

17-Feb-2023

# Artificial Intelligence

## Intelligence :-

They have ability to solve problems -

Creativity -

decision making -

They can perceive the environment -

Learnability -

Memorization -

## Why human being intelligence ?

They have ability to solve problems, creativity, decision making and they can perceive the environment and have ability to learn previous experiences -

## Artificial Intelligence :-

AI means to trying copy and displayed by machines that simulates human and animal intelligence -

## Application :-

1- Siri it is the conservation application which can understand human communication -

2- Chat GPT It take input from human language and you give then proper reply - It provides randomly data -

3- Autonomous vehicles They automatically drive by itself - Simply call & which you can sit - Machine learning process it is -

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#### 4- Robots

just like  
chances

machines. or  
being programs -

#### 5- Google Assistant

just like  
Recommender System

it like Facebook,

Instagram the users provides the

documents and it my its background

algorithms in it - Algorithms of Artificial

Intelligence -

→ These applications are very few and limited -

→ Mimic means to copy -

### Four types to approach AI :-

1) Thinking humanly -

Based on human mind -

2) Thinking Rationally -

Based on logical

reasoning - Rationally means to thinking or reasoning -

Thinking should be well and help to perform anything -

3) Acting humanly -

Copy human being

acting -

4) Acting Rationally -

To achieve a

particular goal -

### Components of AI :-

1) Learning

4) Perception

2) Reasoning

5) Language understanding

3) Problem Solving

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→ Perception means sensing something -

→ Artificial Intelligence is like umbrella term it is the main field and advanced version of artificial intelligence - Deep learning, machine learning, data science, science -

### Machine Learning -

→ Machine learning is the subset of data which you can provide and training also it -

→ Training and Testing are the main two steps of part of machine learning -

### Deep Learning -

→ Deep learning is the subset of machine learning -

### Goals of Artificial Intelligence -

→ Two major goals of AI is ;

1) Performance and Efficiency -

→ Time and memory & space efficiency like -

2) Accuracy -

↓  
less of errors -

least chances of errors -

### Fields of AI -

Machine learning -

Deep learning

Natural language processing -

Computer vision -

(like face detection  
recognition,  
images and feed into  
able systems etc.)

### Types of AI -

There are Type. 1 & 2 -

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Type

1 -

- Narrow (small things, limited scope).-  
(World Artificial intelligence)-
  - General (AGI)
- (Robot)  $\rightarrow$  (It can apply to solve problems) -
- Strong / Super Intelligence -
  - Achieved by Practical -

Type 2 -

- Reactive Machines -
- Limited Memory -
- Theory of Mind -
- Self-aware -

**Reactive Machine :-**

$\rightarrow$  In reactive machines take input and also  
detect or provide output and whatever it  
done - Perform basic operations -

**Limited Memory :-**

$\rightarrow$  To store previous data, predictions  
using to make better -

**Theory of Mind :-**

$\rightarrow$  AI begins to interact with the  
emotions and thoughts of human -

**Self Aware :-**

$\rightarrow$  AI achieved to nirvana -

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# Artificial Intelligence

## Define AI -

### Artificial Intelligence

where Artificial means copy of something natural and intelligence means able to think.

### Artificial Intelligence :-

- It can be defined as a copy of a human brain with thinking ability -
- AI is the science and engineering of making intelligent machines, especially computer programs.
- Basically, it is man-made thinking power -
- John McCarthy is the father of artificial intelligence -
- Examples, Robots.

## Goals of AI :-

- Expert System -
- To Implement Human Intelligence in Machines / Creation -
- Performance and Efficiency -
- Accuracy.

## Contribution of AI :-

- 1) Computer Science -
- 2) Biology -
- 3) Linguistics -
- 4) Math -
- 5) Engineering -
- 6) Psychology -

## Applications of AI :-

- 1) Siri -
- 2) Chat GPT -
- 3) Autonomous Vehicles -
- 4) Robots -
- 5) Google Assistant -
- 6) Recommender System -

## Components of AI :-

- 1) Reasoning -
- 2) Learning -
- 3) Problem & Solution -
- 4) Language Understandability
- 5) Perception -

## Four Types To Approach AI :-

- 1) Thinking humanly -
- 2) Thinking Rationally -
- 3) Acting humanly -
- 4) Acting Rationally

