① what is AI 2m

→ AI is the study of how to make computers make things which at the moment people do better

② state any two application of AI (2m)

→ ① Expert system ② speech recognition
③ natural language processing.
④ Intelligent Robots.

③ what is an AI technique & Describe characteristics of AI technique giving example.

→ ① AI technique is a method that exploits knowledge that should be represented in such a way that.

① capture generalieation (characteristics)
② understood by people.
③ modifieable.
④ can be used in multiple places

② search (AI technique).
use of knowledge.
abstraction.

④ State some of the less desirable properties of knowledge.

→ ① voluminous
② Hard to characterize accurately

③ constantly changing
④ Differs from the data can be used

⑤ Difference betwee knowledge & data.
→ Data :-
Data are the raw alphanumeric values obtained through different acquisition methods. Data in their simplest form consist of raw alphanumeric values.

~~Info~~ knowledge :-
Knowledge is what we know. Knowledge is unique to each individual and is the accumulation of past experience and insight that shapes the lens by which we interpret, and assign meaning to, information.

⑥ state any 2 AI technique.
→ search
use of knowledge
Abstraction.

⑧ what is Turing test
→ xerox ⇒

ch-2

① Difference between informed and uninformed search.
→

Informed	uninformed
① It uses knowledge for the searching process	It doesn't use knowledge for searching process.
② It finds solution more quickly.	It finds solⁿ slow as compared to informed search
③ It provides the direction regarding the solution	no suggestion is given regarding the solⁿ in it.
④ It is less lengthy while implementation	It is more lengthy while implementation
⑤ Greedy search, A*. search, graph search	Depth first search, Breadth first search.

② state the 4 components using which a problem can be well formulated formally
→ ① Initial statate
② Action
③ transition
④ Goal state.
⑤ Path costing

(2) Differentiate between Dfs & Bfs.

→

BFS	DFS
⊛ uninformed search technique	uninformed search techniqu
(1) Bfs stands for Breadth first search.	Dfs stands for Depth First search.
⊛ complete solution	incomplete.
(2) Bfs uses queue data structure for finding the shortest path	Dfs uses stack data structure.
⊛ optimal solution	no optimal solution.
(3) Bfs is more suitable for searching vertices which are closer to the given source.	Dfs is more suitable when there are solution away from source.
(4) The Time complexity of Bfs is O(V+E)	The Time complexity of DFS is also O(V+E)
(5) In Bfs there is no concept of Back-tracking.	Dfs angorithm is a recursive algorithm that uses the idea of backtracking
(6) Bfs requries more memory	Dfs requires less memory

Back page

(3) state the measures that evaluate an algorithms performance.

→ (1) Time complexity

(2) space complexity

(3) processor & memory

(4) capacity

(4) write a short note on production system.

→ A production system" is a computer program typically used to provide some form of artificial intelligence, which consist primarily of a set of rules about behaviour but it also includes the mechanism necessary to follow these rules as the system responds to states of the world. Those rules, termed productions, are a basic representation found useful in automated planning, expert systems & action selection production consist of two parts: a sensory precondition and an action.

(5) Explain DFS search : state the disadvantag.

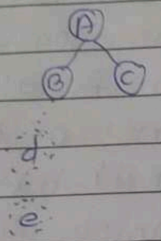
→ (1) DFS searching technique starts with the root node of the graph G, and then travel to deeper and deeper until we find the goal node or the node which has no children by visiting different node of the tree.

② The data structure which is being used in DFS is stack.

③ This is uninformed search technique also called as blind search

④ This algo. works on only present value. i.e no use of heuristic value.

⑤ space & time complexity of DFS is also $O(b^d)$ where v is vertices & E is edges.



Disadvantages

① It is possible that may states keep reoccurring. There is no guarantee of finding the goal node.

② sometimes the states may also enter into infinite loops.

⑥ Explain BFS search. state its disadvantages

→ for traversing or searching tree or graph data structures. It starts at the tree root and explores all of the neighbor nodes at the present dept prior to moving on to the nodes at the next depth level.

② The data structure which is being used in BFS is Queue.

③ This is uninformed search technique also called as blind search

④ Space & time complexity of BFS is $O(b^d)$

⑦ Define search stratergy.

→ A search stratergy is an organised structue of key terms used to search a database.

