

Artificial Intelligence

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DATE :

Chapter 1. Introduction (6-7 marks)

Intelligent

- A - Problem solving
- B - Learning.

Date Event

1822 - First difference engine designed by Charles Babbage when he proposed an idea for programmable computer.

1840 - Ada Lovelace, first programmer who wrote the first algorithm intended to be processed by a machine to generate music.

1943-1946 - First electronic computer idea ^{enric} was developed

1956 - It is supposed to be the birth of AI. Dartmouth conference was held and many logics, theories were developed.

1958 - LISP programming software was developed by John McCarthy

1963 - Marvin & John McCarthy developed AI lab in MIT.

1972 - Prolog was developed.

1990 - AI System beats human chess master.

1994 - Twin & robot cars : Vamp & Vitaz designed by Ernest Dickmann & Daimler Benz drove more than one thousand kilometer on a Paris free three lane highway on normal traffic on speed upto 180 km/hr

1999 - Sony introduced AIBO, dog like creature playing football.

2006 - Second conference of AI was held where features of AI was discussed.

2013 - Kirovo space robot was sent to space to fetch data and send back to earth.

2015 - Sophia was designed which can express more than 50 expression and has citizenship of Saudi Arabia.

Definition of AI:

AI is the science of making a machine think & act like an intelligent person who ensures that the actions & thinking in machine should be rational.

AI can be defined in term of different categories.

① Acting like human

This approach is also called Turing test approach

which is not interested with how you got the result but interested with similarities to what human behaviours are. Turing test measures the performance of intelligent machine against that of human being. Factors required to pass the Turing test are:

i) Natural language processing (NLP):

- To make communication easier

ii) Knowledge representation

- To store information

iii) Machine learning

- To adapt with new circumstances

Alan Turing:

"I believe that in about fifty years time, it will be possible to program computer with a storage capacity of 10^9 bits to make them play the imitation game so well that an average interrogator will not have 70% chance of making the right identification after five minutes of questioning."

Limitation of Turing test:

Turing test fails to account for the difficulty in articulating conscious awareness. For example:

- How do you know how to move your arm?
- How do you choose which word to say?
- How do you recognise what you see?
- How do you locate your memory?
- How do you make Generalisation?

② Thinking like human:

This approach is also called cognitive based approach which focus not only on just on behavior but also look at reasoning process. This approach needs to understand how human thinks.

Different ways to determine how human beings think are:

- Inspection, experience, current perception.

E.g: General problem solver

③ Thinking like rational agent:

It is also known as law of thought.

A system is said to be rational if it does the right thing for which it knows. It tries to modify on the basis of given premises driving to the result as a right think.

④ Acting like rational agent:

It is also known as rational agent approach.

Rational agent acts to achieve the best output when there is uncertainty. Rational agent is more general than law of thought approach which emphasis on current inference.

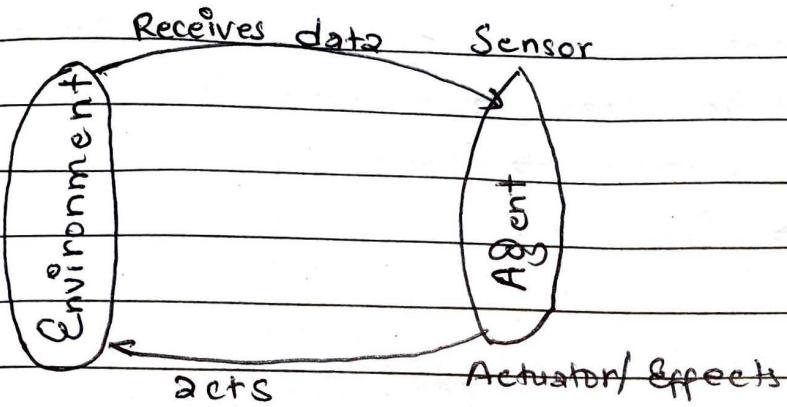


Fig: Simplified version of AI

Environment:

a) Discrete / Continuous

Agent:

An agent perceives data from the environment with the help of sensor. Mapping is done with the agent by writing certain program. Finally, the actuator acts upon the environment.