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## Artificial Intelligence

### Advantage & Disadvantage

#### PROS

→ less room for errors

#### CONS

→ High development Cost -

Two factors :-

- Performance
- Accuracy

→ The Turing Test :-

A machine can be described as a thinking machine if it passes the turning Test -

Natural language -

Knowledge representation -

Automated reasoning -

Machine learning -

→ Future Artificial Intelligence :-

Used in other technologies like IoT, Blockchain -  
AI have a very important part for decision making -  
like Robotics, Big Data -

→ ( $(Agents^x)$ ) Problem Solved In AI :-

We have some problems  
and you trying to solve that problems -  
by using artificial intelligence -

→ Steps To Solve Problem By AI :-

To define the problem -

To Analysis the problem -

To Identify multiple solutions -

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To choosing the best solution -

To Implement the problem -

→ Agents and Environment :-

Perceives / observes the environment -

Then Decision making -

Observation by sensing -

Then Decided or observed by Sensors -

Note → Human beings are Agents

Then perform actions by using effectors, (are parts of the body) -

Note → Human beings are natural agents

→ Definition Of Agents :-

Agent can be any machine , device that perceives and take decision by Sensors and then perform any action by effectors .

Example → Vacuum cleaner -

→ Robotic Agent :-

Robot is also an agent -

Cameras and infrared range finders for sensors -

Decision making / taking by programs in that agents

→ Agents are also Architectural process -

