

## Artificial Intelligence

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new topics  
numerical science

speed up the task

21/03/23

### (AI)

Q What is AI?

- The field of artificial intelligence or AI goes further still, it attempts not just to understand but also to build intelligent entities.
- AI is one of the newest field in science & engineering.

→ In simple words AI is the simulation of human intelligence process by machine, especially computer systems.

Q Application of AI :-

There are numerous real world applications of AI system today.

- Speed recognition → It is also known as Automatic Speed recognition (ASR)
- Medical Science (Research)
- E-commerce
- Weather Forecasting
- In the field of Banking - fraud detection
- Automatic vehicles / driver less vehicles
- field of Monitoring

Q The Rational agent approach:-

features required for a machine to pass the Turing Test:-

- Natural language processing → NLP is required to communicate with interrogator in human language like English.
- Knowledge representation → To store what it knows or learns
- Automated reasoning → To use the stored info + answer questions and to draw new conclusions

In computer science and computer, the term Artificial intelligence has played a very prominent role. The term has become more popular due to recent advances in AI & Machine learning.

Q Turing Test :-

In 1950 Alan Turing introduced a test, to check whether a machine can think like a human or not. This test is known as the Turing test.

The related to human mind and machine. In this game if our interrogator would not be able to identify which is a machine and which is human, then the computer passes the test successfully, and the machine is said to be intelligent and can think like human.

The importance lies in making our life easier. Two technologies are a great help to humans and are programmed to minimize human efforts as much as possible. These machines speed up the tasks and processes with guaranteed accuracy and precision, making them useful & valuable tool.

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### \* The rational agent approach :-

An agent is just something that acts. of course all computers programs do something, but computer agents are expected to do more.

→ An rational agent is one that acts so as to achieve the best outcome or, when there is uncertainty, the best-expected outcome.

### \* Intelligent Agent :-

#### AI Agents :-

An agent can be anything that perceives its environment through sensors and act upon the environment through actuators. An agent runs in cycle of perceiving, thinking and acting.

An agent can be:

- Human Agent :- human agent has eyes, ears and other organs which work as sensors, and hand, leg work as actuators.

- Robotic Agent :- camera, Infrared sensor, mic etc. are sensors

- Motors, electromechanical as actuators

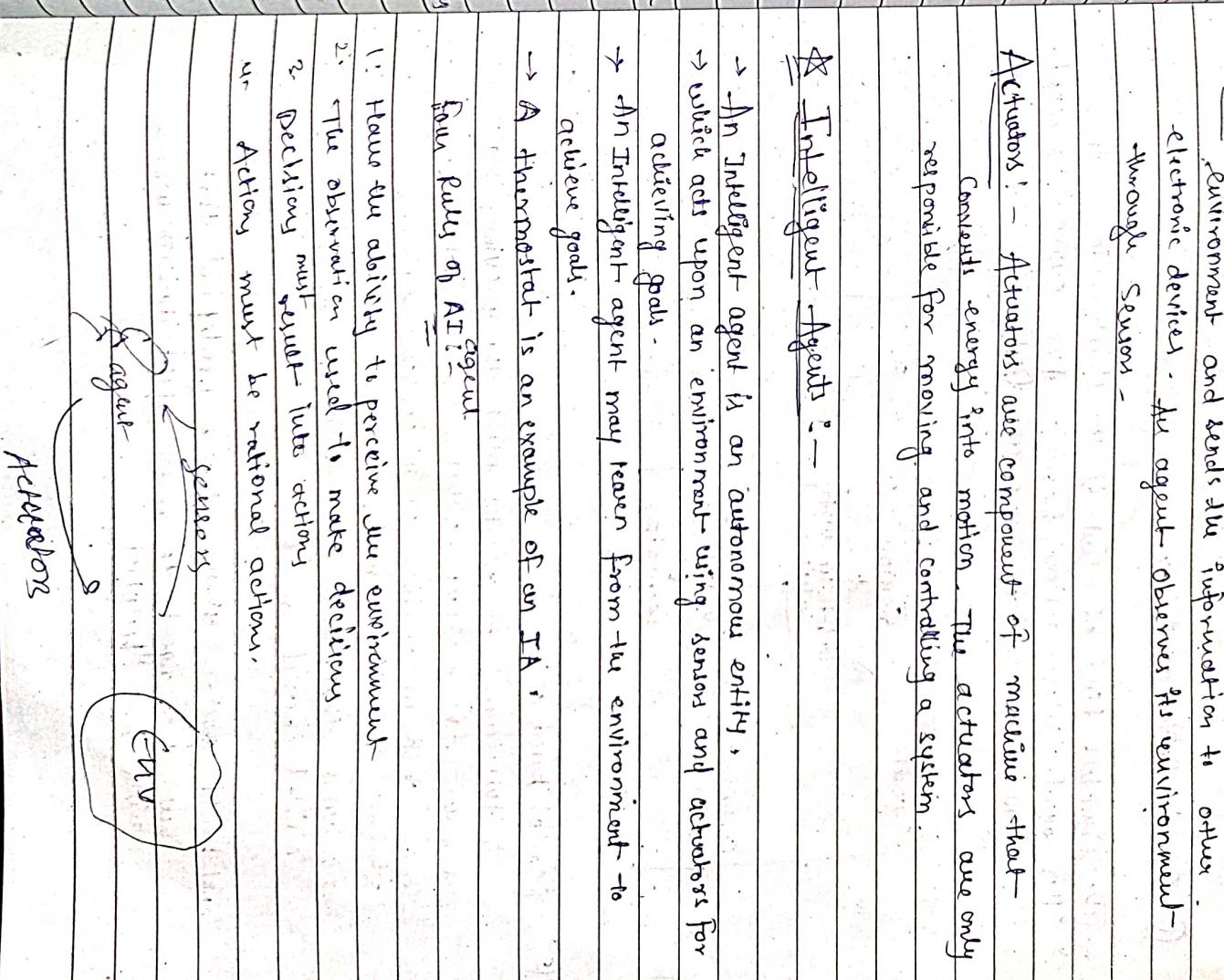
- Software Agent → keystrokes, file contents as sensors