Environment

a) Discrete / Continuous

If there are limited number of distinct, clearly defined state of the environment, then the environment is discrete else continuous.

E.g: Chess → Discrete

Driving car → Continuous.

- (b) Static / Dynamic
If the environment does not change while an agent is active then it is static else dynamic.
e.g.: Crossword puzzle → Static
Chess → Dynamic.

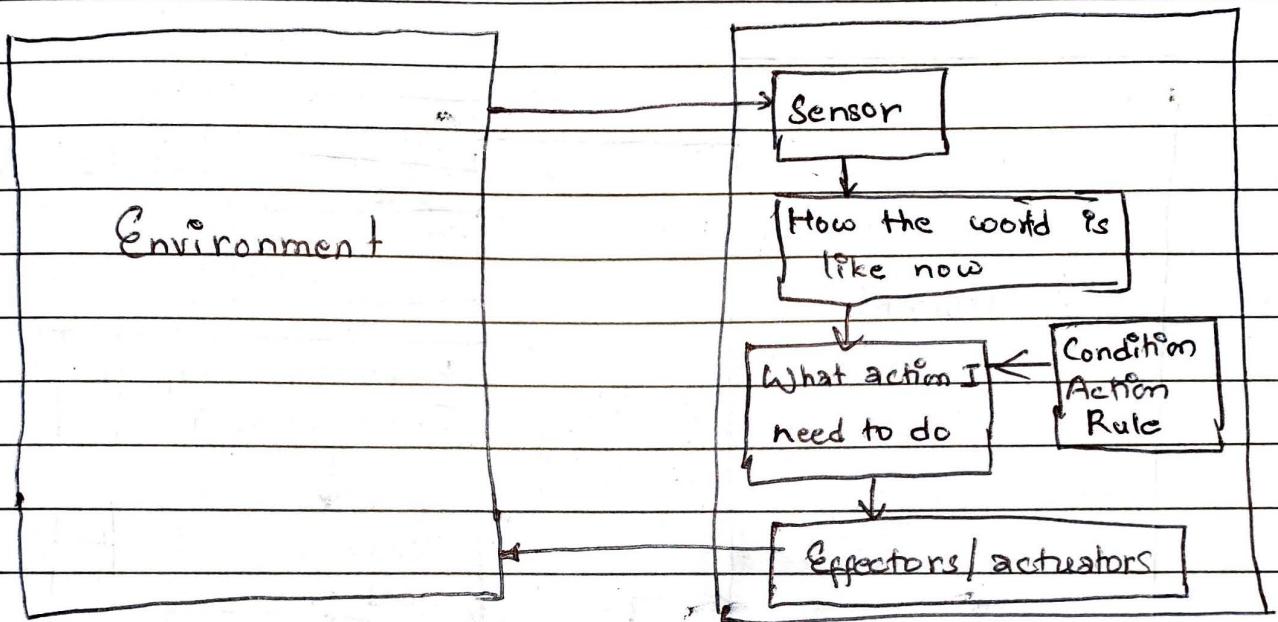
- (c) Single agent/ multiple agent!
If the environment contains only one agent then it is single else multiple-agent environment.
e.g.: Single agent: AC
Multiple agent: Chess, FIFA.

- (d) Deterministic / Non-deterministic: (Random, stochastic)
If the next state of environment is completely determined by the current state and agent action of the agent then it is deterministic. else non-deterministic.
e.g.: Deterministic: Chess
Non-deterministic: Medical analysis

- (e) Episodic / Non-episodic
If one environment is related to the other episodes then it is non-episodic else episodic.
e.g.: Episodic: Vacuum cleaner cleaning agent.
Non-episodic (Sequential): Chess

