UNIT I

Fundamentals

→ does the human work & minimizes the workload of humans.

* Computer - Electronic Machine (Hardware & Software)

1. I/p - users (I/p device - keyboard, Mouse)
2. Processing - CPU (Control Processing Unit) (Brain of computer).
3. O/p - Monitor, printer.

Programming Language, Machine Language.

Computer Hardware.

→ physical components.

→ Fuction efficiently & produce useful output only when H/W & S/W work together.

→ Internal Computer Hardware.

process/Store the instructions delivered by the program/OS.

1. Mother board
2. CPU
3. RAM
4. Hard drive
5. Solid State Drive
6. optical Drive
7. GPU
8. NIC
9. Heat sink

2) ① Mother Board → Central hub.
holds the CPU & functions are carried out.

② CPU - brain of computer. Clock speed - measure the computer performance & Efficiency.

③ RAM - Temporary Memory. Volatile Memory (Stored data is cleared when computer is switched off).
Information is immediately accessible to programs.

④ Hard drive - Store Temporary & permanent data.

⑤ SSD - Non-Volatile, Safe to store. Data remains permanent even when the computer is switched off.

⑥ GPU - Extension to CPU. Graphical Data.

⑦ NIC - Connect to Network / LAN / N/w Adapter.

External Hardware Components.

* peripheral components, controls either I/p or o/p functions

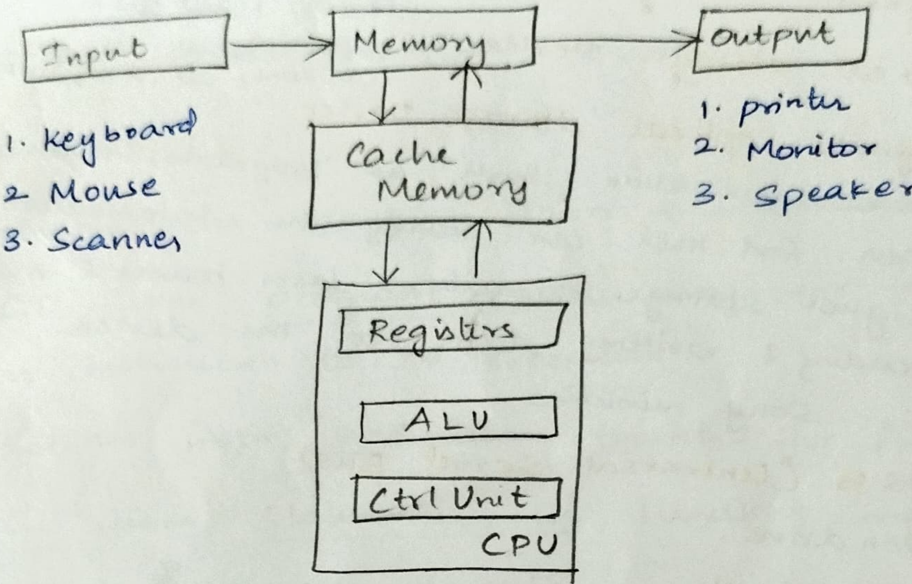
1. Mouse.
2. keyboard
3. Microphone
4. Camera
5. Memory card.

Hardware - Tangible components - run the instruction provided by the software.

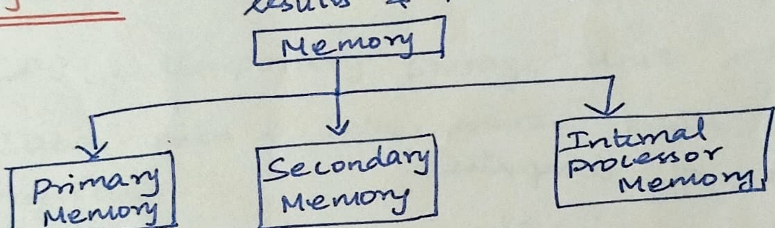
Software - Intangible Components - User - H/w - interact & Command - Specific task.

