Unit-1

Artificial :⇒ Made or Produce by human beings rather then occuring Naturally

Intelligence :⇒ it means the ability to aquire, understand and apply knowledge or the ability to exercise thought and reason.

Intelligent is a term describing one or more capability of the Mind including the capacity for abstract though, Understanding, Communication, Reasoning, learning, Planning, emotional intelligence and Problem solving.

Artificial Intelligence :⇒ AI is consult with the design of an intelligence in an Artificial device.

→ AI is a Branch of Computer Science that emphasizes the development of intelligence machine thinking and working like humans.

→ AI is a way of Making a Computer, a Computer-Controlled robot, or a software think intelligently, in the Similar manner the intelligent human thinks.

Goals of AI :⇒

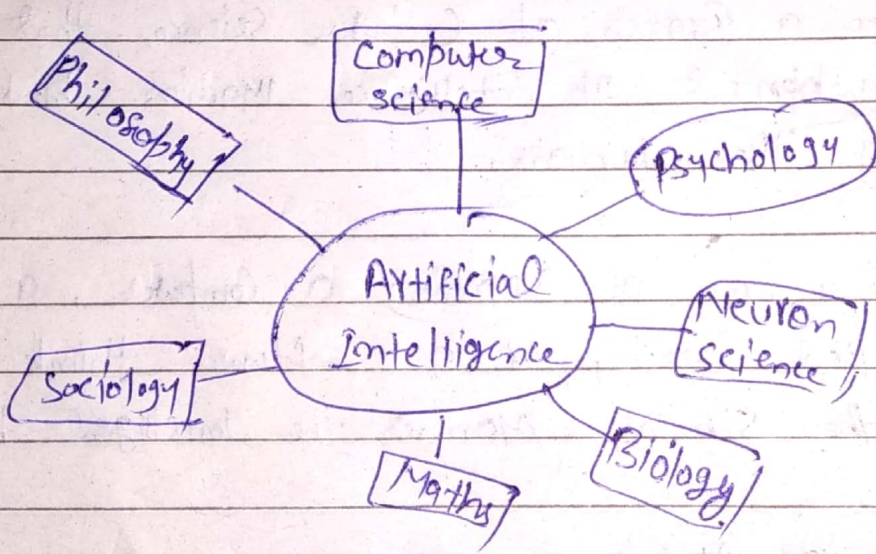
→ To Create Expert System :⇒ the systems which exhibit intelligent behavior, learn, demonstrate, Explain, and advice its users.

→ To Implement Human Intelligence in machines :→

Creating systems that understand, think, learn and behave like humans.

Contributes to AI :→

AI is a science and technology based on disciplines such as Computer science, Biology, Psychology, Lig Linguistics, Mathematics, and Engineering.
A Major thrust of AI is in the development of Computer functions associated with human intelligence, such as reasoning, learning and Problem solving,
Out of the following areas, one or multiple areas can contribute to build an intelligent system.



Application of AI :=>

① Computer vision :=> it is the science and technology of machine that see Means Machine is able to abstract information from an image that is necessary to solve some task.
the image data can take many forms such as video sequences, views from multiple cameras or multi-dimensional data from a Medical scanner.

② Gaming :=> AI plays crucial role in strategic games such as chess, Poker, tic-tac-toe, etc. where Machine can ~~think~~ think of large Number of possible position based on heuristic knowledge

③ Natural language Processing :=> it is possible to intract with the computer that understands natural language spoken by humans.

④ Robotics :=> It is the branch of technology that deals with the designe construction oppression, structured dis-posittion, Manufacturer and application of robots.

⑤ Expert System :=> There are some applications which integrate Machine, software, and special information to impart reasoning and advising. they provide Explanation and advice to the users.

⑥ Speech Recognition :⇒ Some intelligent Systems are capable of hearing and Comprehending the language in terms of sentences and their Meanings while a human talks to it. it can handle different accents, slang words, noise in the background, Change in human's noise due to cold, etc.

⑦ Handwriting Recognition :⇒ the handwriting Recognition Software reads the text written on Paper by a pen or on screen by a Stylus it can recognize the shapes of the letters and Convert it into editable text.

⑧ Image Recognition :⇒ it is the branch of Computer vision it can recognize individual building, car, Person, etc. in a Photo we take with are Camera Phone.

Some other application of AI

→ Machine translation
→ Credit Card fraud Detection & Prevention
→ Astronomy & Space Exploration.

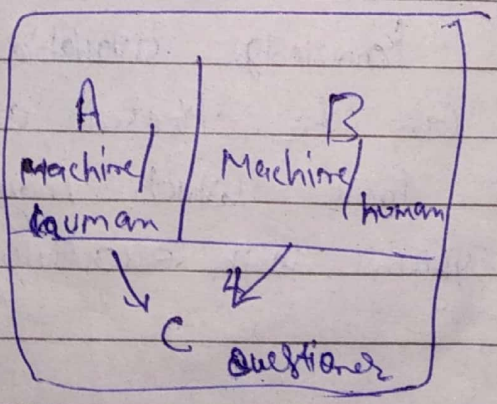
Turing test :⇒ in AI, a turing test is a Method of inquiry for determining whether or not a Computer is capable of thinking like a human being. the test is named after Alan Turing in 1950

Turing Proposed that a Computer can be said to Posses AI if it can MiMic human response Under specific conditions. The original Turing test, also referred to as the Imitation Game, requires three terminals each of which is physically seperated from the other two. One terminal is operated by a Computer, while the other two are operated by humans.

During the test, one of the humans functions as the questioner, while the second human and the Computer function as respondents. the questioner interrogates the respondents within a certain subject area, using a specified format and content. After a preset length of time or number of questions, the questioner is then asked to decide which respondent was human and which was a Computer.

the test is repeated many times. if the questioner makes the correct determination in half of the test runs or less, the Computer is considered to have artificial intelligence, because the questioner regards it as "just as human" as the human respondent.

Ex.:=)



Production System :⇒

⇒ search for the core of many intelligent processes it is useful to structure AI Programs in a way that facilitates describing and performing the search process.

⇒ Production system provide such structures.

⇒ In other words the process of solving the problem can usefully be modeled as production system.

Features of Production system / characteristics of Production system

⇒ Some of the main features of Production system are:-

(a) Simplicity :⇒ The structure of each sentence in a Production system is unique and uniform as they use "IF-THEN" structure. this structure provides simplicity in knowledge representation. This features of Production system improve the readability of Production rules.

