APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

STUDY MATERIALS

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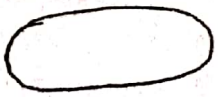
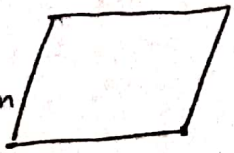
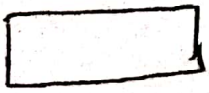
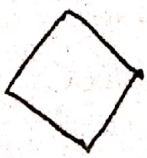
Algorithm and Floco Chart

Algorithm is a step-by-step procedure used to solve a problem for performing certain calculations, data processing etc.

Algorithm contains a finite list of well-defined instructions for performing a task.

Flowchart is a pictorial representation of the steps involved in a procedure.

A Flowchart consists of symbols linked by Arrows.

Symbol	Function
Rounded Rectangle 	Indicates Start/Stop
Parallelogram 	Denotes Input/Output Operations
Rectangle 	Denotes Processing operations used for calculation purpose.
Diamond or Rhombus 	Denotes a condition or decision. Control is transferred according to the true/false test. This box has 2 arrows; one pointing to yes condition & other to No condition.

	Symbol	Function
Connector	○	It indicates a logical flow.
Arrows	↓ → ← ↑	Denotes the flow of control

There are basically 3 types of control structures in structured programming.

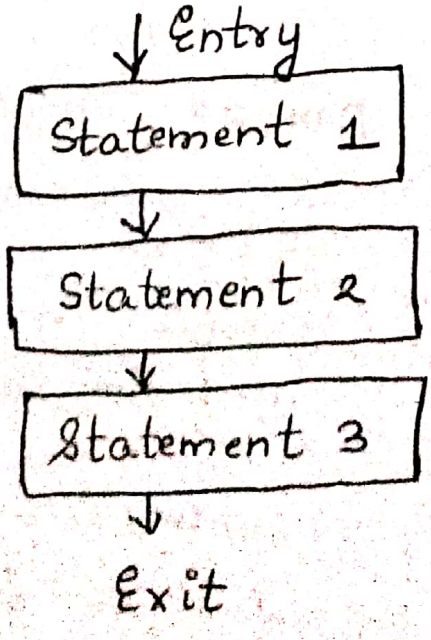
(i) Sequential Structure.

(ii) Selection Structure.

(iii) Looping Structure.

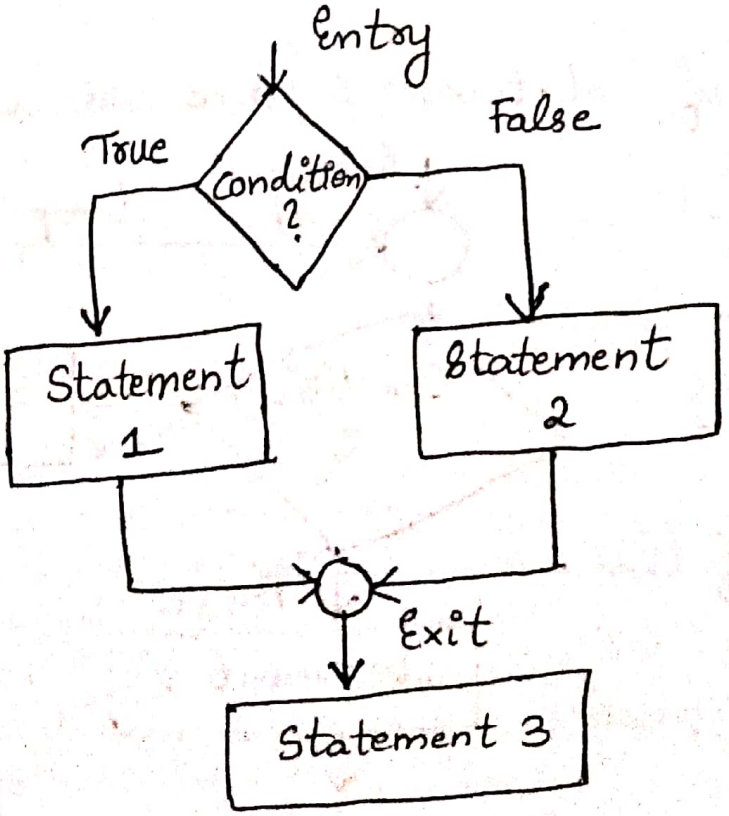
(i) Sequential Structure -

It follows a straight line execution mechanism, where a sequence of statements are executed in a linear fashion.



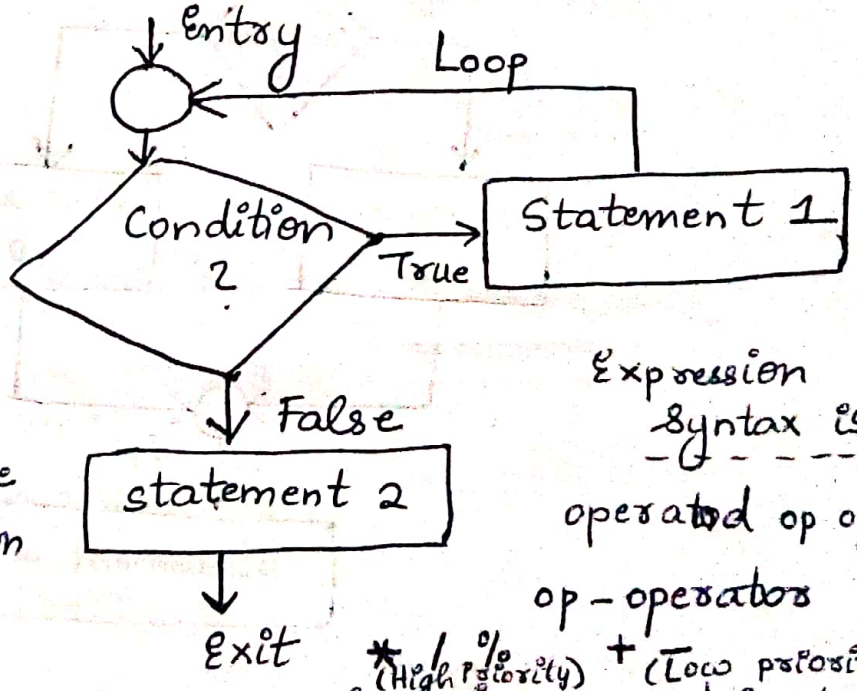
(ii) Selection Structure -

It is a multiple branching statement in which control is transferred to one of the many possible cases, based upon the logical test performed. If condition is true, sequence of statements following yes condition is executed. If the condition is false, sequence of statements following false condition is executed.



(iii) Looping Structure

In this structure, condition is evaluated at the beginning of the loop. Looping action continues until expression in the condition is true. As long as condition is true, sequence of statements following True condition is executed. When the condition becomes false, the loop is terminated and the remaining set of statements are executed.



Expressions are evaluated using assignment statement of the form: variable = value
variable = expression

Expression Syntax is
operand op operand
op - operator
* / % (High priority)
+ (Low priority)

↑ Expressions in C – An expression is a combination of variables, constants and operators written according to the syntax of C language.

Qn) ① Write an algorithm and draw a flow chart to find the sum of N natural numbers?

$$1 + 2 + 3 \ldots + N = \frac{N(N+1)}{2}.$$

Algorithm

Step 1: Start

Step 2: Integer N, sum.

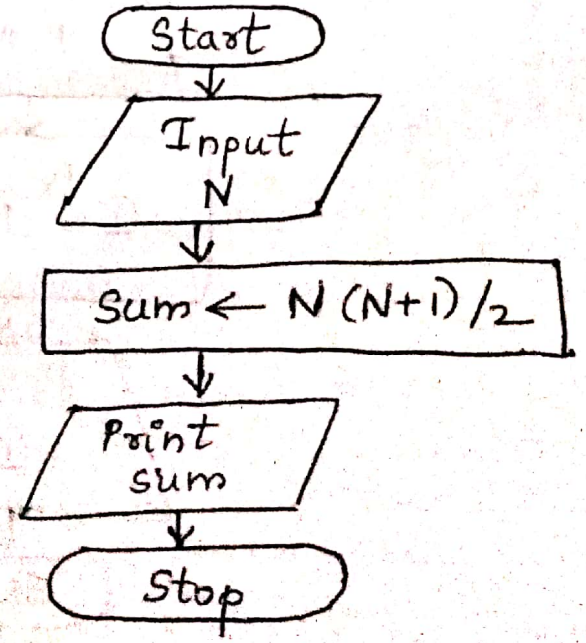
Step 3: Input N

Step 4: sum $\leftarrow (N * (N+1))/2$

Step 5: Print sum

Step 6: Stop

Flow chart



Qn) ② Write an algorithm and draw a flow chart to compute simple interest ?

Algorithm

Step 1: Start

Step 2: float I, P, N, R

Step 3: I ← 0

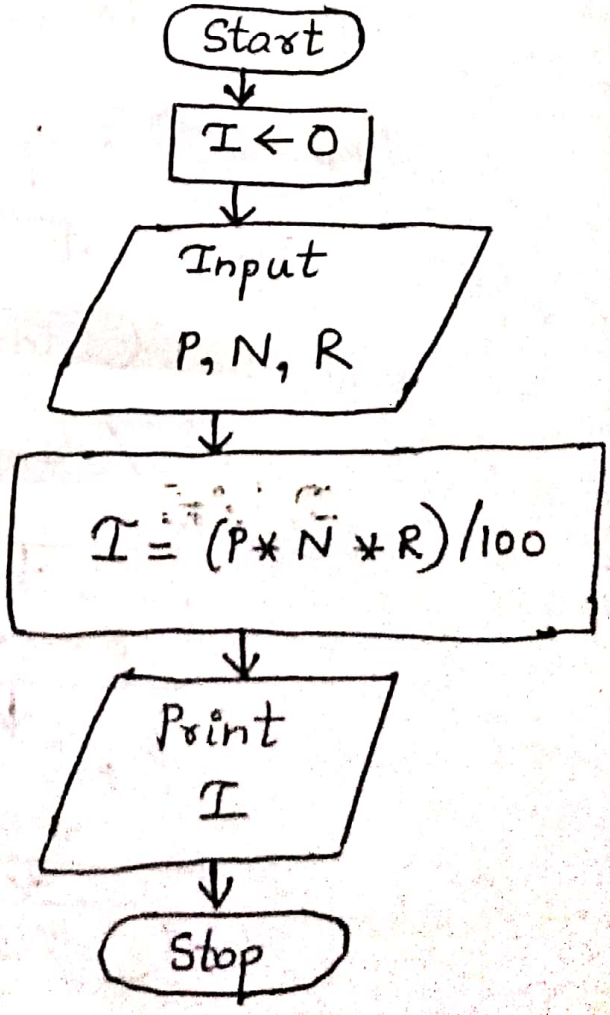
Step 4: Input P, N, R
P → Principle Amount, N → No. of years, R → Rate of Interest

Step 5: I ← (P * N * R)/100

Step 6: Print I

Step 7: Stop

Flow Chart



Qn) Write an algorithm and draw a flow chart ③ to compute compound interest?

Algorithm

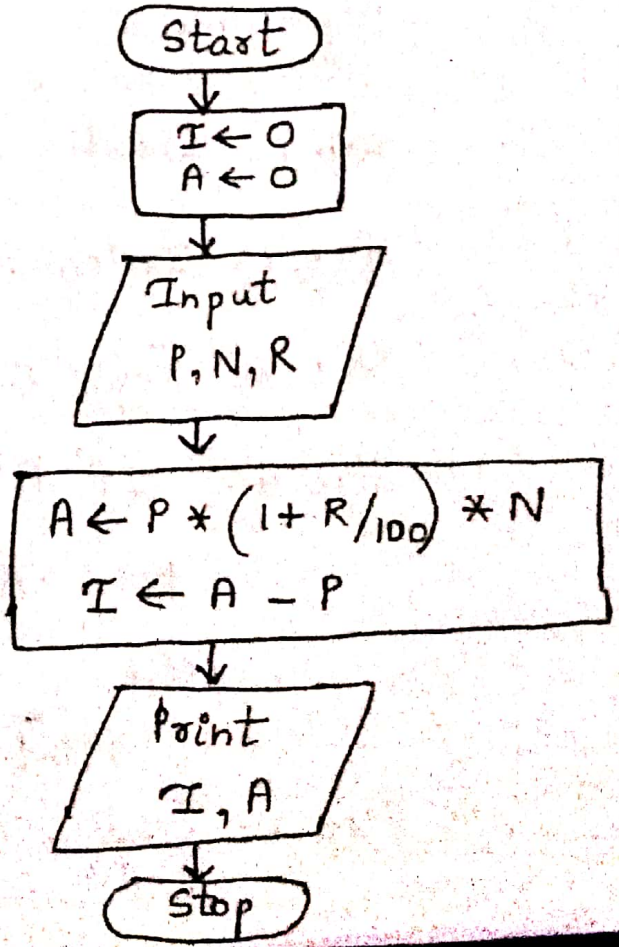
Step 1: Start
Step 2: float A, I, P, N, R
Step 3: A ← 0, I ← 0
Step 4: Input P, N, R
Step 5: A ← P * (1 + R/100) * N
Gross Amount

Step 6: I ← A − P
Compound Interest, Gross Amount, Principle Amount

Step 7: Print A, I

Step 8: Stop

Flow Chart



Qn ④) Write an algorithm and draw a flow chart to find the largest of two numbers?

