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(Adversarial search) Games in AI

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→ The environment with more than one agent is known as multi-agent environment in which these agent is an opponent of other agent and playing against each other.
→ Each agents needs to consider the action of other agent and effect of that action on there performance.
→ The searches in which two or more players with conflicting goals are trying to explore the same search space for the solution which is called adversarial search or games

State space:- 9!
Solution 8

8×8

State space:- 2^{64}

→ The games are modeled as a search problem and Heuristic evalution function and it provides to solve the games in AI.

Types of games in AI:-

① perfect information:- (All the persons should have complete knowledge about the game)
→ A game with perfect information is that in which the agents can check the all environment.
→ The agent can see the moves of their opponents.
→ For ex:- chess, checkers, Go

2 Imperfect information:-
→ If in a game the agents do not have all informations about the game and do not know what will be the

next stage. These types of games are imperfect information games.
for ex:- Blind, Battleship, Bridge, etc.

(3) Deterministic games:- (which follow a particular rule)
→ These type of games follow a strict pattern and particular rules for this game.
→ Randomness is not associated with this game.

(4) Non-deterministic games:-
→ These types of games are unpredictable in nature.
→ The agents has to depend on luck or chance.
→ These games are like dice games or card games.

(5) Zero-sum games:-
→ The zero-sum game are adversarial search which involves pure competation.
→ In the zero-sum game each agent gain or looses or sometimes balanced.
→ one player tries to maximise the single value and the other one tries to minimise.
→ Each move by the player is called a PLY.
→ This type of games includes embedded thinking.
→ EX:- Chess, tik-tac-toe in this, each player is trying to find out the response of his opponent.
So they are using backward reasoning to solve this problem.

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Element of a game :-

⇒ A game can be defined as a type of search in AI which uses the following elements.

(1) Initial state :- (S)
It specifies how the game is set-up at the start

(2) Player :- (S)
~~Player will take input as search space after knowing Initial state.~~
It specifies which player has moved in the state space

(3) Action :- (A)
It returns the set of legal moves.

(4) Result :-
It depends on ~~state~~ state space and action. (S and A)
It is a ~~model~~ transition model which specifies the result of actions in the state space.

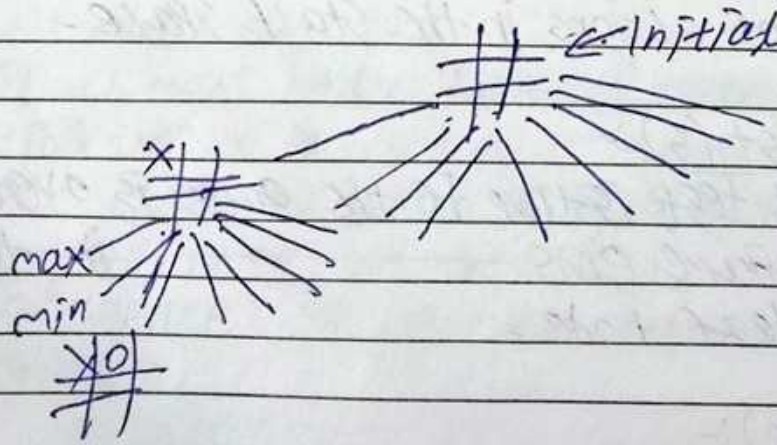
(5) Terminal Test (S) :-
The terminal test is true if the game is over there the game ends ——— in terminal states or leaf node.

(6) Utility (S, P) :-
The utility function gives the final numeric values for a game that ends in terminal state

for Player P.
In tic-tac-toe game the utility function returns -1 if "O" wins, +1 if "X" wins and 0 no one wins.

9.9.25 Game tree:-

It is a tree where the nodes are the game states and the edges of the tree represent the moves of players.
It contents initial state, action functions, result state, terminal state and utility function
For example tike-tace-toe game tree:-
① In this tree we have initial state where no player has started there game
② There are two players max (X) and min(O).
③ The players have alternate turn with max is the starter.
④ max maximises the result and min minimises the result.



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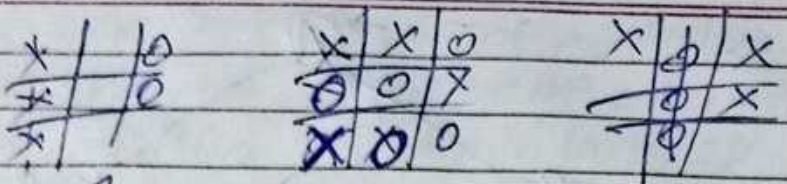
Terminal nodes

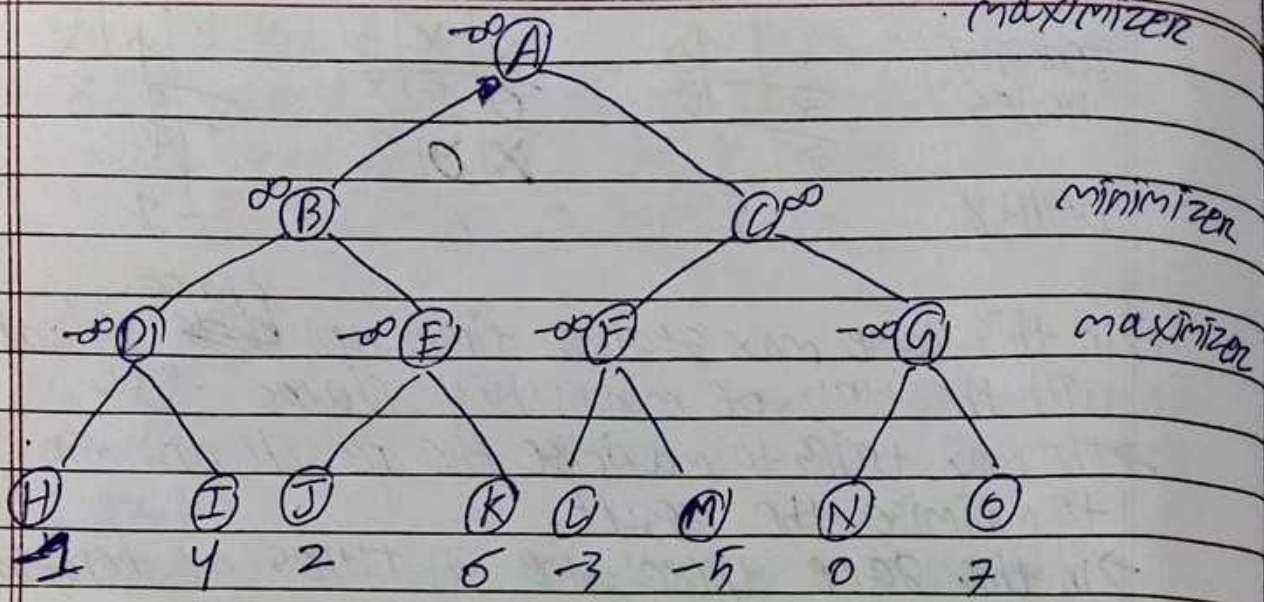


utility 1 0 -1

→ In this game max starts first and place 'X' and next with the turn of min which places '0'.
→ The max tries to maximise the result and min tries to minimise the result.
→ In this game there are 3 types of terminal nodes either max is wining or min is wining or no one is wining.
→ According to terminal node results the utility function returns +1, -1 or 0.
→ In AI, BFS algorithm provides slow result with searching the target or result nodes.
→ So an advanced algorithm with maximum optimization algorithm is provided called minimax algorithm.
→ A game requires particular rules, legal moves and condition of wining or loosing.