(b) Modularity :⇒ this means Production rule code the knowledge available in discrete pieces. Information can be treated as a collection of independent facts which may be added or deleted from the system with essentially no deleterious side effects.

(c) Modifiability :⇒ this means the facility of modifying rules. It allows the development of

Production rules in a form first and then it is accurate to suit a specific application.

(d) Knowledge Intensive! ⇒ the knowledge base of Production system stores pure knowledge. this part does Not Contain any type of Control or Programming Information. Each Production rule is normally written as an English Sentence; the Problem of semantics is solved by the very structure of the representation.

Classes of Production System! ⇒

(a) Monotonic Production System! ⇒ It is a system in which the application of a ~~rule~~ rule Never Prevents the later application of another rule that could have also been apply at the time the first rule was selected in monotonic learning May Not learn Many Knowledge that Contradict what it already knows. Never replaces a statement with it's Navigation ~~knowledge~~ knowledge base only grows with New facts in Monotonic

(b) NoN-Monotonic Production System! ⇒ it is a One in which this (Monotonic definition) is Not true. NoN-Monotonic learning learn Knowledge that Contradict what it already knows. it replace old knowledge with New.

(c) Partially Commutative Production system :⇒ it is the Production system with the Property that if the application of a particular sequence of rules transform state x into state y, that any permutation of these rules that is allowable also transform state x into state y. these Production system are useful for solving ignorable Problem. they can be implemented without the ability to backtrack to Previous state when it is discover then incorrect path has been follow hence database will Never have to be restore they are good for problems where things do Not change, New things that created

(d) NoN - Partially Commutative Production System :⇒ Problem in which irreversable changes in occur for

eg: Add a chemical 2X, change the temperature to the order in which action are Performed important.

(e) Computative Production System :⇒ this is a Production System that is both Monotonic and Partially Commutative

	Monotonic	NoN-Monotonic
Partially Commutative	theorem Proving	Robot Navigation
NoN - Partially Commutative	Chemical Synthesis	Bridge

Advantage of Production System

→ Production system provides an excellent tool for structuring AI Programs.

→ Production System are highly modular because the individual rules can be added or removed or Modified independently.

→ the Production rules are expressed in a natural form, so the statements contained in the knowledge base should the a recording of an expert thinking out loud.

Problem characteristics :=>

(1) Is the Problem decomposable ?

A very large ~~General Method applicable to a large~~ and Composite Problem can be easily solved if it can be broken into smaller Problems and recursion could be used. Suppose we want to solve

Ex. $\int x^2 + 3x + \sin x \cos 2x \, dx$

this can be done by breaking it into three smaller Problems and solving each by applying specific rules. Adding the result the Complete solution is obtained

(2) Can solution steps be Ignored or Undone ?

- Problem fall Under three classes ignorable, recoverable

and irrecoverable. this classification is with reference to the steps of the solution to a problem. Consider theorm Proving. we may later find that it is of No help. we can still proceed further, since Nothing is lost by this redundant step

— Now Consider the 8 Puzzle problem tray and arranged in specified order. while moving from the start state towards goal state we may take / make some stupid Move and Consider theoram Proving. we may proceed by false proving lemma. But we may backtrack and undo the unwanted move. this only involves additional steps and the solution steps are recoverable.

— Lastly Consider the game of chess. if a wrong Move is made, it can Neither be ignored nor be recovered. the thing to do is to make the best use of current situation and proceed. this is an example of an irrecoverable solution steps

1. Ignorable Problems Ex:- theorem Proving
   in which solution steps can be ignored.

2. Recoverable Problems Ex:- 8 Puzzle
   in which solution steps can be undone.

(3) Irrecoverable Problems Ex - Chess
   in which solution steps can't be undone.

A knowledge of these will help in determining the

Control Strategies.

(3) Is the universe Predictable ?

Ans Problems can be classified into those with certain outcome (8-Puzzle and water-Jug Problems) and those with uncertain outcome (playing cards). In certain-outcome Problems, Planning could be done to generate a sequence of operators that guaranteed to a lead to a solution. Planning helps to avoid unwanted solution steps. For uncertain out come problems, planning can at best generate a sequence of operators that has a good Probability of leading to a solution. the uncertain outcome problems do Not gurantee a solution and it is often very expensive since the number of solution paths to be explored increases exponentially with the numbers of points at which the outcome can Not be predicated. thus one of the hardest types of problems to solve is the irrecoverable, uncertain-outcome problems (Ex:- playing cards).

(4) Is a good solution ~~absolute~~ absolute or relative ?

Ans There are two categories of problems. In one, like the water Jug and 8-puzzle problems, we are satisfied with the solution, unmindful of the solution path taken, whereas in the other category not just any solution is acceptable. we want the best, like that of traveling sales man problem, where it is the shortest path. in any-path problems, by heuristic methods

we obtain a solution and we do Not explore alternatives. For the best-path problems all possible paths are explored using an exhaustive search until the best path is obtained.

(5) the Knowledge base Consistent ?

Ans In some problems the knowledge base is consistent and in some it is Not. for example Consider the case when a Boolean expression is evaluated. the knowledge base Now contains theorems and laws of Boolean Algebra which are always true. On the Contrary consider a knowledge base that contains facts about production and cost. these keep varying with time. Hence many reasoning schemas that work well in consistent domains are Not appropriate in inconsistent domains

Ex:- boolean expression evaluation.

(6) What is the role of knowledge ?

Ans though one could have unlimited computing Powers, the size of the knowledge base available for solving the problem does matter in arriving at a good solution.

eg: the game of Playing chess, Just the rules for determining legal Moves and some simple Control Mechanism is sufficient to arrive at a solution. But additional knowledge about good strategy and tactics could help to Constrain the search and speed up the execution of the program, the solution would then be realistic.

(7) Does the task requires interaction with the Person

As Solitary in which the Computer will be given a problem description and will produce an answer, with no intermediate Communication and with the demand for an explanation of the reasoning process. Simple theorem proving falls under this category. given the basic rules and laws, the theorem could be proved.

Ex: theorem Proving (give basic rules & laws to Computer)

(8) Problem Classification.

As Actual Problems are examined from the point of view, the task here is examine an input and decide which of a set of known classes.

Ex:- Problems such as Medical diagnosis, engineering design.