Rational Agents -

Particular agent has ability

to solve by taking good / wise decisions -

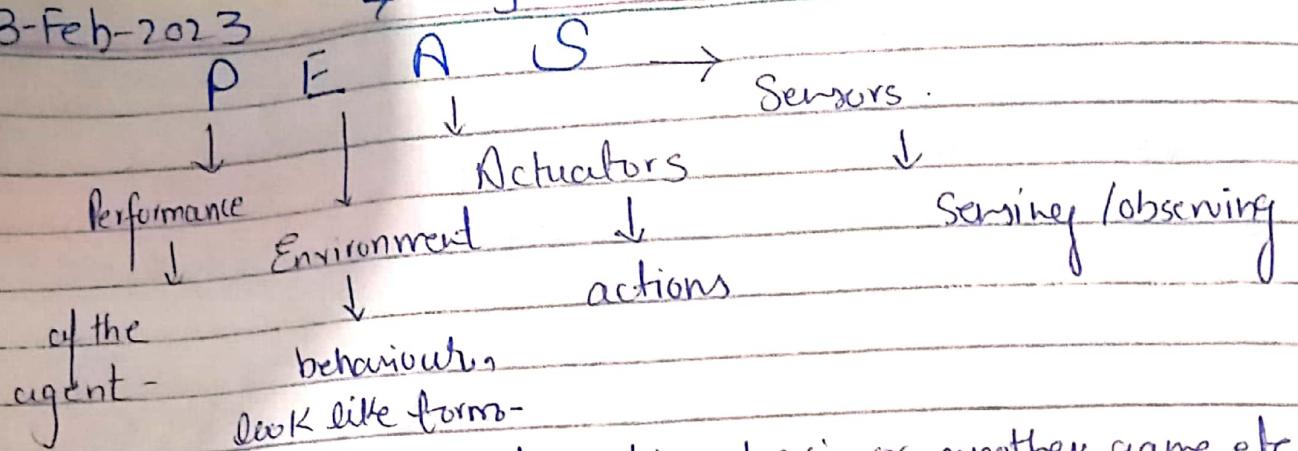
Based on logical and wise decisions -

AI is about building rational agent

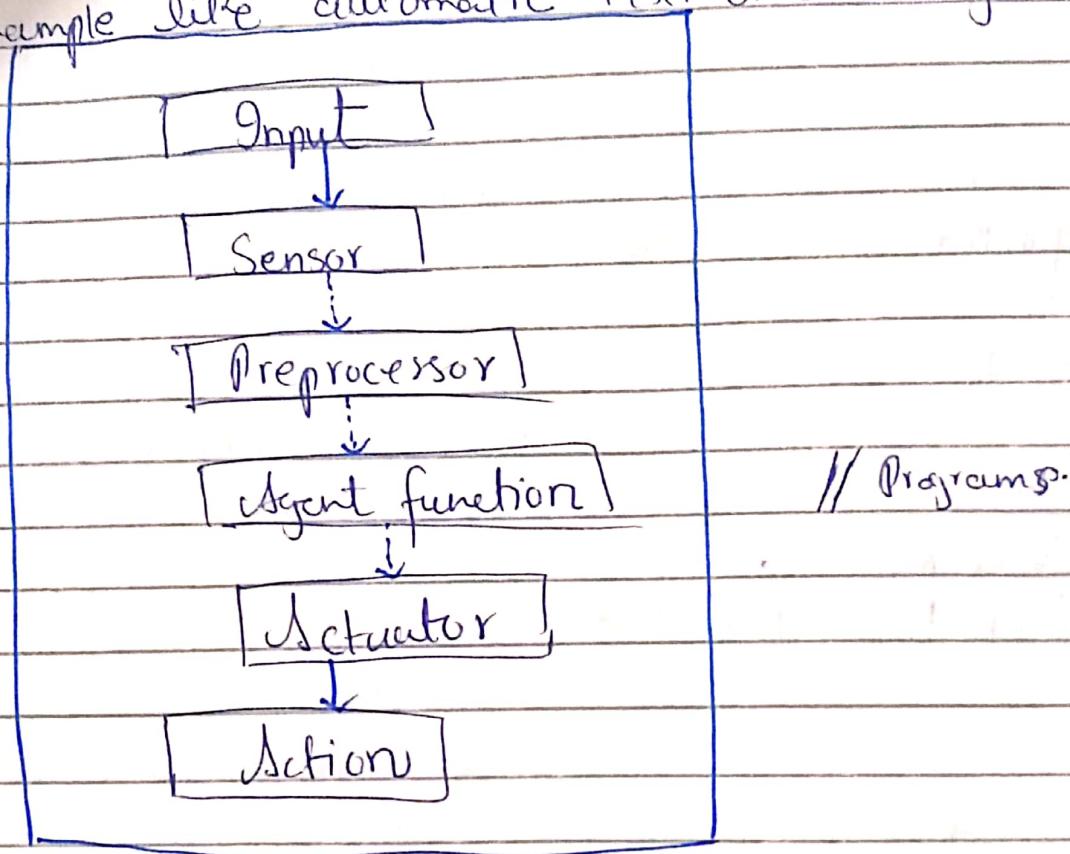
We help the agent to take some wise right decision.

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Agent is a Reas



Example like automatic taxi or another game etc -



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## Artificial Intelligence

### Problem Solving In AI 8-

- Defining the Problem -
- Analysing the problem -
- Identifying the problem -
- Choosing the best solution -
- Implementing the Solution -

### Components to formulate the associated problem 8-

- Initial state -
- Action -
- Transition -
- Goal test -
- Path Costing -

### Measuring Performance In PS 8-

Completeness - (Proper solution give)

Optimality - (Provide only best solution)

Time Complexity - (Limitations, Constraints we have)

Space Complexity - (Evaluate algorithm) -

### Searching 8-

→ Searching is the problem in AI -

→ Data - Driven Search (Initial to goal)

→ Goal - Driven Search (Goal to initial)

### Generate and test Approach 8-

→ Simplest Approach -

→ Also called blind or brute force -

→ We are generating from possible states here -

### Searching

Initial state  $\leftrightarrow$  Goal

By moving intermediate state.

28 - March - 2023 :

Types of Searching :-

→ Uninformed searching  
- Blind, Brute force, & test and generate

Searching :-

→ Informed Searching :-

- We know the initial state  
and goal state - we have  
heuristic search - it is more efficient -