minimax algorithm in AI :-

→ minimax algorithm is a recursive and back tracking algorithm which is used in decision making of game tree.
→ minimax algorithm is mostly used in game playing.
→ In this algorithm there are two players max and min.
→ Both the players fight with the opponent to get the maximum benefit.
→ It utilises DFS concept to select the individual nodes.



max = $-\infty$

min = ∞

Steps:-

1. In the first step the algorithm generates the game tree and apply the initial values by assigning the levels max and min.
2. The max level nodes are assigned with $-\infty$ and min level nodes are assigned with ∞ as initial values.
3. the first utility value from bottom is maximizer whose initial values of nodes are $-\infty$.
4. The node values will be obtained by comparing with its terminal node values. For example, the value of node D = max $(-\infty, \max(-1, 4)) = \max(\infty, 4) = 4$

similarly the value of node

E = max $(-\infty, \max(2, 6)) = \max(\infty, 6) = 6$

F = max $(-\infty, \max(-3, -5)) = \max(\infty, -3) = -3$

G = max $(-\infty, \max(0, 7)) = \max(\infty, 7) = 7$

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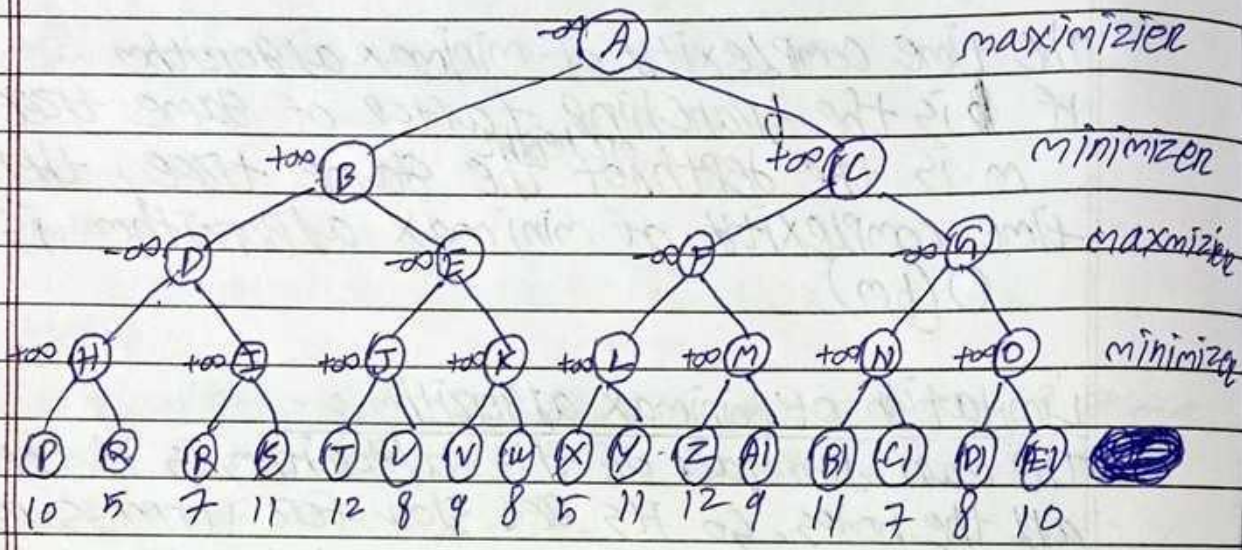
(3) In the next step it is a turn of minimizer, whose initial value is $+\infty$. so the value of node
$B = \min(+\infty, \min(4,6)) = \min(\infty, 4) = 4$
$C = \min(+\infty, \min(-3,7)) = \min(\infty, -3) = -3$

(4) Now it's a turn of maximizer, whose initial value is $-\infty$. So the value of node
$A = \max(-\infty, \max(4,-3)) = \max(-\infty, 4) = 4$

The time complexity of minimax algorithm.
If b is the branching factor of game tree and m is the depth/height of the game tree, then the time complexity of minimax algorithm is
$O(b^m)$

Limitation of minimax algorithm :-
The main drawback of this algorithm, is it checks all the nodes. So its get slow for unnecessary checkings. So it can be improved by alpha beta pruning technique.

Ex:-
The terminal values are
10, 5, 7, 11, 12, 8, 9, 8, 5, 11, 12, 9, 11, 7, 8, 16



node H = min (∞, min(10, 5)) = min (∞, 5) = 5
node I = min (∞, min(7, 11)) = min(∞, 7) = 7
node J = min (∞, min(12, 8)) = min(∞, 8) = 8
node K = min (∞, min(9, 8)) = min(∞, 8) = 8
node L = min (∞, min (5, 11)) = min(∞, 5) = 5
node M = min(∞, min (12, 9)) = min(∞, 9) = 9
node N = min(∞, min(11, 7)) = min (∞, 7) = 7
node O = min(∞, min (8, 10)) = min (∞, 8) = 8

node D = max(-∞, max(5,7)) = max(-∞, 7) = 7
node E = max(-∞, max(6,8)) = max(-∞, 8) = 8
node F = max(-∞, max(5,9)) = max(-∞, 9) = 9
node G = max(-∞, max(7,8)) = max(-∞, 8) = 8

node B = min(+∞, min(7,8)) = min(∞, 7) = 7
node C = min(∞, min(9,8)) = min(∞, 8) = 8

node A = max(-∞, max(7,8)) = max(-∞, 8) = 8

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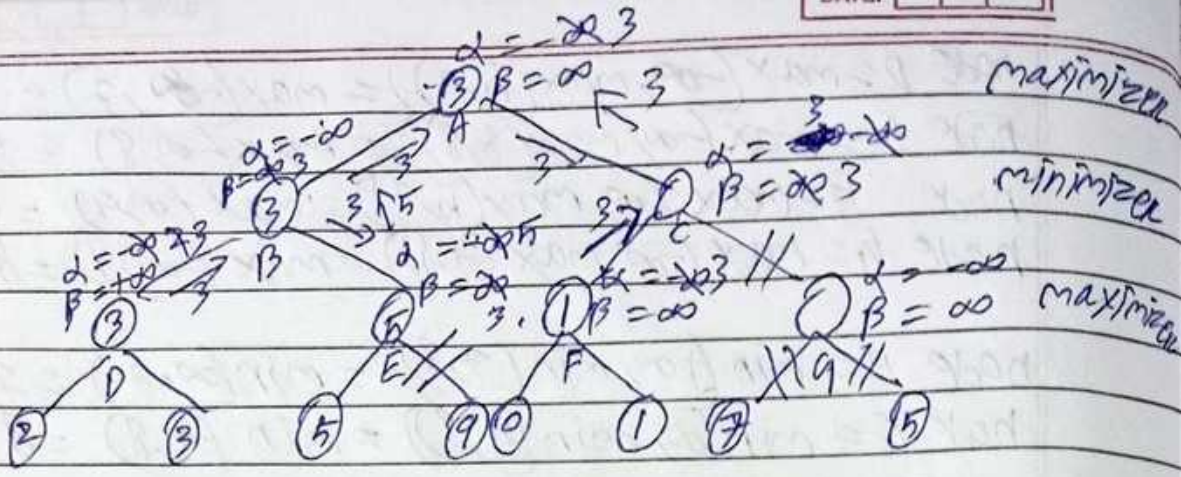
Alpha-Beta Pruning :-

→ This algorithm is the modified version of minimax algorithm.
→ It is an optimization technique for the minimax algorithm
→ In this technique regularly we check the condition $\alpha \geq \beta$ if it satisfies at any node then the subtree will not be traversed or pruned.
→ In this technique we have two parameters α and β.
→ α :- The best choice we found in the path of maximiser will be provided to α and the initial value of α is $-\infty$.
→ β :- The best choice we have found along the path of minimizer is called Bita and the initial value of Bita is $+\infty$.

