UNIT-1

→ What is AI?

1] Thinking humanly
2] Acting humanly
3] Acting rationally
4] Thinking rationally

→ Questions:

1] What is artificial intelligence?
2] What are the different types of AI?
3] What are the different applications of AI?
4] What is machine learning?
5] What are the different types of ML?

→ What is Machine Learning?

Machine Learning is a class of algorithms which is data-driven, i.e. unlike 'normal' algorithms it is the data that 'tells' what the 'good answer' is.

UNIT-2
INTELLIGENT AGENTS

→ Agents
An agent is anything that can be viewed as
- perceiving its environment through sensors and
- acting upon the environment through actuators.
- Assumption: Every agent can percieve its own actions (but not always the effects)

→ Types of Agents
1] Human Agents:
- eyes, ears and other organs for sensors
- hands, legs, mouth and other parts for actuators.

2] Robotic Agents:
- motors, cameras, infrared range finders for sensors.
-

3]
-
-

→ Agents and environments
* PEAS: Performance, Environment, Actuator, Sensors

1] PEAS Properties of a Medical Diagnosis System
1] Performance: Accurate, Precise, Matching symptons to the respective device correctly.
2] Environment: Patients, Doctor, Hospital, Clinics.
3] Actuators:
4] Sensors: Camera, Thermometer, Oxymeter, BP

2] PEAS Properties of a robotic pizza delivery agent

1] Performance: Maintain hygiene, Speed, Punctual
2] Environment: Roads, Customers, Pizza place staff,
3] Actuators: Accelerator, Brake, Signal, Horn, Steering whe
4] Sensors: Cameras, sonar, speedometer, GPS, odometer, engine sensors, Keyboard.

3] PEAS Properties of Satellite Image Analysis System

1] Performance: correct image categorization
2] Environment: downlink from orbiting satellite
3] Actuators: Display categorization of scene
4] Sensors: Color pixel arrays.

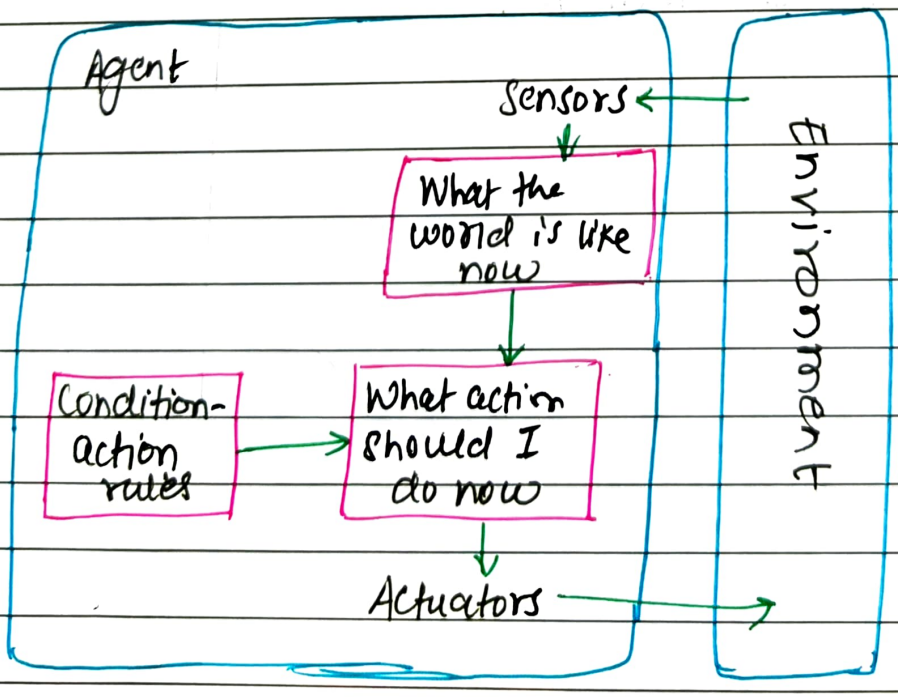
→ Environment Types

1] Fully observable vs. partially observable
2] Deterministic vs. stochastic
3] Episodic vs. sequential
4] Static vs. Dynamic
5] Discrete vs. Continuous
6] Single agent vs. multiagent