AI Representation Techniques :=>

1. Logical Representation ~~Techniques~~ Schema
2. Procedural Representation ~~Techniques~~ Schema
3. Network Representation Schema
4. Structure Representation Schemes

(1) Logical Representation schema :=>

(i) Propositional logic :-

(a) sky is clear → P
(b) it is the summer season → Q
(c) One feels hot → R

P ∧ Q → R

(ii) Predicate logic :-

(a) Tom is a cat
(b) Jerry is a mouse
(c) Tom & Jerry are friends
(d) If bird is a Parrot then it is green

Cat (Tom)
Jerry (Mouse)
Friends (Tom & Jerry)
(∀ x : (bird (x) ∧ Parrot (x)) → green

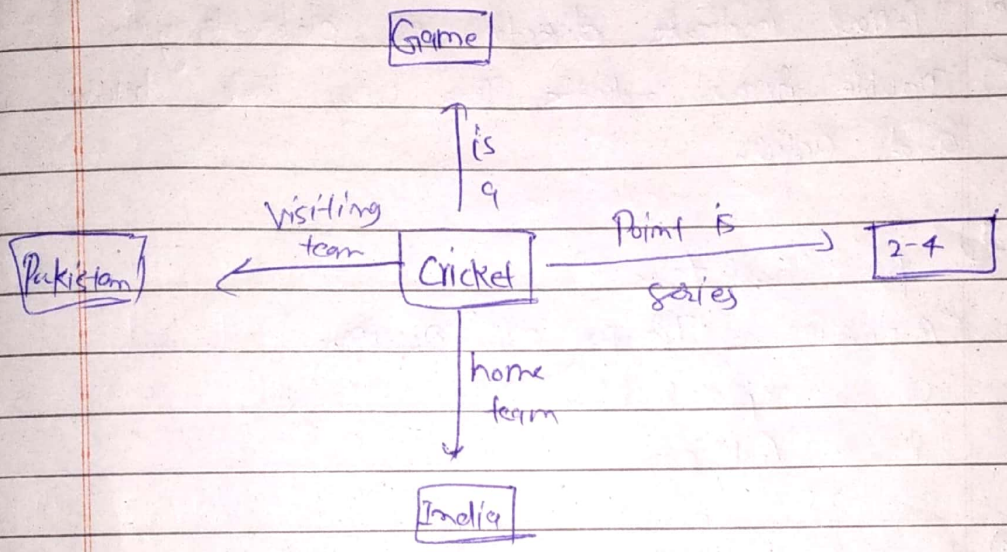
(2) Procedural Representation Logic :-

```
IF (A > B)
  {
    if (A > C)
      Printf ("A is largest");
    else
      Printf ("C is largest);
  else
    if (B > C)
      Printf ("B is largest");
    else
      Printf ("C is largest");
```

③ Network Representation Schema :→

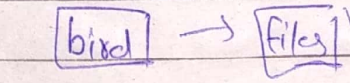
(i) Semantic Network

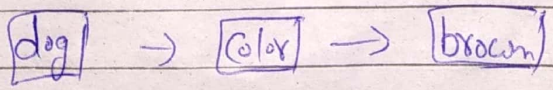
(a) Knowledge represented by graph
(b) Node represent object or Concept
(c) arc represent relationship

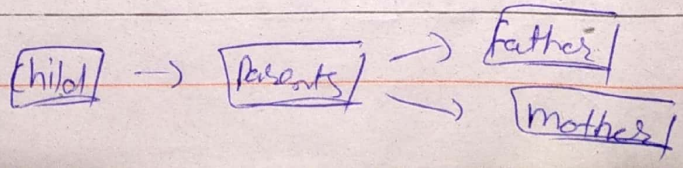


(ii) Conceptual Graph :=>

(a) this is a finite Connected bipartite graph.
(b) Concept represent by - box
(c) Conceptual relation on ellipse



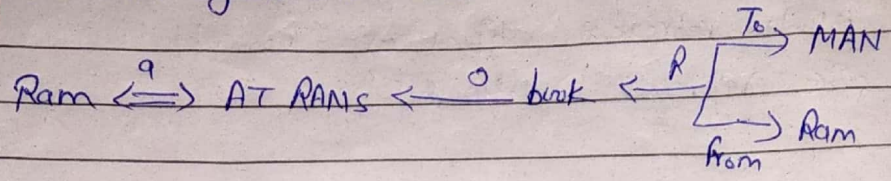




(iii) Conceptual Dependency (CD)

(a) Knowledge can be represented by CD

ex. "Ram gave a book to a Man"



(b) Arrow indicate direction of dependency

(c) Double Arrow indicate Two way link between a to R and action

(d) p → past tense
ATRANS – Transfer of possession
O → Represent object
R → Relation