State Space :-

→ State Space means all possible states -

Uninformed Search Strategies :-

- BFS

- DFS

→ Breadth - First Search :-

. Expand shallowest unexpanded node -

. Root node → O

. Level by level nodes over tree -

. Expanded all nodes / level -

. FIFO Queue -

Closed

A

A B C

A B C D

A B C D F

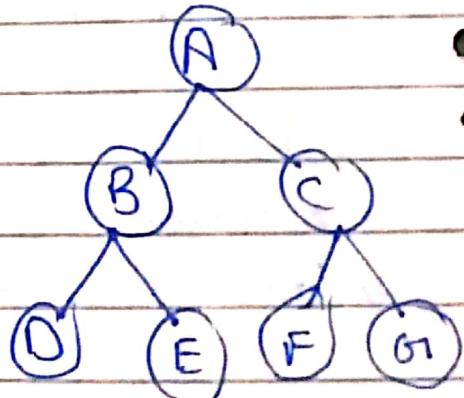
Open

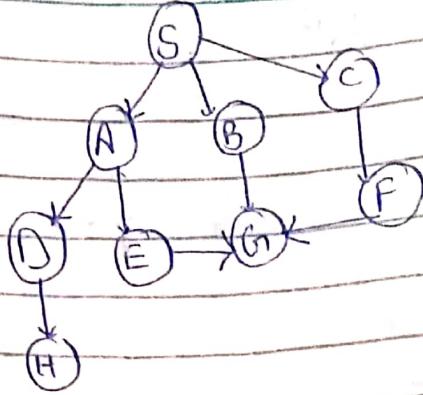
A

B, C

C, D, E

D, E, F, G





closed

S

S, A

S, A, B

S, A, B, C

S, A, B, C, D, E

S, A, B, C, D, E, F

S, A, B, C, D, E, F

open

8

A, B, C

B, C, D, E

C, D, E, G, F

D, E, G, F

E, F, H

F, G, H

G, H

Properties of BFS -

Complete -  $O(b^{d+1})$  depth - branching factor

Time -

$$= \alpha(2^{d+1})$$

Space - keeps every node in memory -

Optimal -

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→ DFS 8-

Depth First Search will be incomplete

Time Complexity 8-

$$\rightarrow O(b^m)$$

Space Complexity 8-

$$\rightarrow O(b^m)$$

↓ branching factor      → Depth

→ DFS is better than BFS -

→ Maximum no. of branching in a tree is called  
Branching factor -

### DFS

→ Two Variants of DFS -

→ DLS - (Depth limited Search)

→ Iterative Deepening -

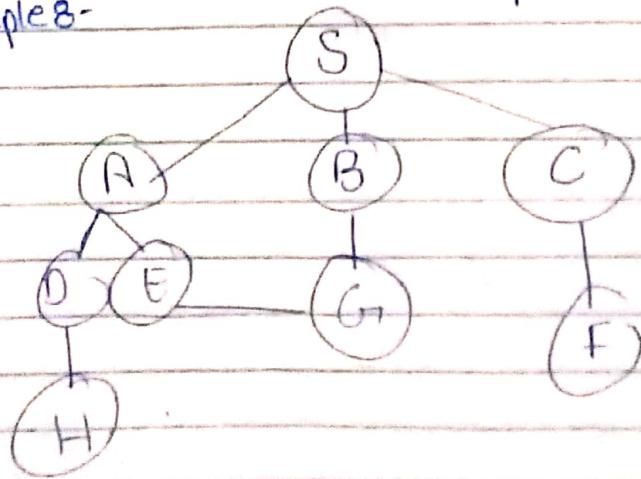
↳ predefined the limit.

↳ you can define the limit -

- if goal is after the limited set then  
list is a disadvantage -

- It cannot check the duplicate nodes -

Example 8-



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Closed

Open

S

A

AB

ABC

ABC,

S,

A

AD,

A B E:

A, DEB

AD E B G

S

A B C

BC

C

A

{ } .

{ } .

{ A B C }

D E B C

E, B C

BC

B C

C

→ Bidirectional Search :-

→ Complete & Optimal - Not, T E, S → Complexity  
 $O(b^{n/2})$  -

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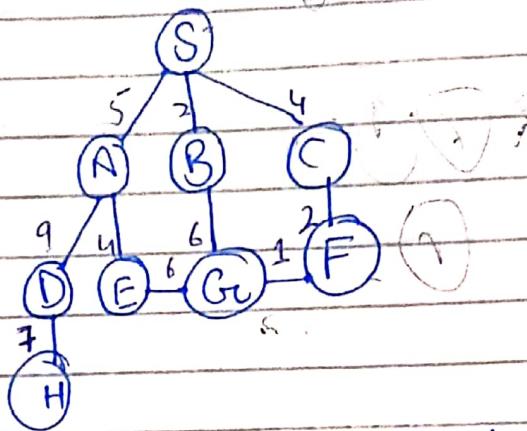
# Artificial Intelligence

## Uniform Cost Search UCS

Implement Queue<sup>8-</sup>

Implementation in ascending order -

- Distances  $g(n)$
- Priority (Queue)



Open

S

B

C, B

C, B, A

F

G<sub>r</sub>

Closed

S

B: 2, C: 4, A: 5.