$\alpha \geq \beta$



Step 1 :-

(1) In step-1 the terminal values will be taken as leaf nodes and construct the game tree.
Initialize all the nodes except the terminal nodes as $\alpha = -\infty$ and $\beta = +\infty$.

(2) At Node D, it is the turn of maximizer, so α will be updated. After comparing the terminal values with α at node D $\alpha = 3$ and $\beta = \infty$.
So 3 will be back tracked to node B.

(3) At Node B, it is the turn of ~~maximizer~~ minimizer, so β will be updated by the value 3. The same α & β value will be traversing to its subsiquent node E.

(4) At node E, it is the turn of maximizer, so α will be updated. First α is updated by 5 which satisfies the condition $\alpha \geq \beta$, so the node 9 will be pruned or deleted. From node E 5 will be back tracked which will not change the value of node B as 3 is less then 5.

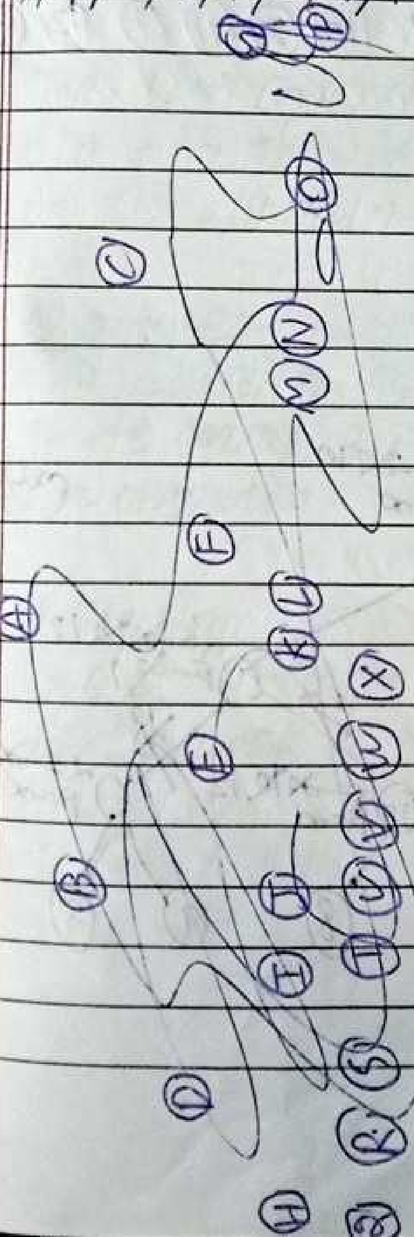
(5) 3 is back traced to node A, as it is the turn of maximizer so α will be updated by 3. The value of α and β will be transferred for

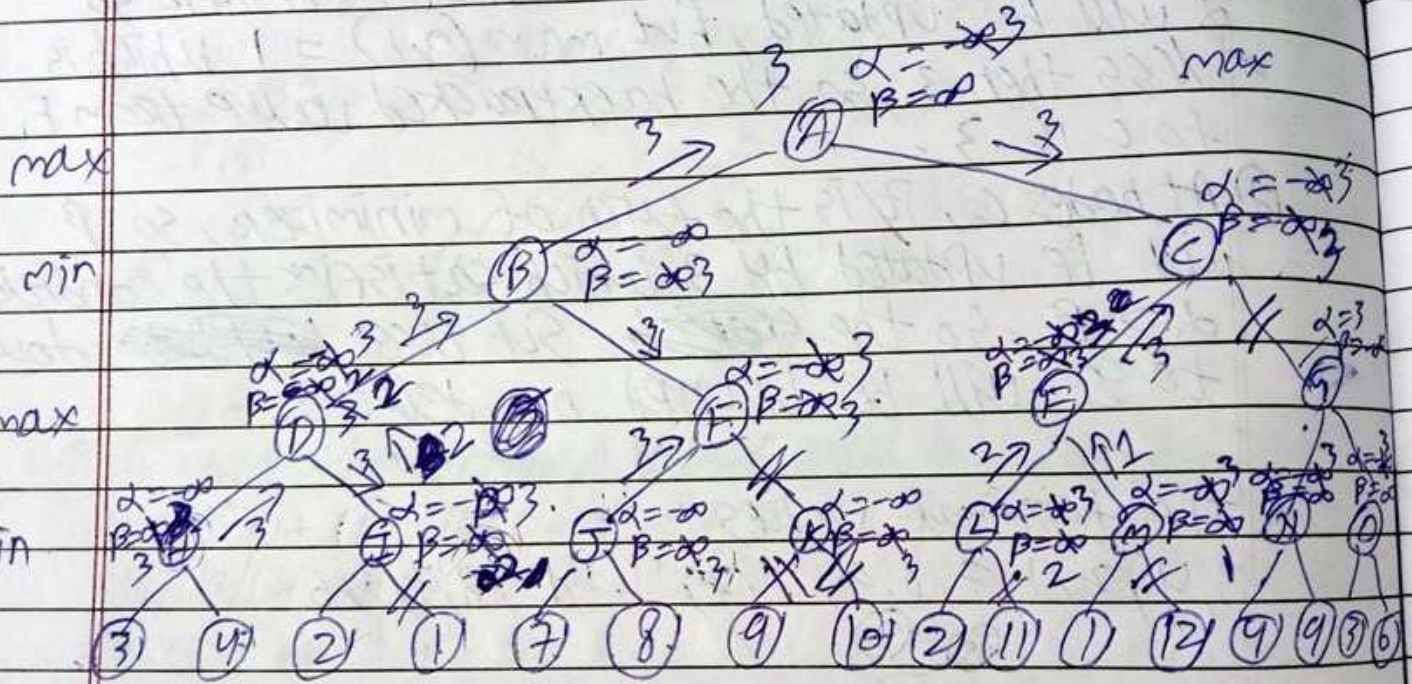
its subsiquent node C and again to F.

(6) At node F, it is the turn of maximizer so α will be updated, but max (0,1) = 1 which is less then 3, so the backtracked value from F to C is 3.