Task Environment	Observable	Deterministic	Episodic	Static	Discrete	Agent
Crossword Puzzle	Fully	Deterministic	Sequential	Static	Discrete	Single
Chess with a clock	Fully	Strategic	Sequential	Semi	Discrete	Multi
Poker	Partially	Stochastic	Sequential	Static	Discrete	Multi
Backgammon	Fully	Stochastic	Sequential	Static	Discrete	Multi
Taxi driving	Partially	Stochastic	Sequential	Dynamic	Continuous	Multi
Medical Diagnosis	Partially	Stochastic	Sequential	Dynamic	Continuous	Single
Image Analysis	Fully	Deterministic	Episodic	Semi	Continuous	Single
Part picking robot	Partially	Stochastic	Episodic	Dynamic	Continuous	Single
Refinery controller	Partially	Stochastic	Sequential	Dynamic	Continuous	Single
Interactive English Tutor	Partially	Stochastic	Sequential	Dynamic	Discrete	Multi

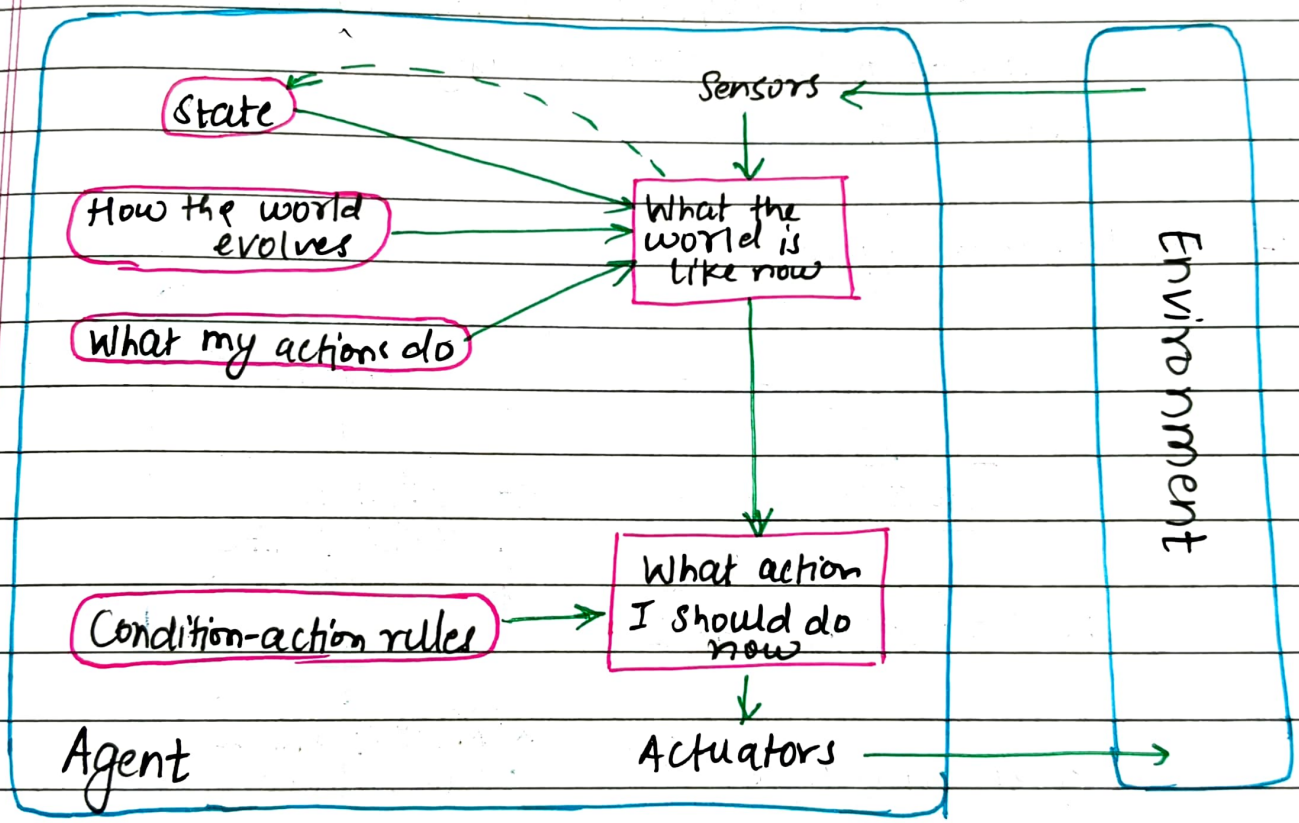
→ Types of Agents

1] Simple Reflex Agents



function SIMPLE-REFLEX-AGENT (percept) returns an action
  static: rules, a set if condition-action rules
  State ← INTERPRET INPUT (percept)
  rule ← RULE MATCH (State, rules)
  action ← RULE_ACTION [rule]
  return action.