① Application Software
② System Software.

Basic Computer Organization.



(2) **Memory Unit** → Store data & instruction & intermediate processing results & Final processed information.



Primary Memory.

* Built-in Unit of the Computer
* Data is stored in Machine Understandable binary form

① ROM (Read- Only Memory) - (Non - Volatile)

- permanent memory Contents Cannot be changed by end user.
- BIOS information - which performs POST (power-on Self Test).

② RAM - Volatile

- Temporary memory. power off Contents get erased.
- Data is of no usage, Contents are erased.

③ Cache Memory

- Store data & related application that was last processed by CPU
- CPU & main memory - intermediate cache is placed

Secondary Memory.

* External storage device connected to computer.
* Connected externally. Non-Volatile.

① Magnetic storage Device → read, erased & rewritten.
FLOPPY, Hard disk

② Optical storage Device → laser beam.
CD-ROM, CD-RW, DVD

③ Magneto-optical Storage Device.
Store information such as programs, Files & backup data. End user can modify the information.
Higher storage capacity → laser beams & magnets for reading & writting data to the device.
Ex: Sony minidisc

④ USB (Universal Serial Bus)
pendrive.
Compactable.
Storage Capacity is large.

③ CPU

* Brain of computer
* processing in sly.
* Controls the Components of sly.

Main operations

1. Fetching instructions from memory
2. Decode the inst to decide what operation to be done
3. Execute the instruction.
4. Store the result in memory.

Main Components:

1. ALU
2. CU
3. Registers.

1. ALU (Arithmetic Logic Unit)
   ↳ Arithmetic operations (add, sub, mul, div)
   ↳ Logical operations (AND, OR, NOT)

2. Control unit (CU)
   - Controls the flow of data & information
   - CU uses program counter reg for fetching the next instruction to be execution.
   - fetches instn and gives to ALU for processing.
   - CU uses Status register handling Conditions such as overflow of data.

3. Registers.
   - CPU - temporary storage unit - Registers.
   - Data, instn & intermediate results are stored in registers.

(i) program counter (PC)
(ii) Instruction Register (IR) - Instn to be decoded by CU
(iii) Accumulator - results produced by CPU
(iv) Mem. Add. Register (MAR) - Address of next. location in Mem. to be accessed
(v) Mem. Buffer Register (MBR) - Storing data Sent/Received to CPU.
(v) Mem. Data Register (MDR) - Data & operands.

Algorithm

* Set of instruction when executed in a sequence will get a solution.