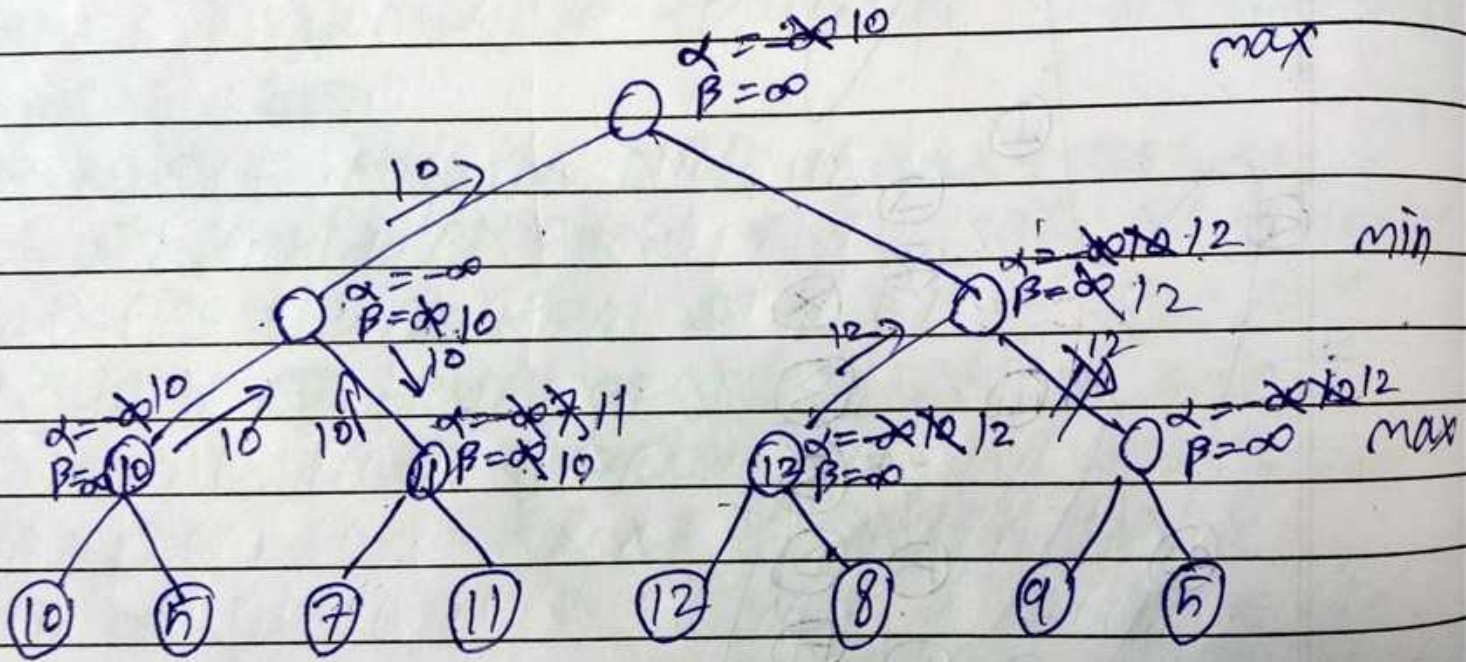
(7) At node C, it is the turn of minimizer, so β will be updated by 3 which satisfies the condition α ≥ β. So the ~~search~~ sub tree down to see will be pruned or deleted.

Q The terminal values
3, 4, 2, 1, 7, 8, 9, 10, 2, 11, 1, 12, 14, 9, 3, 6





Terminal vale 10, 5, 7, 11, 12, 8, 9, 5


α = -∞ 10
β = ∞
max
10
α = -∞
β = ∞ 10
10
α = -∞ 10
β = ∞
10
10
α = -∞ 7, 11
β = ∞ 10
11
α = -∞ 12
β = ∞ 12
min
12
α = -∞ 12 12
β = ∞
12
α = -∞ 12 12
β = ∞
max
12
α = -∞ 12 12
β = ∞
10
5
7
11
12
8
9
5

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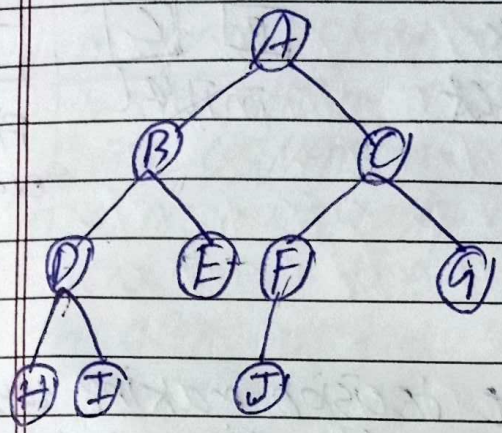
Iterative deepening:-

→ This algorithm is a combination of BFS and DFS.
→ It provides the best depth limit and gradually increasing until the goal is reached.



1st → A
2nd → ABC
3rd → ABDECFG
4th → ABDHIECFJG

The time complexity if b is the branching factor and d is the depth, then the time complexity of this algorithm is O(bd)

Advantage:-

This algorithm is the combination of BFS and DFS, so the searching is faster and utilises less memory for operation.

Limitation:-

The main limitation of this algorithm is it repeats all the work of its previous stage.

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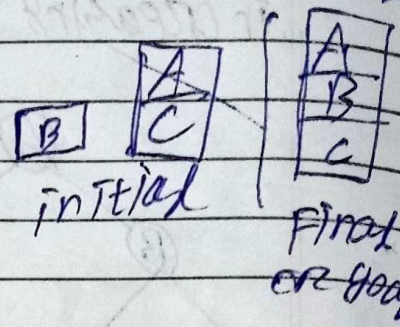
Planning in AI :-

The planning in AI is to do the decision making tasks by the Robotic agents to achieve a specific goal.

Predicate	Action
ON (A,B)	Stack
clear (A)	unstack
ON (B,C)	
ON (A,B)	



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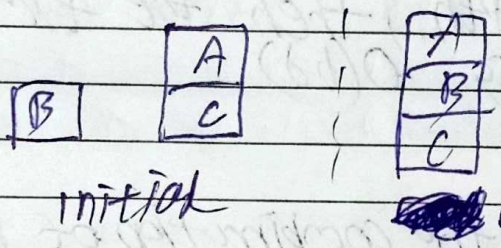
Block world problem :-

The planning in AI is above decision making tasks performed by the agent or the computer program to achieve a specific goal.



Predicate	Action
ON (A,B)	Stack (A,B)
clear (A)	unstack (A)
ON (B,C)	Stack (B,C)
ON (A,B)	Stack (A,B)

In this problem we have 3 blocks of same size which can be stacked upon each other. The goal state provides the arrangement A upon B and B upon C.

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Component of a Planning System:-
1. Create various rules to reach the goal state.
2. Choose the best rule for applying for goal state.
3. Apply the choosen rule for finding the best solution.

Non-Linear Planning:-
In this type of planning it does not follow the linear sequence of complition of goals.
Two or more tasks can be completed within a fixed duration of time.
The agent needs to solve the sub problems before completion of the final goal.

For ex:- we are taking the car for servicing If an emergency call, the agent has to make then, it will switch on the bluetooth and receive the call. So task 2 will be completed first then task 1.
The task completion depends on the constrent or condition.
So the non-linear planning completes its goals using constrent satisfication.