⑧ How is time & space complexity measured in searches ?

→ Time Factor :- The time is calculated or measured by counting the number of key operations such as search in searching algorithm.

Space factor :- The space is calculated or measured by counting the maximum memory space required by the algorithm.

3 Heuristic Search Technique.

① state any 4 heuristic search technique (2m)

→ ① A* search
② Simulated Annealing
③ Hill climbing.
④ Best first search.
⑤ Beam search.

② Explain the generate and test straterdgy of problem solving. (4m)

→ The generate & test stratergg is the simplest of all the approaches. It consists of the following steps.

Algorithm: Generate-and-test.

① Generate a possible sol^n. for some problems, This means generating a perticular point in the problem space. for others, It means generating a path from a start state.

② Test to see if this is actudlly a solution by comparing the chosen point or the endpoint of the chosen path to the set of acceptable goal states.

③ If a solution has been found, quiet. Otherwise return to step 1.

This approach is what is known as the British Museum algorithm, finding an object in the British Museum by wandering randomly.

③ Explain the pros and cons of the Generate-and-test stratergy (2m)

→ Disadvantages :-

The generate-and-test approach is not very efficient because it generates many arong assignments of values to variables which are rejected in the testing phase.

Advantages :-

In this technique, all the solutions are generated and tested for the best solution.

④ state the method to implement generate-and-test. (2m)

→ ① Exhaustive generate-and-Test
② Heuristic generate-and-test.
③ plan generate-and-test
- Create a list of candidates.
- Apply generate-and-test to that list.

⑤ what is the British Museum. (2m)

→ The British Museum algorithm is general approach to finding a solution by checking all possibilities one by one, begining with the smallest. The term refers to a conceptual, not a practical, technaive where the number of possibilities is enormaus.

⑥ what is hill climbing straterty? (2m)

→ A hill-climbing algorithm is a local search algorithm that moves continiously upword (increasing) until the best solution is attained. This algorithm comes to an end whent the peak is reached. This agorithm has a node that comprises two parts: state and value.

⑦ How is Hill climbing ~~Strotergy~~ differeent from Generate-&-test strotergy

→ Hill climbing is the variant of. generate and Test method. The-generate and test method produce feedback which heps to decide which direction to move in the search space.

Hill climbing algorithm search move in the direction which optimizes the cost.

⑧ Absolute and Relative.

Absolute = finding best path

Relative = finding any path

⑪ Stepest Ascent Hill climbing.

→ The stepest Aseent Algorithm is a variation of the simple hill-climbing algorithm. This algorithm examines all the neighbouring nodes of the current state and selects one neighbours node whichich is closest to the goal state. This algorithm consumes more time as it searches for multiple neighbours.

(23) Discuss any three search methods used to navigate through the search tree. explain. Advantages & disadvantages of these method.

→ ① Dept First search. (DFS)

② Breadth first search (BFS)

③ uniform cost search

(24) What is best first search? explain how it is implemented in A* and Ao* algorithm.

→ The best first search uses the concept of a priority queue and heuristic search

It is a search algorithm that works on a spescific rule. The aim is to reach the goal from the initial state via the shortest path. Best first search is an algorithm for finding the shortest path from a given starting node to a goal node in a graph.

(25) Explain the simulated annealing algorithm.

→

(27) Explain A* algorithm.

→ A* algorithm is searching algorithm that searches for the shortest path between the initial and the final state. It is used to various applications, such as maps. In maps the A* algorithm is used to calculate the shortest distance between the source (initial state) and the destination (final state)

A* algorithm has 3 Parameters:

- g: The cost of moving from the initial cell to the current cell. Basically it is the sum of all the cells that have been visited since leaving the first cell.

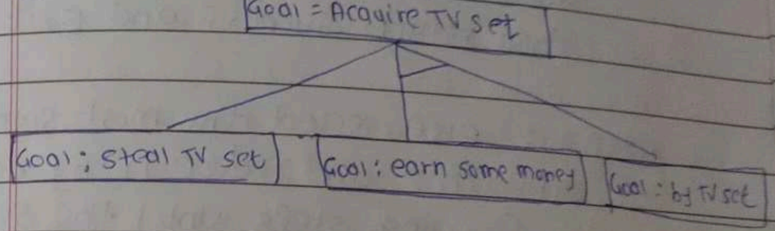
- h :- also known as the heuristic value, it is the estimated cost of moving from the current cell to the final cell. The actual cost cannot be claculated until the final cell is reached.