Algorithm 1

Step 1: Start

Step 2: integer A, B
Step 3: Input A, B
Step 4: If A is greater than B, perform
Step 5. , else perform Step 6

Step 5: Print "A is greater"

Step 6: Print "B is greater".

Step 7: Stop

Algorithm 2

Step 1: Start

Step 2: Integer A, B

Step 3: Input A, B

Step 4: If A > B

Print A, A "is greater".

else

Print B, B "is greater".

Step 5: Stop

Qn) Write an algorithm and draw a floco chart to find the largest of 3 numbers?

Algorithm

Step 1: Start

Step 2: integer A, B, C

Step 3: Input A, B, C

Step 4: If A > B and A > C then

Print A, " is the largest"

Step 5: else If B > C then

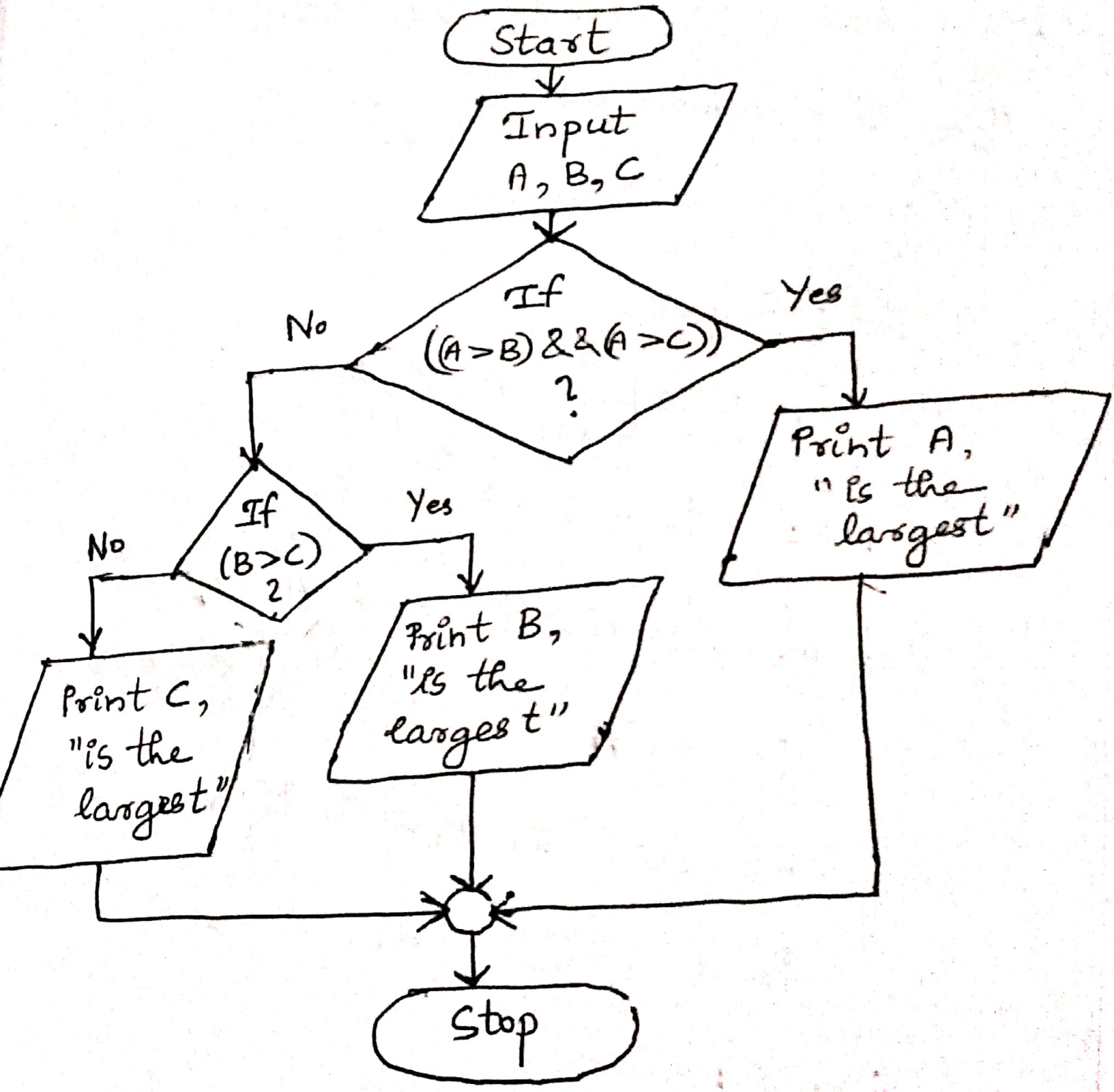
Print B, " is the largest"

Step 6: else

Print C, "is the largest"

Step 7: Stop

Flow Chart



Prime Number

Prime numbers are numbers that are divisible by 1 and itself.

The largest factor of a number N must be less than or equal to N/2. So, take N/2 as the limit and check all the integers smaller or equal to N/2.

If N is divisible by any number between 2 and N/2, then N is not a prime number.

Pseudcode of Prime number Program

get Number N from user

get flag = 1

for i ranges from 2 to N/2 do

begin

if Number N divisible by i then

set flag = 1

end

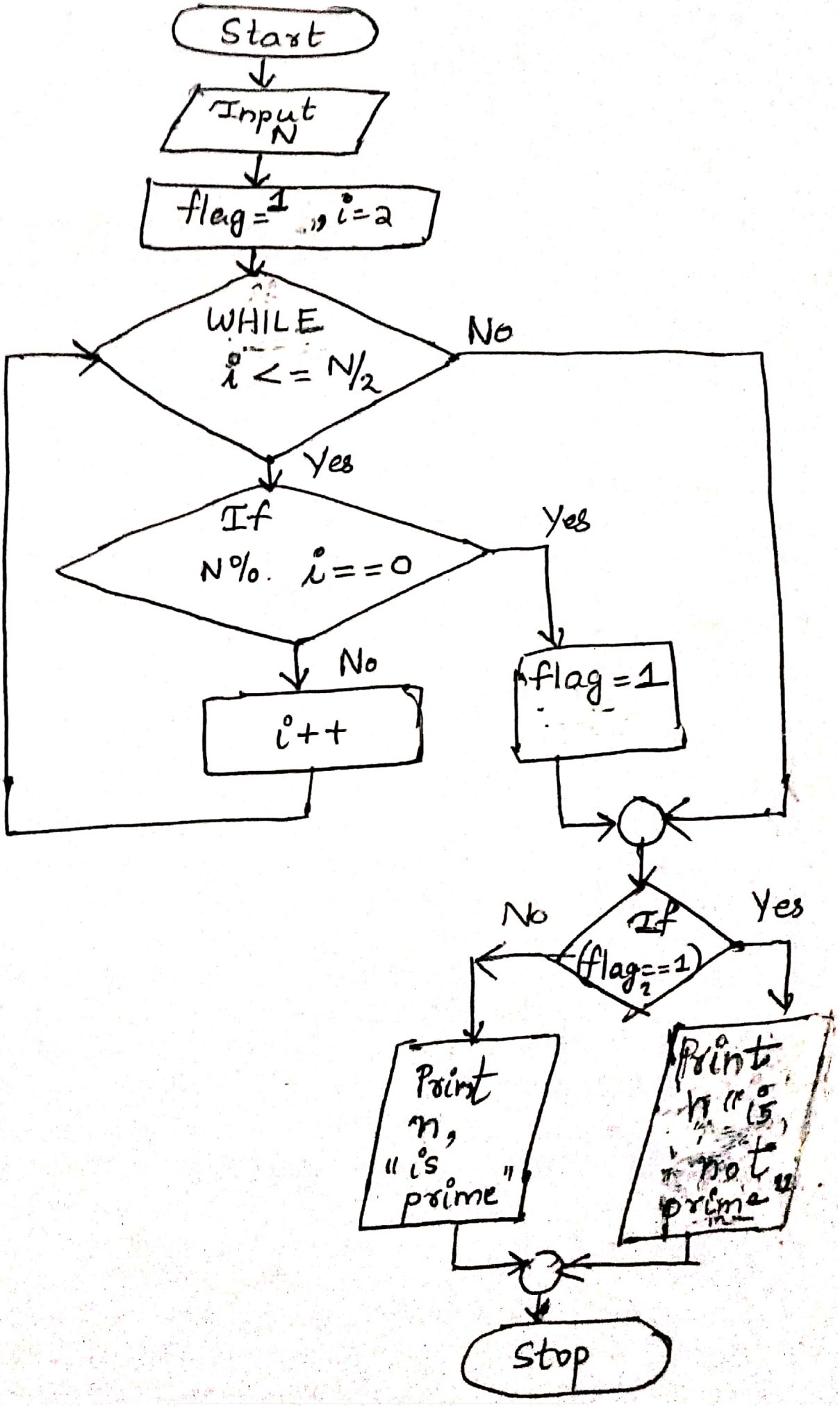
if flag == 1 then

display number N is not prime

else

display number N is prime

Flow Chart



Algorithm to check whether a number is Prime or Not - Prime numbers are numbers that are divisible by 1 and itself.

Step 1: Start

Step 2: Declare variables n, i, flag.

Step 3: Initialize variables

flag ← 1

i ← 2

Step 4: Read n from user.

Step 5: Repeat the steps until i <= (n/2)

Step 5.1: If remainder of n % i equals 0

flag ← 1

Go to Step 6

Step 5.2: i ← i + 1

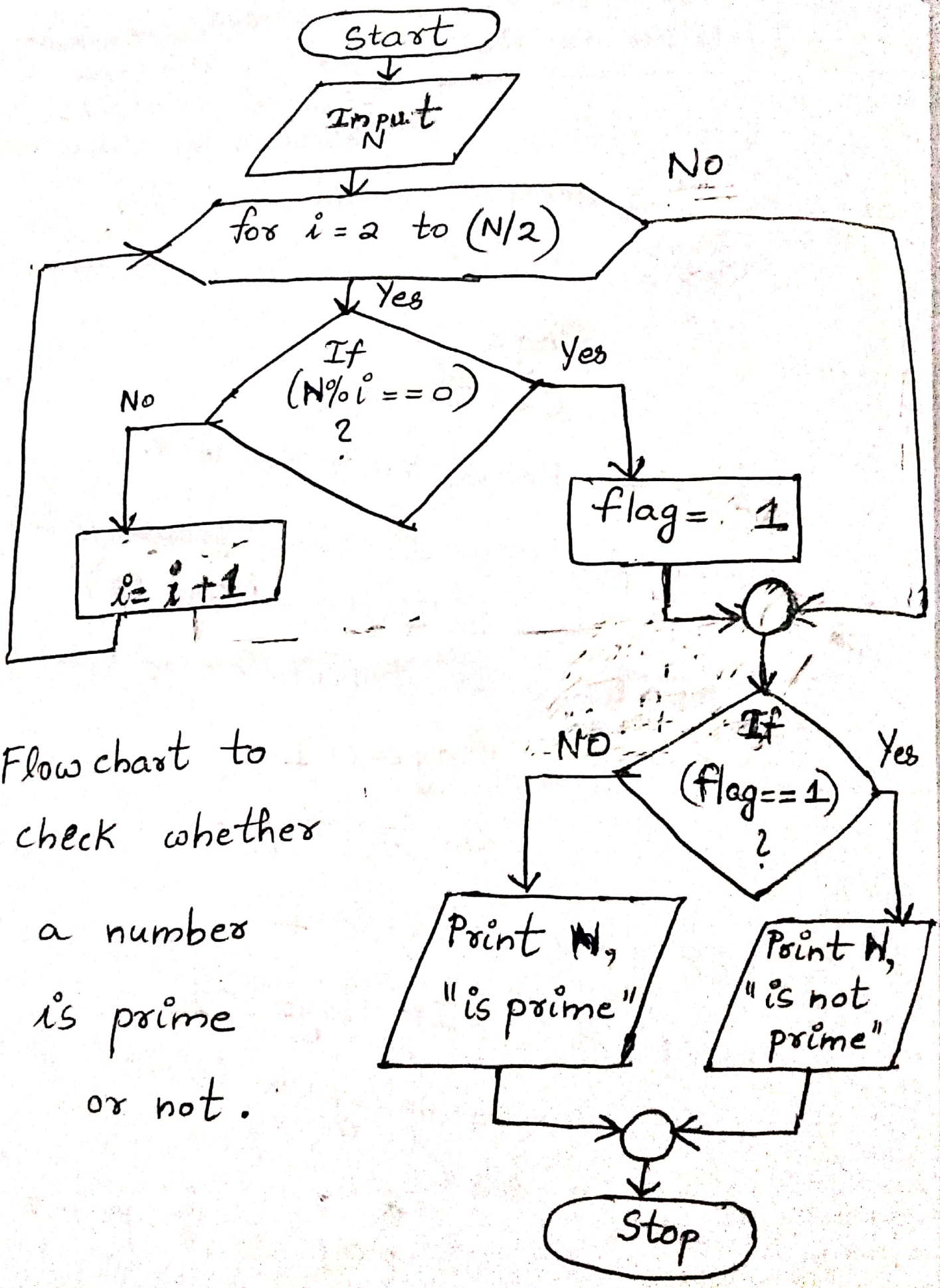
Step 6: If flag == 1

Display n is not prime

else

Display n is prime.