2] Model-based reflex agents



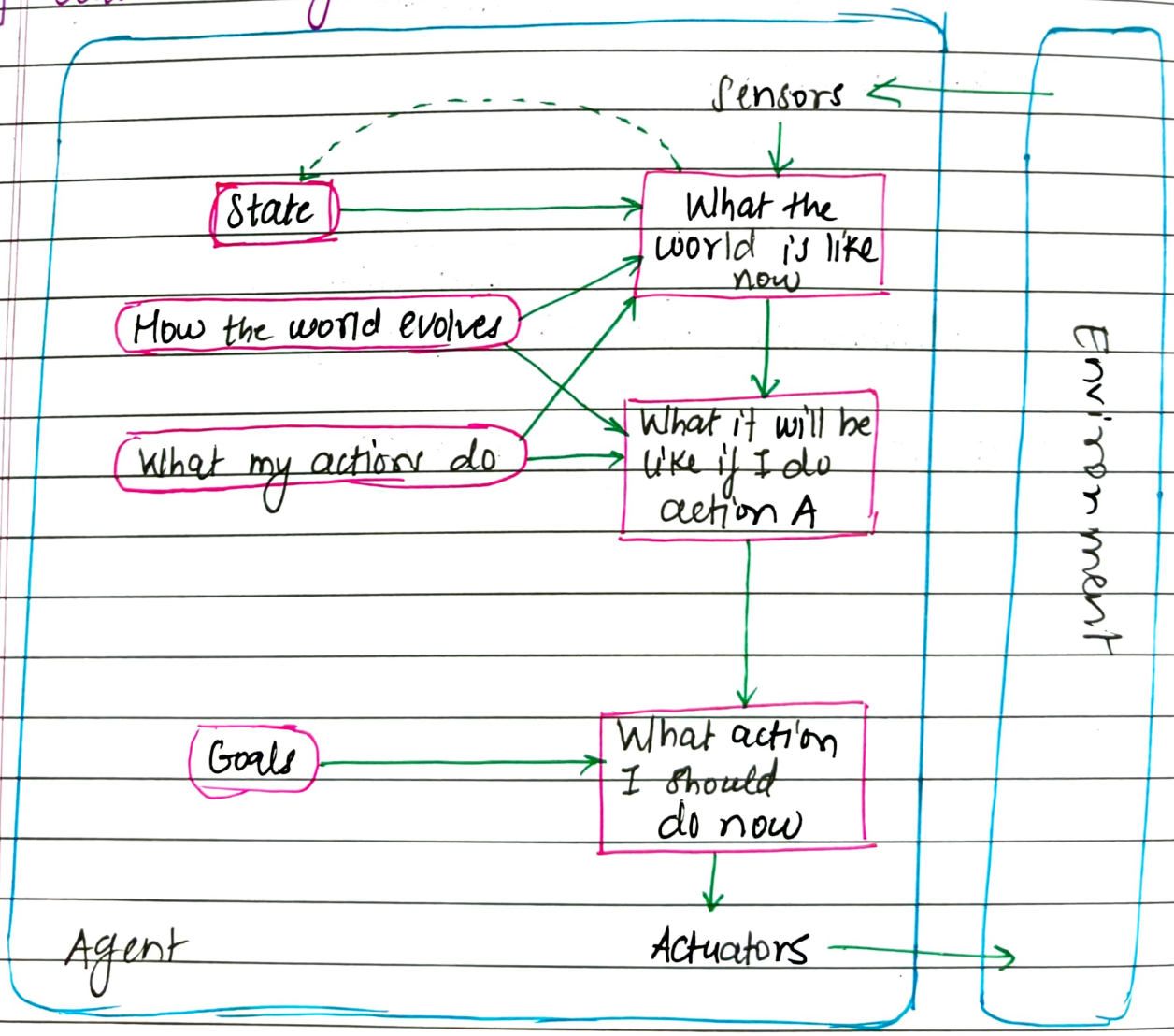
3] Model-based reflex agents

function REFLEX-AGENT-WITH-STATE (percept) returns an action