- f: it is the sum of g & h so
  $f = g + h$.

(28) What are AND-OR Graphs. (2m)

→ The AND-OR GRPH (or tree) is useful for representing the solution of problems that can solved by decomposing them into a set of smaller problems, all which must then be solved. This decomposition, or reduction, generates arcs that we call AND arcs.

eg



(30) What is constraint satisfaction?

→ In artificial inteligence and operations research, constraint satisfaction is the process of finding a solution through a set of constraints that impose conditions that the variables must satisfy.

(31) What is means-ends analysis? (2m)

→ Means-ends analysis is a problem solving straterg that arose from the work on problem solving of Newell and Simon (1972) In means-ends analysis, one solves a problem by considering the obstackles that stand between the

↓ Initial problem state and the goal state

(8e) explain the means ends algorithm (4m)

→ lets we take current state as CURRENT and Goal state as GOAL then following are the steps for the MEA algorithm.

• step 1 : compare CURRENT to GOAL, if there are no difference between both then return success and Exit.

• step 2 : Else, select the most significant difference and reduce it by doing the following steps until the success or failure occurs.

ⓐ select a new operator O which is applicable for the current difference, and if there is no such operator, then signal failure.

ⓑ Attempt to apply operator O to CURRENT ; Make a description of two states.

i) O-start, a state in which O's precondition are satisfied.

ii) O-Result, the state that would result if O were applied In O-start

ⓒ If

(First-Part ← ... MEA

(CURRENT, O-START)

And

(Last-Part ← MEA (O-Result, GOAL), are successful, then signal success and return the result of combining FIRST-PART, O, and LAST-PART

(35) Difference between forward Vs Backward Reasoning. (4m)

→

	Forward Reasoning	Backward Reasoning
①	The forward Reasoning is data driven approach.	Backward Reasoning is goal driven.
②	The process start with new data and facts in the forwarde	Backward Reasoning begins with the Result.
③	Forward Reasoning aims to determine the result followed by some sequence.	backward Reasoning emphesis on the acts that support the conclusion.
④	The forward Reasoning is an opportunistic approach because it could produce different Results.	In Backward Reasoning a spesific goal can only have certain Predetermine initial data which makes it restricted.
⑤	The flow of the forward Reasoning is from antecedant to consequent.	Backward Reasoning works in reverse order in which it starts from conclusion to. incipient.

IV Knowledge Representation.

① What are facts? (2m)

→ Truth in some relevant world. These are things that we want to represent.

② A good system for representation of knowledge in a particular domain is a must in an AI problem. state the properties that such a system must possess (2m)

→ ① Representation Accuracy.
② Inferential Adequacy.
③ Inferential Efficiency.
④ Acquisitional efficiency.

③ State the various methods of representing knowledge; (2m)

→ ① logical Representation.
② semantic network Representation
③ Frame Representation.
④ production Rules.

④ Describe any two methods of representing knowledge.

→ ① Logical Representation :-

Logical Representation is a language with some concrete Rules which deals with propositions and has no ambiguity in representation. Logical Representation means drawing a conclusion based on various conditions. This representation lays down some important communication rules. It consist of precisely defined syntax and semantics which supports the sound inference.

(2) semantic Network representation :-

semantic network are alternative of predicate logic for knowledge representation. In semantic networks we can represent our knowledge in the form of graphical networks. This network consist of nodes representing objects and arcs which describe the relationship between those objects. semantic network can categorized the object in different forms and can also link those objects. semantic network are easy to understand and can be easily extended.

(5) What are computable functions & predicate explain with the help of examples.

→ computable functions are the basic objects of study in computability theory. computable functions are the formalized analogoue of the intuitive notion of algorithms, in the sense that a function is computable if there exist an algorithm that can do the job of the function. i.e. given an input of the function domain it can return the corresponding output.

- Turing machines or Register machines.

- predicate :-

A predicate is function that tests for some condition involving its arguments and returns nill if the condition is false, or some non-nill value if the condition is true. one may think of predicate as producing a boolean value.

(6) What is resolution? (2m)

→ Resolution is a theorem proving technique that proceeds by building refutation proofs, i.e. proofs by contradictions. It was invented by a john Alan Robinson.

