Date 16/09/22

ARTIFICIAL INTELLIGENCE.

Data $\xrightarrow{\text{Process}}$ Information $\xrightarrow{\text{Process}}$ Knowledge $\Longrightarrow$ Intelligence.

Database :- A collection of data & information.

⇓

Knowledge :- A collection of database + knowledge.

Searching
- → Linear searching O(n)
- → Binary searching O(logn)
- → BFS
- → DFS
- → Best First serve/Hill climbing search.

(*) What is AI?

↳ It is a branch of CSc. It deals with the study and creation of computer systems, that exhibits some form of Intelligence.

Application Areas :—

→ Game Playing.
→ NLP [Natural Language Processing].
→ Speech Recognition.
→ Reasoning.
→ Expert System.
→ Medical Diagnosis.
→ MYCIN/DENDRAL.
→ Simulation for drive and flight.
→ Heuristic Problem Solving.

History Of AI :—

→ Father of Modern Computer :— Allan Turing.
1950 - 1954

Improvised By
→ John Mc Carthy (1956)
→ Marvin Monsky (1959)

Task Classification Of AI :-

3 Types of Classification :—

i) Mundane Task (Common/Ordinary).
ii) Formal Task.
iii) Expert Task.

Mundane Task :-

a) Perceptual (Vision & Speech)
b) NLP → Understanding.
→ Generation.
→ Translate.
c) Commonsense Reasoning.

Formal Task :—

a) Game playing.
b) Theorem proving.
c) Problem solving.

Expert Task:

a) Engg. Design.
b) Scientific Analysis.
c) Medical Diagnosis
d) Finantion.

Date
19/09/22

Problem Solving Techniques:

1) Branch and Bound.] AI Techniques
2) NP Complete

Desirable Properties Of Knowledge:

→ Volumnous.
→ It is hard to characterize accurately.
→ It is organised.
→ Constantly changing.

→ AI technique is a method that ~~exhibits~~ exploits Knowledge that should be represented in such a way that * can be easily modified to correct errors and reflect changes in real world.

* can be used in many situation even if it is not totally accurate or complete.

* can be used to narrow the range of possibilities that must usually be considered.

Techniques:-

* Search.
* Use of Knowledge.
* Abstraction.

Reasons to model human performance:-

Level of the model.

→ To test the psychological Theory of performance.
→ To enable computers to understand human reasoning.
→ To enable people to understand computer reasoning.
→ To exploit what knowledge we can gather from people. (Learn after harvesting)

Problem space & Searching

→ To solve a complex program in AI, we have 4 steps:-

1) Defining the problem.
2) Generating attractive sol^n.
3) Evaluation.
4) Applying the best sol^n to solve the problem.

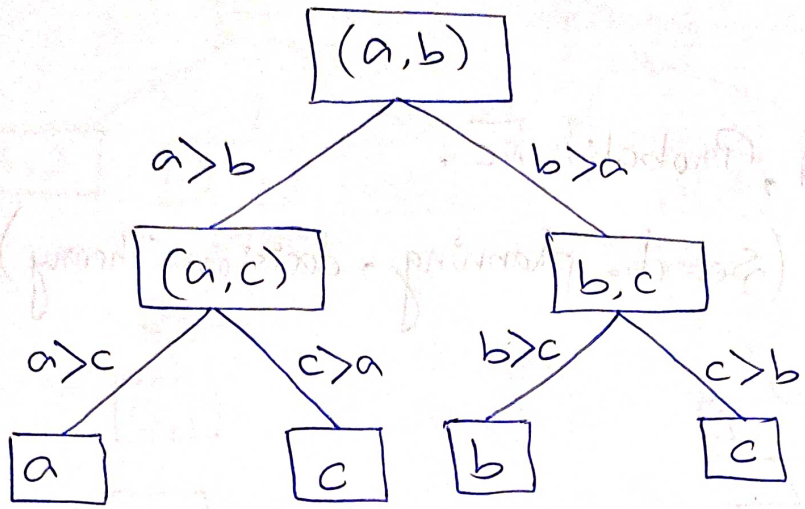
State Space Search.

1) Many problems can be represented as a set of states called State Space and a set of rules (how one state is transformed to another).
2) State space can be represented as a graph.