- Display, processing file actuators

### \* Intelligent Agents :-

Actuators :- Actuators are components of machine that responsible for moving and controlling a system.

Sensor → Sensor is a device which detect the change in environment and sends the information to other electronic devices. An agent observes its environment through Sensors -



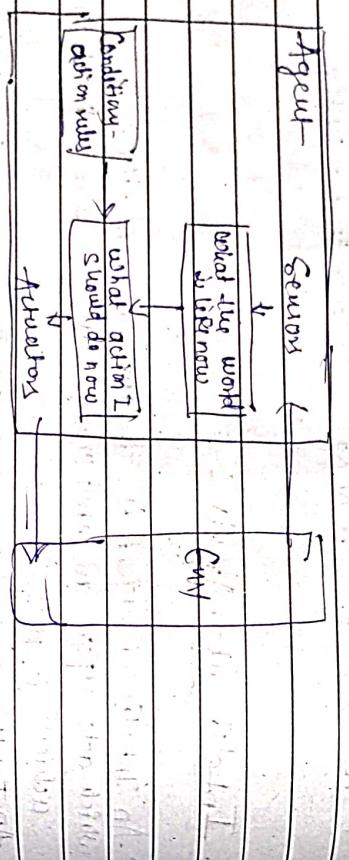
Unit - 2

## Types of agents :-

## Uninformed Search

## Informed searching

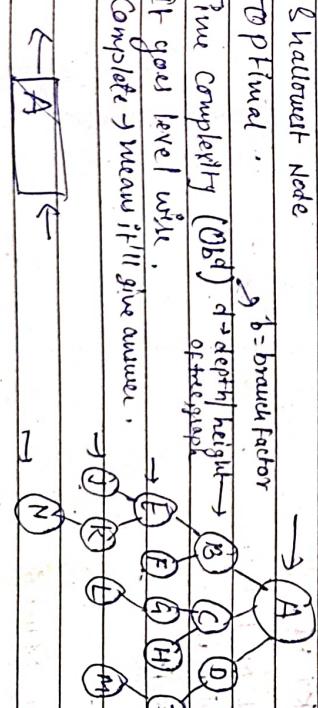
- ① Simple Reflex agent:-  
→ The simplest kind of agent is the simple reflex agent.  
→ These agents select actions based on the current perception ignoring the rest of pre percept history.



BFS (Breadth First Search) :-

→ Uninformed Search technique / blind technique / Brute force method

- Shallowest Node  
 $\rightarrow$  Optimal.       $b$  = branch factor



- Uninformed Search technique / blind technique / Brute Force method

→ FIFO Queue

→ Shallower Node

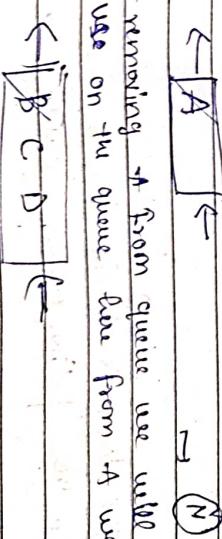
→ Optimal

$b = \text{branch factor}$

→ Time Complexity ( $O(b^d)$ ) → depth / height → A → B, C, D

→ If goal level wise → E, F, G, H, I

→ Complete → means it'll give answer → J, K, L, M, N



- After removing A from queue we will write where A is taking use on-in queue tree from A we can go to B,C,D so

- Figures is called a model.