(4) Structure Representation schemes ⇒

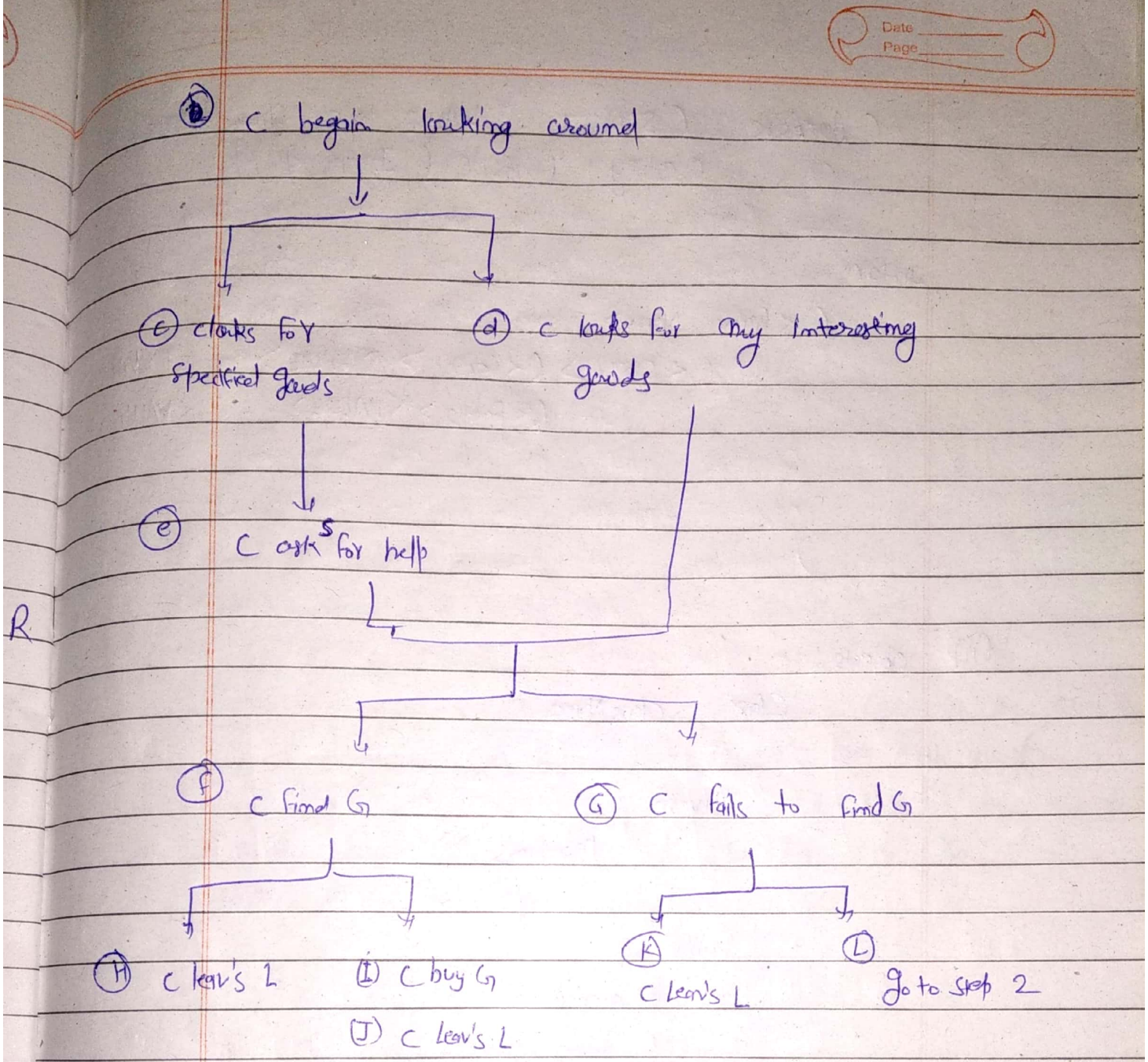
(1) scripts

ex

shopping script
C - Customer
G - Goods
L - Location
S - Sales man

(a) C Center in L

↓



(ii) Frames :=>

=> It just like structure in C language
=> It has collection of slots and values.
=> Slot may be any size of any type.

ex:- (Ram
(PROFESSION (VALUE Professor))
(AGE (VALUE 40))

(ADDRESS (STREET (VALUE 10.5 green Parle))
(CITY (VALUE (JAIPUR))))

Syntax:-

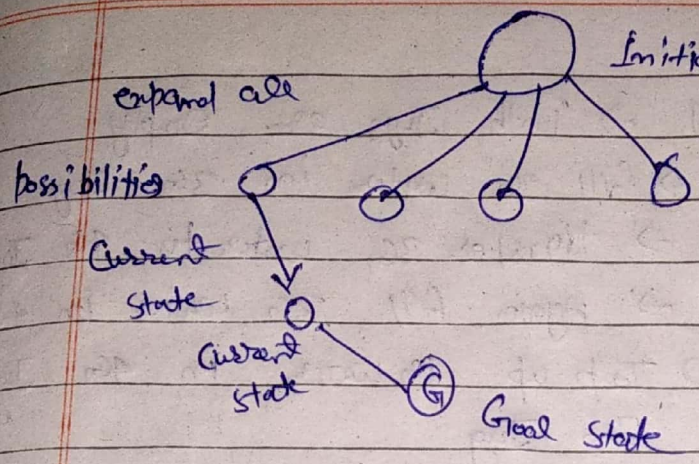
(<Frame Name>
(<SLOT1> (<fact1> <VALUE> ---- <VALUE>)
(<fact2> <VALUE> ---- <VALUE>)
;
;
)

(ii) objects:-

Class ClassName
{
Private:
members;

Public:
members;
}

State Space Search technique:⇒ this technique is based on expand all the Possible path of the current state, a State which leads to the Goal State will be the solution of Concern Problem in the technique we are Not any try to find best or smallest path



Example :⇒

① Water and Jug Problem :⇒

Problem :⇒ we have two Jar's with the capacity of 4G and 3G both Jar's having No any markers on it, there is a water supply motor that can be use to Fill the Jars the Problem is we have to fill the water 2G in 4G Jug

(X,y) = (0,0) Initial State
(X,y) = (2, any) Goal State

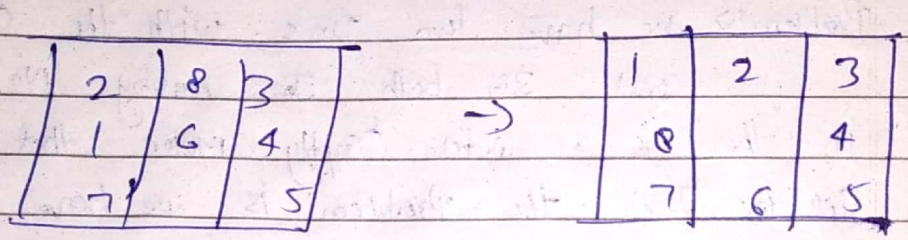
Solution path :⇒

(0,0)
(0,3)
(3,0)
(3,3)
(4,2)
(0,2)
(2,0)

Solution :⇒

(X,y) = (0,0) → Both Jugs are empty
(0,3) → Fill 3G water in 3G Jug
(3,0) → Transfer 3G water to 4G Jug
(3,3) → Again Fill 3G water in 4G Jug
(4,2) → Top up 1G water in 4G Jug from 3G Jug
(0,2) → Make empty 4G Jug
(2,0) → transfer 2G water to 4G Jug