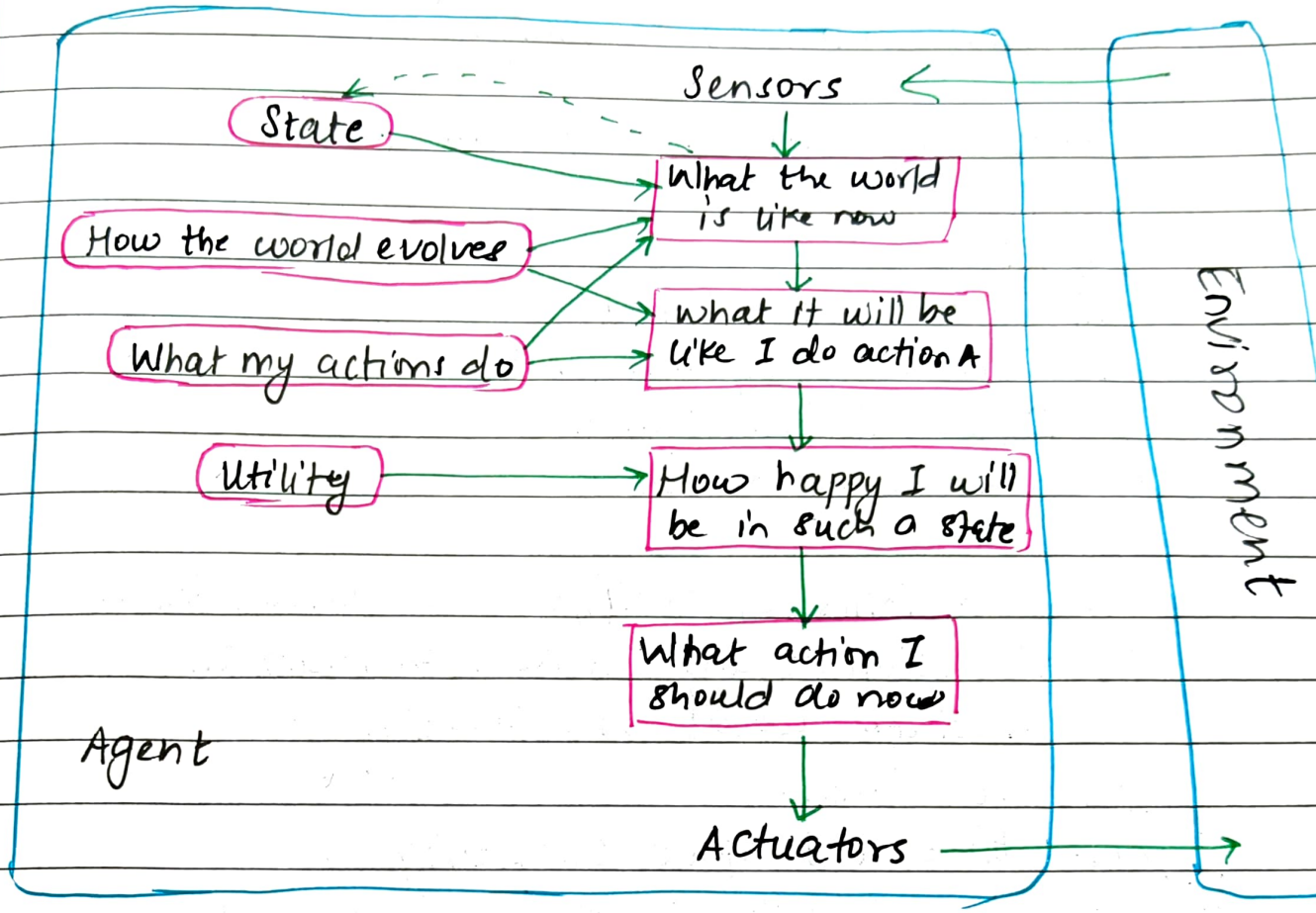
static: state, a description of the current world state
rules, a set of condition-action rules
action, the most recent action, initially none.