An agent that uses such model is called a model based agent.

(3) Goal based agent → where goal is predefined that help the agent to make right decision which will be helpful.

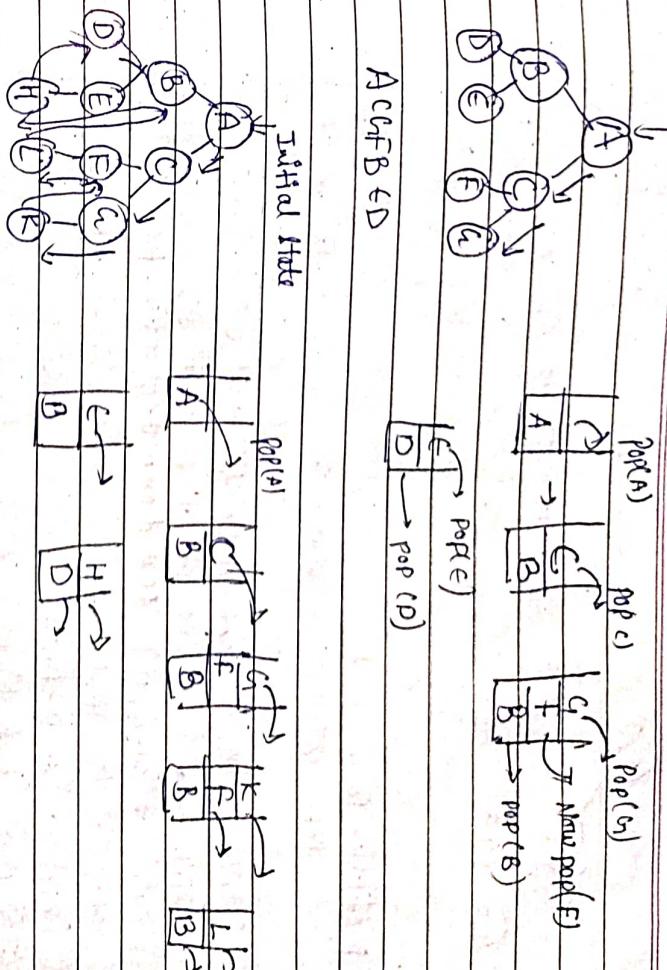
- from the point

Unit - 2

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Start node.

Breadth first search is a simple strategy in which the root node is expanded first, then all the successors of the root node are expanded next, then their



ACCFB

Initial State

101

A.

1

(2)

1

ACCOLFELBEHD

**Production System:** Set the rules in form of  $P \rightarrow Q$ .

= Water jug

If there are 2 jumps without measurement

卷之三

If always expand the deepest node in the current frontier of the search tree it will

Position of the search tree  
Time Complexity =  $O(6^d)$

→ Incomplete  
→ Deepst Node

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8 puzzle problem without Heuristic :-

→ Blind Search (Uninformed)

→ BFS

→ L, moves (up, down, left right)

production form :-

1st    4(2)    3(1)

① (2,1,1) → (4,1,1) completely fill 4 lit jug

② (2,1,1) → (2,1,3) completely fill 3 lit jug

③ (2,1,1) → (2-d, 4) pour d amount of water from 4 lit jug.

④ (2,1,1) → (2,1, y-d)

⑤ (2,1,1) → (4, y-(4-2))