Nodes → States
Arcs → Action

* Draw a state space representation to find the largest of 3 no.s (a, b, c)

b



Date
21/09/22

Russel & Norvig — Cognitive Science

	Like a human	Not necessarily like human
Think	Systems that can think like human.	Systems that think rationally.
Act	Systems acts like a human	Systems that acts rationally.

Subareas of AI:—

→ Perception: Vision, Speech recognitions, etc. (understanding)

→ Machine Learning: Neural Networks.

→ Robotics

→ NLP

→ Reasoning and decision making.

→ Knowledge Representation. →
- Propositional Logic.
- FOL.
- Semantic Network
- Rule based system
- Frames / Slot and filler technique.

Eg:- Bhaskar is writing and Bhaskar is talking.
W T

→ ↳ WAT

→ Reasoning: Logical, Probabilistic.

→ Decision making (Search, planning, decision Theory).

Searching: ——

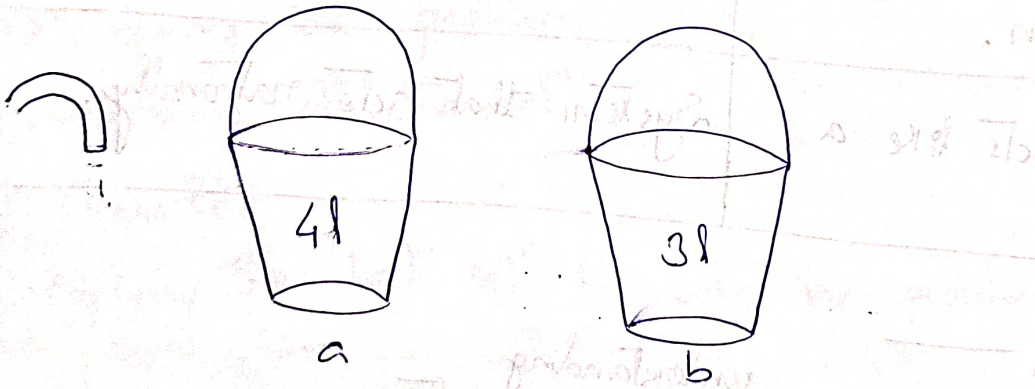
→ Uninformed Search.

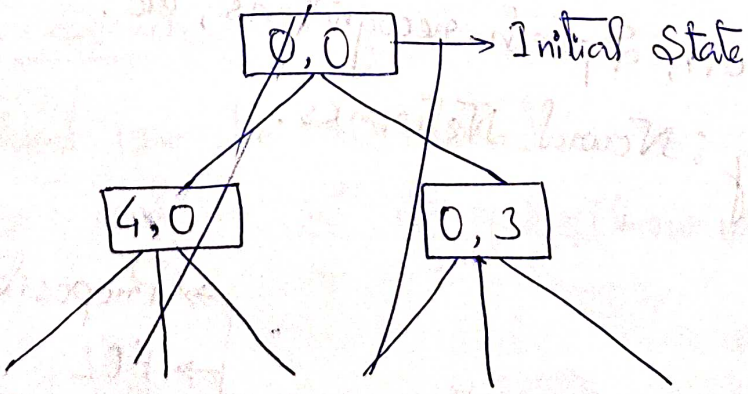
→ Informed Search / Heuristic Search.