Resolution is used, If there are various statements are given, and we need to prove a conclusion of those statements.

vert a

slot -and- filler structure

① state the Limitations of semanticnets
→ ① semantic Nets are not intelligent, dependant on creator.
② Links on object represent only binary relations.
③ Negation, disjunction and general non-taxonomic knowledge are not easily expressed.

② short Note on Frames :
→ - The idea behind a frame was originally that it would represent a "frame of memory" - for instance, by capturing the objects and their attributes for a given situation or moment in time.
- A frame would contain slots where a slot could contain
- identification information
- relationships to other frames.
- descriptors of this frame.
- Procedural information how to use this frame
- defaults for slots.
- Instance information

④ short Note on CD (4-5 m)

→ conceptual Dependancy originally developed to represent knowledge acquired from natural language input.

The goal of this theory are.

- To help in the drawing of inference from sentences.
- To be independent of the words used in the original input.
- That is to say : for any 2 (or more) sentences that are identical in meaning there should be only one representation of that meaning.

CD Provides :-

- a structure into which nodes representing information can be placed.
- a spescific set of primitives.
- at a given level of granularity.

Examples of Primitive Acts are,

ATRANS ⇒ Transfer of an abstract Relationship e.g. give.

PTRANS :- Transfer of the physical location of an object. e.g go

PROPEL : Application of a physical force to an object. eg. push.

MTRANS : Transfer of mental information e.g tell

MBUILD : construct new information from old. eg. decide

⑤ short note on script.

→ • scripts were introduced by schank and Abelson introduced in 1977 that used CD framework.

- The scripts are useful in describing certain stereotyped situations such as going to theater.
- It consist of set of slots containing default values along with some information about the type of values similar to frames.
- It differ from FS as the value of the slots in script must be ordered and have more specialized Roles.
- In real world situations, we see that event tends to occur in known patterns because of clausal relationship to the occurence of events.

⊛ Each script contains the following main components.

- Entry conditions : Must be satisfied before events in script can occur.
- Results :
- Props :
- Roles:
- Track:
- Scenes.

ch vi

Game Playing.

① Explain the min-max Algorithm. (4m)

The min max algorithm in AI, popularly known as the minimax, is a backtracking algorithm used in decision making, game theory and artificial intelligence (AI). It is used to find the optimal move for a player, assuming that the opponent is also playing optimally.

The steps for the min-max algorithm in AI can be started as follows.

① Create the entire game tree.

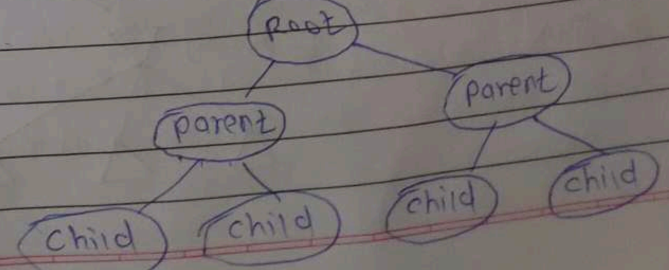
② Evaluate the scores for the leaf nodes based on the evaluation function.

③ Backtrack from the leaf to the root nodes:

· For Maximizer, Choose the node with the maximum score.

For Minimizer, choose the node with the minimum score.

④ At the root node, choose the node with the maximum value and select the respective move.