state ← UPDATE_INPUT (state, action, percept)
rule ← RULE_MATCH (state, rules)
action ← RULE_ACTION [rule]
return action.

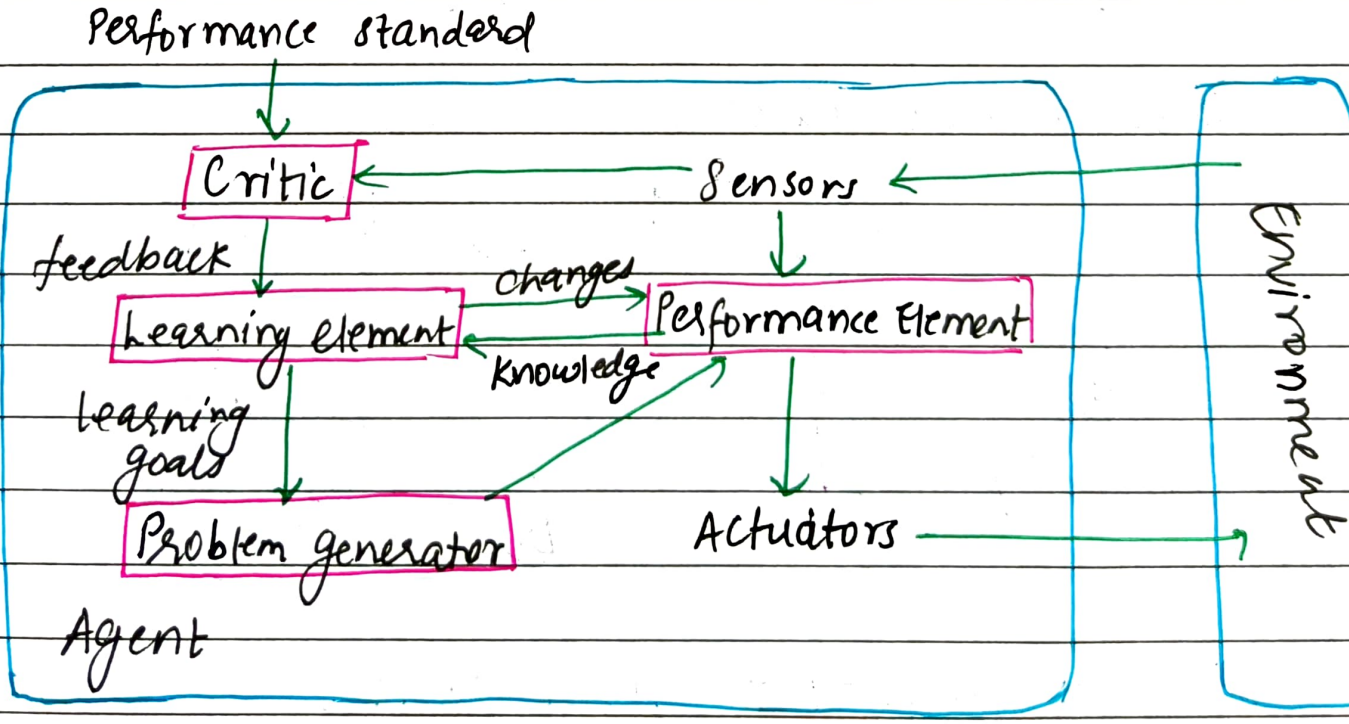
4] Goal-based agent



5] Utility-based agents



6] Learning Agents



UNIT-2

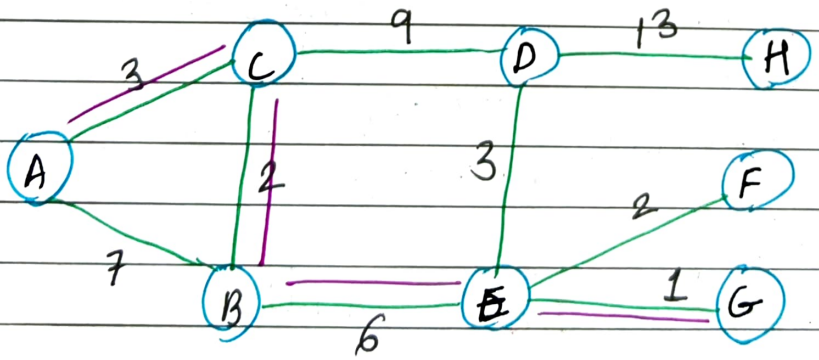
SEARCHING TECHNIQUES

There are two types of searching:
1] Uninformed searching techniques
2] Informed searching techniques.

There are different algorithms in uninformed search:
(i) DFS
(ii) BFS
(iii) Uniform Cost Search
(iv) Iterative deepening DFS
(v) Depth Limited Search
(vi) Bidirectional search

Characteristics of uninformed search techniques:
1] Search without any extra information.
2] No knowledge about the solution.
3] Time consuming
4] More time and space complexity.
5] Ensures optimality in terms solution but do not guarantee reasonable amount of time and space complexity.

DFS



~~ABCDHEFG~~ ABEFGDHC
~~ABCEDFGH~~

Uniform Cost Search

A: source

G: goal.

(same graph as before).

3+2+6+1 = 12

A: source

H: goal

A → C → B → E → D → H

Characteristics of uniform cost search:

1] Used for weighted tree or graph traversal.
2] Goal is to find path from source to goal node with lowest cumulative cost.
3] Node expansion is based on path cost.
4] Priority queue is used for Implementation.

Advantages of uniform cost search:

1] It can give optimal solution.

Disadvantages of uniform cost search:

1] It does not guarantee optimal solution within reasonable time.
2] It can get stuck in an infinite loop.

Informed Search

A* Search

orm Cost Search

: source

: goal.

same graph as before).

3+2+6+1 = 12

: source

: goal

→C→ B→E→D→H

aeteristics of uniform cost search:

for weighted tree or graph traversal.

is to find path from source to goal node

lowest cumulative cost.

e expansion is based on path cost.

rity queue is used for Implementation.

antages of uniform cost search:

can give optimal solution.

dvantages of uniform cost search:

does not guarantee optimal solution within

sonable time.

can get stuck in an infinite loop.