Non-Linear Planning Algorithm (weak):-
Step 1:- Initialize the set 'S', the set of propogisitions in the goal State.
Step 2:- Remove the unachieved propogisitions from 'S'.
Step 3:- Achieve the remaining propogisitions by step addition, step promotion or step Subtraction.

Step 4:- Review all the steps in the plan to do any new plan addition

Step 5:- if 'S' is empty, then all the task are completed else go to step 2.

Hierarchial Planning / Level-wise planning:-

In order to solve the hard problems, the problem solver creates plans in level-wise.

The first level of planning is superficial.

the next levels will be little bit extended.

It will provide hierarchy of actions.

For ex:- Planning to Goa in holiday trip.

Level 1:- (i) Buy the ticket from the available websites

(iii) Reach the airport

(iv) Reach to Goa.

(v) Reach the hotel

Level 2:- (i) Compare the ticket price from various websites providing air tickets.

(ii) Buy the air ticket which ever is cheaper.

(iii) Book a taxi from your house to airport.

(v) Board the airport and reach to Goa.

(vi) Book the taxi to reach the desired hotel.

(vii) Discuss with the local venders regarding your holiday trip.

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Level 3:- (i) Search for different websites and available discounts.
(ii) Discuss for comparing the ticket prices.
(iii) Book the to and from ticket for the members
(iv) Book a taxi from your house to the airport and pay the bill.
(v) Do the security check in the airport.
(vi) Board in the flight to reach Goa.
(vii) Book a taxi to reach the booked hotel Discuss with the local venders regarding your holiday trip.
(viii) Choose the best price for maximum spots.

Reactive System:-
The Reactive System is different from linear, non-linear or hierarchial planning which are deliberate plannings. This system we have to react depending on the observable situations.
For example:- thermostat.
The job of thermostat is to keep the temperature of room at constant level.
If the room temperature is above k degree, then it will switch on the AC.
If the room temperature is below k degree then the AC will be off.
In this type of system, some situations requires immediate attentions and rapid action.

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Advantages:-

(1) Robustness:- In this system the model provides accurate and quick response in the real time tasks like driving the cars, walking of a robot, etc.

(2) Triangle table :- It provides a way of achieving multiple goals simultaneously as one goal depends on other and continues for different tasks.

(3) Meta Planning:- The technique to know the region or the solution is meta planning where the modification in individual plans can be done according to the requirement.

(4) Case based Planning:- In this the reactive system reuses the old plans for the new models or new set of plans.

understanding :-

→ The agent needs the complete representation from one set of actions to another set of actions.
→ So the understanding between the two different representation is very essential.
→ The success or failure of any action by the agent depends on the understanding of the concept.
→ So it is a process of mapping the input from the original form to the output in action form.

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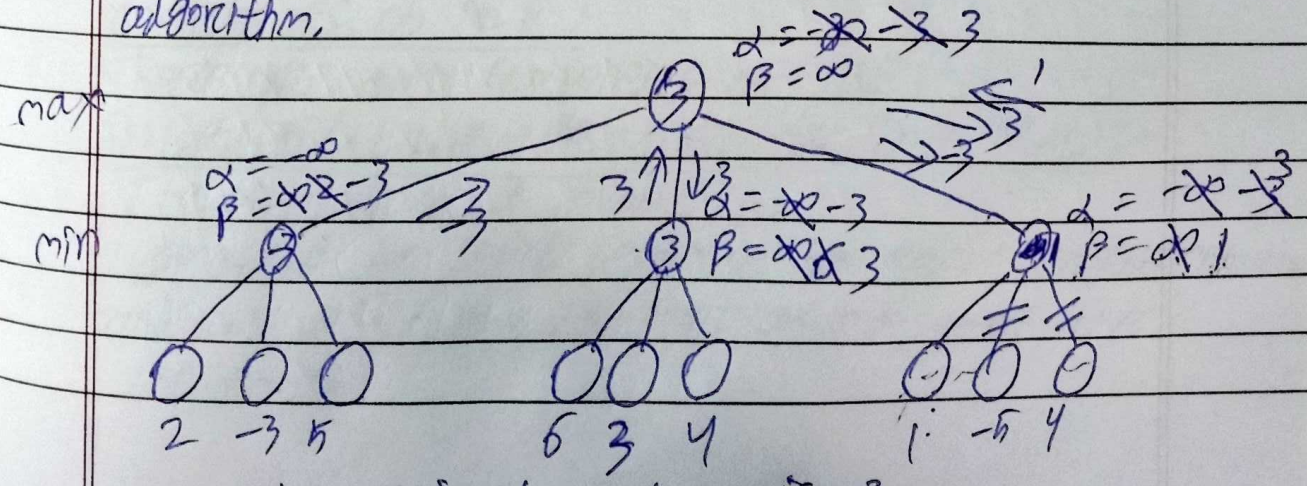
- The actions should be simplified in order to assign to the agents

What makes understanding hard:-
There are some factors which creates difficulty in understanding. Factors are:

1. If the target representation is very complex for which you can not able to map to the original representation.
2. There are different type of mapping like one-to-one, one-to-many or many-to-many which creates complexity in understanding.
3. Noisy or disturbing inputs create difficulty in understanding.
4. The label of interaction ~~which~~ what the source component should not be complex one.
5. The intermediatory actions sometimes may be unavailable.
6. understanding if provided with the constrent satisfication then the issue can be resolved. Steps are:-
   (i) Analyse the Problem to determine the actual conditions.
   (ii) Solve the Problem by applying constrent satisfication algorithm.



The optimal value is 3.

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unit-3

Q1 Discuss the types of games in AI.

Q2 Describe the various element of games in AI.

Q3 Explain minimax algorithm with example.

Q4 Explain alpha beta pruning algorithm with example

5 Discuss iterative deepining method.

6 Discuss block world problem. 2 mark

7 Describe non-linear planning algorithm.

8 Discuss hierarchical planning with example

9 Describe reactive system and its advantages

10 What is understanding and what makes understand hard.

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Natural Language Processing (NLP) :-

→ It is a part of computer science, human understandable languages and artificial intelligence.

→ This technology is used by the machines to understand, analyse and manipulate the human understandable languages.

→ It helps the developers to perform the tasks like translation, automatic summarisation, speech recognization, topic segmentation, etc.

→ NLP is an AI method to communicate with intelligent systems using natural language like english.

→ Processing of natural language is required to interact with the robot in human understandable language and get the decisions from the system.

Example :-

1. Personal Assistants
   - Google Assistant, Siri, Cortana,
2. Auto complete :- google, bing, etc
3. Spell checker :- all the browsers, IDE,
   - word processors (ms word)
4. machine translation :- Google translator

components of NLP :-

There are two components of NLP :-

1. Natural Language understanding (NLU) :-

   The understanding involves :-

   - Mapping the input sentence to useful representation and analysing the different aspects of the languages.

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② Natural Language Generation (NLG) :-
It is the process of producing meaningful sentences in the form of natural language with 3 different steps :-

(i) Text Planning :- It includes retrieving or extracting the relavant content from knowledge base.

(ii) Sentence Planning :- It includes choosing the required words which forms a meaningful sentence.