Representation of Algorithm

1. Normal English
2. Flowchart
3. Psendocode

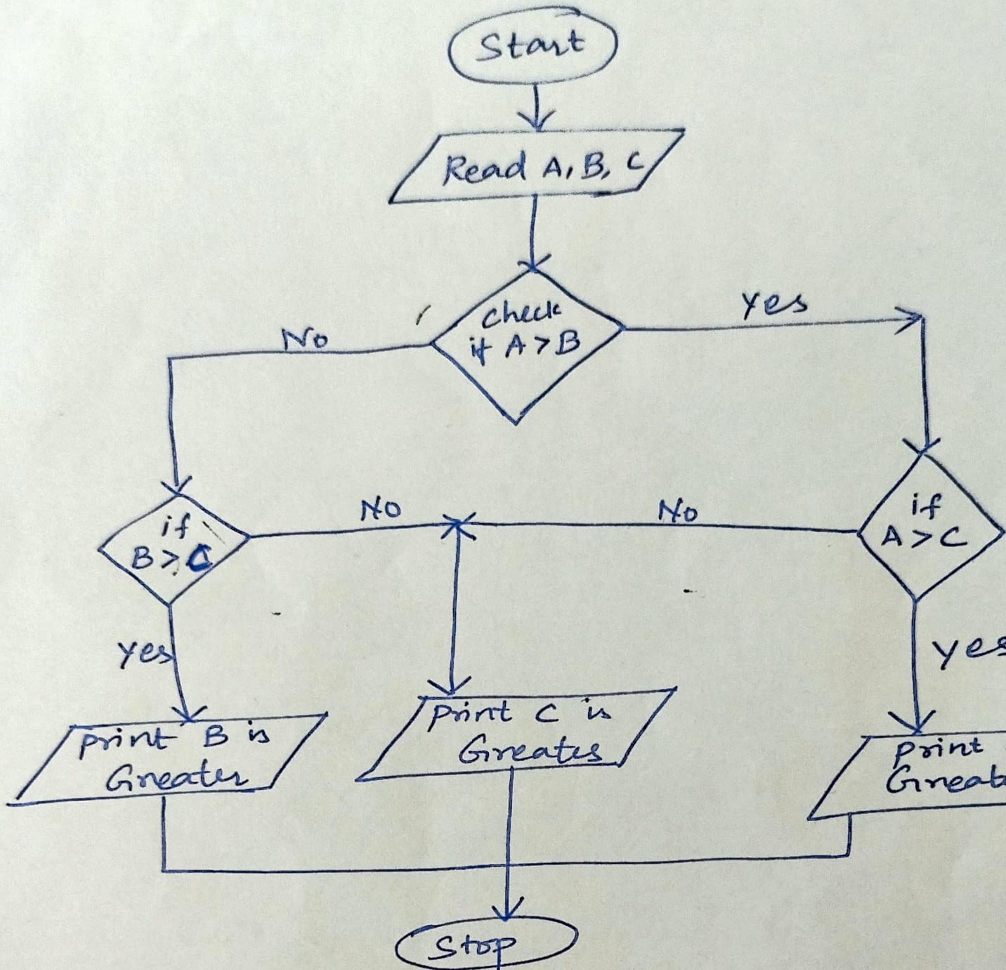
Flowchart.

① Flow lines
② Terminal symbols
③ Input/ output symbol
④ Process symbol
⑤ Decision Symbol
⑥ Connectors.

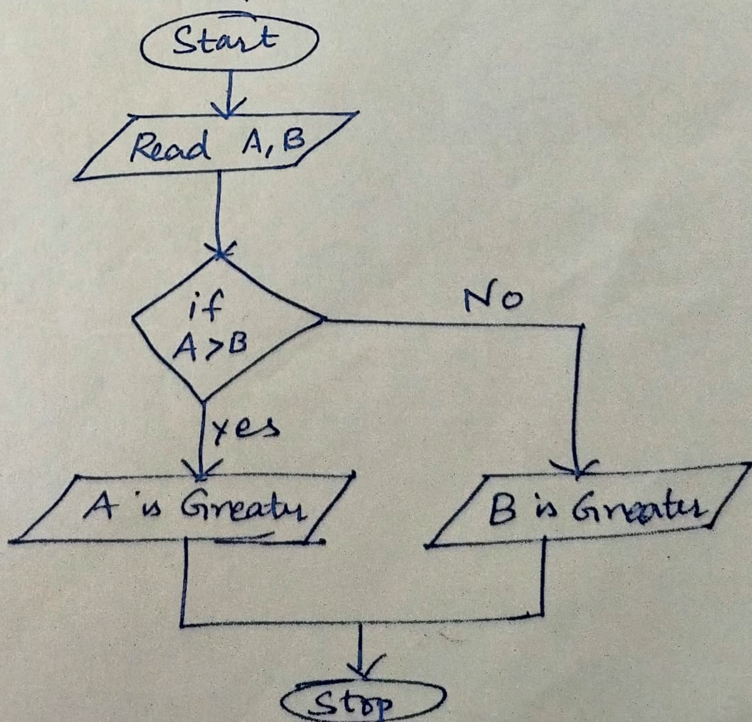
Example:

1. Addition of two numbers
2. Greatest of two numbers, even/odd, Neg/positive.
3. Calculate the SI, Area of circle
4. Calculate Total & Average of Students in a class
5. Sum of 5 numbers.