Step 7: Stop



Flow chart to check whether a number is prime or not.

Qn) Write a C program to print the largest of 3 numbers and to find whether the largest number is prime or not?

```
#include <stdio.h>
#include <conio.h>
void main()
{
int A, B, C, max;
printf("Enter the three numbers");
scanf("%d %d %d", &A, &B, &C);
if((A>=B) > (A>=C))
max = A;
else if (B>C)
max = B;
else
max = C;
N = max;
printf("Largest number is %d', max);
```

```
for (i=2; i<=N/2; i++)
  {
  if (N%i==0)
    {
     flag=1;
      break;
    }
  }
if (flag==1)
  printf("Number %d is not
                  prime", N);

  else

  printf("Number %d is prime", N);
  getch();
}
```

Qn) Write a C program to swap the values of 2 variables without using a third variable?

```
#include <stdio.h>
#include <conio.h>

void main()
{
int a = 7, b = 4;
printf ("\n A = %d  B = %d", a, b);

a = a+b;

b = a-b;

a = a-b;

printf ("Now  A = %d , B = %d", a, b);

getch();

}
```

Qn) Write a C program to compute addition, subtraction, multiplication and division using switch-case statement?

```
#include <stdio.h>
#include <conio.h>
void main()
{
 int a,b,sum,sub,mul,ch;
 float div;
 printf("Enter 2 numbers");
 scanf("%d %d", &a, &b);
 printf("1.Addition 2.Subtraction 3.Multiplication
  4.Division\n");
 printf("Enter your choice");
  scanf("%d", &ch);
 switch(ch)
 {
 case 1:
      sum = a+b;
      printf("Sum= %d", sum);
      break;
 case 2:
      sub = a-b;
      printf("Difference = %d", sub);
      break;
case 3:
      mul = a*b;
      printf("Multiplication = %d", mul);
      break;
case 4:
      div = a/(float)b;
      printf("Division=%d", div);
      break;
default:
      printf("Invalid
              choice");
      break;
 }
  getch();
 }
```

Qn) Write an algorithm to check whether largest of 3 numbers is prime or not?

Algorithm

Step 1: Start

Step 2: integer A, B, C, max, N, i, flag

Step 3: Initialize variables $i \leftarrow 2$, $flag \leftarrow 1$

Step 4: Input A, B, C

Step 5: if A > B, and A > C then
max = A
Print A, "is the largest".

Step 6: else if B > C then
max = B
Print B, "is the largest".

Step 7: else
max = C
Print C, "is the largest"

Step 8 - Initialize N with max.

Step 9: Repeat Steps until $i <= (N/2)$

Step 9.1: If remainder of N % i equals 0
flag ← 1
Go to Step 9

Step 9.2: $i \leftarrow i + 1$

Step 10 : If flag == 1

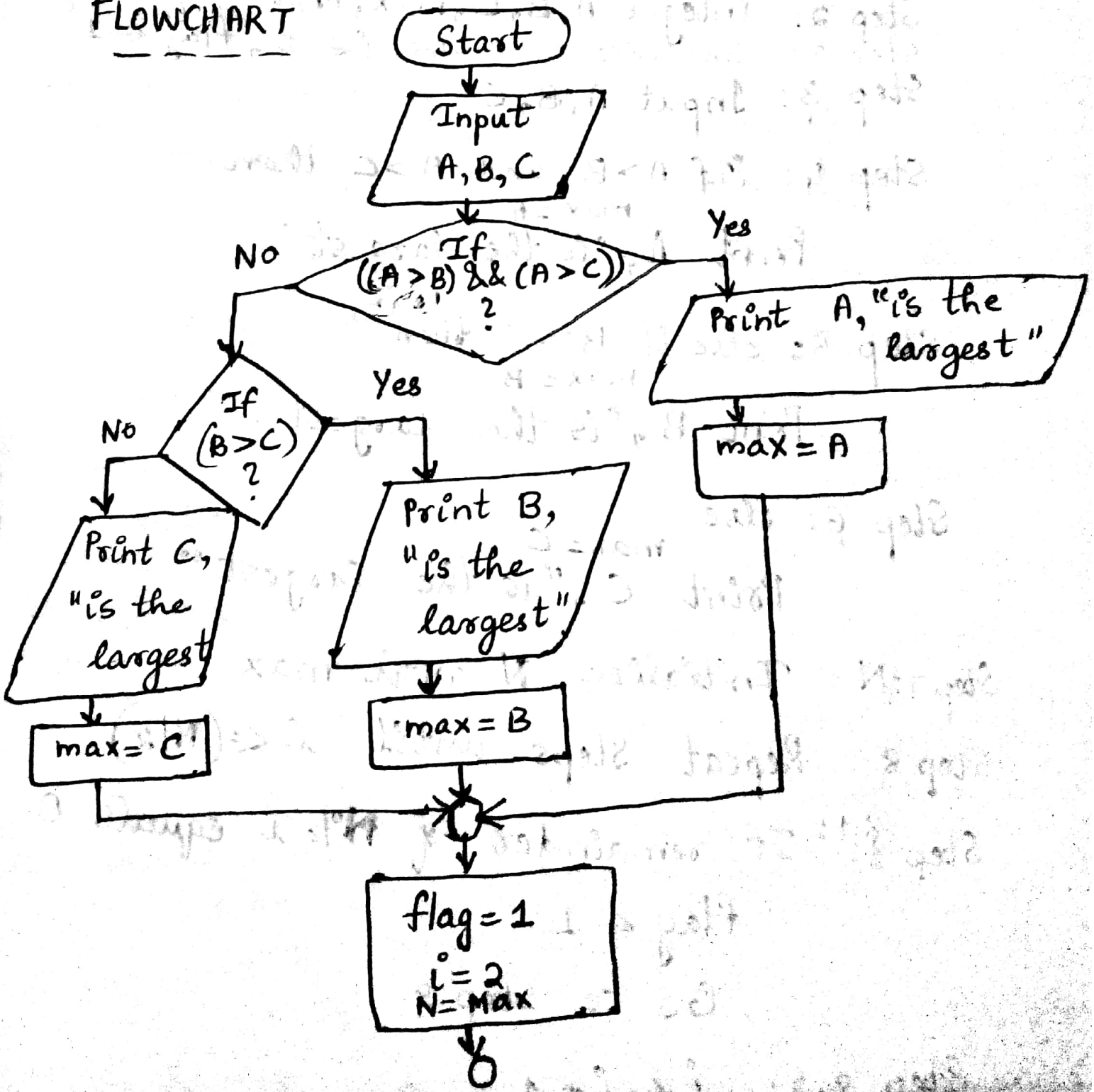
Display n is not prime

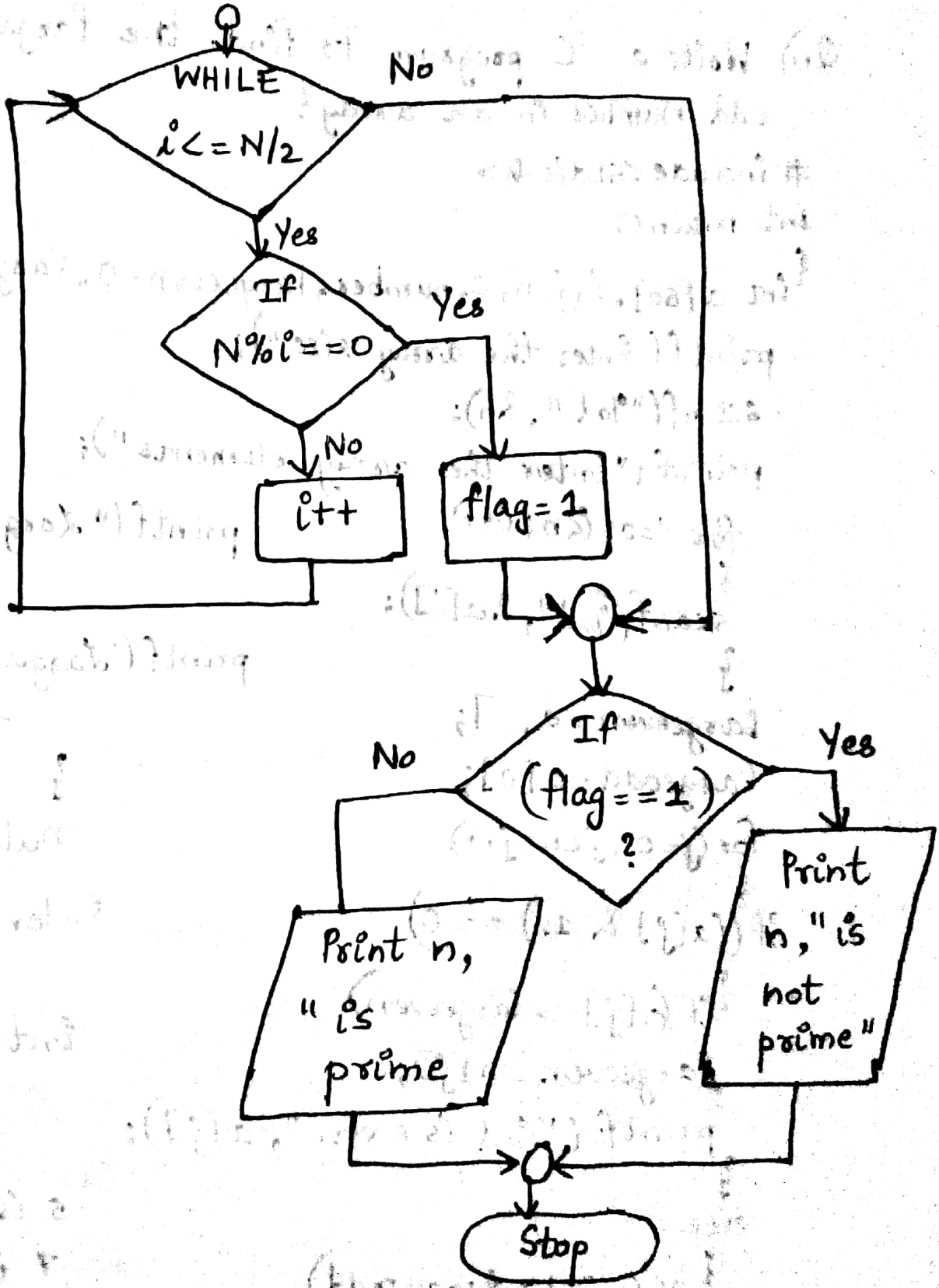
else

Display n is prime

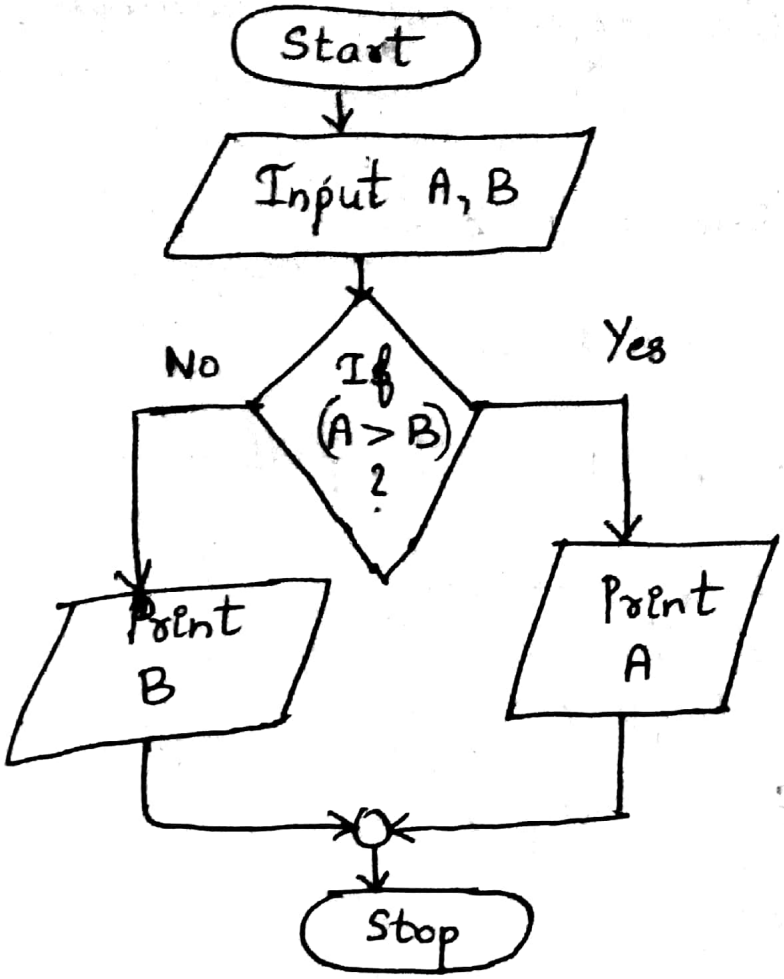
Step 10 : STOP.