(11) 8-Puzzle Problem :⇒

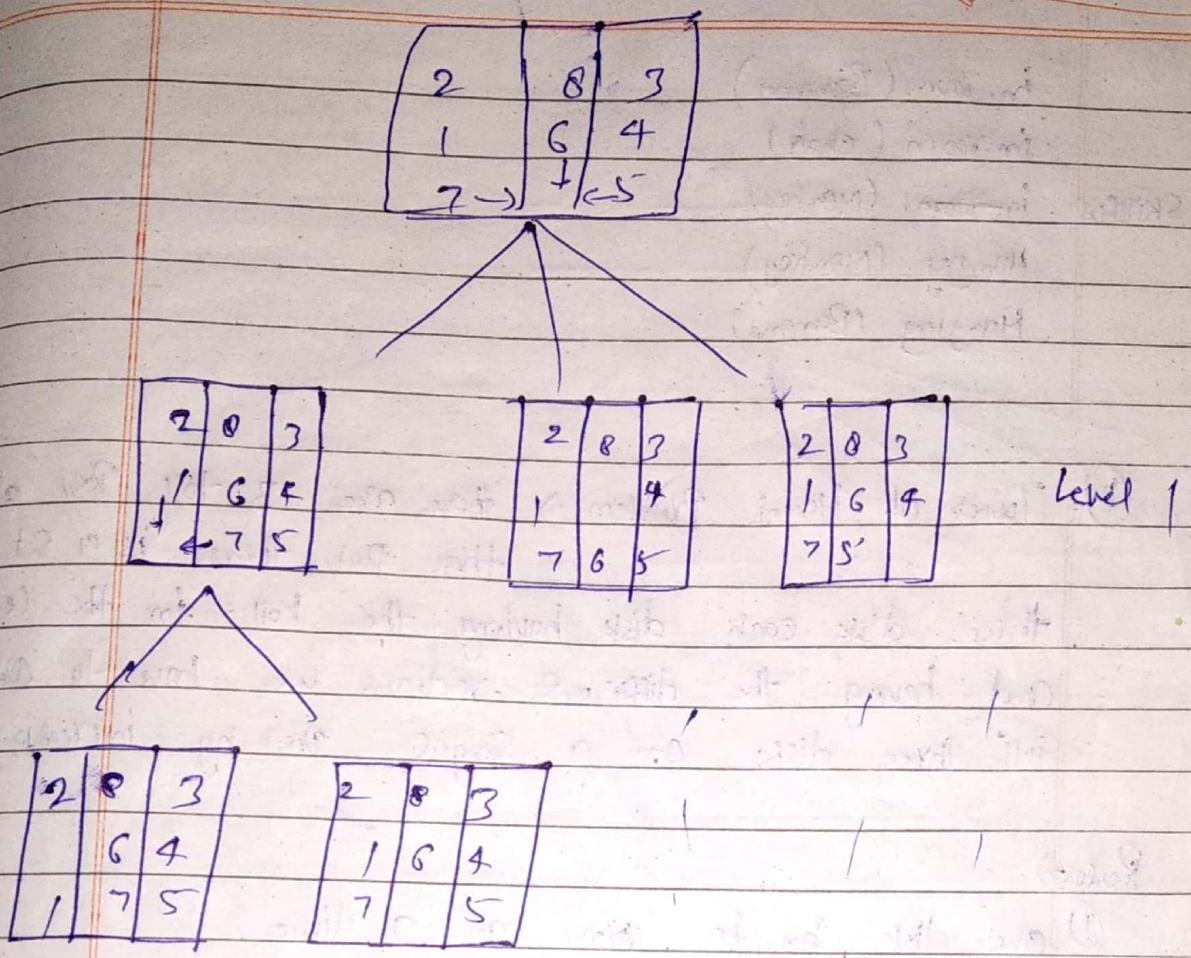


Rules :⇒

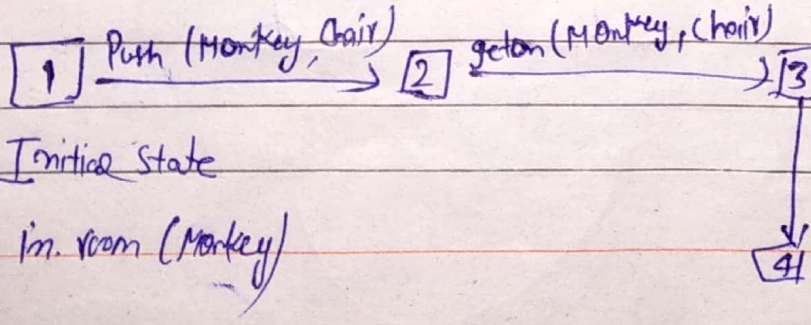
→ One tile can move at once
→ It can move one step up, down, left, right
→ Cross movement of tile Not allowed.

Problem :⇒ we have the 9 Squares in a big Square or 9 tile in a square each tile assign a Number and one box is empty we have to follow the rules and shift the tile to achieve the Goal state

Solution :⇒



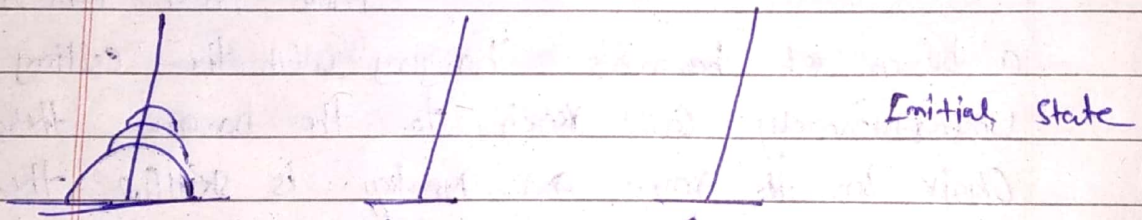
(iii) Monkey & Banana Problem :- A Hungary Monkey find itself in a room in which a bunch of banana's hanging with the ceiling. A Monkey unfortunately can't reach to the banana's there is a Chair in the room and Monkey is skillful the ceilling height is around 5 fit Now we have to find best sequence to the Action for the Monkey to get the banana.