rmed Search

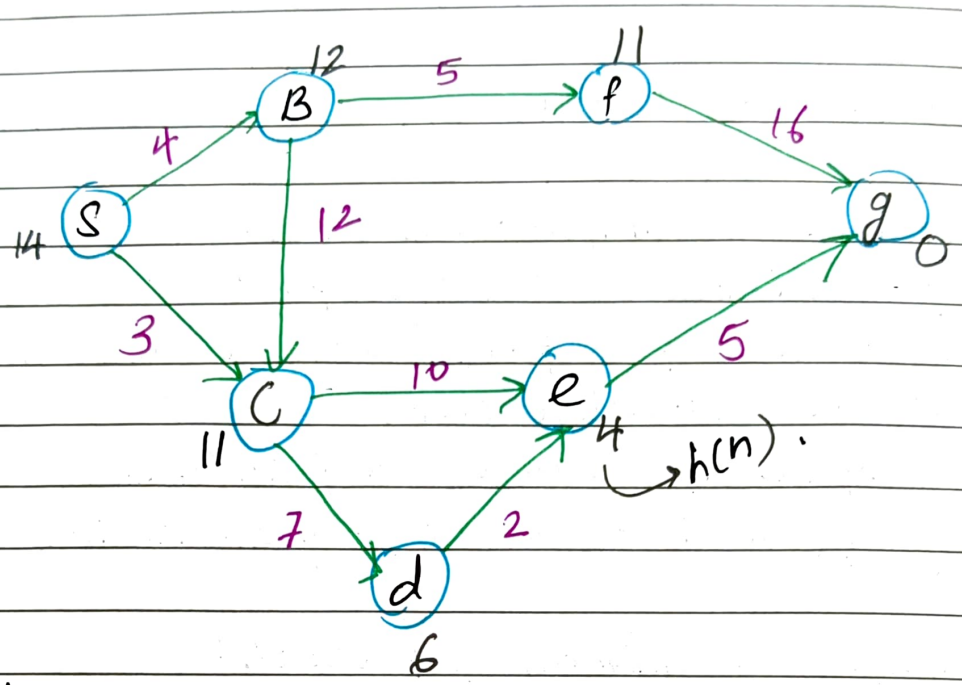
Search

A* search will follow the equation below:

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

- $g(n)$ ↓ : path cost from source to n
- $h(n)$ ↓ : Estimated cost from n to Goal.

2]



A* search → will definitely come in the exam.

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

- $g(n)$ ↓ : Actual path cost from source to n
- $h(n)$ ↳ : Estimated path cost from n to Goal.

h(n) is called Heuristic function.

Heuristic → some extra information about the problem.

Node	h(n)
S	14
B	12
C	11
D	6
E	4
F	11
G	0

$S \rightarrow C \rightarrow d \rightarrow e \rightarrow g$

Path cost = 3 + 7 + 2 + 5 = 17

→ Greedy Best First Search

$f(n) = \cancel{g(n)}.\ h(n)$.

[Refer the same graph].

From S to G find out the shortest path using Greedy Best First search.

$S \rightarrow C \rightarrow e \rightarrow g$.

$3 + 10 + 5 = 18$.

Solve 8 tiles / 8 puzzle problem using GBFS & A* Sea

1	2	3
	4	6
7	5	8

Start State

1	2	3
4	5	6
7	8	

Goal State

Step 1: There can be three states.

1	2	3
4		6
7	5	8

$h(n) = 2$ ✓

1	2	3
7	4	6
	5	8

$h(n) = 4$ ✗

	2	3
1	4	6
7	5	8

$h(n) = 4$. ✗

* We find the Heuristic value ($h(n)$) by finding out how many tiles (digits) are different from the goal state.

Step 2: There can be four states.

1		3
4	2	6
7	5	8

$h(n) = 4$ ✗

1	2	3
4	5	6
7		8

$h(n) = 2$ ✓

1	2	3
	4	6
7	5	8

$h(n) = 4$ ✗

1	2	3
4	6	
7	5	8

$h(n) = 4$ ✗

Step 3: 3 states

1	2	3
4		6
7	5	8

$h(n) = 3$. ✗

1	2	3
4	5	6
	7	8

$h(n) = 2$ ✗

1	2	3
4	5	6
7	8	

$h(n) = 0$. ✓

For GBFS, when $h(n) = 0$, we find the goal state. However in A* $h(n)$ can never be zero for 8 tiles problem.