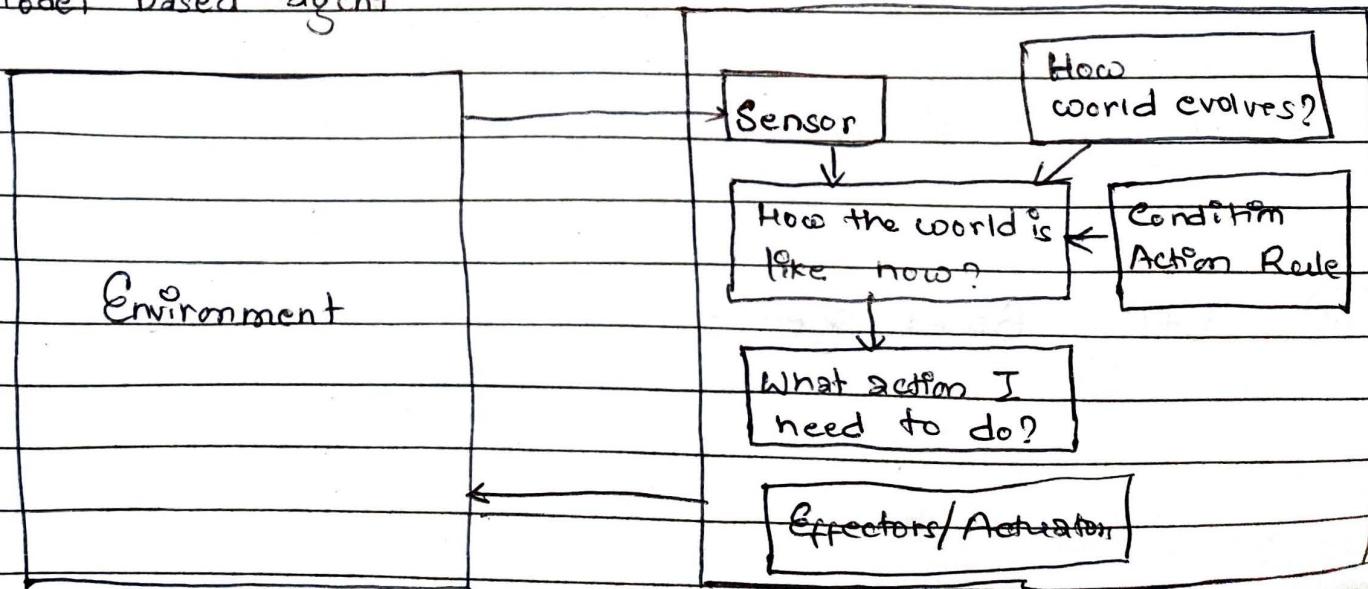
Types of agent:

(i) Simplex Reflex agent



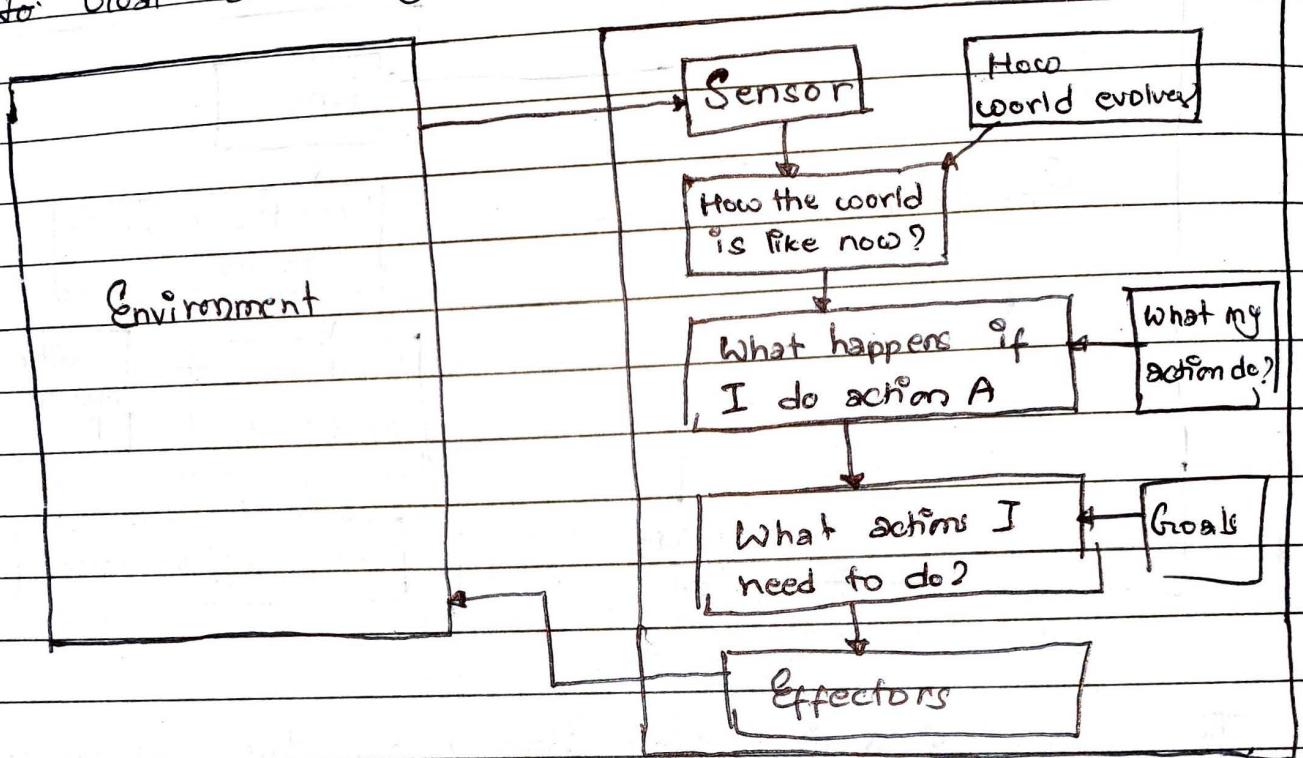
- They choose action only based on the current state.
- They are rational only if current decision depends on the current state.