Greatest of Three Numbers.



Greatest of two numbers.



* Algorithm. After plan for developing pgm by logic - correct seq & procedure of instn required to carryout the task. (1)

* Algorithm - Logic of the program. It is the basic tool used to develop problem solving.

* "a Unambiguous - (Clear) sequence of instructions designed in such a way that if the instn are executed in specified sequence, the desired results will be obtained".

Characteristics:

* Algorithm - precise & unambiguous
  - instn should not be repeated again.
  - instn should be in sequence.
  - Result produced after algorithm terminates.

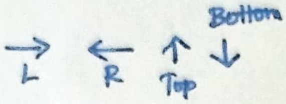
Representation of Algorithms.

* Normal English
* Flowchart
* Pseudocode
* Decision table
* program.

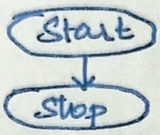
Flowchart

* pictorial representation of an algorithm. Sequential steps are represented in flowchart using standard symbols.
* Layout & visual representations of the plan.
* Symbol - oriented design - identifies the type of stmt from the symbols used.
* Arrows ← Connecting b/w 2 symbols.
* process of drawing flowchart for an algorithm is called Flowcharting.
* Flowcharts - Easy to. Understand.
  - helps in reviewing & debugging of a pgm.
  - easy to analyze & compare various methods.

Symbols used:

① Flowlines 

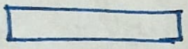
Exact sequence in which instn are to be executed. Drawn with * arrow head.

② Terminal symbol 

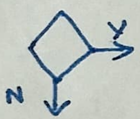
[oval shape] → begin + End
→ start (no Entering ↓)
→ stop (no ↓ Exit flow line.)

③ Input/output symbol.  [parallelogram]

- Input (Read) & output (write)
- denotes fn of I/O devices in the pgm.

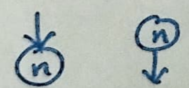
④ Process Symbol  [Rectangle]

- used for calculations & initializations of memory locations.
- Arithmetic operations, data movements.

⑤ Decision symbol 

[Diamond shaped symbol]

- Indicate at a point decision is to be made b/w two alternatives.
- Yes (True), No (False).

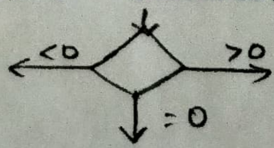
⑥ Connectors 

[circle & a digit/letter placed in link to specify the link].

Rules:

Example: Greatest of 2 nos, odd/Even, +ve/-ve number.

* Standard symbols should be used.
* only one should enter decision symbol, 2/3 flow lines can leave decision according to the possible answer.



* Annotation Symbol - describe data/ computational steps more clearly --- [This is top Secret data

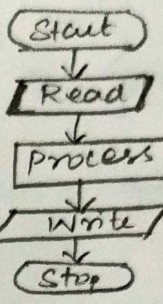
* Flow lines should not cross eachother.

* words in Flowchart - common stmts & easy to understand.

Design structures in Flowcharts.

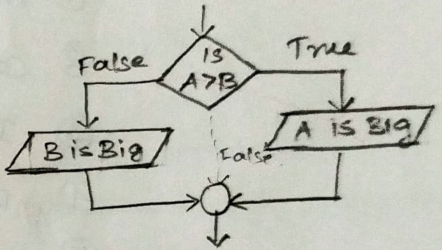
Design flowchart for any program & later we can combine to get the solution for complex problems, 3 designs:

① Sequence structure.



- simplest, series of stmts
- sequence (same direction)
- can include any number of instn.

② Selection structure.