FLOWCHART





Flow chart of largest of 2 numbers -



Qn ⑤) write an algorithm and draw a flow chart to compute the sum of two numbers?

Algorithm

Step 1: Start

Step 2: integer n_1, n_2

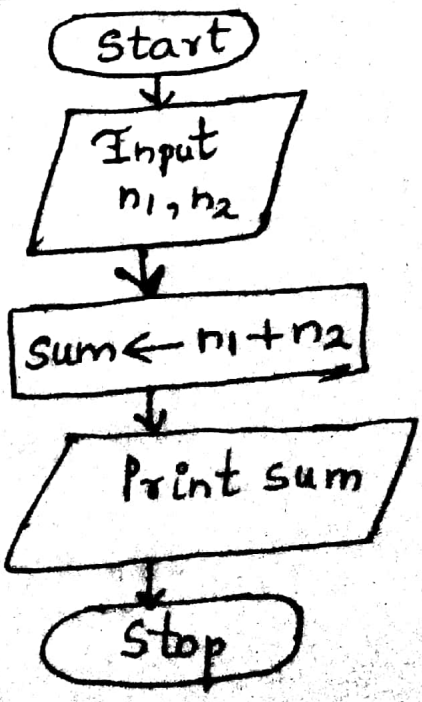
Step 3: Input n_1, n_2

Step 4: sum $\leftarrow n_1 + n_2$

Step 5: Print sum

Step 6: Stop

Flow Chart



Qn⑥) Write an algorithm and draw a flowchart to find the largest of 3 numbers?

Algorithm

Step 1: integer A, B, C

Step 2: Input A, B, C

Step 3: If A > B then perform Step 4

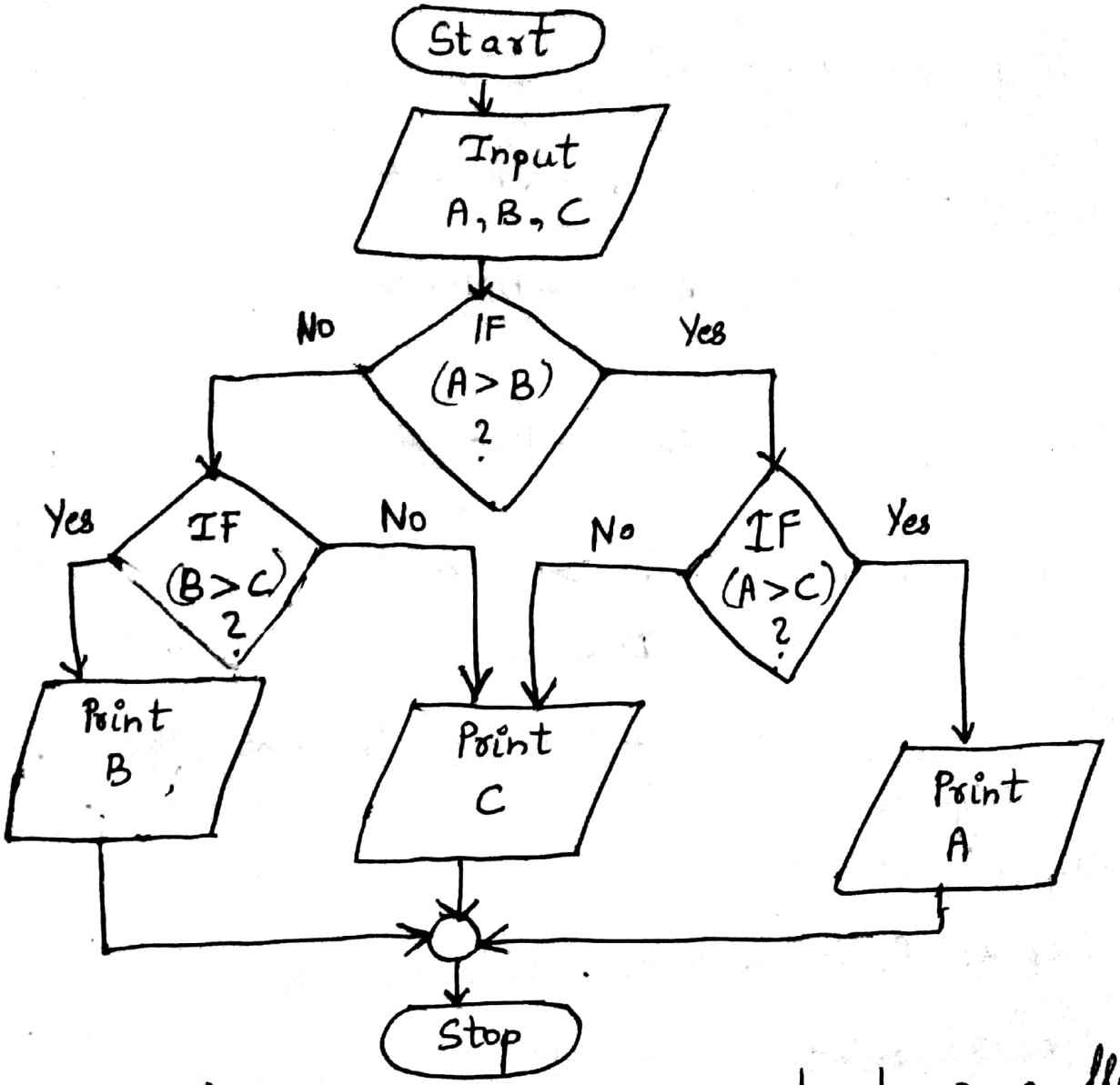
Step 4: If A > C then
begin
Print A, "is the largest number"
Perform Step 7
end
else

Step 5: If B > C then
begin
Print B, "is the largest number"
Perform Step 7
end
else

Step 6: Print C, "is the largest number"

Step 7: Stop

Flow Chart



Qn (7)) Write an algorithm and draw a flow chart to print number is even or odd?

Step 1: Start

Step 2: Input n

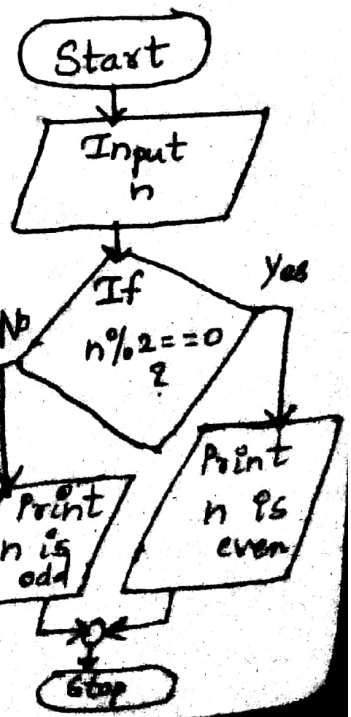
Step 3: If (n%2 == 0)

Print "The number is even"

else

print "The number is odd"

Step 4: Stop



Qn(8) Write an algorithm and draw a flow chart to find the roots of a quadratic equation?

Discriminant, $D = \sqrt{b^2 - 4ac}$

Roots, $r_1 = \frac{-b + \sqrt{D}}{2a}$.

$r_2 = \frac{-b - \sqrt{D}}{2a}$.

If Discriminant, $D > 0$, roots are real

$D < 0$, roots are imaginary

$D = 0$, roots are equal.

Algorithm

Step 1: Start.

Step 2: float a, b, c, D, r_1, r_2

Step 3: Print "Enter the coefficients of a, b and c

Step 4: Input a, b, c

Step 5: D ← b * b - 4 * a * c

Step 6: If (D == 0)

$r_1 \leftarrow -1 * b / 2a$

$r_2 \leftarrow r_1$

Print r_1 and r_2, roots are real and equal.

Step 7: else

if (D > 0)

$r_1 \leftarrow (-1 * b + sqrt(D))/2a$

$r_2 \leftarrow (-1 * b - sqrt(D))/2a$

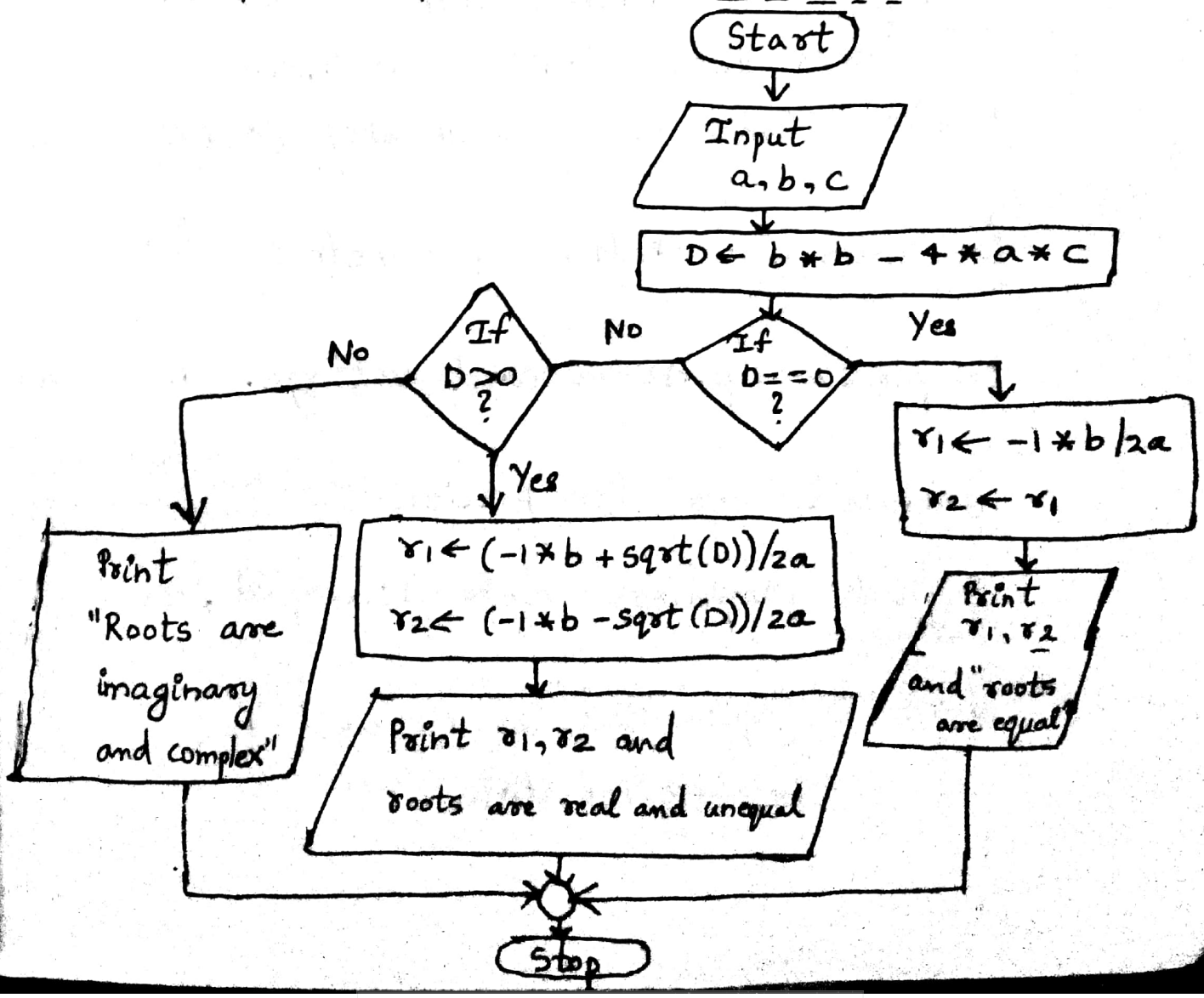
Print r_1 and r_2, roots are real and unequal.