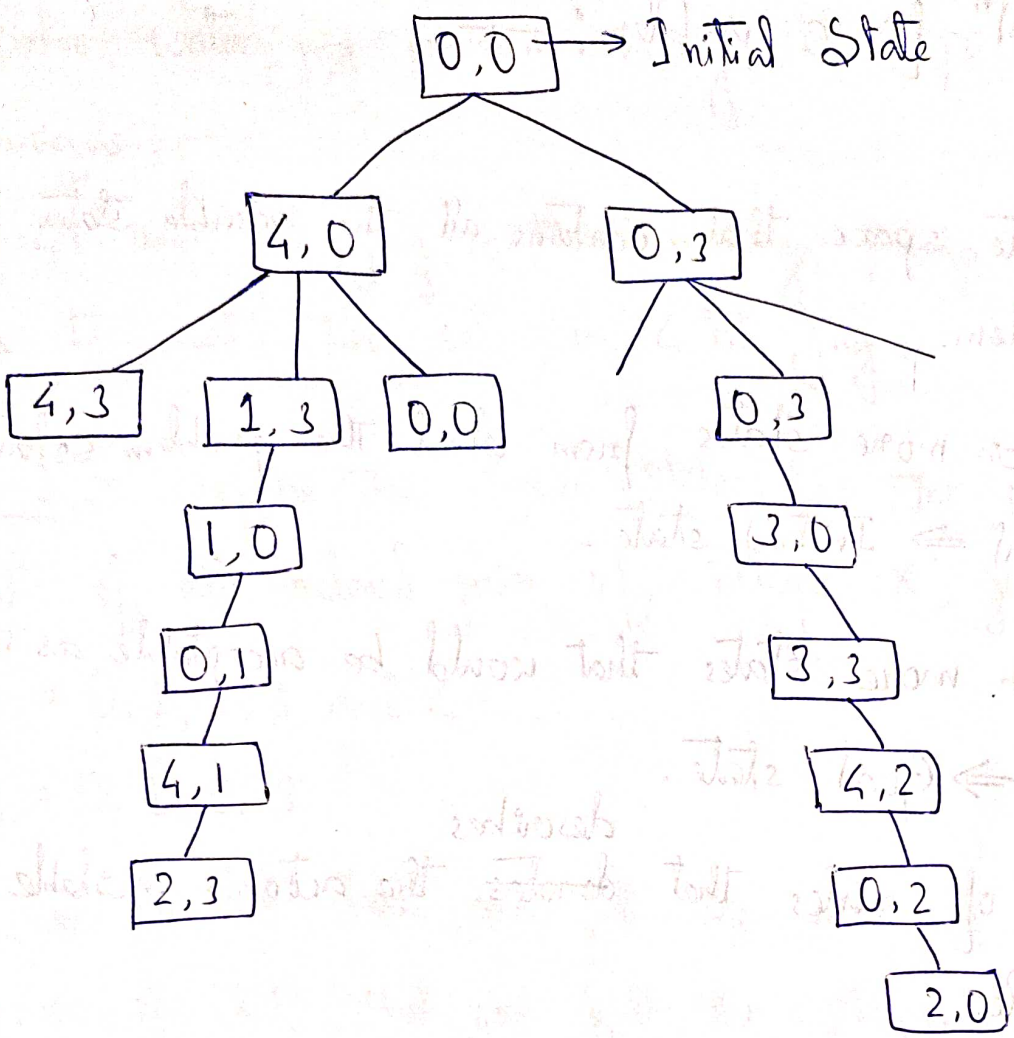
→ Game tree search.

Success Of AI: ——

→ Games: Chess, Checker, Poker, Tic Tac Toe, etc.






0,0
Initial State
4,0
0,3
4,3
1,3
0,0
0,3
1,0
3,0
0,1
3,3
4,1
4,2
2,3
0,2
2,0

Searching the soln for a problem: —

4 Steps: —

1) Define a state space that contains all the possible states for solving a problem.

2) Specify one or more states from which the problem solving process may start ⇒ Initial state.

3) Specify one or more states that would be acceptable as soln to the problem ⇒ Goal state.

4) Specify a state of rules that ~~denotes~~ describes the actions available.
↳ Production Rules.

Production System.

4 Components: —

1) Set of rules. of the form $C_i \longrightarrow A_i$, if x then y.
(C_i ⇓ Condition; A_i ⇓ Action)

2) One or more. Knowledge Based ~~(KB)~~ contain information req to solve a problem.

3) Control ~~std~~ strategy (plan) determines the order in which the rule are applied to the database and resolve the conflicts if any.

4) A Rule applier: Computational system that implements the contro strategy and applies the rules.

~~4~~ Type

Q:- Solve water jug problem using state space searching technique :—

4l and 3l jug without making pump to fit water has to set two set in 4 lit jug.

Soln:-

Step-1:- Define the Space state for the problem.

Set of all ordered pair of integer x, y

$x = 0, 1, 2, 3$ and 4

$y = 0, 1, 2, 3$

x : no. of lit that can fill the 4l jug.

y : no. of lit that can fill the 3l jug.