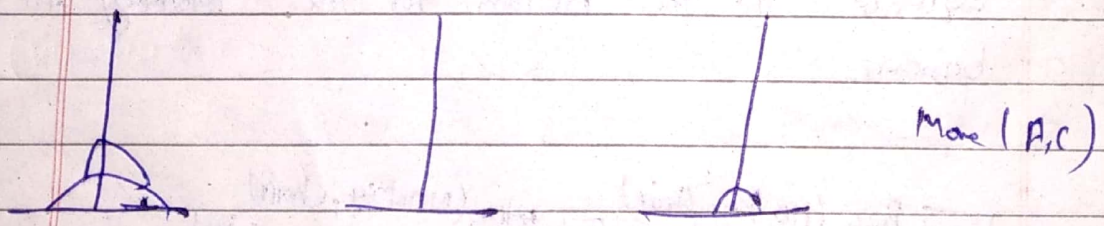


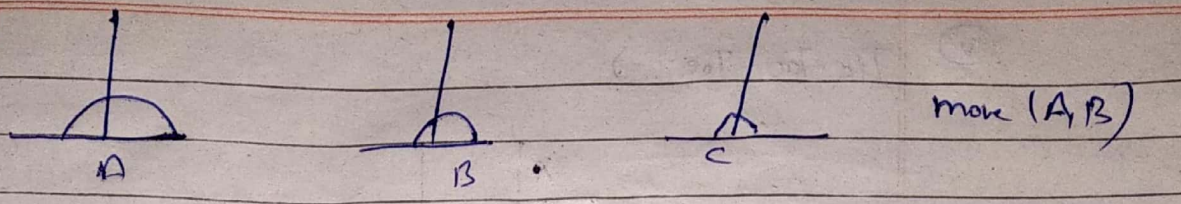
Im. Room (Banana)
Im. Room (Chair)
Skillful Im. Room (Monkey)
Hungry (Monkey)
Hanging (Banana)

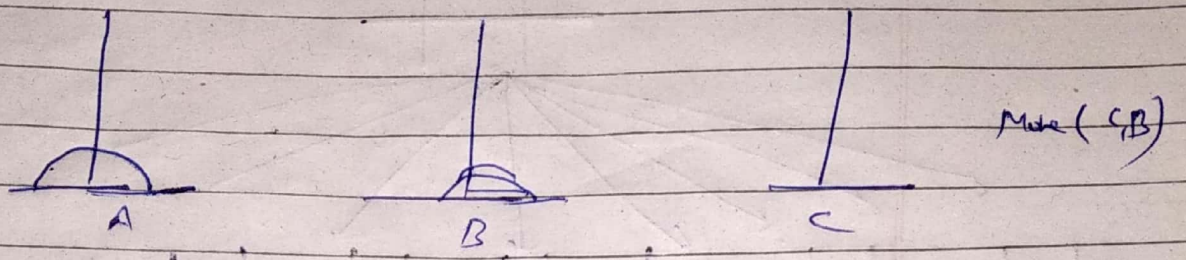
(iv) Tower of Hanoi Problem :⇒ there are 3 toll Post all thes Post there is a set of three disk each disk having the holl im the Center and having the different vadious we have to arrang all three disk on a Singal Post by increasing vadius

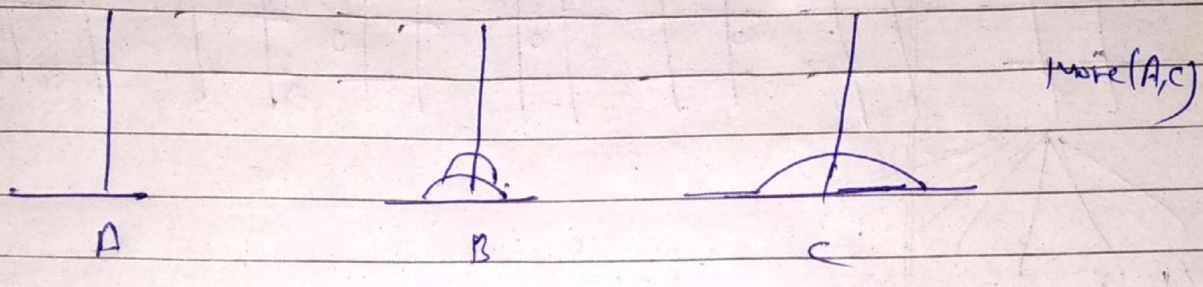
Rules⇒
① One disk Can be Move at a time
② only top disk on any Post May remove to another
③ large disk Cannot be Place on the Small disk.

