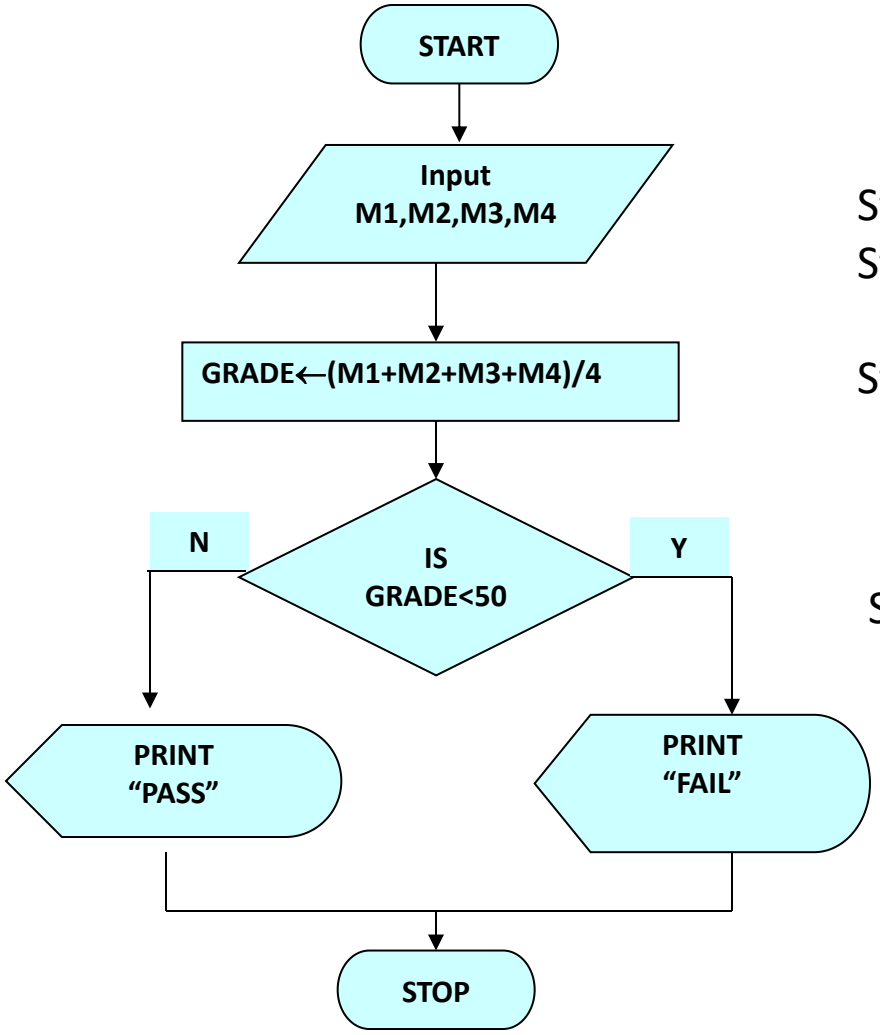
Simple Algorithm : pseudo-code

```
if student grade is greater than or equel to 90
   print |A|
else
   if student grade is greater than or equel to 80
      print |B|
   else
      if student grade is greater than or equel to 70
         print |C|
      else
         if student grade is greater than or equel to 60
            print |D|
```

Note: All statements showing "dependency" are to be indented.

Simple Algorithm : flow chart

Flow chart



Algorithm

Step 1: READ M1,M2,M3,M4
Step 2: SET GRADE =
(M1+M2+M3+M4)/4
Step 3: IF GRADE <50 then
PRINT “FAIL”
ELSE
PRINT “PASS”

Step4: EXIT

Algorithm for Addition of two numbers 10 and 20

- Step-1: Set NUM1=10 and NUM2=20
- Step-2: Set NUM3=NUM1+NUM2
- Step-3: Print NUM3
- Step-4: Exit

Algorithm for Addition of two numbers taking from User

- Step-1: Read NUM1
- Step-2: Read NUM2
- Step-3: Set NUM3=NUM1+NUM2
- Step-4: Print NUM3
- Step-5: Exit

Algorithm to find out the sum and product of any two numbers taking from User

- Step1: READ NUM1 and NUM2
- Step2: SET SUM = NUM1 + NUM2
- Step3: SET PRODUCT = NUM1 * NUM2
- Step4: PRINT SUM, PRODUCT
- Step5: EXIT

Algorithm to find out largest between two numbers taking from user

- Step1: READ NUM1 and NUM2
- Step2: IF NUM1 > NUM2 then

  PRINT: NUM1 is largest

  ELSE

  PRINT: NUM2 is largest
- Step3: EXIT

Algorithm to find out largest between three numbers

- Step1: READ NUM1, NUM2, NUM3
- Step2: SET LARGEST = NUM1
- Step3: IF NUM2 > LARGEST then