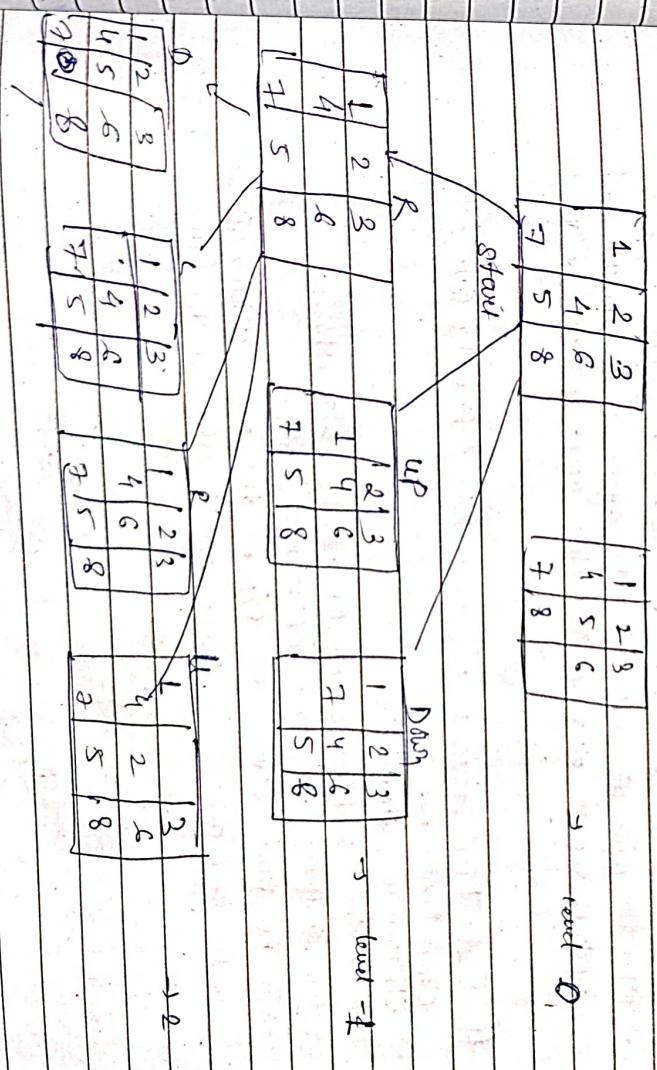
⑥ (2,1,1) → (2-(3-y), 3)

⑦ (2,1,1) → (0,1,y) 2<=0 } for

⑧ (2,1,1) → (2,1,0) y>0 } empty

⑨ (2,1,1) → (2+d, 2, 0) 2+d < 4 } for adding

⑩ (2,1,1) → (0,4+y) . 2+y < 3 } for adding



| No. | 4 lit | 3 lit                   | Rules         | Production |
|-----|-------|-------------------------|---------------|------------|
| 1   | 0     | 0                       | Initial State |            |
| 2   | 0     | 3                       | Rule 2        |            |
| 3   | 3     | 0                       | Rule 9        |            |
| 4   | 3     | 3 <sup>(optional)</sup> | Rule 2        |            |
| 5   | 4     | 2(3-(4-3))              | Rule 5        |            |
| 6   | 0     | 2                       | Rule 7        |            |
| 7   | 2     | 0                       | Rule 9        |            |

## A\* (Heuristic in AI)

- It is a technique designed to solve a problem quickly.
- ⇒ The informed search algorithm is more useful for large search space. Informed search algorithm uses the idea of heuristic, so it is also called heuristic search.
- It is used to find the most promising path.
- Takes the current state of the agent as its input and produce the estimation of how close agent is from the goal.

① Best First Search :> BFS + Priority Queue

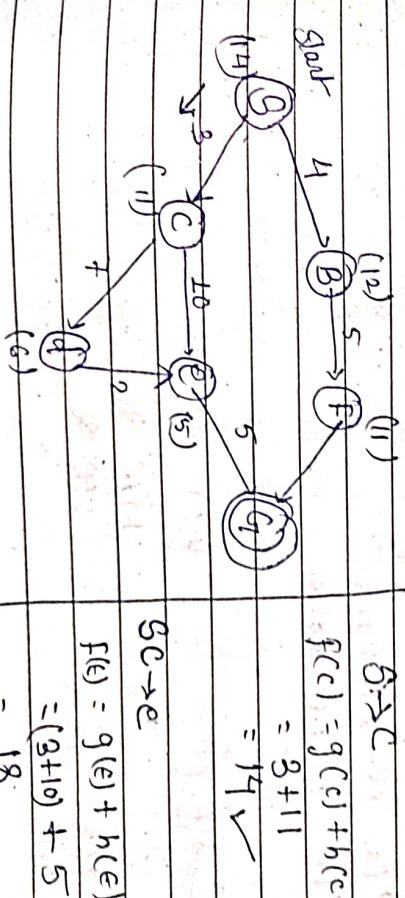
comes under the

→ Informed, Heuristic

→ It is the combination of DFS & BFS algorithms.