Step 8: else

Print "Roots are imaginary and complex".

Step 9: Stop

Flow chart



DIVYA CHRISTOPHER

Basic definition : A Computer

A Computer is a machine for performing calculations automatically.

Summary -

A computer is an electronic machine that

- accepts data from the users.
- processes the data by performing operations and calculations on it.
- generates desired output results.
- stores data in magnetic disks, tapes, HDD, CD, DVD, etc.

Earlier computers were analog machines used for measuring realtime parameters like temperature, pressure and voltage. The values produced were less precise.

Digital computers were developed, where data is represented as 0s and 1s.

ie digital data

Features:-

- Computers process data very fast, at the rate of Millions of Instructions per Second (MIPS).
- Computers provide a high degree of accuracy.
- Computers work diligently for long hours with the same speed and accuracy. (Computers do not get tired).
- Computers can store large volumes of data temporarily in primary (main) memory (RAM) and permanently in secondary storage devices like hard disk and compact disk.
- Computer is versatile in nature. It can perform different types of tasks with the same ease.

Limitations:-

- Computers cannot perform any task by its own, instead it executes tasks based on the instructions fed to it by the user.

History of Computers

① ABACUS - First mechanical calculating device.

② Punch Card System - Data was represented in a punch card. Presence of hole in the punched card is represented as binary one and the absence of hole as binary zero.

③ Charles Babbage's Analytical Engine (1791 - 1871) 1823
Device for performing complex mathematical calculations.

④ Difference Engine

Generations of Computers

I) First Generation (1940 to 1956) using Vacuum Tubes -

Input was fed to the computer through punched cards and paper tapes. Instructions were written in machine language using 0s and 1s. They are enormous sized computers. Computation time: milli seconds.

Eg:- UNIVAC (Universal Automatic Computer)
ENIAC (Electronic Numeric Integrator and Calculator).
EDVAC (Electronic Discrete variable Automatic Co

II) Second Generation using Transistors
(1956 to 1963)

- Transistors allowed computers to become smaller, faster and cheaper. Computation time: Msecs (microsecs)
- Primary memory used magnetic core technology.
- Secondary memory used magnetic tapes and disks. Assembly language instructions were used like ADD, SUB, MOV, etc.
Eg:- IBM 1401, CDC 1604
High level languages like COBOL and FORTRAN were also developed.

III) Third Generation using Integrated Circuits
(1964 to 1971)

- IC silicon chip is incorporated by embedding multiple transistors on the silicon chip.
- Speed and efficiency of computer has been improved.
- Keyboard and Monitor were interfaced through the operating system.
- Computation time was in nano seconds.
- Operating System (OS) facilitates multiple applications to be run at the same time.
- High level languages itself were extensively used for programming. Eg:- IBM 370, PDP 11.

(IV) Fourth Generation using Microprocessors Personal Computers (1971 to Present)

They use Large Scale Integration (LSI) and Very Large Scale Integration (VLSI) technology, where thousands of components (millions of transistors) are integrated in a small chip.

Several new operating systems like MS-DOS and MS-WINDOWS were developed during this time, which supports GUI. Machines work with a faster computation time i.e in pico seconds.

Eg:- Intel 4004 chip embedding CPU and Memory.

In 1984, Apple introduced Macintosh.

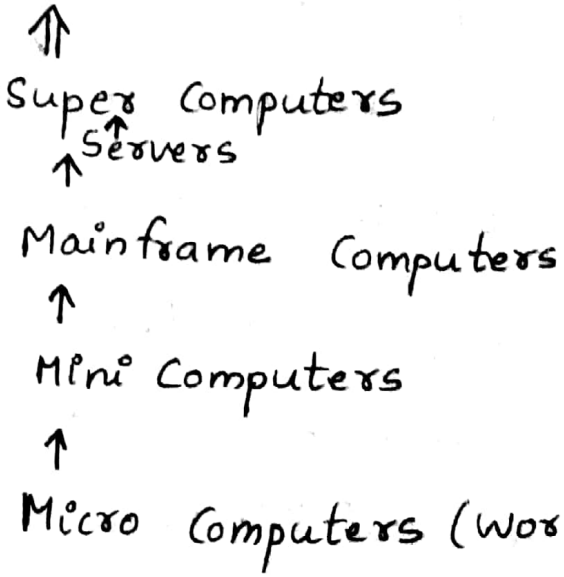
(V) Fifth Generation (Present and Next) using Artificial Intelligence

These computers use Super Large Scale Integrated (SLSI) chip that has parallel processing capacity to execute programe in

parallel. Eg:- Intel dual core microprocessor.

Eg:- Expert Systems, Natural Language Processing (NLP), Speech Recognition, Voice Recognition, Robotics.

Types of computers



(i) Micro Computers (Work Station) - They are small, low-cost and single-user digital computer. They consist of CPU, software, input unit, output unit, memory unit and storage unit (HDD).

Eg:- IBM PC based on Pentium microprocessor.

→ Desktop Computer / Personal Computer

→ Notebook Computers / Laptop (small in size, has battery back up and costlier than desktop, all functionality of the desktop).

→ Netbook (Low weight and Low Cost, can be designed for accessing web-based applications)

→ Tablet computer can accept input from a stylus or Pen instead of Keyboard or mouse.

→ Handheld computer or Personal Digital Assistant (PDA) is a small computer that can be held on top of the palm. PDA uses a pen or stylus for input. PDAs are less-powerful and can be connected to the Internet via wireless connection.

→ Smart phones - PDAs emerged into smartphones. These devices function both as cellular devices and a small PC. They can be connected to the Internet wirelessly.

Eg:- Nokia, Apple, HTC, LG, Samsung, Blackberry

(ii) Mini Computers -

They are digital computers used in multi-user systems. They have high processing speed and high storage capacity and can be used for real-time applications in industries and research centers, engineering and CAD calculations.

Eg:- IBM (8000 series), PDP 11.

(iii) Main frame computers – These are multi-users, multi-programming and high performance computers. They operate at a very high speed and high storage capacity. It is a heart of a network of computers, which allows hundreds of people to work at the same time on same data. These computers require a cold and dry environment. User accesses the main frame computer using a dumb terminal, intelligent terminal or PC.

dumb terminal – cannot store data or do processing of its own.

Intelligent terminal works along with input and output device to do processing, but cannot store data of its own.

Applications Eg:- Banks use mainframe computers like CDC 6600, IBM ES000 series for frequently accessing the same data.

(iv) Super Computers - These are the fastest machines measured in FLOPS (Floating Point Operations per second), which are capable of performing trillions of calculations per second.

Applications - Weather Forecasting
Climate Research.

Eg:- IBMs Road Runner System
IBMs Blue Gene
PARAM assembled in India by C-DAC, Pune (Center for Development of Advanced Computing)
Computing power of PARAM PADMA is (10^{12}) 1 Tera FLOP/FLOPS.

The COMPUTER SYSTEM

Computers are made up of hardware consisting of physical devices for input, output, storage and processing of data, using CPU, Motherboard and Memory.

Simple Input devices - Keyboard, Mouse

Simple Output devices - Printers, Floppy disks, Magnetic tapes, Memory stick, USB, Hard disks, optical Storage Media like Compact disc(CD) and Digital Versatile Disk(DVD), Speaker, Monitor etc.

Computers are made up of software which is a set of instructions that tells the computer about the tasks to be performed and how these tasks are to be performed.

Program is a set of high-level language instructions indicating the tasks to be performed by the computer.

(System Programs and Application Programs)

(a) System software involving System Programs

(b) Application software involving Application Programs.

COMPONENTS OF COMPUTER HARDWARE

Figure below shows the typical interaction among the different components of the computer.

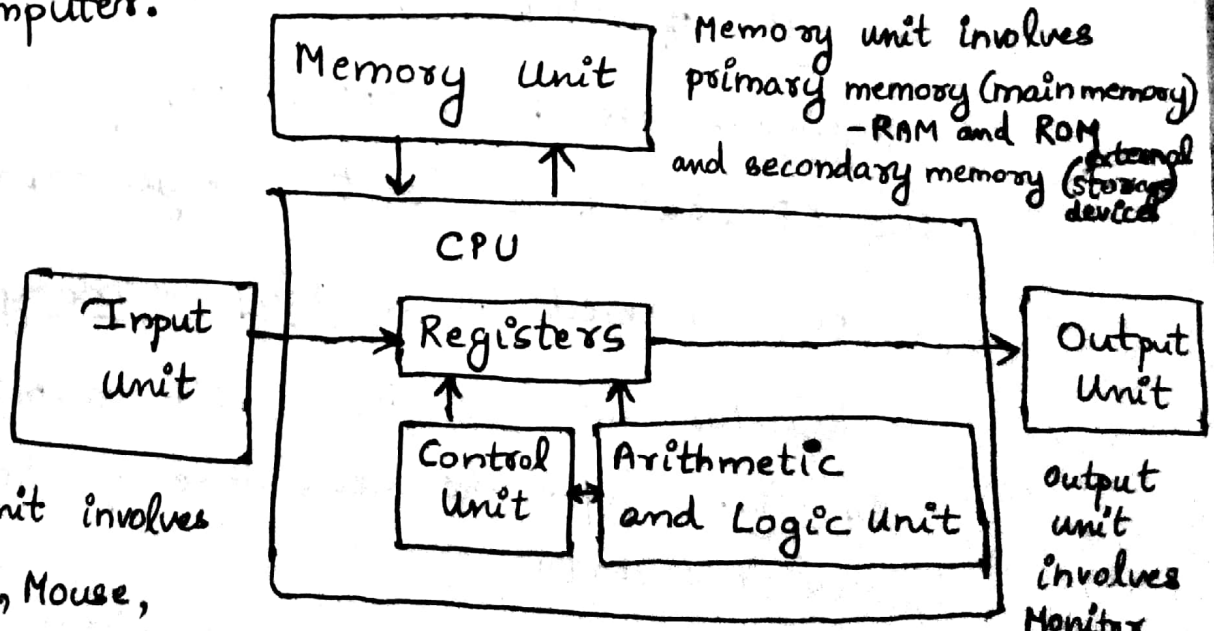


Fig ①. Computer System Hardware

(Processor)
CPU is the brain of a computer, as it processes the input data obtained from the user and generates output information through display devices. Eg:- Pentium I, Pentium 4

Every program and data is processed in a memory unit during program execution.

In main or primary memory, data and instructions and output are temporarily stored during program execution. Eg. of storage device - Hard disk.

In the storage unit of a computer

In secondary memory like USB, CD/DVD, magnetic/optical disks and magnetic tapes, data, programs and output are permanently stored in the storage units.

Eg:- CD-Recordable (CD-R), CD-Recoritable (CR-RW), Digital Video Disk-Recordable (DVD-R)

CPU has a set of registers for temporary storage of data and instructions.

Registers are high speed storage areas within the CPU, but have least storage capacity, and is hence named as working memory.

Register size can be 8-bit, 16-bit, 32-bit or 64-bits. Bigger the size, more quicker CPU can process the data.

A total of 6 types of registers are used by CPU.

(i) Program Counter (PC) -

It contains the address of next instruction to be executed.

(ii) Instruction Register (IR) -

It contains the current instruction fetched recently.

(iii) Accumulator (ACC) -

It stores the result of arithmetic and logic operations.

(iv) Memory Address Register (MAR) -

It contains the address of the next instruction to be accessed.

(v) Memory Buffer Register (MBR) -

It temporarily stores data from memory or the data to be sent to memory.

(vi) Data Register (DR) -

It stores the operands and any other data.

Primary Memory (Main) involves RAM (volatile, temporary storage) and ROM (non-volatile, permanent storage).

Information in RAM gets erased when the computer is turned off. ROM is programmed by the manufacturer and could not be erased.

There are 2 types of RAM:- Access speed: 2 to 10 nano secs.

(a) Static RAM (SRAM) - It holds programs and data for longer periods, without refreshing the memory. It uses 4-6 transistors for each memory cell without the capacitor. (faster)

(b) Dynamic RAM (DRAM) - This memory has to refresh / recharge the capacitor many times in a second, inorder to hold the programs and data. (slower)

Without refreshing, contents may be lost.

DRAM uses transistors arranged in a matrix of rows and columns, and capacitors that can hold binary information (0/1).