C: 4, A: 5, G<sub>r</sub>: 8

A: 5, G<sub>r</sub>: 8, F: 6

G<sub>r</sub>: 8, F: 6, D: 4, E: 9

G<sub>r</sub>: 8, E: 9, D: 4

E: 9, D: 4

Open

G<sub>r</sub>

E

D

Closed

E: 9, D: 14

D: 14

H: 21

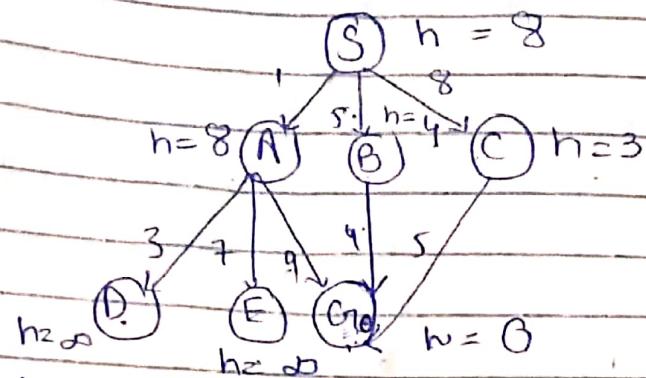
A\* Search 8-

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

Calculate Value of  $f(n)$  when moving from

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1 node to another -



Closed

S  
A  
B

Open

S

A: 9, B: 9, C: 11, D: ∞, E: ∞

B: 9, G: 10, D: ∞, E: ∞

G: 9, C: 11, D: ∞, E: ∞

G: 9, C: 11, D: ∞, E: ∞

A.	B: 9, G: 10, C: 11, D: ∞, E: ∞
B.	G: 9, C: 11, D: ∞, E: ∞
G.	C: 11, D: ∞, E: ∞

$$f(n) = 1 + 8 = 9$$

$$f(n) = 9 + 6 = 9$$

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## Artificial Intelligence.

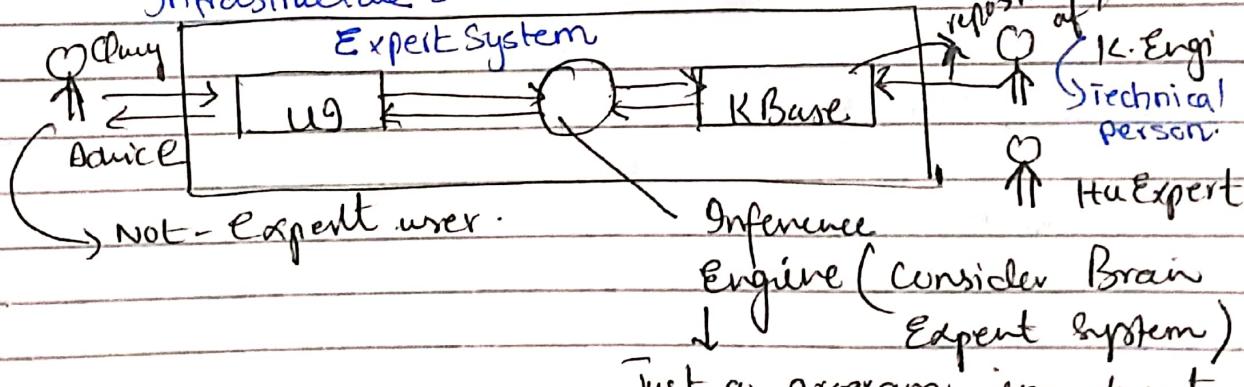
### Bidirectional Search :-

- Time and space Complexity is reduced by its factors -  $O(b^{d/2})$
- Two way (two directional) -

### Expert System :-

- It can be a System, Tool, application and software that provide advice to human or human being -
- Provide Expert System or opinions and recommendation to human being -
- Example spell checker, grammar etc -  
↳ Medical Diagnostic System etc -

### Infrastructure :-



Components :- (Molecules) and in between it is knowledge.

- Knowledge Base -
- Inference Engine -
  - (- Redundancy means repetition)
- User Interface -

Concepts & Characteristics of Expert Systems -

- K. Acquisition - , K. - Representation
- Inference - ? - Explanation

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## Strategies of Inference Engine 8-

- Forward chaining -
- Backward chaining -

### Forward Chaining 8 -

- It takes input and provides output - / To answer the question of ex. System -
- Example - Medical Diagnostic etc -

### Backward chaining 8 -

- Already know the output and diminishes -
- Opposite to rest forward chaining -
- Trying to identify cause if you know the solution its backward -

## Characteristics of Expert System

- High Performance -
- Understandable -
- Reliable - ( Error free ) .
- High responsive - ( System take time to give output )

→ ( clear the problem and find the solution then for expert system - )