→ In Best first search we expand the node which is closest

to the goal node and closest cost is estimated by heuristic function



→ A\* is a admissible algorithm  
(\*\*) → admissible - which means optimal solution will be there

② A\* algorithm of search:

→ Informed searching

→ Based on Heuristic function

$$\begin{aligned}
 f(n) &= g(n) + h(n) \\
 A \rightarrow B \quad &f(n) = g(n) + h(n) \\
 \text{Actual cost from start} &g(n) \\
 \text{Estimation cost from } n \text{ to goal node} &h(n)
 \end{aligned}$$

$$\begin{aligned}
 \text{A* Search} &= S \rightarrow S \\
 S \rightarrow d &f(d) = g(d) + h(d) \\
 f(n) &= g(n) + h(n) \\
 f(d) &= 0 + 14 = 14 \\
 &= 16 \checkmark \\
 f(B) &= g(B) + h(B) \\
 &= 4 + 12 = 16
 \end{aligned}$$

$S \rightarrow D \rightarrow e$

$$f(e) = g(e) + h(e)$$

$$= 12 + 5 = 17$$

$gCDe \rightarrow G_1$

$$f(u) = g(u) + h(u)$$

$$= 17 + 0 = 17$$

$S \rightarrow C \rightarrow D \rightarrow E \rightarrow G_1$

$S \rightarrow A \rightarrow C \rightarrow D \rightarrow E \rightarrow G_1$

Two condition :-

:  $h(n) \geq h^*(n)$  over estimation

$h(n) \leq h^*(n)$  under estimation

( $\rightarrow$ )

$200 \rightarrow A$

$40 \rightarrow f(A)$

$f(A) = g(A) + h(A)$

$200 \rightarrow B$

$50 \rightarrow f(B)$

$f(B) = g(B) + h(B)$

$100 \rightarrow C$

$50 \rightarrow f(C)$

$f(C) = g(C) + h(C)$

$50 \rightarrow D$

$50 \rightarrow f(D)$

$f(D) = g(D) + h(D)$

$50 \rightarrow E$

$50 \rightarrow f(E)$

$f(E) = g(E) + h(E)$

$= 50 + 50 = 100$

(b) For under estimate :-

$$h(A) = 30$$

$$S \rightarrow A \quad f(A) = 200 + 30 = 230$$

$$S \rightarrow B \quad f(B) = 200 + 20 = 220 \quad \checkmark$$

here  $f(B)$  is min

$$S \rightarrow B \rightarrow G_1 \quad f(G_1) = g(G_1) + h(G_1)$$

$$= 200 + 50 = 250 \text{ Ans}$$

(\*) Are admissible in under estimation  
but here  $f(A)$  is min as compared to  $f(G_1)$

Hill climbing search Algo :

↳ Local search Algo, greedy Approach

↳ A variant of Greedy and test

↳ DFS with heuristic

↳ Based on local maxima

↳ No backtracking

Initial State

Evaluate



Local Search

No

Yes

Build/exit

Current state = Initial state

Yes

No

Update

CS = NS

Not

Apply new operator "D" (move)

New state

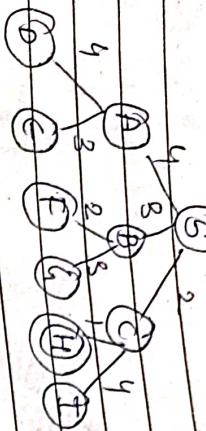
Yes

Exit

No

### [8 puzzle with Heuristic:]

Informed search



Select min value thus is optimal soln.

$G \rightarrow C \rightarrow H$

= min value thus is optimal soln.

first corner = move . . element value  
 middle       $2 \times 4 = 8$

$$\begin{matrix} \text{middle} & 3 \times 4 = 12 \\ \text{corner} & 4 \times 1 = 4 \\ & \underline{\underline{24}} \end{matrix}$$

① Local Maxima

② Plateau/flat maxima

$h$  = No. of mismatched tiles

|   |   |   |                    |
|---|---|---|--------------------|
| 1 | 2 | 3 |                    |
| 4 | 5 | 6 | $\leftarrow h = 3$ |
| 7 | 8 |   |                    |

|   |   |   |                    |
|---|---|---|--------------------|
| 1 | 2 | 3 |                    |
| 4 | 5 | 6 | $\leftarrow h = 3$ |
| 7 | 8 |   |                    |

Step 2

up

down

right

Select min

$h$  in work

$\leftarrow$

Stop

③ Ridge:- Backtracking to above

$h = 4$

D

$h = 4$

2

$h = 2$

1

$h = 1$

0

|   |   |   |  |
|---|---|---|--|
| 1 | 2 | 3 |  |
| 4 | 5 | 6 |  |
| 7 | 8 |   |  |

Select min

$h$  in work

$\leftarrow$

Stop

|   |   |   |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 |   | 8 |

L

|   |   |   |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 |   |

M

|   |   |   |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 |   |

R

|   |   |   |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 |   |

$$h = 1$$

$$h = 1$$

$$h = 0$$

movement = Right - down - Right