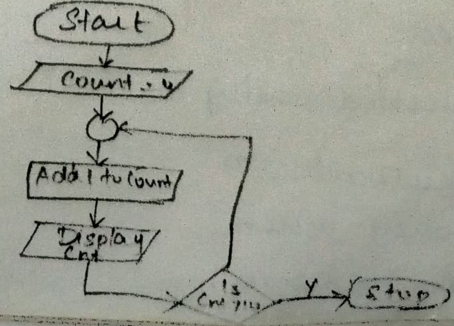
- Decision (make questions).
- operations done on decision made.
- 2 exists (two branches
  ↓
  rejoined to single flow to exit the structure)
- selection (True → one-sided selection)
  * null-sided should end with Exit.

③ Loop structure.

Execute sequence of steps in no. of times until particular condition is met

(i) Top tested loop → if count <10 →(T) goes into loop
→(F) goes to stmt after loop.

(ii) Bottom tested loop → Trailing decision loop
decision - last stmt of loop.



Pseudocode.

* Flowcharting symbols were established bf structured program*
* So flowchart will not be able to handle some concepts.
* pseudocode - formal design tool with structured design
  - Visual, narrative, used for planning prog. logic

Pseudocode Also ↓ Called PDL Program Design Language

- pseudo (initiation / false).
- code (set of stmts / instn in pgm. lang).
- written in English, very clear.
- Rules :
  1. Write one stmt per line.
  2. Capitalize initial keywords.
  3. Indent to show hierarchy
  4. End multiline structure.
  5. keep stmt lang independent.

Example. To calculate student total and average.

```
READ   name, class, M1, M2, M3
       Total = M1+M2 +M3
       Average = Total/3
IF   average is greater than 75
       Rank = Distinction
ENDIF
WRITE   name, Total, Average, Rank
```

Advantages.

- Word processor
- Easily Modified
- read & understood easily
- converting pseudocode to pgm. lang is easy when compared with Flowchart.

Disadvantages.

- Not Visual (pictorial represent)
- No standardised style/ Format

output

Ser

Computer Software

* Set of instructions grouped into programs that make the computer to function in the desired way.
* Collection of pgm to perform a task.
* instructs H/w what to do.
* pgm - set of instn stored in memory
  written in high level lang understandable by computer

CPU fetches an instn, decodes it & the executes required operation.

After execution - pgm counter - next instn fetched & executed

Types of Software.

* Application Software
* System Software.

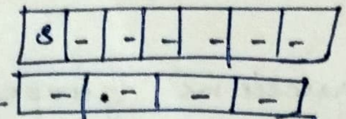
① System Software.

* Set of programs that governs the operation of computer system and make H/w to work.
* Controls the internal operations of computer sy.
* Types
  - OS - Controls all components (CPU, Mem, I/o devices) of computer. Ex: DOS, WINDOWS, UNIX, LINUX.
  - Language processors. Conversion of high level language to Machine language.
    - ↳ Assembler
    - ↳ Interpreter
    - ↳ Compiler
  - Utility pgms - Virus Scanner, Disk defragmenter.

② Application Software

* Set of pgms to carryout operations of specific Applⁿ.
* It is written by programmers to enable computer to perform specific task.
* Types
  - Customised Appltn S/w - based on customer requirements.
  - General Appltn S/w - General requirements for a specific task. Customers can use it simultaneously.
* Example: Result preparation, Railway reservation, billing

int a[10] char – 1
int – 2
float b[20] float – 4



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Notes:

* OS – control all H/w parts of computer system
  – Manage resources & overall operations of computer sys

* Function of os – Memory Mgt
  – File Mgt
  – Security Mgt
  – Process Mgt
  – User Interface

* compiler – Convert high-level lang to machine lang
  – Source code to binary code

* Interpreter – Line-by-line executes the source code.