(iii) Text realization :- It is a mapping from sentence Plan to sentence structure.

Advantages of NLP :-
→ NLP helps user to ask questions about any subject and get the response within a second.
→ It offers exact answers of the questions by avoiding the unwanted informations.
→ NLP helps the computer to communicate with human in human understandable language.
→ most of companies use NLP to improve the efficiency during documentation Process.

Limitation of NLP :-
Training of various dataset of different kinds of language is a difficult task to train the model. So it can not able to predict the exact word or sentence that is input from the user.

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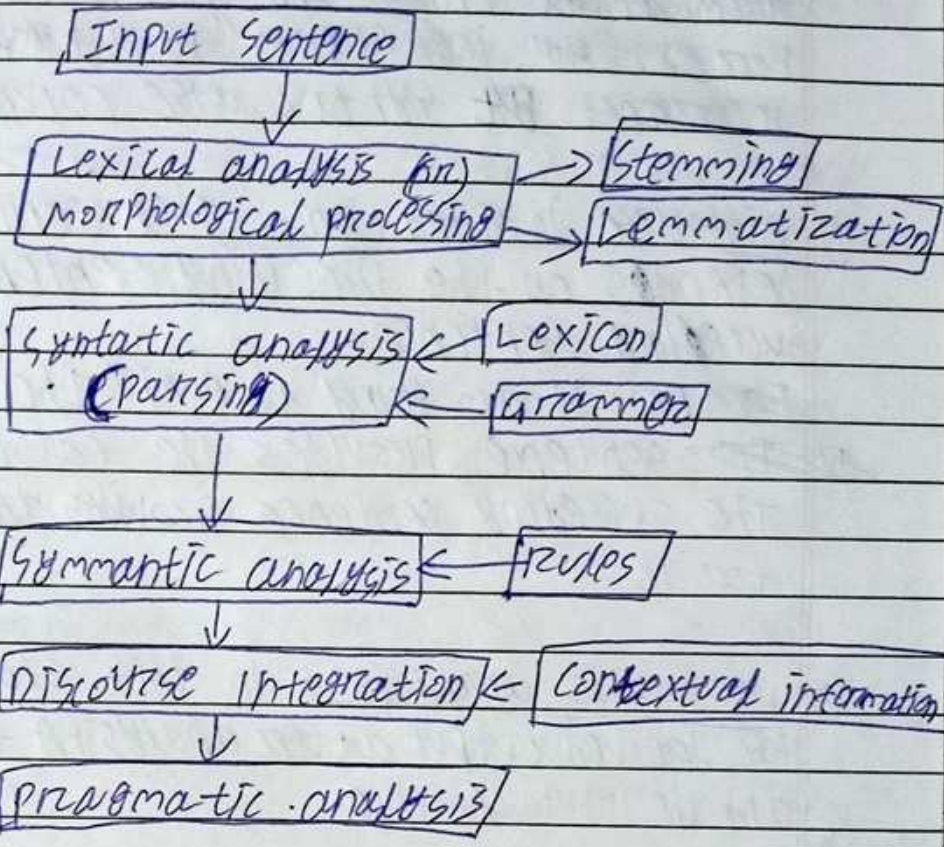
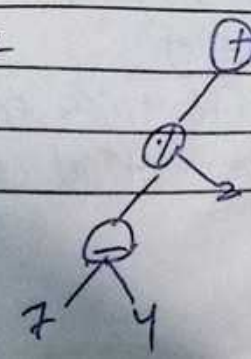
Stages of NLP:-



① Lexical analysis/morphological processing:-
This is the first stage of NLP which steps the input sentence and converts it to meaningful lexicons.
Ex:- It is a cat
Lexicons:- It, is, a, cat

② Syntatic analysis:- In this stage it checks the grammar by creating the parse tree.
For ex:- "Agra goes to Anil". is syntatical incorrect sentence.
For ex:- 3+(7-4)/2



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(3) Symmantic analysis :- In this stage it checks the grammatical errors and the rule violation.
For ex :- "Hot ice cream" is symmantically incorrect but syntax wise correct.

(4) Discourse integration :- The meaning of the sentence depends on the preceding sentence and the succeeding sentence.
For ex :- "I am going to pune" the preceding sentence provides the cause for it.
The succeding sentence provides the objective for it.

(5) pragmatic analysis :- In this stage it will check the derived output after analysing the knowledge base and the input sentence.

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(1) Morphological Analysis :-
→ It deals with the understanding of distinct words according to the lexicon principal.
→ In this stage it identifies and analysis the structure of sentence.
→ In this stage we have two steps :-
① Stemming :-
→ In this process the word will find out the individual suffix like -ing, -ly, -ful, etc from the original word.
② Lemmatization :-
In this process it tries to obtain the root of the word using the grammatical concept

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② Syntatic analysis (Parsing) :-

This stage is used to check the grammar, arrangement of words and interrelationship between them.

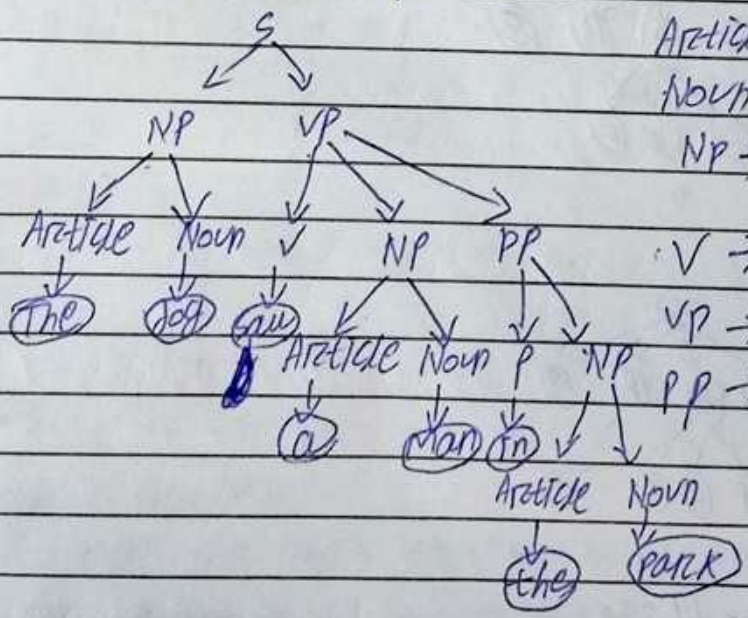
For ex:- "Delhi goes to Agra" is rejected by the syntatic analyser as it does not make any sense.

Grammer :-

It is utilised to check the syntatic rules provided by natural languages.

Ex:-

The dog saw a man in the park



S -> NP | VP

Article -> a | an | the

Noun :-> dog | bird

NP -> Article + Noun / Article

V -> saw | goes

VP -> V | NP | PP

PP -> P | NP

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Parsing :-

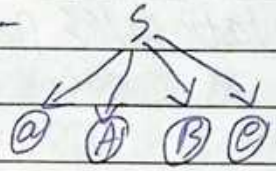
⇒ It is used to implement the task of component creation using the input data with a structural representation.