In DRAM, transistors and capacitors are paired to make a memory cell.

Access Speed : 50 - 150 ns. (nano secs)

Read Only Memory (ROM) has only read capability and no write capability. ROM Memory chip stores BIOS (Basic Input Output System) which contains start-up instructions for the computer.

BIOS performs a Power On Self Test (POST) that checks whether the hardware devices are present and is functioning properly. It also checks whether operating system (OS) is present on the hard drive and it finally invokes the Bootstrap loader to load the operating system into memory

BIOS ROMs are accompanied by smaller CMOS chips (Complementary Metal-Oxide Semiconductor).

When the computer is turned off, power supply stops providing electricity to the motherboard. CMOS is kept powered by a button battery on the motherboard and hence even if the computer is turned on again, system still displays the correct clock time.

System Clock synchronizes the internal activities of a computer. System clock pulses at a rapid rate measured in millions of instruction cycles per second (MHz) / Mega Hertz (GHz) which is billions of instruction cycles per second. (MIPS) Giga Hertz (BIPS)

Computers speed is linked to the speed of system clock.

Processor takes higher clock frequencies to complete execution of fewo instructions.

ROMs are of different kinds:-

(a) PROM (Programmable Read Only Memory) - The contents of PROM cannot be changed, after it has been programmed.

(b) EPROM (Erasable Programmable ROM) –

EPROM chips can be erased by exposing it to ultra violet light and can be reprogrammed after removing from the computer.

(c) EEPROM (Electrically Erasable Programmable ROM)

EEPROM chips can be erased by electric charge and can be reprogrammed even while it is fixed in the computer.

(d) Flash Memory – It is a semiconductor-based non-volatile (permanent), recoritable computer memory that can be electrically erased and reprogrammed.

It stores data in memory cells by combining the features of RAM and ROM.

RAM feature – contents can be stored in it any time

ROM feature – data is not lost, even after processor is turned off.

Eg:- Used in digital camera, mobile phone and laptop computer.

Summary of Memory Unit – unit

The purpose of storage is to hold data for longer periods of time, without continuos support of electric power.

Cache Memory - It is placed in between CPU and RAM. (Fast memory) CPU Registers utilize the cache memory. When CPU needs an instruction or data during processing, it first looks in the cache, and if the information is present it results in a cache hit and if the information is not present, it will result in a cache miss.

Motherboard is a large Printed Circuit Board (PCB) containing central processor, memory chips, interfaces, connectors for input/output devices and expansion slots. Many internal devices like video cards, graphics cards sound cards, etc are housed on smaller circuit boards attached to motherboard.

I/O Ports and Interfaces -
Users can connect camera, scanner and printer to the computer through USB Port.

Firewire is a bus used for harddrives.

RJ45 connector (LAN or ETHERNET port) is used to connect the computer to a network.

(Video Graphics Array) VGA connector interfaced with Graphics card is connected to Monitor.

Audio plugs are used to connect sound speakers and microphone.

PS/2 port is used to connect mouse and keyboard into PC.

SCSI port connects harddisk drives and network connectors.

Expansion Slots -

- ISA (Industry Standard Architecture) slot is used to connect modem and input devices.
- PCI (Peripheral Component Interconnect) slot is used to connect audio, video and graphics.
- AGP (Accelerated Graphic Port) slot is used for Graphics card.
- PC Card is used in Laptop computers, which includes Wi-Fi card, Network card and external modem.

Arithmetic and Logic Unit (ALU) carries out the arithmetic and logical operations in an instruction. Arithmetic operations supported by the arithmetic unit are addition, subtraction, multiplication and division. Logic operations supported by the logic unit are testing for greater than, less than or equal to condition.

Control Unit (CU) coordinates and controls the various components of the CPU, including input and output devices. CU tells computer memory when to fetch the data and instructions, what arithmetic and logic operations to perform, where to store the result

(Control Unit)

The machine cycle consists of 4 stages: Fetch - Decode - Execute - Store
(Instruction cycle) (Execution cycle)

Bus is a group of parallel wires connecting different parts of the computer system. Each wire can carry one bit of data. Bus width is defined by number of wires in the bus. Parallel wires in a bus acts like a highway with multiple tracks.

An 8-bit bus can move 8 bits at a time, while a 64-bit bus can move 64 bits at a time.

Internal bus (System bus) connects components inside the motherboard like CPU and system memory.

External bus connects different peripherals, I/O ports, expansion slots to the computer.

System bus comprises of Data bus, Address bus and Control bus. Address bus is a group of wires used to transfer addresses of memory or I/O devices.

Data bus transfers data between microprocessor/CPU and memory / input and output devices.

Control bus is used to read/write data from/to memory

Secondary Memory stores data and instructions permanently, by providing a back-up storage facility.

It has high storage capacity, than primary memory.

Eg:- Magnetic tape drives, Magnetic disk drives and optical disk drives.

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INPUT AND OUTPUT PEVICES

Computer interacts with the external environment via input-output devices.

Input devices enables the users to input data and instructions to the computer.

Eg:- Keyboard, Mouse, Punch Card, Barcode Reader, MICR (Magnetic Ink Character Recognition)

After processing of user fed data, computer provides output to the output devices, like Monitor, Printer & Speaker

Human Data Entry devices –

① Keyboard - It is an input device for entering text and numbers.

Eg:- QWERTY Keyboard has 101 keys including character keypad, numeric keypad, function key, Control Keys (Ctrl, Alt) and special purpose keys (Enter, Shift, Spacebar Keys).

② Mouse (Pointing device) - It is a palm-sized pointing device with a rubber ball on the bottom side. When mouse is moved over a smooth surface, ball rolls and pointer on the display moves in the same direction.

Optical Mouse uses a Light Emitting Diode (LED) and a Sensor to detect the movement of mouse

Pick Device

③ Touch Screen - It is an input device that accepts input when the user places a finger tip on the computer screen. Computer selects options based on finger touch. eg:- Automatic Tellers Machine (ATM).

Source Data Entry device

④ Audio Input device -

Microphone is used to input a person's voice into the computer. A sound card in the microphone translates the analog audio signals into digital codes, that the computer can store and process. Sound card can also translate back the digital sound into analog (voice) signal, which can be sent to speakers.

Optical Input Devices -

⑤ Scanner -

It is used to input data directly into the computer from a document, without typing the data. Flat-bed scanner in a photocopy machine has a glass top and a lid that covers the glass. The document to be scanned is placed on the glass top, which activates the light beam beneath the glass top and starts scanning from left to right.

⑥ Optical Character Recognition (OCR) -

It is a technique for scanning a printed page translating the page using OCR software to American Standard Code for Information Interchange ASCII text that is editable. OCR uses optical character reader for recognition.

⑦ Magnetic Ink Character Recognition (MICR) -

It is used for recognizing the magnetic encoding numbers printed at the bottom of a cheque. MICR Readers are used to process large volumes of cheques. The bottom of the bank cheque includes bank number, branch number and cheque number.

⑧ Optical Mark Recognition (OMR) -

OMR is used to detect dark marks on the paper. OMR Reader scans the forms and processes the forms using an application software.

OMR is used to read the answers of objective type tests. Eg of an App using OMR - OMR Evaluator

⑨ Barcode Reader -

Barcodes are read using reflective light by Barcode Readers, which interprets the barcode using spacing and thickness of bars. The individual bar pattern is converted into alpha-numeric digits and is fed to the application software in computer / mobile phone.

OUTPUT DEVICES - They provide output to the user, which is generated after processing of input data.

⑩ Hard copy devices - Printer

A Printer prints the output information from the computer in machine readable form to hard copy output in a paper. (human understandable form).

Clarity of the printer is determined by the Resolution of the printer, measured in dots per inch (dpi)

Types of printers are:-

Impact Printers

(a) Dot Matrix Printers with 80 column and 132 column printer with resolution ranging from 72 to 360 dpi.
Eg:- Payroll & Accounting documents.

(b) Daisy Wheel Printers prints 1 character at a time, ie it prints only text, not graphics.

(c) Drum Printers prints 200 - 2500 lines per minute.
Eg:- Newspaper Printing.

Non-Impact Printers

(d) Ink-jet Printers sprays ink drops directly on the paper like jet and has 500 dpi resolution.

(e)* Laser Printers can print 24 pages of text per minute and their resolution ranges from 400 - 1200 dpi.

(11) Soft Copy Devices -

Monitor - It is a common output device.

Monitor is of 2 kinds:

(a) Monochrome display monitor - It uses only 1 color to display text.

(b) Color display monitor - It uses 256 colors (2^8 colors) to display an image / video at 1 time.

Monitor sizes - 14 inch, 15 inch, 17 inch, 19 inch, 21 inch

An image on the monitor is created by a configuration of dots called pixels.

Clarity of the image depends on 3 factors:-

(i) Screen Resolution - no: of pixels in horizontal and vertical direction. More the number of pixels, sharper is the image. Resolutions eg - 800x600, 1024 x 768.

(ii) Dot Pitch - Diagonal distance between two colored pixels on a display screen.

(iii) Refresh Rate - no: of times per second the pixels are recharged, so that their gloco remains bright.

(12) Speaker - It sends audio output from the computer via sound card that translates digital sound back into analog signals.

(13) Modem (Input/Output device) - Modulator and Demodulator allows a computer to communicate with another computer over telephone lines. It converts digital data from computer to analog signals for outgoing transmission and converts analog to digital signals for incoming signals.

In General, I/O Devices are attached to computer via I/O Ports. Device Controller controls the signals on the wires of I/O Port or Bus.

Each device has its own Device Driver, Device Driver is a software via which the operating system communicates with the device controllers.

software installed on a computer.

SYSTEM SOFTWARE AND APPLICATION SOFTWARE

System software provides functionality to the computer using different device drivers.

System software controls the computer hardware, including processor, memory and input/output devices, and it acts as an interface between the application software and computer hardware.

Operating System, Device drivers and system utilities constitute the system software for management of computer and its resources.

Egs of System Utilities - Anti-virus utility,
Data compression utility
Disk Partitioning utility
Disk Cleaners

To control the behavior of a computer, we can write programs using various programming languages.

Generations of Programming languages

1GL - Machine language

2GL - Assembly language

3GL - C, COBOL, FORTRAN, PASCAL, C++, Java.
(High level languages)

4GL - .NET
(VB.NET
C#.NET)
Scripting language (Java script)
SQL, MyBase, Oracle, My SQL.

5GL LISP, PROLOG

Application software is used by user to accomplish a specific task.

Application software may be a single program (MS-Word) or a set of programs (MS-office), written for various applications like graphics processors, word processors, media players, database applications, telecommunication etc. purpose

Word processing software - MS-WORD

Image processing software - Adobe Photoshop

Accounting software - Tally Software

Spreadsheet software - MS Excel

Presentation software - MS - Power Point

CAD/CAM software - Auto CAD

Web browser software - Access WWW (World Wide Web) to search documents and images.

Eg:- Internet Explorer 8,
Mozilla Firefox,
Google Chrome.

Pseudo code

It consists of short, readable and formally-styled structured English language used for explaining an algorithm.

Qn) Write pseudocode for multiplying 2 numbers?

①
Read values of A and B
Compute C by multiplying A with B
Print the result C
End

Q) Write pseudocode for finding the maximum of three numbers?

```
Read values of A, B, C
If A is greater than B and A is greater than C
    Assign A to MAX
Else if B is greater than C
    Assign B to MAX
Else
    Assign C to MAX
Print MAX
End
```

Introduction to Structured Approach to Programming

→ Structured Programming involves building a program using small modules.

→ In Structured Programming, the problem to be solved is broken down into small tasks that can be written independently.

Small tasks are combined together to form a complete task.

(a) Procedural Programming –

- It requires a given task to be divided into smaller procedures, functions or subroutines.
- A single program consists of main() function, many procedures and functions, where each procedure or function performs a specific task.
- When a procedure or function is called, execution control jumps to the called procedure or function, executes it and after execution control comes back to calling procedure or function.

(b) Modular Programming –

It requires breaking down of a program into a group of files, where each file consists of a program that is executed independently.

Different files of a program are integrated using main program file.

Eg:- C, COBOL, PASCAL are examples of structured programming languages.

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MODULE 1

Compilers and Interpreters

Compilers translates the entire high-level language program to machine code, whereas Interpreters does a line-by-line translation of high level language program to machine code.

In compiled-typed languages like Pascal, C, C++, syntax and semantics checking is done by the Compiler at compile-time. It analyzes the local declarations only once and a layout is created for these variables in memory. Such a kind of binding of variables done at compile-time, is called Static binding (Early binding).