$h(n)$ → Manhattan Distance

Consider the previous example to calculate the number of moves.

Step 1:

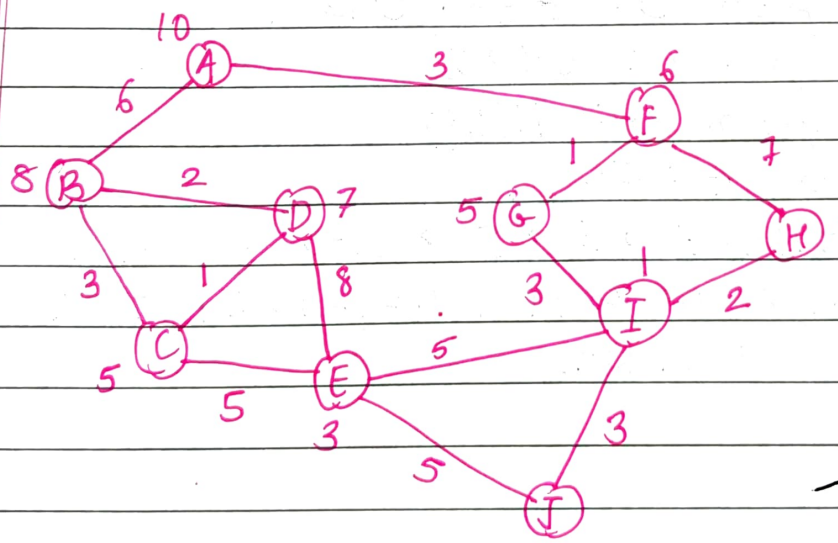
1	2	3
4		6
7	5	8

0 → already in place.
n → no. of moves required to move to the final place.

$h(n) = 0+0+0+0+1+0+0+1 = 2.$

* Heuristic value only calculates the no. of misplaced tiles and ~~Manhattan~~ Heuristic value for Manhattan distances calculates the no. of moves required.

1] Find out the path cost using A^* search.



* for directed graph, take source as the node that has no incoming edge.
- Write detailed steps in exam not just the path
- Goal node is the node with 0 Heuristic value.

A → F → G → I → J

Path cost = 3+1+3+3 = 10.

* for undirected graph, if no start is given then take the first node as start node or takes.

2] Solve Travelling Salesman Problem using Greedy Best First Search. consider the following distance matrix of the cities and the distances between them.

City	A	B	C	D	E	F	G	H
A	0	20	42	35	30	25	44	50
B	20	0	30	34	25	20	37	40
C	42	30	0	12	18	30	25	26
D	35	34	12	0	14	15	24	18
E	30	25	18	14	0	10	20	22
F	25	20	30	15	10	0	18	21
G	44	37	25	24	20	18	0	15
H	50	40	26	18	22	21	15	0

Nearest ~~from~~ unvisited city from A : B(20)
Nearest from B : F (20)
Nearest ~~from~~ ~~C~~ : ~~D(12)~~
Nearest from F : E(10)
Nearest from E : ~~C(18)~~ D(14)
Nearest from D : ~~C(12)~~ C(12).
Nearest from C : G(25)
Nearest from G : H(15)
Return to A : 50

Path : A → B → F → E → D → C → G → H → A
Total cost = 20+20+10+14+12+25+15+50
= 166 km.

3] Initial state:

1	2	3
5	6	
7	8	4

Goal state:

1	2	3
5	8	6
	7	4

Step 1: 2 states:

1	2	
5	6	3
7	8	4

h(n) = 5 ✗

1	2	3
5		6
7	8	4

h(n) = 3 ✗

1	2	3
5	8	6
7		4

h(n) = 1 ✓

Step 2: Two states

1	2	3
5	8	6
7	4	

h(n) = 1 ✗

1	2	3
5	8	6
	7	4

h(n) = 0 ✓