* Assembler – convert Assembly lang to machine lang

Examples:

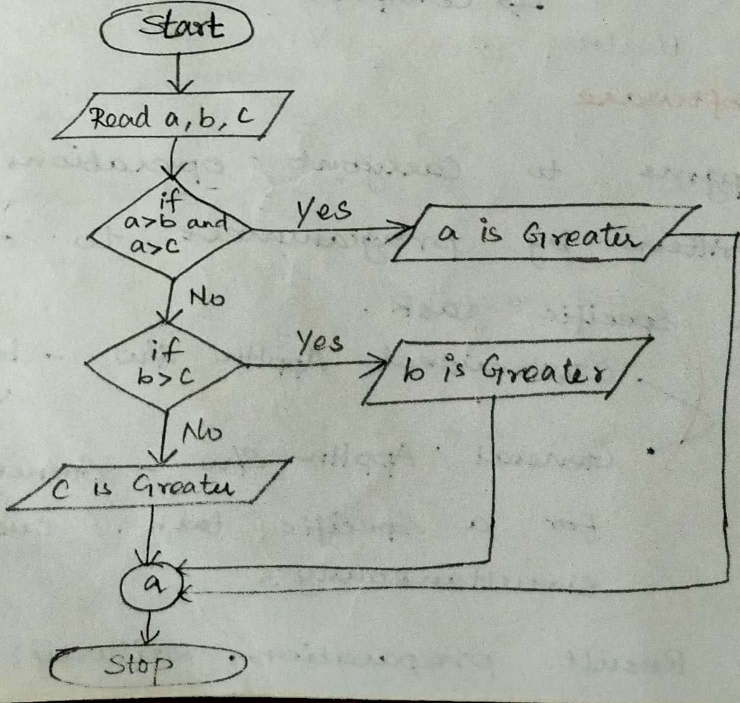
① Area of circle.

② Convert Celcius to Fahrenheit $F = (1.8 * C) + 32$.

③ Greatest of 3 numbers.

Internet Terminologies

1. Web page
2. Home page
3. Browser
4. URL
5. ISP
6. Download & Upload
7. online & offline
8. Hypertext
9. Web server
10. Web site.



a>b
a>c

a	b	c
5	10	15
15	10	5
5	15	10

ALGORITHMIC PROBLEM SOLVING

Algorithmic problem solving is solving problem that require the formulation of an algorithm for the solution.