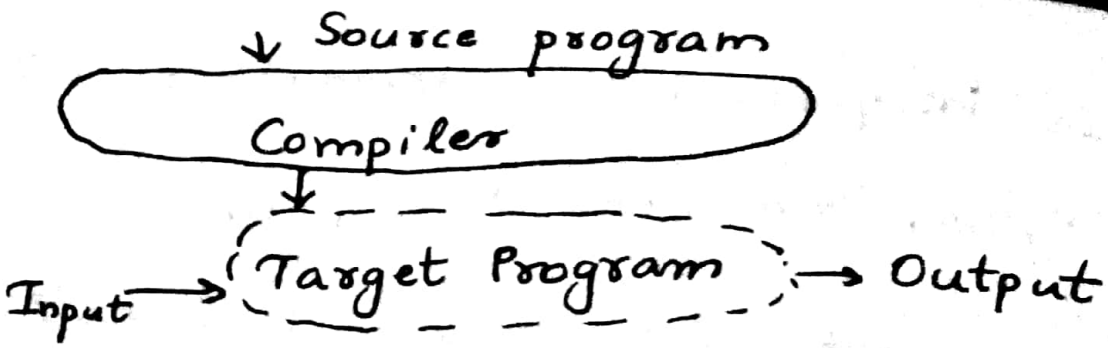
In interpreter-based languages like Python, Perl and Ruby, Interpreter analyzes the local declarations so many number of times at run-time. Such a kind of binding is called Dynamic binding (Late Binding).

Another eg - SmallTalk also delays type checking until run-time.

There are 7 types of compilation techniques used by programming languages:-

(i) Pure Compilation -

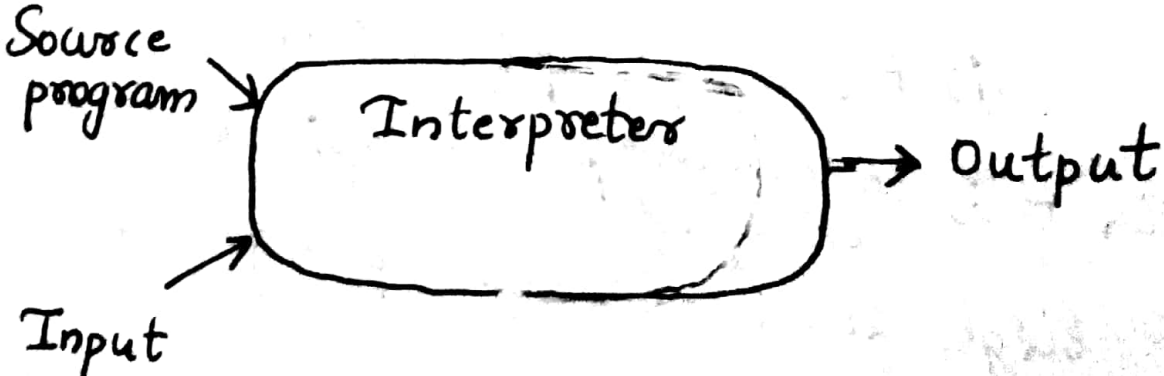
In all compile-time languages, Compiler translates a high-level source program into an equivalent machine language (target) program (object code). Such a kind of binding of variables done at compile time, is called static binding or early binding.



Eg:- C, Pascal, C++

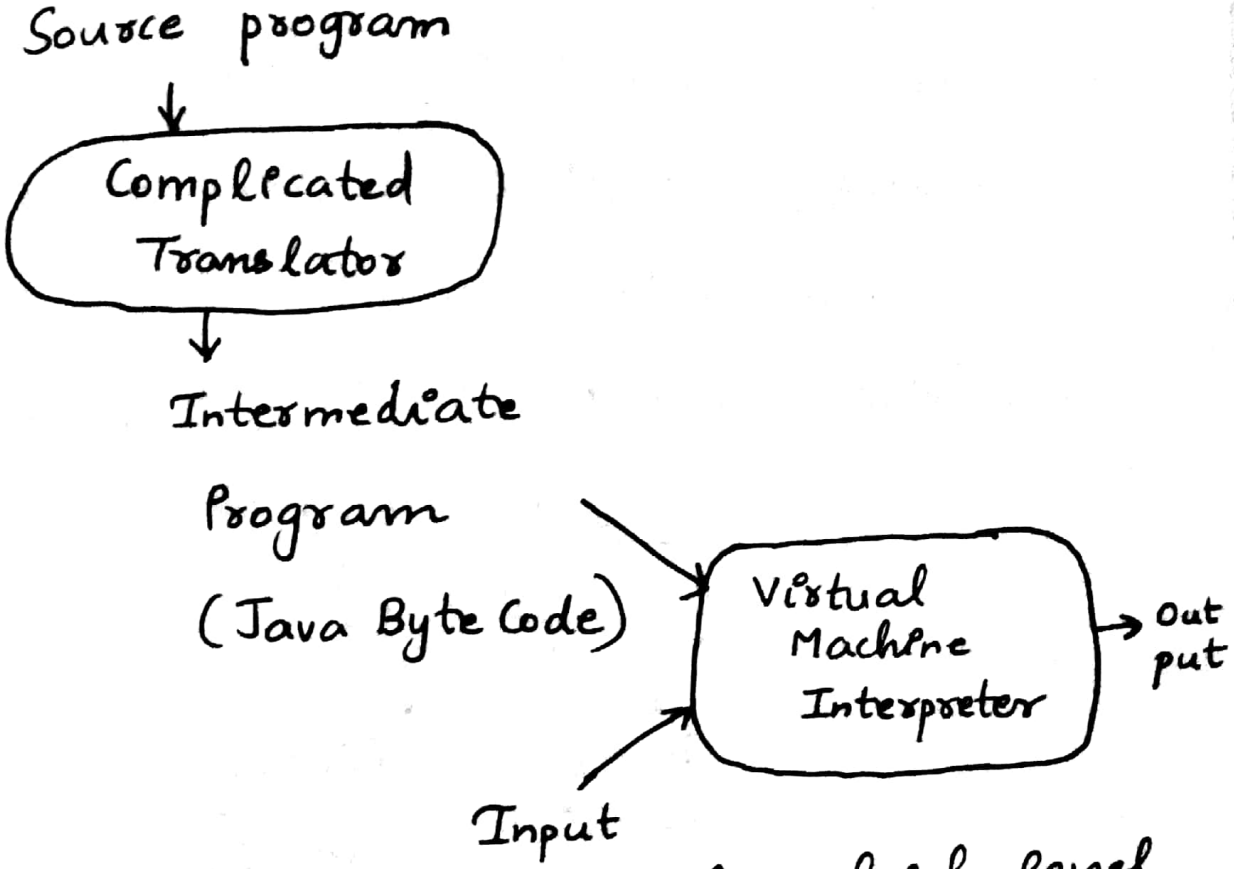
(ii) Pure Interpretation -

In all interpreter-based languages, Interpreter reads a high level language program each statement by statement and converts it to machine language. Such a kind of binding of variables done at run-time, is called dynamic binding or late binding.



Eg:- Perl, Tcl, Python, Ruby.

(iii) Mixing of Compilation and Interpretation -



Java is an example of a high-level language program that mixes both compilation and interpretation.

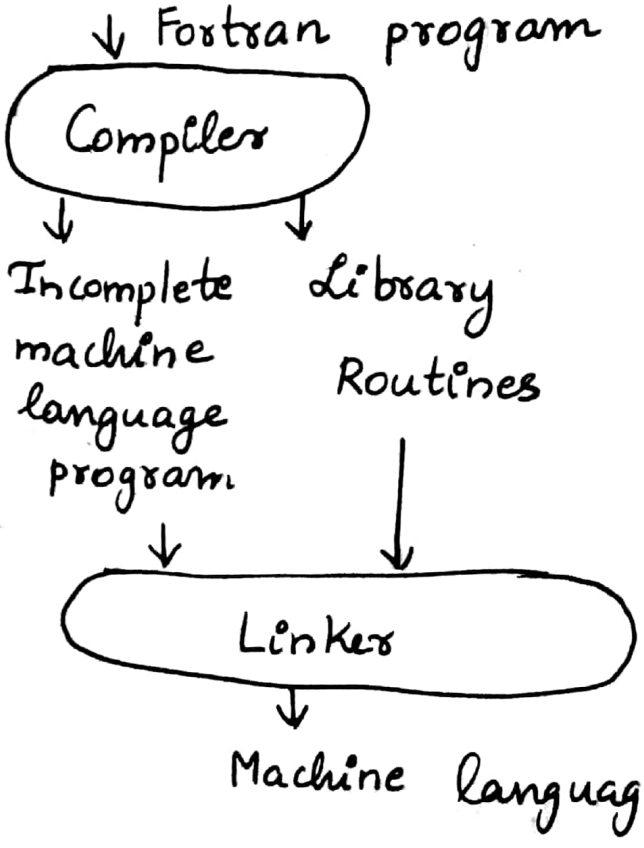
A complicated translator (compiler) produces code that is executed by a complicated virtual machine interpreter (JVM)

(iv) Loader - eg:- Java Runtime Environment (JRE)

Loader software is used to load and relocate executable program in main memory.

(v) Linker- Eg:- FORTRAN

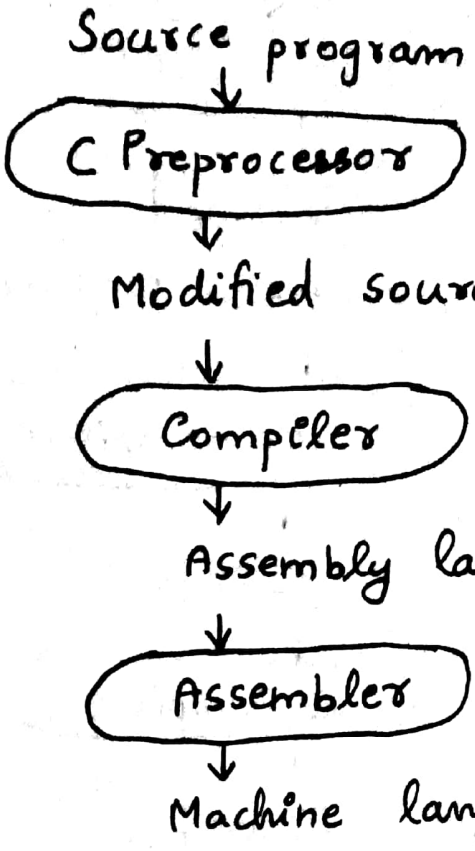
Compiler relies on a separate program called linker to merge appropriate library routines (sin, cos, log) and several object modules into the final machine language program.



(vi) Post-compilation Assembly of C Compiler-

C preprocessor can be instructed to delete portions of the code itself, by providing conditional compilation facility that allows several versions of a

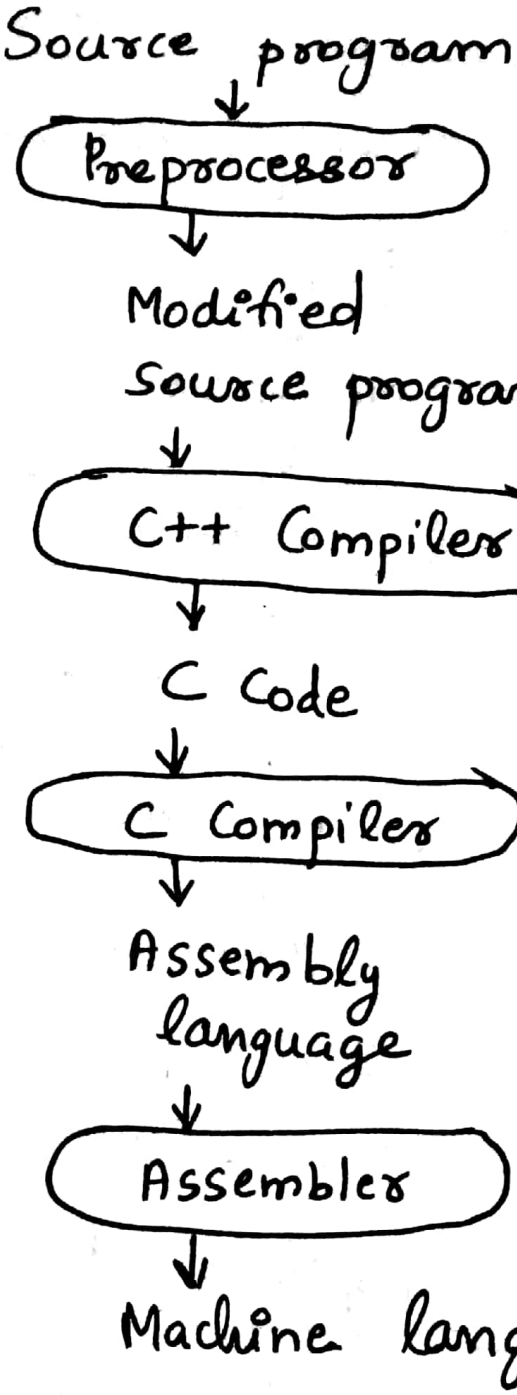
program to be built from the same source. program



The intermediate program generated is the Assembly language.