(ii) Model Based agent



- o Updating the state requires the information about current state and how current state was evolved.

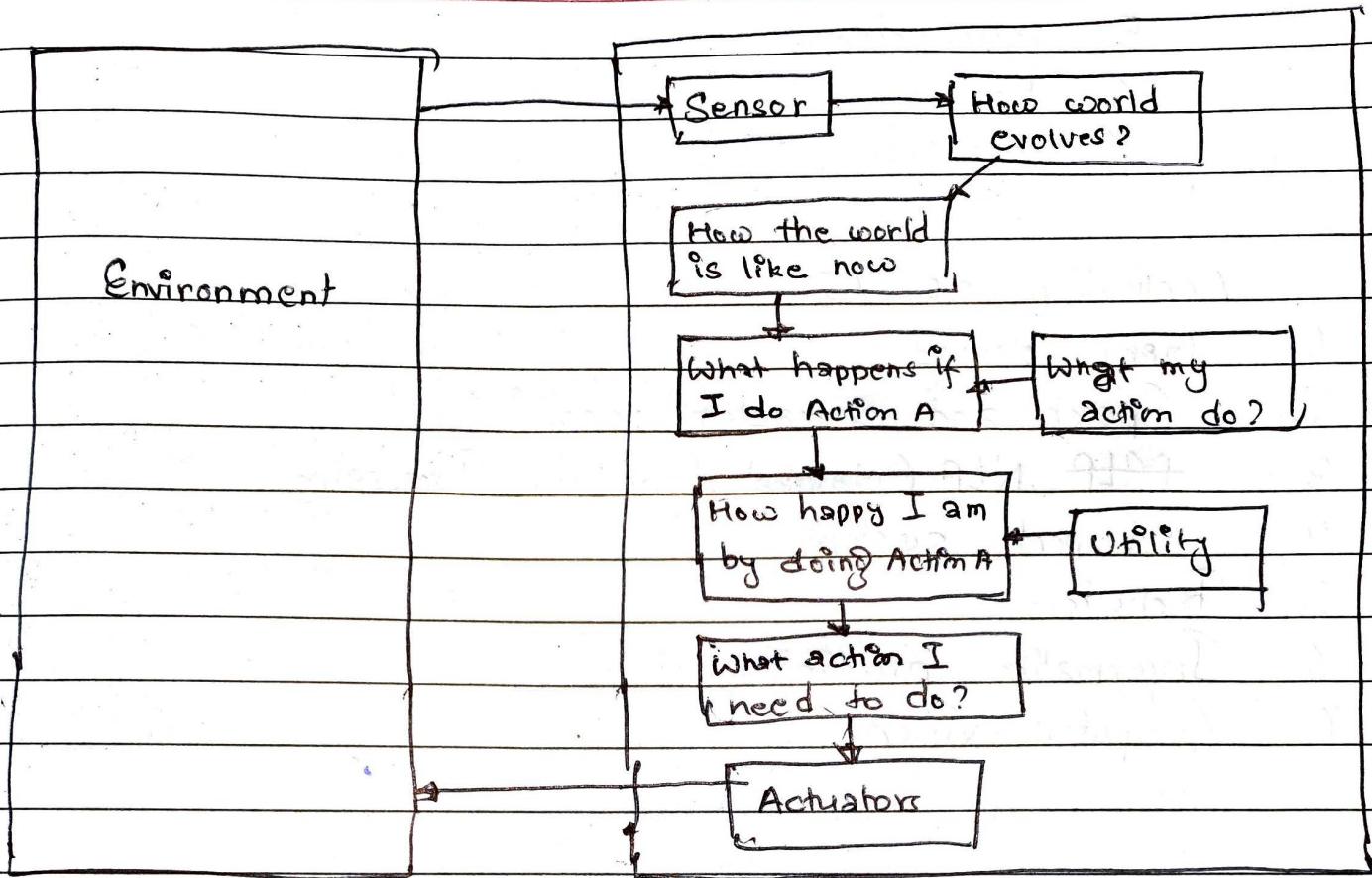
III) Info: Goal Based Agents



- o They choose their action in order to achieve goals.
- o Goal based approach is more flexible than reflex agent - since the knowledge supporting a decision is explicitly modeled. thereby allowing for modifications.
- o A goal is a description of desirable situation.

IV)

Utility Based agents



- o They choose action based on a preference or utility for each state.
- o Goals are inadequate often:
 - a.) There are conflicting goals out of which only ~~two~~ one can be achieved
 - b.) Goals have some uncertainty of being achieved and we need to ~~not~~ weigh likelihood of success against the importance of a goal.

Q. What are the foundations of AI?

- Ans
1. Computer Science
 2. Philosophy
 3. Mathematics
 4. Economics

5. Neuroscience

6. Psychology.

7. Linguistic.

Applications of AI:

1. Game playing
2. Speech and character recognition.
3. MLP NLP (Natural Language Processing)