⇒ we have two types of parsing :-

① top-down Parsing :-

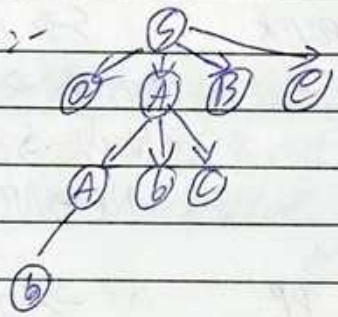
In this technique, the Parser is creating tree from root to the leaf node.

Step 1 :-

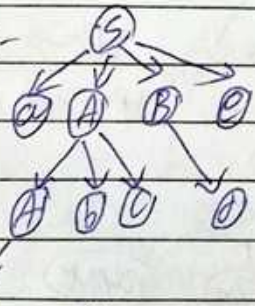


S → aABC
A → Abc | b
B → d

Step 2 :-



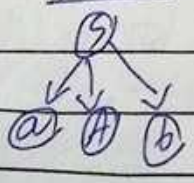
Step 3 :-



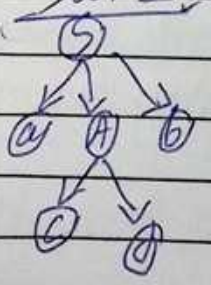
output :- abbcde

S → aAb
A → Cd

Step 1 :-



Step 2 :-



output :- acdb

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② Bottom-Up Parsing :-

In this approach, the root will be found out after starting from the leaf nodes.

It uses shift and reduce approach to find out the parsh tree.

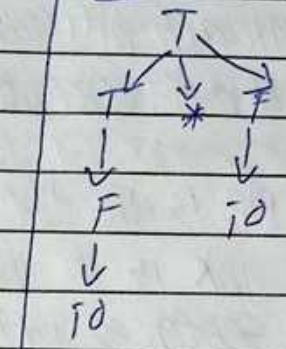
E → T
T → T * F
T → id
T → F
F → id
initial id * id

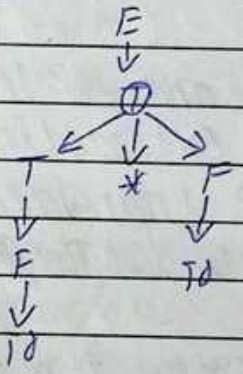
step 1 :-
id * id

step 2 :-
F * id
id

step 3 :-
T * id
F
id

step 4 :-
T * F
F id
id

step 5 :-


step 6 :-


③ Semantic analysis :-

→ In this stage the rules provided in the dictionary along with case grammar and concertual grammar will be considered.

→ It uses two different steps.

① Lexical Processing :-

In this step individual words will be matched with the dictionary and if not found the proper meaning we have to check for case grammar or conceptual grammar.

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For ex:- I will meet you at the diamond.

This sentence is rejected by the dictionary but is accepted by the core grammar.

(i) Sentence level processing:-
In this approach different sentences can provide values for its different meaning.

S1:- The pig is in the pen.
S2:- The ink is in the pen.
Both the sentences utilise the same word 'pen' with different meanings

Symantic analysis includes
(i) entity extraction
(ii) machine translation
(iii) natural language understanding

Entity extraction means it collects individual entities from the given source.

machine translation means it converts the human understandable text to machine level language

Natural language understanding means it converts the machine level language to the logical structure representation

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(4) Discourse integration:-
This stage includes the meaning of a single sentence which is combined with some preceding and succeding sentences.
For example:- Anil is going to Agra.
This sentence contains a preciding sentence "It was discussed with family members" and succeding sentence "He wants to see Taj mahal".
It contains different stages like
(i) identify the entities
(2) parts of the entities
(3) parts of the action
(4) entities involved in the action
(5) planning sequence.

(5) Pragmatic Analysis:-
This sentence deals with the overall communication and the effect of interpretation.
For example:- close the window
can be a request to a friend or an order from the authority.

Spell checking:-
It scans the text and extracts the word from it.
the spell checker is a common tool for language processing.
It is a process of detecting the incorrect words and providing suggestions for it.

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Spelling errors :-
There are 3 types of spelling error occured.
(i) Typographic Error :- In this type of error the mistakes committed during typing.
For EX :- → Netwrk
→ Network

(ii) Orthographic Errors :- Due to lack of concerned languages, the spelling errors may occur.
For EX :- welkome → welcome
color → colour

(iii) Phonetic Error :- This result due to poor listening power of the user. The word spelling is correct but it is misspelled.
For EX :- Ruff
Rough

These spelling error occur due to :-
~~(i) insertion of new word~~
(i) Insertion :- An extra letter may be inserted as the Phonetic is same. For EX :- maxiimum

(ii) Deletion :- A letter may be missing but still Phonetically the word is correct. For EX :- Netwrk

(iii) Substitution :- Sometimes a part of the word is replaced wrongly by the user. EX :- Intellugence

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Spell checking techniques:-

(i) Dictionary look-up :- As many words pronunciation is different in different regions. So we need to match that word with dictionary to find out the correct meaning. Ex:- 'soperr' is correctly is 'super'.

(ii) context dependent error detection :-
Some sentences or word utilization creates confusion for the spell checker. So the user has to understand the context of the sentence.
For Ex:- Peace comes from within
Piece comes from within

Learning :- (2nd part of unit-4)
It is the basic building block of AI solutions.
It is described as;-
(i) improvement of performance with large data.
(ii) It decides how to modify the performance of element.
(iii) It focuses on the processing of input-output pair.
(iv) Its main elements are knowledge and feedback.

There are 3 different AI learning models:-
(i) Supervised Learning model :-
In this type of learning model the class name is provided with data. That means the data is labeled with a particular class.

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This model is stored in the machine with a proper label name. It is of two types:-

(I) Classification :- In this process the input data is labeled using the training provided.
For example :- class Boy and class Girl.

(II) Regration :- It is the process to identify the label data and calculate the result on the basis of prediction.

(II) unsupervised model :-
In this process the result is unknown. So the result can be obtained by creating the label for a data. It is of 2 types :-
(1) Clustering :- In this technique the input data find its meaningful group and provides its class.

(2) Dimensionality Reduction :- In this process unnecessary features or columns are removed or substituted for complexity reduction. For EX :- Age and DOB one is sufficient. Similarly FName, middle Name and LName can be substituted as full name.

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(III) Reinforcement learning model :-
→ In this model there is no training dataset.
→ It works as an agent with the environment to get the feedback.
→ The environment in this model provides the required feedback. For ex :- In various e-commerce websites the products are provided with their rating and reviews.

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=> basing on the customer reviews, the user takes decision.

methods of learning :-

There are 5 methods of learning

(i) memorization :-

In this method the learning technique is quite simple. It does not require any inference knowledge, so the data can be memorized as it is.

For EX: memorizing the formula, multiplication table, etc.

(ii) Direct instruction :-

Direct instruction is a little bit complex form of learning.

In this case the user gets the knowledge directly from the application or the operation.

(iii) Analogical learning :-

In this type of learning the existing concept provides the base knowledge.

The uniqueness is added to provide the new concept in the knowledge.

(iv) Learning by Induction :-

In this technique of learning the system is habituated in performing a particular tasks for number of times. So for the next time the system will able to find out the correct answer.