(vii) C++ Compiler (True Compiler) -

It analyzes the syntax and semantics of C++ source program, and generates error messages before running the program. C compiler is used behind C++ Compiler. The C++ Compiler invokes the C compiler with the generated C code, that would be passed through second round of compilation without producing any errors.



The intermediate program generated is the C code.

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Array Operations

1) Searching an Array

∘ Linear Search

In this type of search, a sequential search is made over all items one by one. Every item is checked and if a match is found, then that particular item is returned, otherwise search continues till the end of the data collection.

Linear Search eg

Element	10	14	19	26	27	31	33
Index	0	1	2	3	4	5	6

There are a total of 7 elements in the array.
The search element 31 is found in position 5.

Default array indexing starts from 0 and ends at n-1.

Linear Search Algorithm -

Start

Step 1 :

Step 2 : integer pos, i, count=0, a[10], n, s

Step 3 : Read the limit, n

Step 4 : Input the array elements

for(i ← 0 ; i < n ; i++)

Read a[i]

Step 5 : Input the number to be searched.

Read s.

Step 6 :

```
for (i←0 ; i<n ; i++)
{
if (a[i] == s)
{
  count ++;
   pos= i+1;
}
}
```

Step 7:

```
if (count == 0)
print "Number not found"
else
print "Number", s, "is found
at position", pos
```

Step 8: Stop

Pseudocode for Linear Search -

```
Read the limit, n
Input the Array elements as a list
Input the number to be searched.
for each array element in the list
    if array an element == search value
        return the array element found
            with location in an array
    end if
end for
End.
```

2) Sorting an Array

(a) Bubble Sort

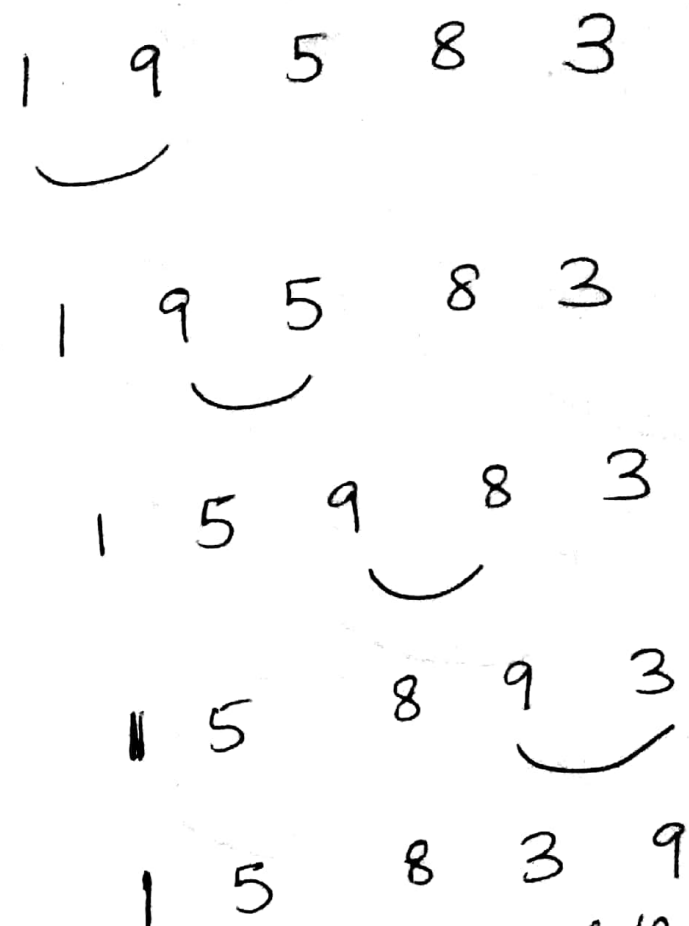
It is a sorting algorithm which is a comparison-based algorithm, in which each pair of adjacent elements are compared and the elements are swapped, if they are not in order.

Eg:-

The array elements are

1 9 5 8 3

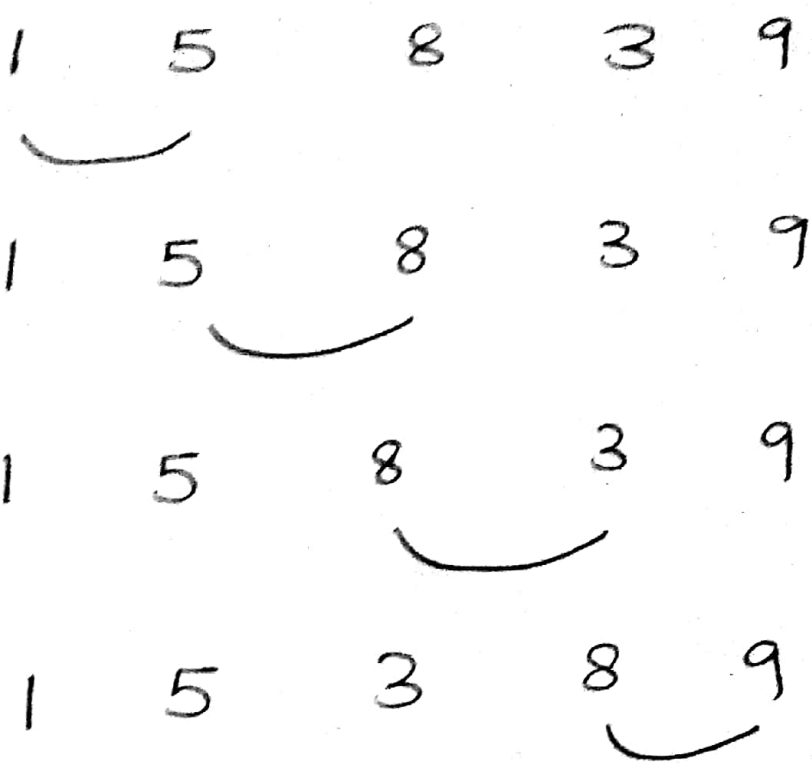
First Pass - Algorithm compares the first 2 elements, and swaps if first number is greater than second number.



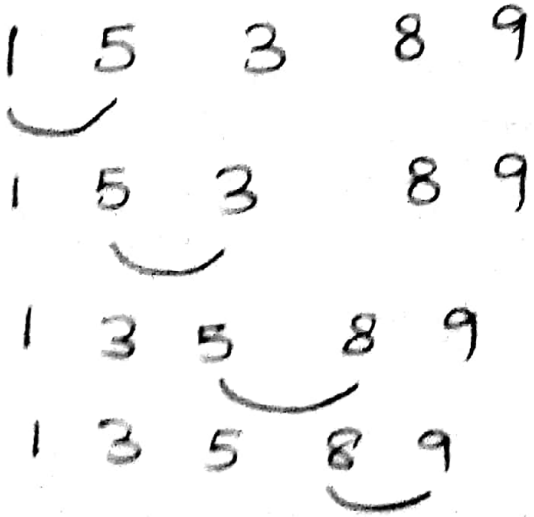
From the beginning of the list, Algorithm again compares the first 2 elements, and swaps if first number is greater than second numbers

The sorting process continues until the entire list is sorted.

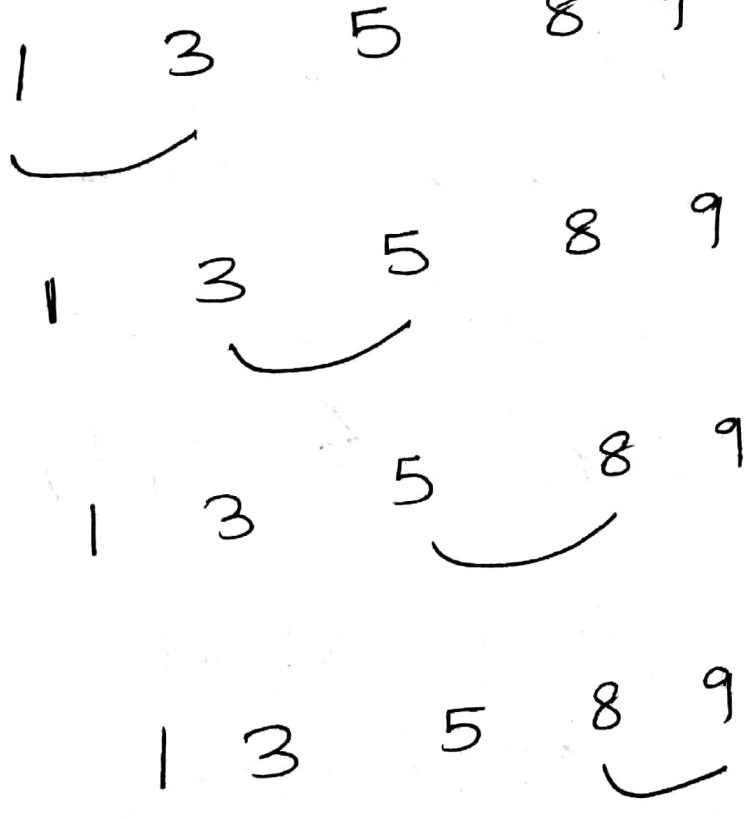
Second Pass -



Third Pass - From the beginning of the list, algorithm again compares the first two elements, and swaps if first number is greater than second number in the list.



Fourth Pass - From the beginning of the list, algorithm again computes one whole pass, without any swap, to ensure that the list is sorted.



Finally, the list is sorted.

Algorithm - Bubble Sort

sorting in Ascending order

Step 1. Start
Step 2. integer i, n, ..., a[10], temp
Step 3. Read the limit, n.

Step 4. Input the array elements

```
for (i← 0 ; i< n; i++)
Read a[i]
```

Step 5.

```
for (i← 0 ; i< n ; i++)
{for (j← i+1 ; j< n; j++)
{
if (a[i] > a[j])
{
temp = a[i];
a[i]= a[j];
a[j] =temp;
}
}
}
```

Step 6. Print the array elements

```
for (i← 0 ; i< n; i++)
Print a[i]
```

Step 7. Stop

Pseudocode for Bubble Sort

Read the limit, n

Input the array elements as a list.

for all elements of the list

```
for (i = 0; i < n; i++)
    for (j = i+1; j < n; j++)
        if a[i] is greater than a[j]
            Swap a[i] and a[j]
        end if
    end for
end for
```

Print the array elements as a list

end.

(*Note - In Descending order sorted list, we compare whether a[i] is lesser than a[j] to perform swap between array elements.)

try it now

A KTU STUDENTS PLATFORM

SYLLABUS

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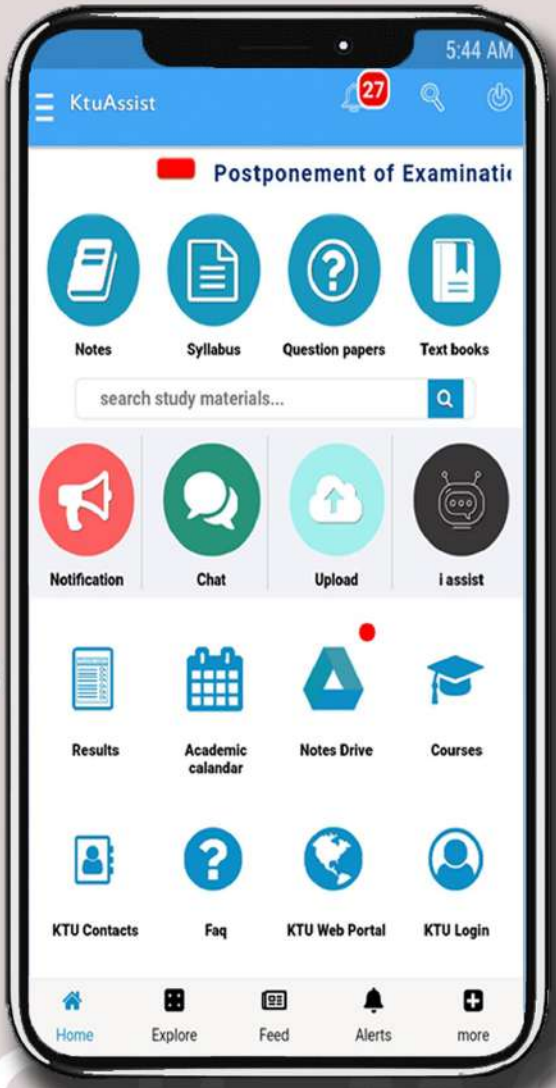

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