## Hill Climbing Search

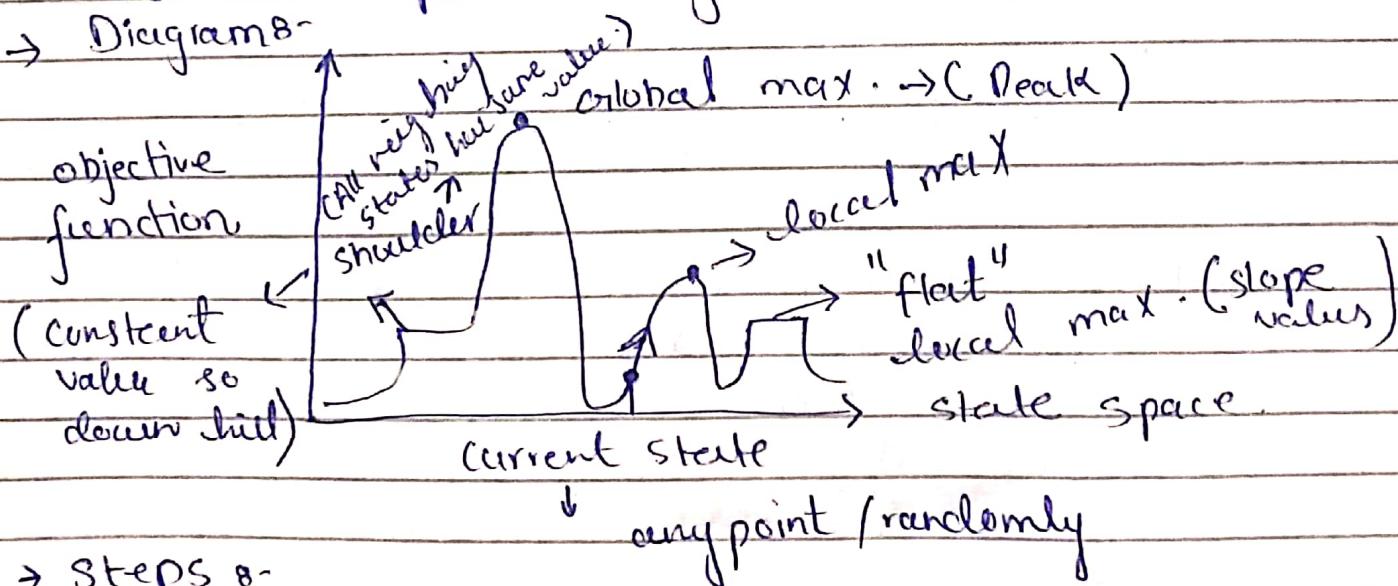
→ Features :-

- Local Search algorithm - (local & global information)
- Greedy algorithm - (find better point to current then move it)
- No backtracking - (once move so can't back)
- Croal driven Search - (provide solution and find path) -

→ Explanation :-

- Hill climbing Search is a local Search algorithm
- To find peak of the mountain or best solution to the problem -
- Optimizing the mathematical problems -
- Node of HC has two components state/ value -
- We don't need to search tree or graph -
- It keeps a single current state -

→ Diagram :-



→ Steps :-

- Select random state.
- Compare with goal state.
- If is goal so return solution.
- Not so compare N.S.
- N.S. create C.S.
- No better then move N.S.
- Exist.

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(online class)

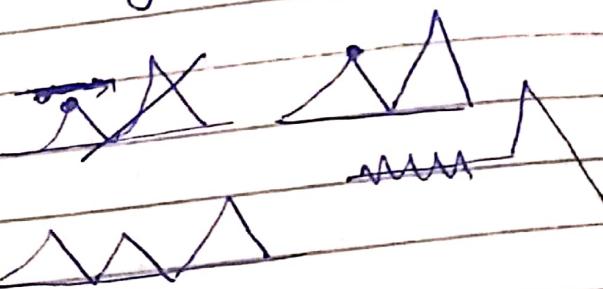
- Regions in the state Space Landscape :-
- Local Max - (Better than NS)
  - Global Max - (H.V, Best possible state).
  - Current State - (Currently agent present).
  - Flat local Max -
  - Shoulder -

→ Types :-

- Simple hill climbing -
- Steepest-Ascent Hill climbing -
- Stochastic Hill climbing -