4. Expert system.
5. Robotics.
6. Information predictor.
7. Computer vision.

Chapter 2 - Problem Solving

Problem solving agent is a kind of goal based agent which finds sequence of actions that leads to the desirable state from initial state.

Well defined problem:

A well defined problem can be described by:

- a) Initial state - The given state of the problem from where we start in the problem domain.
- b) Operator or successor function - For any state X , return $S(X)$ which is the set of states reachable from state X with possible action.
- c.) State spaces: All states reachable from initial state by sequence of action.
- d.) Path: Sequence through which our solution is passed
- e.) Path cost: Function that assigns a cost to a path

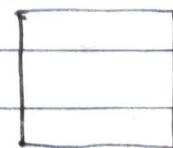
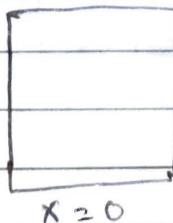
Cost of a path is the sum of cost of individual action along the path.

- f.) Goal test : Test to determine if the current state is goal state or not.

Water Jug Problem :-

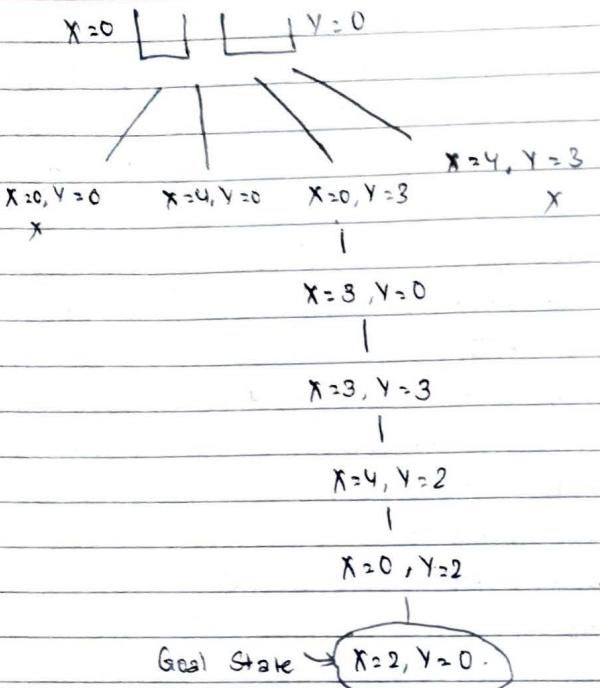
Initial state

4ltr.