  LARGEST = NUM2
- Step4: IF NUM3 > LARGEST then

  LARGEST = NUM3
- Step5: PRINT LARGEST
- Dtep6: EXIT

Algorithm to test whether an inputted number is positive or negative or equals to zero

- Step1: READ NUM
- Step2: IF NUM == 0 then

  PRINT: Inputted number is zero

  ELSE IF NUM > 0 then

  PRINT: Inputted number is positive

  ELSE

  PRINT: Inputted number is negative
- Step3: EXIT

Algorithm to find out the factorial of any number

- Step1: READ NUM
- Step2: SET FACT = 1
- Step3: SET I = 1
- Step4: Repeat steps 5 and 6 while I <= NUM
- Step5: FACT = FACT * I
- Step6: I = I + 1
- Step7: PRINT FACT
- Step8: EXIT

Assignment-1

- Write an algorithm for following task
- Take basic salary, DA%, HRA% as input from user
- Then give output based on following conditions
- **h**igh income group if gross salary is greater than or equal to 80000
- medium income group if gross salary between greater than 60000 and less than 80000
- Lower Income group if gross salary less than 60000
- Gross=BA+DA+HRA

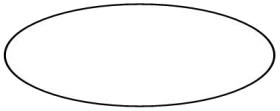
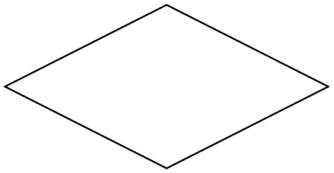
Assignment-2

- Write an algorithm for displaying even and odd numbers from 1 to 100.

Flow Chart

- Flow chart is a graphical representation of an algorithm.
- It shows logic of an algorithm
- Represents sequence of operations
- It shows control flow from one action to the next
- Used to analyze, design, document and manage a program.

Flowchart Symbols

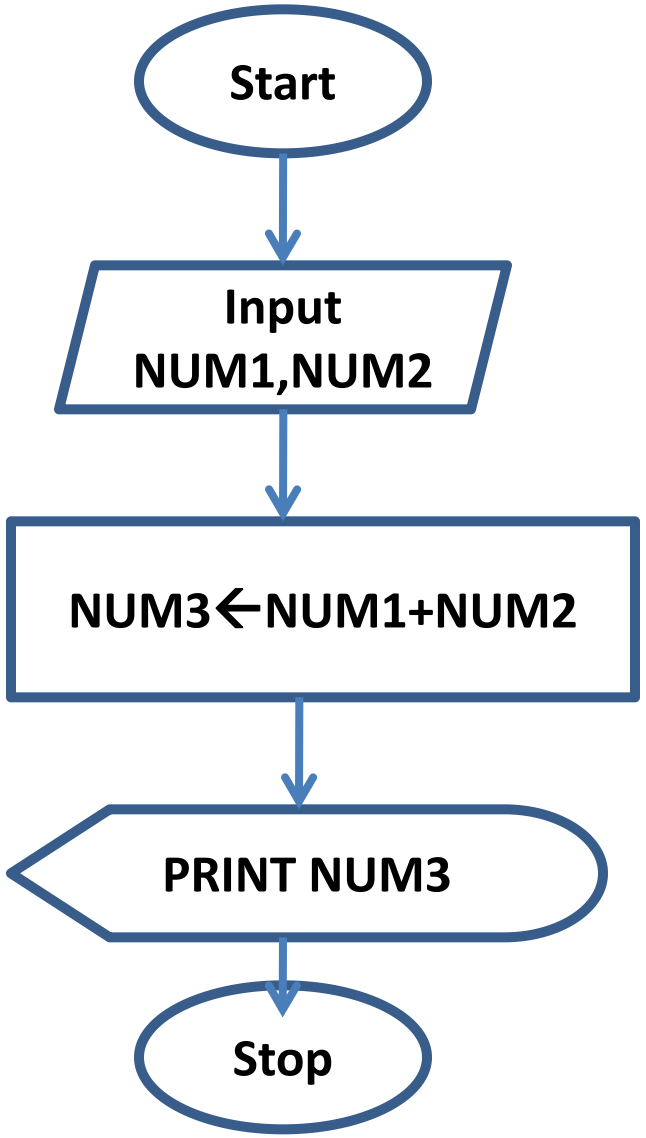
Name	Symbol	Use in Flowchart
Oval		Denotes the beginning or end of the program
Parallelogram		Denotes an input operation
Rectangle		Denotes a process to be carried out e.g. addition, subtraction, division etc.
Diamond		Denotes a decision (or branch) to be made. The program should continue along one of two routes. (e.g. IF/THEN/ELSE)
Hybrid		Denotes an output operation
Flow line		Denotes the direction of logic flow in the program

Example of algorithm and flow chart for adding two inputted numbers and printing

Algorithm

- Step-1: Read NUM1
- Step-2: Read NUM2
- Step-3: Set NUM3=NUM1+NUM2
- Step-4: Print NUM3
- Step-5: Exit

Flow chart



Example-2: Algorithm & Flow Chart

Question: Write an algorithm and design a flow chart for the following problem.