→ Problems In Hill Climbing :-

- Local Maximum -
- Plateau -
- Ridges -

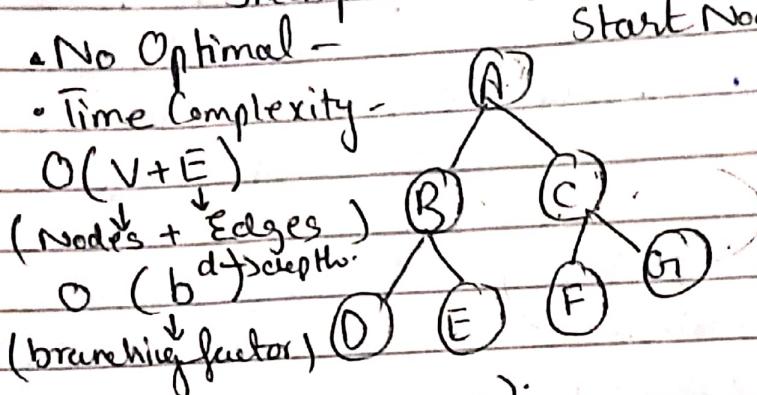


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## Artificial Intelligence

### Quiz Preparation DFS (Depth First Search)

- Uninformed Search technique - (Presently)
- Stack (LIFO) - (data structure)
- Deepest Node - (leaf then backtrack).
- Incomplete. (more infinite no give may solution).
- No Optimal -
- Time Complexity -  
 $O(V+E)$   
(Nodes + Edges)
- Space Complexity  
 $O(b^d)$  (depth)  
 $O(b)$  (branching factor)

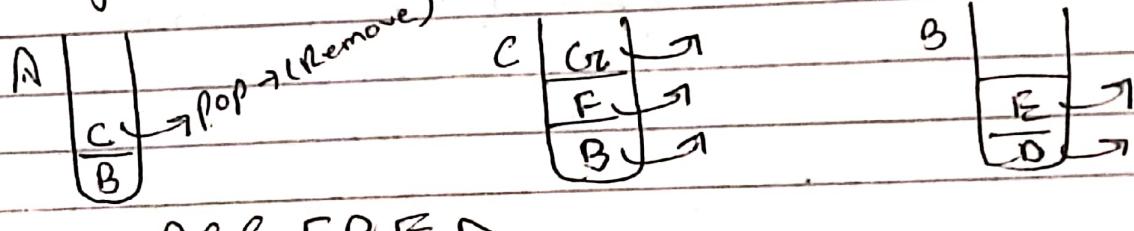


Space Complexity

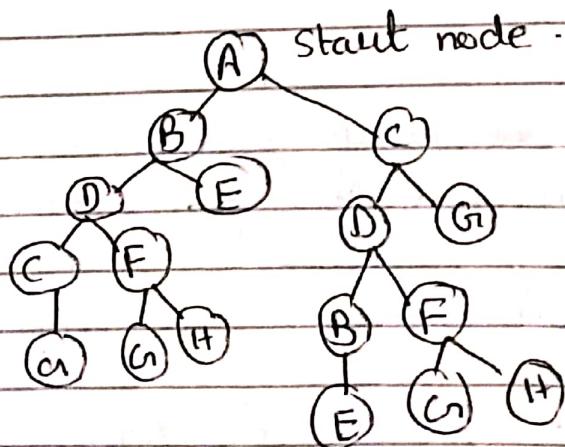
$$= O(bm),$$

$$\approx O(bd).$$

- Recursive Algorithm.
- (null means stop)



→ ACGBFED



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AI.

A\* Algorithm / Search.

- Informed technique.

- Used equation  $f(N) = g(N) + h(N)$ .

(Cost find)

↓

w.

↓

(Actual list)

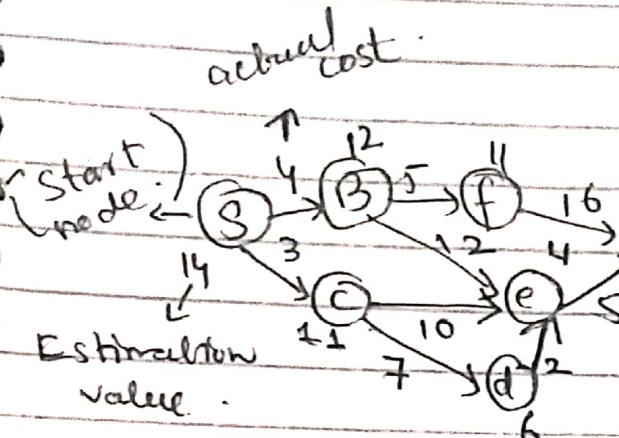
↓

from start node to  
n )