Step-2:- Initial state (0,0)

Step-3:- Goal state (2, n)

Step-4:- Production Rules:—

	Cond^n		Action	Explan
Rule-1:-	(x,y) and $x=0$	$\longrightarrow$	$(4,y)$	Fill 4l jug
Rule-2:-	(x,y) and $y=0$	$\longrightarrow$	$(x,3)$	
Rule-3:-	$(4,0)$	$\longrightarrow$	$(0,0)$	
Rule-4:-	$(0,3)$	$\longrightarrow$	$(0,0)$	
Rule-5:-	$(4,3)$	$\longrightarrow$	$(0,3)$	
Rule-6:-	$(4,3)$	$\longrightarrow$	$(4,0)$	

Date
26/09/22

BFS Algorithm:—

1) Create a variable called node_list and set it to initial state.
2) Until goal state is found or node_list is empty. ~~perfor~~
   Perform the following steps:—
   a) Remove the 1st element of node_list called 'E'. If node_list is empty, then quit or terminate.
   b) For each way that each rule can match the state described in E.
      i) Again we have further apply the rule to generate a new state.
      ii) If the new state is a goal state then quit and return the state.
      iii) Otherwise, add the new ~~list~~ state at the end of the node_list.

Advantages:—

i) If There is a soln then BFS is ~~given~~ guaranted to find it.
ii) BFS will never get ~~to~~ trapped by unwanted nodes.
iii) If there are multiple soln, BFS returns the minimal soln (in min no. of steps).

Disadvantages:—

i) Requires more memory, as it stores all the nodes at present level to search the next level.
ii) Time complexity is high.

DFS Algorithm:—

1) If initial state is goal state then quit & return success.
2) Otherwise, do the following untill success or failure obtained.
   i) Generate a successor 'E' of the initial step if there are no success then failure is returned.
   ii) Call DFS 'E' as initial state.
   iii) If success is returned then terminate the search otherwise continue in the loop.

Advantages:—

i) Less memory requirement.
ii) Less time.
iii) Soln can be ~~found~~ formed without much more search.

Disadvantages:—

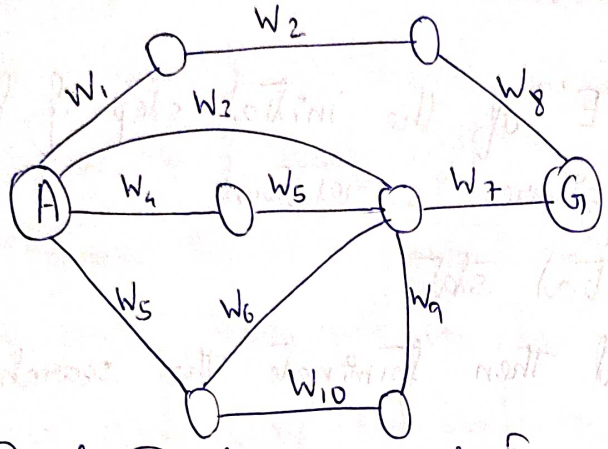
i) Not guaranteed soln.
ii) Determination of depth until the search ~~may~~ may consume the time.

Informed Searching / Heuristic Searching:—

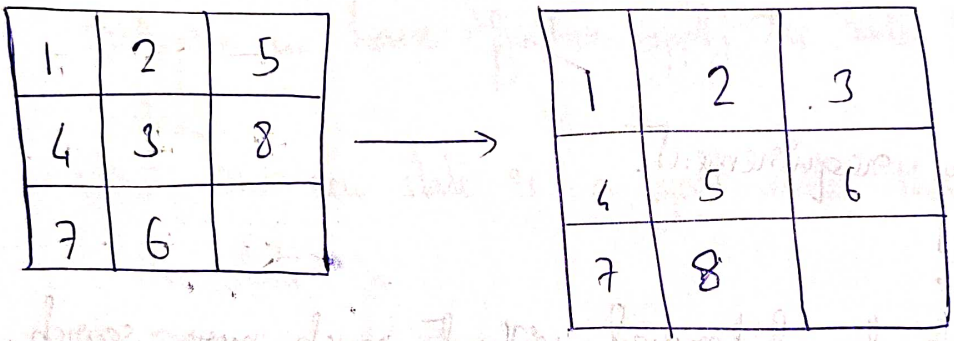
1) When more information than the initial state; Operator (Production Rules), and the goal state is available and the searching size can be minimized.