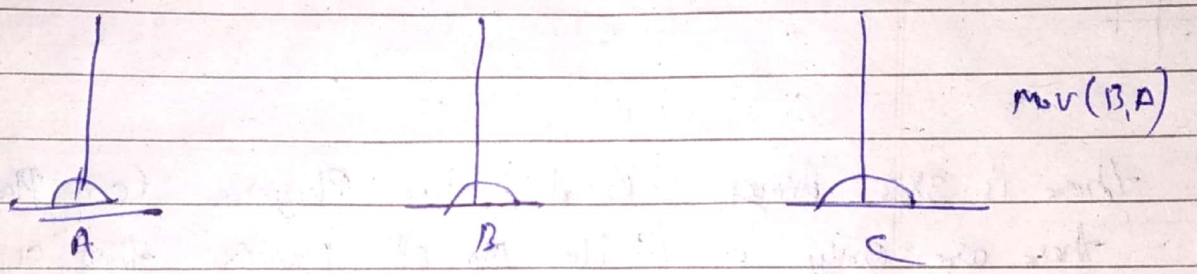


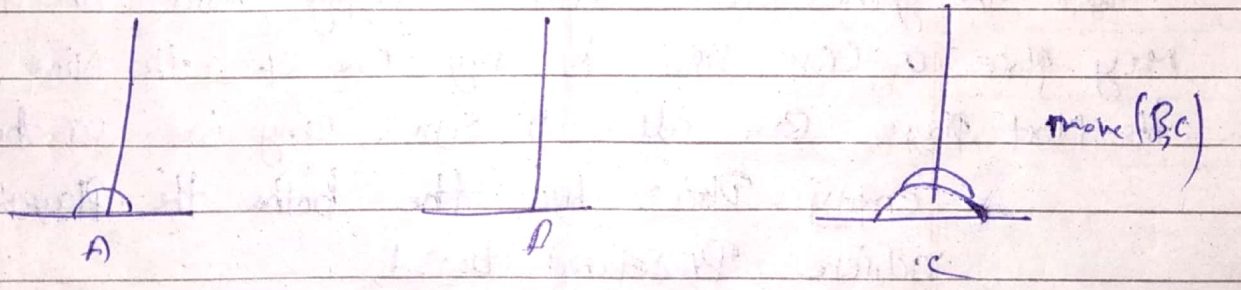


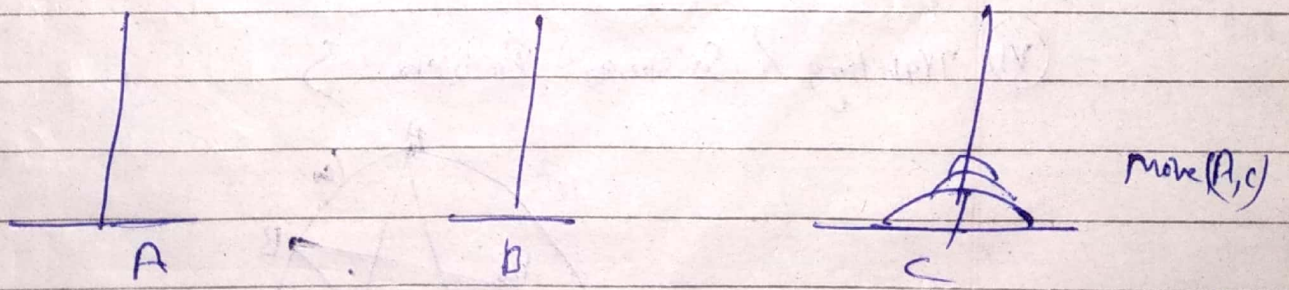






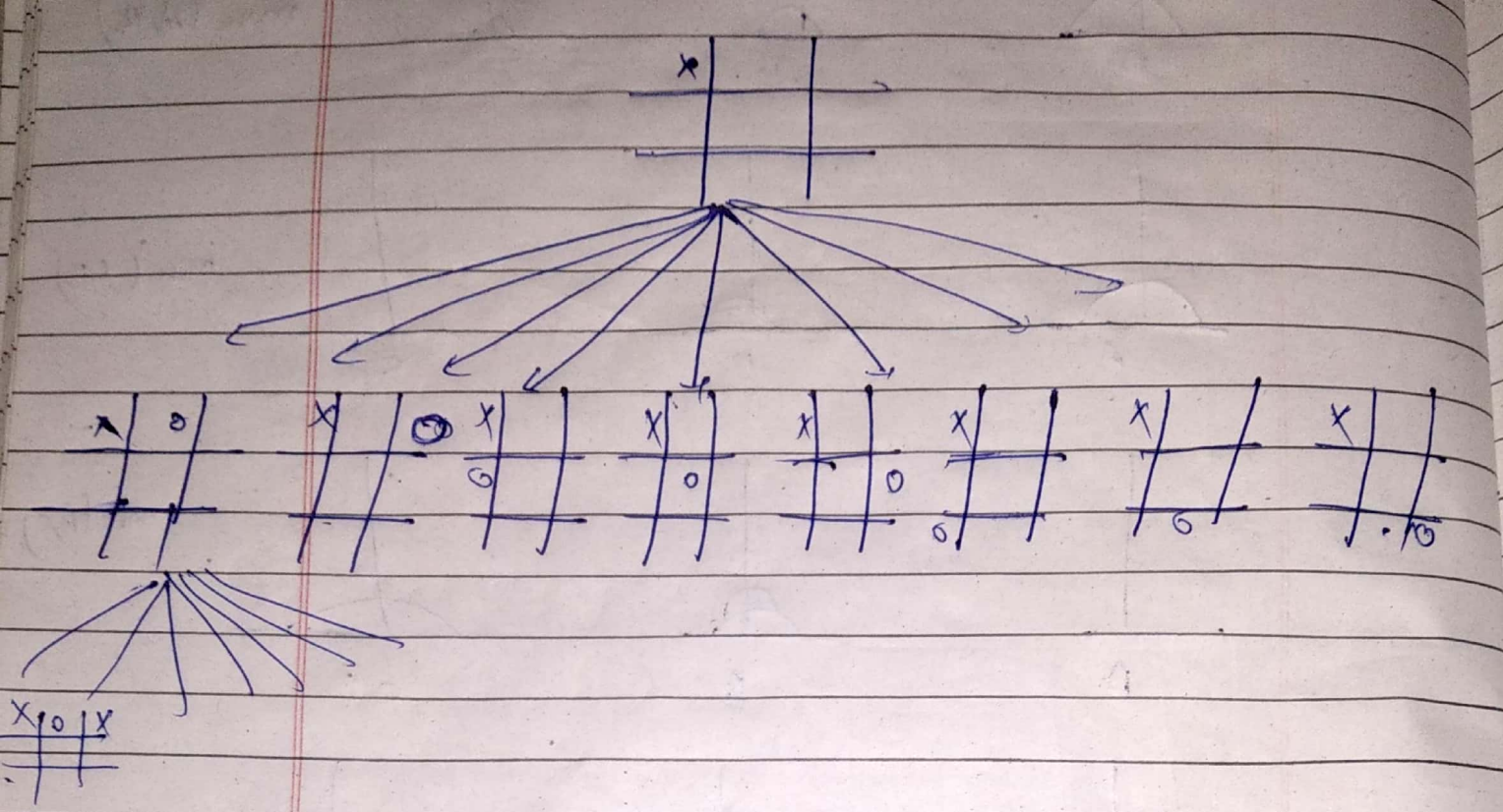






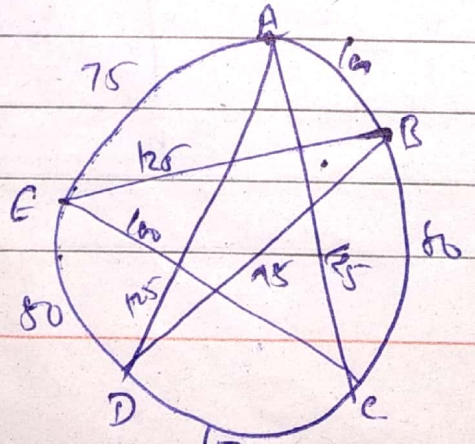
Goal State

(v) Tic-Tac-Toe :⇒



there is 3×3 Array Board, two Players Can Play this game there are only a finite No. of Moves that a Player Can Make the game start with the empty bord the first Player may place a Cross Sign in any one of the Nine ~~Plates~~ Places the Next Player Can also O Sign any one of the remaining empty Places both the both the Player's try to achieve Predefined board.