Pseudocode

- Input a set of marks in 4 subjects.
- Calculate their average by summing and dividing by 4.
- if average is below 50

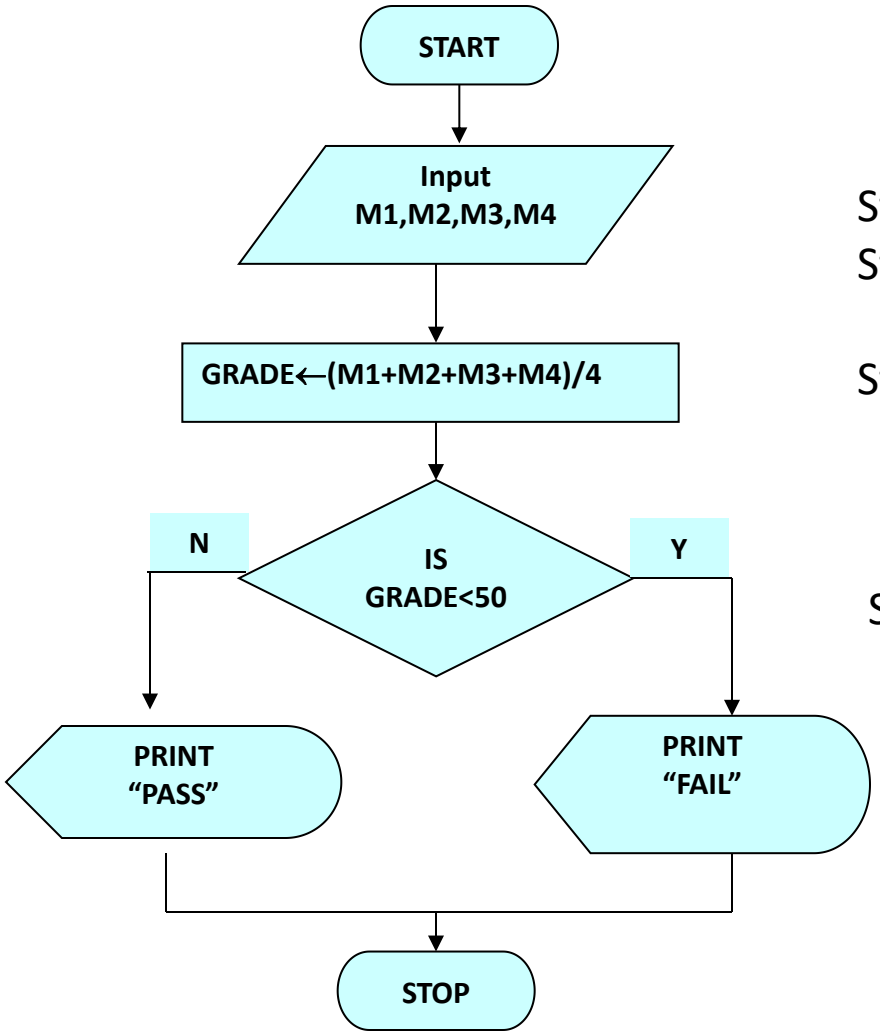
  Print “FAIL”

  else

  Print “PASS”

Example-2

Flow chart



Algorithm

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(M1+M2+M3+M4)/4
Step 3: IF GRADE <50 then
PRINT “FAIL”
ELSE
PRINT “PASS”
Step4: EXIT

Assignment Questions

1. Write algorithm and flow chart for Addition of two numbers 10 and 20
2. Write algorithm and flow chart to find out the sum and product of any two numbers taking from user
3. Write algorithm and flow chart to find out the factorial of any number
4. Write an algorithm and a flow chart for checking an inputted number even or odd
5. Write an algorithm and a flow chart for displaying even and odd numbers from 1 to 100.

Assignment Questions

6. Write an algorithm and draw a flowchart that will read the two sides of a rectangle and calculate its area.

Question-7

- Write an algorithm and a flow chart for following task
- Take basic salary, DA%, HRA% as input from user
- Then give output based on following conditions
- **h**igh income group if gross salary is greater than or equal to 80000
- medium income group if gross salary between greater than 60000 and less than 80000
- Lower Income group if gross salary less than 60000

Reference

1. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). *Introduction to algorithms*. MIT press.
2. Internet sources

References

- Silberschatz, A., Galvin, P.B. and Gagne, G., 2013. Operating system concepts essentials. Wiley Publishing.
- Internet Source