→ Heuristic information is called Heuristic search. [Rule of Thumb]

TSP [Travelling Salesman Problem]:-



8-Puzzle Problem:- Brute Force



→ Find state space.

Uninformed Search

1) BFS
2) DFS
3) Uniform Lost Search

Informed Search

1) Hill Climbing Search.
2) Best First Search (BFS + DFS
3) Generate & Test.
4) Problem Reduction.
5) Constraint Satisfaction.
6) Branch and Bound.
7) Means and Analysis.

Date
27/09/22

Problem Characteristic.

1. In order to solve a problem it is reqd. to analyze the problem.

i) Is the problem decomposible into a set of independent, smaller, and easier subproblem.

Eg:- $\int (x^2 + 3x + \sin^2 x(\cos^2 x))\, dx$

$= \int x^2 dx + \int 3x dx + \int \sin^2(\cos^2 x)\, dx$

$= \frac{x^3}{3} + 3\frac{x^2}{2} + \int (1 - \cos^2 x)\cos^2 x\, dx$

$= \frac{x^3}{3} + \frac{3x^2}{2} + \int \cos^2 x\, dx - \int \cos^4 x\, dx$

ii) Can soln steps be ignored or undone. Eg:- 8-puzzle.

iii) Is the universe predictable, whether the planning is possible to find desired soln.

iv) Is a good soln absolute or relative.

v) Is the soln a state or path.

vi) Role of Knowledge.

Proof

Production System:-

4 Types:-

1) MPS: Monotone Production System.
2) NMPS: Non-Monotone Production System.
3) PCPS: Partially Commutative Production System.
4) NPCPS: Non-Partially Commutative Production System.

1) MPS:- The application of a rule never prevents the application of another rule.

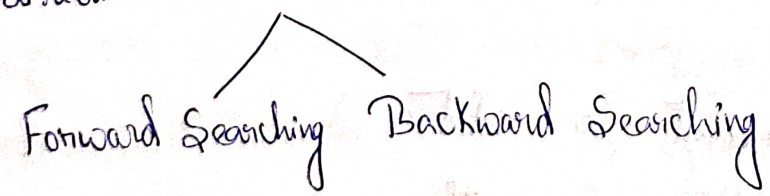
2) NMPS:- Opposite of MPS.

3) PCPS:- The application of a particular sequence of rules transform state x in state y then any permutation of those rules also transforms state x into state y.

4) NPCPS:- Opposite of PCPS.

Issues in Design of search program:—

1) The direction in which the search will proceed.



2) How to select appropriate rule.

Heuristic Search Technique

OR
Alg:- Generate & Test - Simplest HS.

→ Generate a possible soln.

→ Test to see if this is actually a soln comprising with the desired one.

→ If a soln had been found, Then quit ~~question~~ otherwise repeat step 1.

Advantage:- Simplest, easy to implement.

Disadvantage:- Not efficient search technique, many wrong soln may be generated, doesnot provide any feedback. (to rectify the errors).

Hill Climbing Search.

→ Provides feedback (facility to task procedure that are used to divide which direction to move in the search space).

3 Types of hill climbing:-

1) Simple hill climbing: optimization alg.

2) Steepest hill climbing.

3) Simulated Aneaing

Alg:- 1) Evaluate the initial state; if it is a goal state then return it & quit otherwise continue with the initial state as current state.

2) Look until a soln is found.

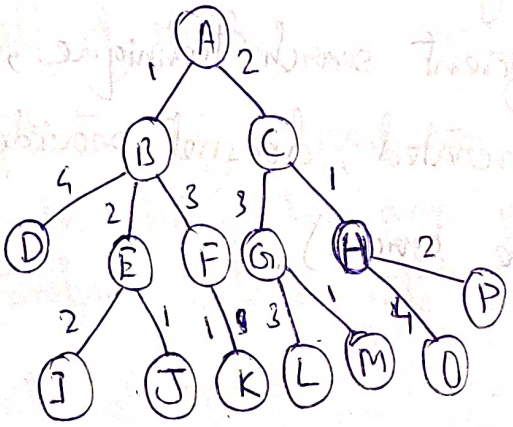
(a) Select an operator (rule) that has not yet applied to the current state and apply it to produce a new state.