3ltr

Goal state: $X=2, Y=0$.



① Initial state: $X=0, Y=0$

② Goal state: $X=2, Y=0$

③ For $X=0, Y=0$

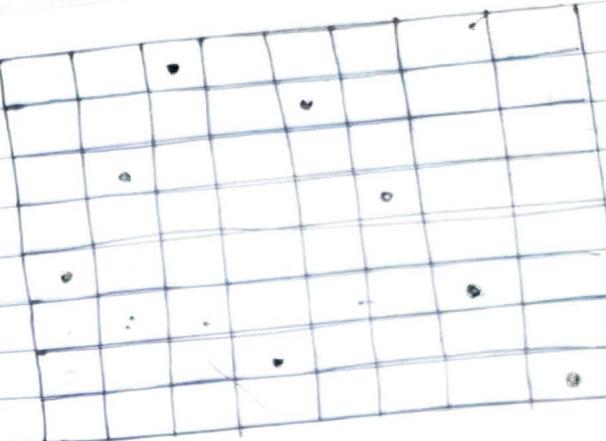
Successor function is

$$S.F. = \{ <x \rightarrow x, y \rightarrow y+3 : x=0, y=0>, \\ <x \rightarrow x+4, y \rightarrow y : x=0, y=0>, <x \rightarrow x, y \rightarrow y : \\ x=0, y=0>, <x \rightarrow x+4, y \rightarrow y+3 : x=0, y=3> \}$$

④ Is there any valid goal state?

⑤ For $x=0, y=3$ state.

$$S.F. = \{ \}$$



Constraint satisfaction problem

In CSP, you are provided set of variable 'X', set of domain 'D' & set of constraints 'C'. Here constraints are applicable to variables having some relation with the help of domain D

Solution of a CSP is an assignment to each variables satisfying each constraints.

E.g.: Crypt arithmetic

Step 1:

Set of variables

$$(X) = \{ F, I, V, E, T, W, O, C, \\ C2, C3 \}$$

$$\begin{array}{r} & C3 & C2 & C1 \\ & T & H & O \\ + & I & W & O \\ \hline & F & I & V \\ & E & & \\ \hline & 5 & 3 & 2 \\ & 1 & 0 & 6 & 4 \end{array}$$

Set of domain (D) = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}

Set of constraints (C) =

- i) First alphabet can't be assigned as 0.
ii) Each variable must be assigned uniquely.

$$0+0 \rightarrow 10C_1 + E \quad \text{--- (i)}$$

$$G+W+W \rightarrow 10C_2 + V \quad \text{--- (ii)}$$

$$C_2 + T + T \rightarrow 10E_2 + I \quad \text{--- (iii)}$$

$$C_3 = F \quad \text{--- (iv)}$$

Step 2.

a) F is assigned as 0 as it is carry over of 1st cant be 0. So, F \rightarrow 1

b) By logic equation (i) $T=5$, So, I \rightarrow 0 & $T=5$

c) So, W=3, So, V=6, W=3

d) So, O=2, So, O=2, E=4

$$\begin{array}{r} 40 \\ \times 10 \\ \hline 40 \end{array}$$

Q. LOGIC

$$\begin{array}{r} 1 \\ 90452 \\ \underline{\times 90452} \\ \hline 180904 \end{array}$$

FORTY

29786

TEN

850

TEN

850

SIXTY

31486

1 1

ONE

5 8 6

ONE

5 8 6

TWO

4 2 5

FOUR

15 9 7

WRONG
WRONG
RIGHT

LETS
WAVE
LATER

CROSS
ROADS
DANGER.

1 1
1 2 3 4

8 0 9 2
1 0 3 2 6

1 1 1
2 4 7 6 5

2 4 7 6 5
4 9 5 3 0

9 8 3 4 4
8 3 2 1 4
2 7 0 5 8