(vi) Traveling Salesman Problem :⇒

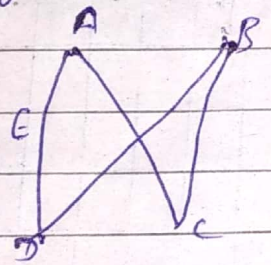


A Salesman has a list of cities each of which he must visit exactly once there are direct road b/w each pair of cities find to route the Salesmen should follow to complete the trip by touching each city at once

Solution path

Step 1 : Move A → E
Step 2 : Move E → D
Step 3 : Move D → B
Step 4 : Move B → C
Step 5 : Move C → A

Solution digram



(vii) Cryptarithmetic Problem :- it is an automatic Problem representing in letters on Maintain in the example our goal is to assign a decimal digit to each of letter in such a way that the ensure to Problem is correct if the same letter comes more than one's

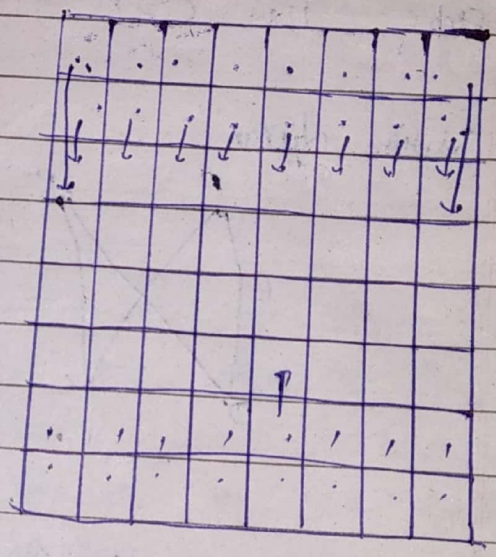
ex.

```
  TWO
  TWO
+ FOUR
```

```
  TWO
  765
  765
+ 765
 1530
```

it Must be assign the Same digit each time No two different letter's May be assign the Same digit.

(VII) Chess Playing :=>



there is a chess board which have 64 squares in state space Method we Calculate all possibilites on each Move by a Players the Path which leads to the goal state will be the Solution of problem.

Production Rules :=> Production System is one of the formalism that helps AI Programme to do Search Process more ~~Connecti~~ Convencily in State Space Problem.

Production System Comprises of

① Initial state and Goal state (s) of the problem along with one or more database consisting of suitable and necessary information for the particular task.

② Production Rules :- Production System consist of Number of Production rules in which left side of the rule is the current state ~~where~~ whereas the right side describes the New state's that is obtain from applying the rule.

③ Control strategies :⇒ Production system also consist of control strategies that's specify the sequence in which the rules are applied when several rules match at once.

Control strategies is one of the most important component of problem solving that describes the order of application of the rule to the current state.

Characteristic of a good strategy

→ Control strategy should cause motion.
→ Control strategy should be systematic.

Search techniques :⇒

(a) Uniformed search
(b) informed search

(a) Uniformed Search :=> it is also called blind search or unguided search, is a class of general purpose search algorithms that operate in a brute-force way. the term 'uniformed' means that they have no additional information about states beyond that provides in the problem definition. these algorithm can be applied to a variety of search problems, since they don't take into account the target problem.

(i) Breadth-first search (BFS) :=> BFS expands all the state one step away from the start state, that expand all the state to steps from the start state then three steps and so on until a goal state is reach

all successor state are examine of the same depth before going deeper

algorithm of BFS :-

Step 1: Create a variable called NODE-LIST and set it to the initial state

Step 2: Until a goal state is found or NODE-LIST is empty do;

a) Remove the first element from the NODE-LIST and call it E, if NODE-LIST was empty then quit.

b) For each way that each rule can match the state describe in E do;

(i) Apply the rule to generate a New state.
(ii) if the New state is a goal state then quit and return this state.
(iii) otherwise add the New state to the end of the NODE-LIST

Advantage of Bfs :-

→ Bfs is a systematic search strategy all Nodes at level in are considered before go into (n+1) level.
→ if any solution exist then Bfs guarantees it find it.
→ Bfs always gives multiple Path are solution on it means if there are many solution, Bfs will always find the shortest Path solution.
→ Bfs Never get strabed in a blind array.

disadvantage of Bfs :⇒

→ All Nodes are to be generated at any level so unwanted nodes are to be remembered and wastage of Memory
→ time and space Complexity is exponential

(ii) Dfs (Depth First Search) :⇒ in Dfs we go as far down at Possible into the search then before backing up and trying alternatives
Dfs is Memory efficient as it only store a singal Path form the root to leafe node along with the remaining unexpected sibling for each node on the Path.

Algo of DFS:-

① If the initial state is a goal state, quit and return success
② otherwise, do the following until succ or failure is signaled.
③ Generate a succ E of the initial state, if there are No more succ signal failure.
(b) Call DFS with E as the initial state
(c) if succ is returned, signal success Otherwise continue in their loop.

Advantage of DFS:=>

→ DFS requires less memory since only the node on the current path are stored.
→ DFS may find a solution without examining much of the search space at all.

disadvantage of DFS:-

→ this search can go on deeper and deeper into the search space and thus on get lost.
→ this is referred to as blind search.
→ DFS can be dengerious when the path closer to the start and further from the Goal has been closer
→ DFS may Not give Optional solution.

Depth - limited Search :=>

=> Depth - first search with a limit on the depth.
=> Depth - first search always expands the deepest node in the current fringe of the search tree.
=> mitigates Infimited depth Path of DFS by cutting the tree on the limit depth.
=> will fail to reach goal if goal resides deeper than depth limit.

Bidirectional Search :=>

=> searches from initial state to last state and also from the last state to initial state, stopping when the two searches meet at a Node in between (or when found the Goal state)
=> Advantage :- ① time and Memory requirements good, Comparatively
② less time Complexity

=> disadv :=> Not always feasible, or Possible, to search backward through possible states.

(b) Informed Search :=> (Heuristic search)

=> If information is available about the Problem this could guide the search.
=> Information is put in an evaluation function f(n) to be able to give a value of each state.

→ Sometimes a heuristic function h(n) is used to guess the value if the information isn't Perfect.

① (Greed)' best first search
② A* (A star) search.

Heuristic Search technique :- it is refer to experience based technique for Problem solving, learning and discovery

Heuristic refers to general Problem Solving rule or set of rule's that do Not guranice the best solution but servers as a useful guide for Problem Solving this Method is used to speed up the Proces of finding a enough solution where is an existing search in Pratical example of this Method include using a rule of thumb, ~~an~~ e. an educated guest, an intutive Judgement or Commonsence.