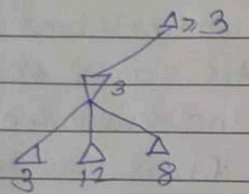


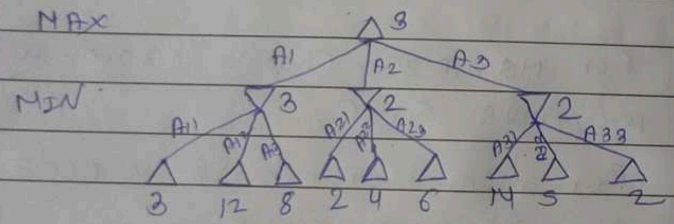
② Explain Alpha-Beta Algorithm

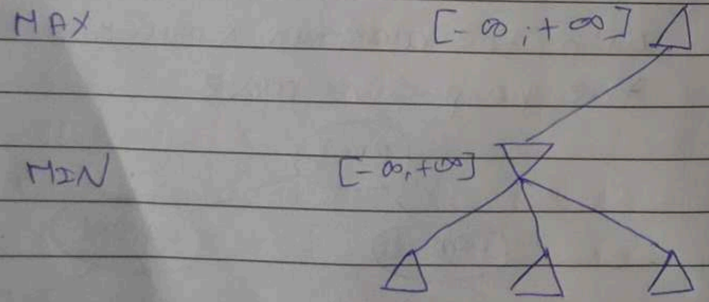
→

- It is based on process of eliminating a branch of the search tree "prunning" the search tree.
- It is applied as standard minimax tree
- prunes away branches that are not necessary to the final decision.

α-β example







VII Learning

① What is Learning ?

→ Learning is the ability to adapt to new surroundings and solve new problems

② Write a short note on Rote Learning.

→ Rote Learning is the process of memorize spescific new items as they are encountered. The basic idea is simple and easy to realize within a computer program: each time a new and useful piece of information is encountered; it is stored away for future use.

Requires:

① organised storage of information, and

② Generalisation.

③ What are capabilities that rote learning must posses in order to be used in complex learning systems.

→ meaningful learning, associative learning spaced repetition and active learning.

④ Write a short note on Learning by taking Advice (Direct instruction).

→
- Involves receiving direct instruction on how to respond to certain situations.
- In a machine, this amounts to straight - forward procedural programming

- In situations where the instructions do not correspond to direct procedures (eg "Take control of the center of the board" in chess), an interpreter is required to translate the instructions to concrete execution steps.

⑧ Write a short note on Learning from Examples.

→ • Classification: The process of assigning, to a particular input, the name of a class to which it belongs.

- Classify by looking at many different examples of a class, and generalising the common features.
- Must define class structure before classification.
- Process begins.

⑨ Explanation based learning.

→ • To extract the concept ~~φ~~ behind the information within.
one example and generalize to other instances.

- Requires domain-specific knowledge
- In general, the inputs to EBL program are.

Q (Inputs to an EBL Program)

1. A Training Example
2. A Goal concept
3. An operationally Criterion
4. A Domain Theory (or knowledge base)

Examples

state space search

① Farmer = F
Dog = D
Rabbit = R
Lettuce = L

Initial state = (FDRL, 0)
Goal state = (0, FDRL)
<FDRL,0> <0, FDRL)
↓
~~<DL, RO>~~ ~~<~~

<DL, FR> → sending Farmer & Rabbit on 2nd side
<FDL, R> → sending F on first side.
<L, FDR> → sending F & D on second side
<L.F.R, D> → sending F & R on 1st side
<R, FDL> → sending F & L on 2nd side.
<FR, DL> → sending F ~~&~~ on 1st side.
<0, FDRL> → sending F & R on 2nd side
<0, FDRL> = Goal state. Reached

② 8-/15- puzzle State space search

1	2	3
4	8	X
7	6	5

⟹

1	2	3
4	5	6
7	8	X

Initial state Goal state.

→ S: (S, A, Result)
S = set of all possible state.
A = set of All possible Action.

X = blank space

Action possible on = up, down, Left, Right

1	2	3
4	8	X_5
7	6_x	5 x

⟹

1	2	3
4	5	6
7	8	X

Initial State Goal state

{(1,2,3), (4,8,x), (7,6,5)} → set of given set

{(1,2,3), (4,8,5), (7,6,X)} → down operation on x

{(1,2,3), (4,8,5), (7,0,6)} → Left operation on x

{(1,2,3), (4,x,5), (7,8,6)} → up operation on x

{(1,2,3), (4,5,x), (7,8,6)} → Right operation on x

{(1,2,3) (4,5,6), (7,8,X)} → down operation on x
↑
Goal state reached
Final state.

~~B~~OX. Representation ⟹

③ crypt Arithmatic problems.