(b) Evaluate the new state as follows.

i) ~~Evaluate~~ If it is a goal state return it & quit.

ii) If it is not a goal state but better than the current state then make it is current state.

iii) If it is not better than the current state then continue in the loop.

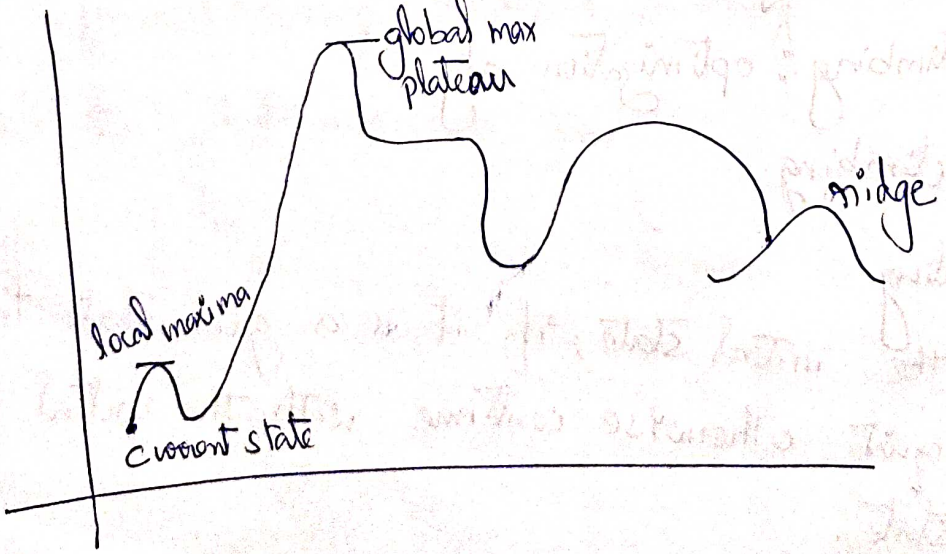


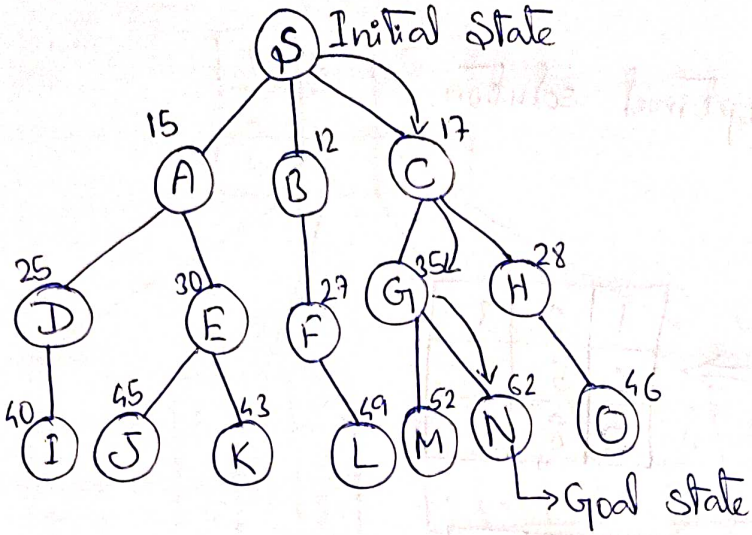
Initial State = A

Goal State = O.

Date
28/09/22

Hill Climbing Disadvantages:-





Cost = 17 + 35 + 62

= 114

Local maxima: A state or node i.e better than all of its neighbouring nodes but not better than global maxima.

Plateau: Flat area of search space in which a set of neighbouring nodes the same value.

Ridge: A special kind of local maxima for an area which has a slope and which unit be obtained by a single move.

Soln:—

a) Back track:— To move to earlier node and try going in different direction and is used to deal with local maxima.

b) Big jump:— Make big jump to some direction to get a new direction to deal plateau.

c) Apply two or more rules.

→ Before doing this test, this cause moving in several direction at once to deal with Ridge problem.

Advantages: ——

→ Definitely gives optimal solution.

→ Time and space