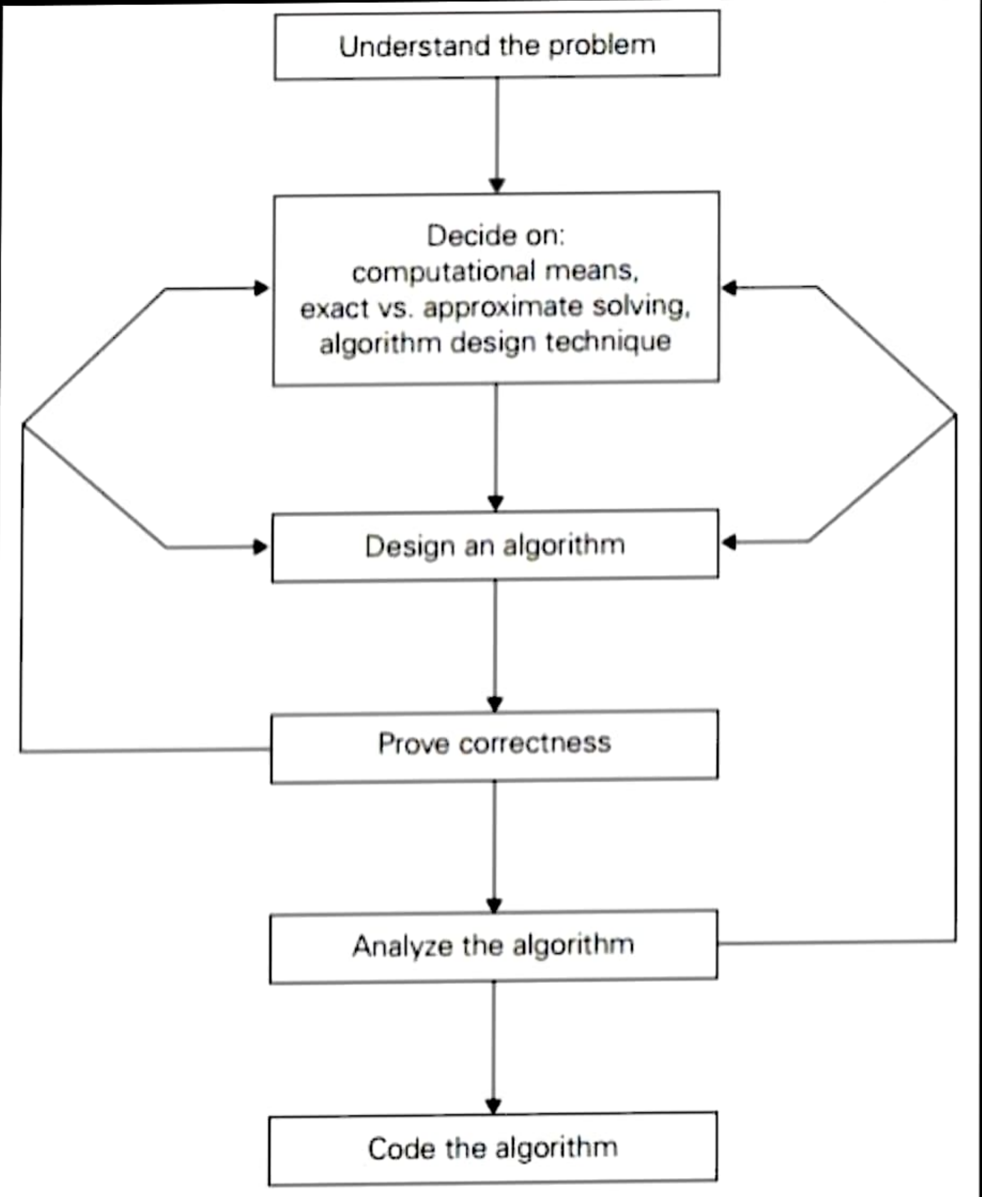


FIGURE 1.2 Algorithm design and analysis process.

Understanding the Problem

- ❖ It is the process of finding the input of the problem that the algorithm solves.
- ❖ It is very important to specify exactly the set of inputs the algorithm needs to handle.

Ascertaining the Capabilities of the Computational Device

- ❖ If the instructions are executed one after another, it is called sequential algorithm.
- ❖ If the instructions are executed concurrently, it is called parallel algorithm.

Choosing between Exact and Approximate Problem Solving

❖ The next principal decision is to choose between solving the problem exactly or solving it approximately.

❖Based on this, the algorithms are classified as exact *algorithm* and *approximation algorithm. Example: exact is addition of two numbers, approximation is solving linear equation*

Deciding a data structure:

❖ Data structure plays a vital role in designing and analysis the algorithms.

❖ Some of the algorithm design techniques also depend on the structuring data specifying a problem's instance

❖ Algorithm+ Data structure=programs.

Algorithm Design Techniques

- An ***algorithm design technique*** (or "strategy" or "paradigm") is a general approach to solving problems algorithmically that is applicable to a variety of problems from different areas of computing.

Methods of Specifying an Algorithm

- ***Pseudocode, flowchart, programming language***

Proving an Algorithm's Correctness

- Once an algorithm has been specified, you have to prove its ***correctness***. That is, you have to prove that the algorithm yields a required result for every legitimate input in a finite amount of time.

❖ A common technique for proving correctness is to use mathematical induction because an algorithm's iterations provide a natural sequence of steps needed for such proofs.

Analysing an Algorithm

Efficiency.

Time efficiency, indicating how fast the algorithm runs,

Space efficiency, indicating how much extra memory it uses.