- cryptarithmatic problem is a type of constraint satisfaction problem where the game is about digits & its unqique replacement either with alphabet or other symbols. In cryptarithmatic problem, the digits (0-9) get subtituted by some possible alphabets or symbols.

$$\begin{array}{r} \text{SEND} \\ +\ \text{MORE} \\ \hline \text{MONEY} \end{array}$$

S = 9
E = 5
N = 6
D = 7
M = 1
O = 0
R = 8
y = 2

$\begin{array}{r} 9 \\ +1 \\ \hline 10 \end{array}$ $\begin{array}{r} S \\ +M \\ \hline 10 \end{array}$

$\begin{array}{r} ① \\ E \\ +O \\ \hline N \end{array} = \begin{array}{r} 5 \\ +0 \\ \hline 5 \end{array}$

$\begin{array}{r} N \\ +R \\ \hline E \end{array} = \begin{array}{r} ① \\ 6 \\ 8 \\ \hline 15 \end{array}$

$\begin{array}{r} D \\ +E \\ \hline Y \end{array} = \begin{array}{r} 7 \\ 5 \\ \hline 12 \end{array}$

② $\begin{array}{r} \text{BASE} \\ +\text{BALL} \\ \hline \text{GAMES} \end{array}$

~~1~~,2,3,~~4~~,5,~~6~~,~~7~~,~~8~~,9

B = 7
A = ~~4~~ ~~8~~ 4
S = ~~6~~ ~~9~~ 8
E = ~~8~~ ~~6~~ 3
L = ~~8~~ ~~3~~ 5
G = 1
M = ~~8~~ ~~6~~ 8 9

$\begin{array}{r} B \\ +B \\ \hline GA \end{array} = \begin{array}{r} 7 \\ 7 \\ \hline 14 \end{array}$

$\begin{array}{r} A \\ +A \\ \hline M \end{array} = \begin{array}{r} \cancel{2} \\ \cancel{2} \\ \hline \cancel{8} \end{array} \begin{array}{r} 4 \\ 4 \\ \hline \cancel{8} \end{array} \begin{array}{r} 3 \\ 3 \\ \hline 6 \end{array} \begin{array}{r} 4 \\ 4 \\ \hline 8 \end{array}$ 7,1,4,

~~7,8~~

7,1,4,3,6

$\begin{array}{r} S \\ +L \\ \hline E \end{array} = \begin{array}{r} \cancel{3}6 \\ 3 \\ \hline 9 \end{array}$ $\begin{array}{r} S \\ +L \\ \hline E \end{array} =$

~~2,6,8,~~9
7,1,4,8
2,3,5,6,9

$\begin{array}{r} E \\ L \\ \hline S \end{array} = \begin{array}{r} 9 \\ 3 \\ \hline 12 \end{array}$ $\begin{array}{r} E \\ +L \\ \hline S \end{array}$ $\begin{array}{r} 68 \\ -03 \\ \hline 9 \end{array}$ $\begin{array}{r} 9 \\ 3 \\ \hline 2 \end{array}$

$\begin{array}{r} 3 \\ +5 \\ \hline 8 \end{array} = \begin{array}{r} E \\ -L \\ \hline S \end{array}$

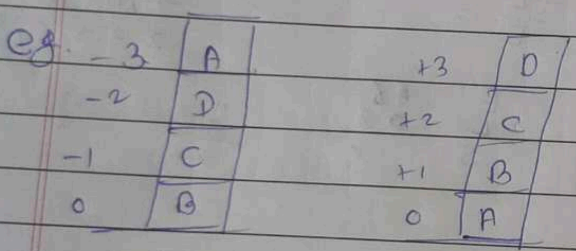
$\begin{array}{r} 8 \\ +S \\ \hline 13 \end{array}$ $\begin{array}{r} S \\ +L \\ \hline E \end{array}$ $\begin{array}{r} ① \\ 4 \\ 4 \\ \hline 9 \end{array}$ $\begin{array}{r} A \\ +A \\ \hline M \end{array}$

* Simple Hill Climbing

Algorithm

1) Evaluate the initial state.
2) Loop until solⁿ is found or there are no new operators left to be applied.
   - select & apply a new operator
   - Evaluate the new state.
     goal - quit.
     better than current state → new current state
3) exit.