(Estimation

↓

cost from n  
to goal node)



$$\text{Find } f(S) = ?$$

$$f(S) = 0 + 14 = 14.$$

$S \rightarrow B$

$$f(S) = 4 + 12 = 16.$$

$S \rightarrow C$ .

$$f(S) = 3 + 11 = 14.$$

↓ min value  
next

$SC \rightarrow e$

$$f(SC) = 3 + 10 + 4 = 17.$$

$SC \rightarrow d$ .

$$f(SC) = 7 + 3 + 6 = 16.$$

save value

explore them

$SB \rightarrow f$

$$f(SB) = 5 + 4 + 11 = 20.$$

$SB \rightarrow e$ .

$$f(SB) = 4 + 12 + 4 = 20.$$

✓

$Scd \rightarrow e$

$$f(Scd) = 3 + 7 + 2 + 4 = 16.$$

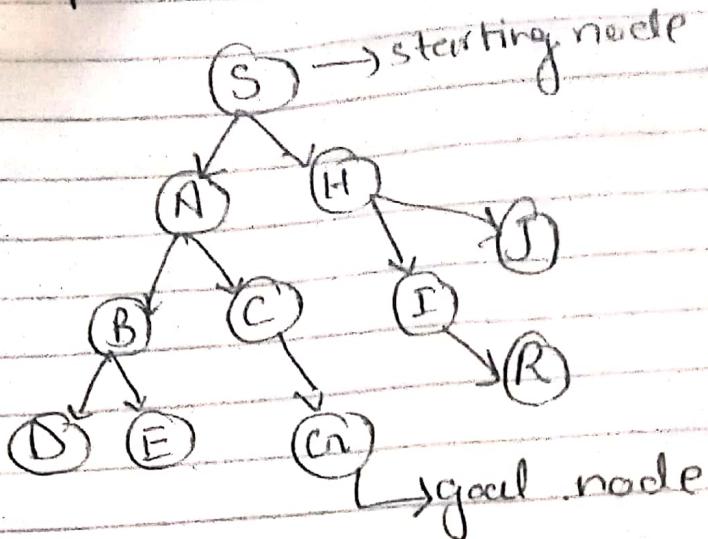
seed

$Scde \rightarrow G$ .

$$f(Scde) = 12 + 5 + 0 = 17 \quad \text{proper answer}$$

## Example DFS

1)



close

S  
SAB  
SABD  
SABDE  
SABDEC  
SABDEC C G

open

S  
~~A, B, C~~  
A, H  
B, C, H  
~~D, E, C, H~~  
E, C, H  
R, H  
G, H  
H

↓ final answer

## a) Example DLS

close

S

A

B

C

S

A

D

Open

S

ABC

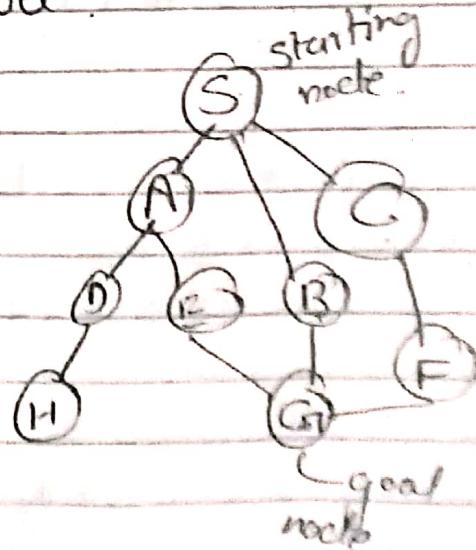
BC

G

{ ABC }

DE BC

E BC



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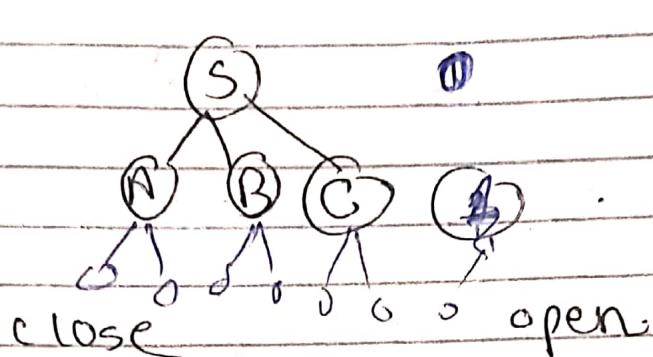
E  
B  
B C

B C  
C C  
C

→ not goal.



[ S | B | C ] Final Answer.



S

S A

S A B

S A B C

\$

A B C

S C

{ 0 }