For ex:- If a person is provided with various kinds of sweets. Then he can able to recognize the next item procured before him.

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(v) Deductive learning:-
This type of learning system helps in deriving the relations associated among the two different users.
It requires inference methods.

(vi) Rote learning:-
This is a concept on the basis of memorization.
It focuses on avoiding inner complexities.
So it is easier for the user to store the knowledge.
For example:- Repeating a poem or song, memorizing the multiplication table, etc.
This strategy is not helpful in Inference system.
It stores the previous computed values.
So 3 different methods are utilised for Rote learning
(1) Hashing
(2) Indexing
(3) Sorting

Drawback of these type of Learning:-
It is not effective in real-time Problems.
When the environment changes, the record is not modifying accordingly.
Caching:- ⇒ It stores the computed values.
⇒ It recalls the information whenever required for computation.
⇒ It saves the time.

Learning by taking advice:-
When a Programmer writes a program he has to follow the instructions of the project manager and it continues till the top most level.

It is a simple form of learning.
The sources of different advices may be the program manager, expert in that field or the internet.
The system should ensure that the knowledge should not conflict the existing knowledge.

Learning in problem solving

① Learning by parameter adjustment:
This learning system relies on evaluation procedure which combines the information from several sources into a single summary.
For ex:- The factors like age and DOB both provides similar values. So one is sufficient.
~~Goal, factors are~~
Those factors or parameters which are more valuable that should be provided more precidence.

② Learning by macro operator:-
The seqvence or action that can be treated as a whole is called macro operator.
once a problem is solved the learning component takes the computed values and store it in macro operator. So it helps in smoothing the learning process.

③ Learning by chunking:-
A production system consist of a set of rules which helps in creating small subgroups which is called chunk. the chunking system helps in dividing big production system into simpler forms.
It can be used to learn the control knowledge.

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(1) Learning by examples:-
In this process of learning it includes various interactive and innovative examples.
this strategies is called concept acquisation

(2) Learning by reduction:-
This process is accomplished through a sequence of reductive inference steps from the given facts. using this strategy the learning system derives new facts.
For ex:- X and y are brothers. X and y sons are cosine brothers.

(3) Learning by Induction:-
The Inductive learning process tries to make the rules in general form. so that the next data can be observed in a particular sequence.
For ex:- the input of a program may be the color of types of fruits and output is the usefulness of the fruit.
Now a new data can be identified whether it is useful or not.

(4) Explanation based learning:-
In this type of learning the user needs explanation about the system. For example if the user wants to play chess, he should be instructed or explained all the rules including how to win or lose.

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⑤ Learning from the observation and discovery :-
This type of learning is based on the observation of environment and learning from the inferences from the environment.
For ex:- The knowledge obtained by running the complex problem repetatedly can provide you simple solutions.

⑥ Learning by Analogy :-
In this type of learning the updated knowledge is extracted by utilising the existing concepts.
For examples:- creating new algorithms are based on the old concepts which provides difficult solutions.

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Formal Learning theory :-
A device can learn a concept from various types of examples. The complexity of the learning function is decided by 3 factors.

① 'h' which is error of tollerance means the maximum error the knowledge can able to tollerate.
② 't' it signifies the number of factors or characteristics used to gain the learning.
③ 'f' It provides the size of production rules to make the discrimination among different learnings.

So the complexity of learning

$$C = f(h, t, f)$$

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Neural Network Learning :

→ This learning concept helps in doing prediction by utilising various input data along with their weights.
→ It processes it for predicting a predicted output which accuracy is almost 100%.
→ It utilises 3 different layers in this network.

① Input Layer:

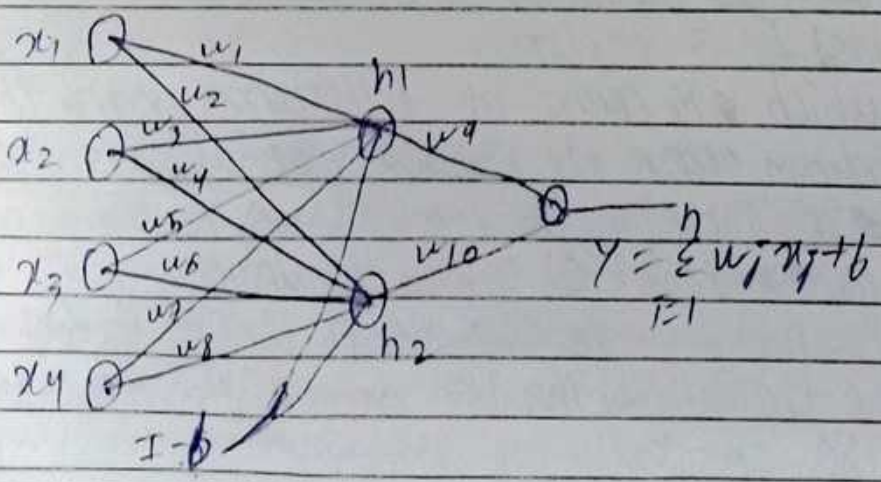
This layer accepts different inputs from various sources with their corresponding weight.

② Hidden Layer:

→ In this layer it process the input data for the output layer.

③ Output Layer:

It provides the predicted output after processing the hidden layer data.



where x_i represents the inputs.
w_i represents the corresponding weights
b is the bias or error margin.

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Generactive Learning:-
~~Generactive~~
In this type of algorithm it solves optimization problems

Some application of Neural Network are:-
(i) Face recognization.
(ii) Speech recognization
(iii) Text translation
(iv) controlling the robots
(v) Reading the hand written texts.

Generactive Learning:-
In this type of algorithm it solves optimization problems and different searching technique.
The different application of generactive Learning
(i) artificial creativity
(ii) code breaking.
(iii) Image processing
(iv) electronic circuit design
etc.

The different factors in generactive Learning are:-
(i) Population:-
It is the sample of the total provided chromosems.
Chromosems:-
It is one of the solution the genetic learning providing through individual gens characters.

Gen :-
It is an element of chromosem.

(2) Fitness function :-
This function is utilished to verify a perticular chromosem will be selected for the next stage or not.

(3) mutation :-
This characteristic provides individual specification in the given chromosem.

Unit - 5
Expert System

=> It is a system that is designed to solve complex problems and provide decision making ability like human experts.
=> It performs by extracting the knowledge from the knowledge base using the reasoning and inferance rules.
=> It solves the complex problems by using facts and heuristic algorithms

Examples of expert systems:-

(1) Dendral :-
This project was made in chemical engineering to detect the unknown organic molecules from various organic data by utilishing the knowledge base of mass spectra and chemical elements

Unit 4

1. Discuss the two components of NLP
2. Describe the advantages and limitations of NLP
3. Discuss the 5 stages of NLP
4. Explain grammar in Parsing
5. Describe the Phrasing techniques with ex.
6. Explain the various types of spelling error
7. Discuss the spell checking technique
8. Discuss learning in AI.
9. Explain any 3 different AI learning model.

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(10) Discuss various methods of learning
11 What is rote learning with example
12 Explain various learning methods in problem solving
13 Discuss the different learning through examples
14 Examplain neural network learning with examples
15 Explain genetic learning and it parameters.

Unit 3 :-