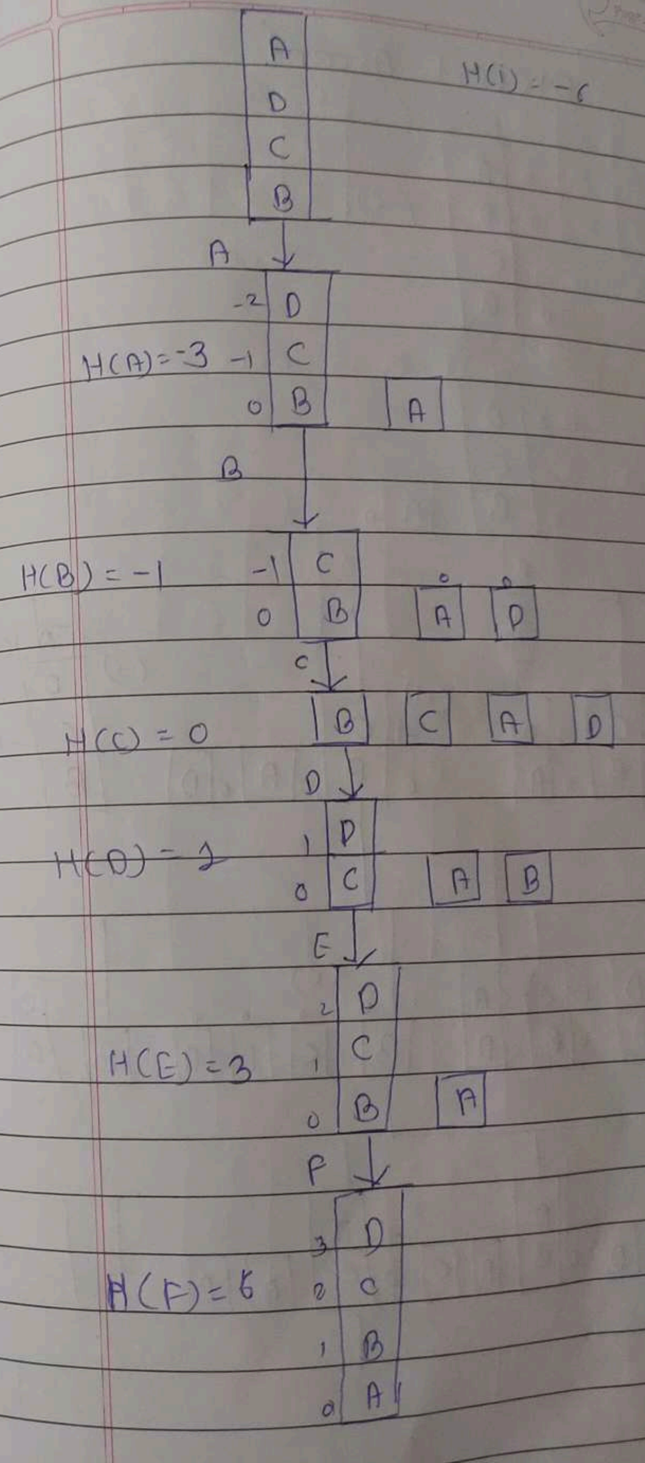
eg.



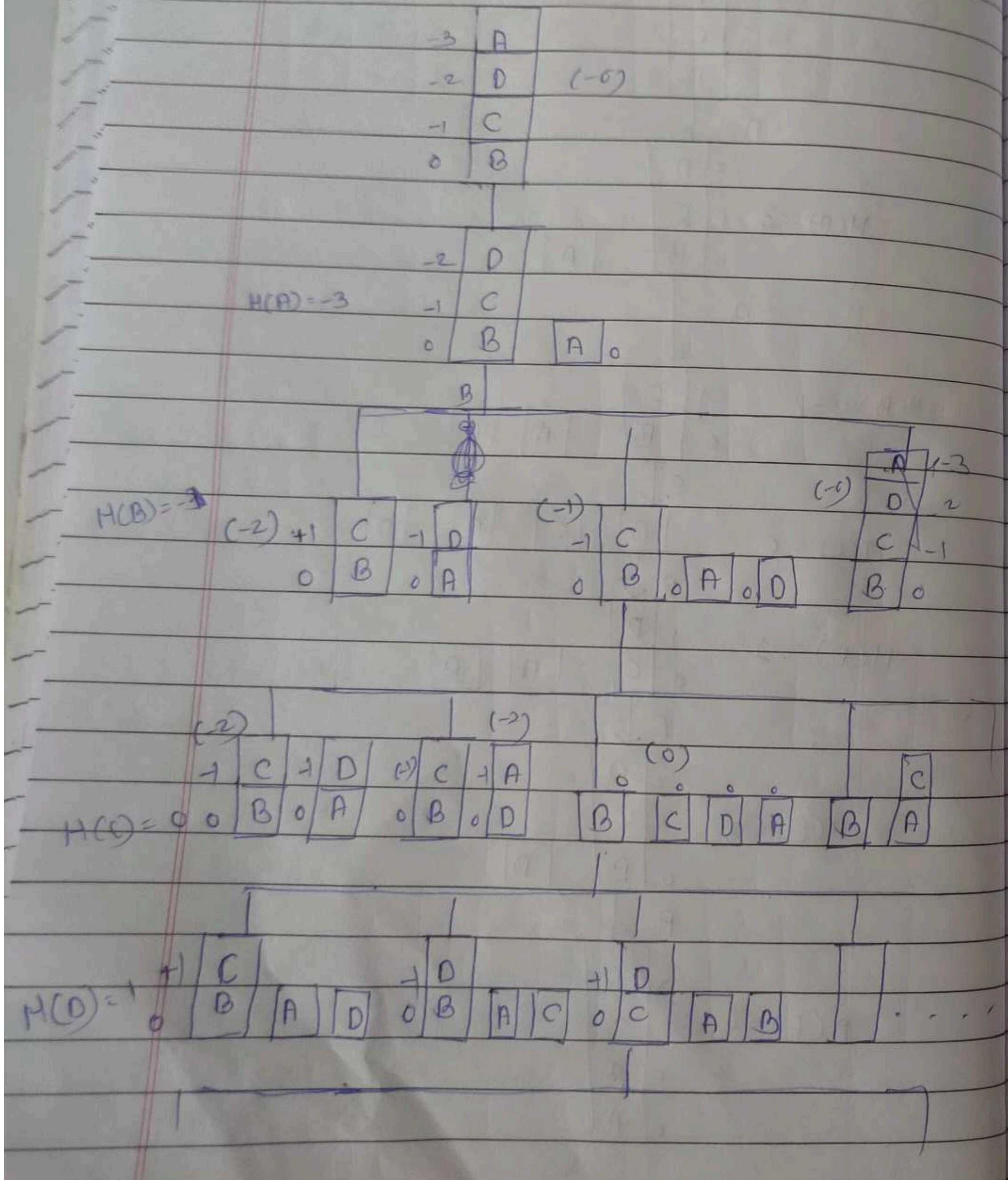
Initial state (i) -6   Final state (G) +6

for each block that has correct support structure add 1 point for every block in the support structure under that block and subtract 1 point for every block under this block if it has incorrect support structure.

H (i) = -6
H (G) = 6



Stepest Ascent



~~Stepest Ascent~~

⊛ A*

Best first search

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

$h(n)$ = cost of the cheapest path from noden n to a goal state

$g(n)$ = cost of the cheapest path from the initial state to node n

A* $F^*(n) = g^*(n) + h^*(n)$

$h^*(n)$ (heuristic factor) = estimate of $h(n)$

$g^*(n)$ (depth factor) = Approximation of $g(n)$ found by A* so far.

	1	3
4	2	5
7	8	6

(4)

Initial

1	2	3
4	5	6
7	8	

(8)

Goal.

H = Add 1 if it is correct Position

H(i) = 4

H(G) = 8

A

	1	3
4	2	5
7	8	6

f' = 0+4

open {A4}

close {Φ}

B

1		3
4	2	5
7	8	6

f' = 1+5

C

4	1	3
	2	5
7	8	6

f' = 1+3

open {B6, C4}

close {A4}

open = {C4, D8, E6}

close = {A4, B6}

D

1	2	3
4		5
7	8	6

f' = 2+6

E

1	3	
4	2	5
7	8	6

f' = 2+4

open = {C4, E6, F8, G~~7~~9 H8}

close = {A4, B6, D8}

F

1	2	3
	4	5
7	8	6

f' = 3+5

G

1	2	3
4	5	
7	8	6

f' = 3+7

H

1	2	3
4	8	5
7		6

f' = 3+5

open = {C4, E6, F8, H8, I10, J12}

close = {A4, B6, D8, G10}

G

I

1	2	
4	5	3
7	8	6

f' = 4+6

J

1	2	3
4	5	6
7	8	

f' = 4+8

open = {C4, E6, F8, H8, I10}

close = {A4, B6, D8, G10, J12}