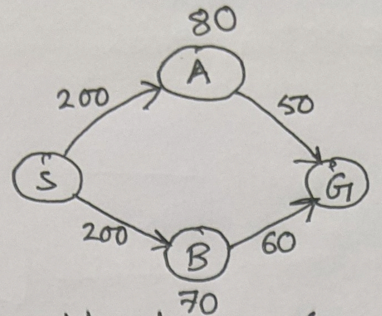
AIFA CLASS TEST - 1 Model Answers

PART - A

1. a) True.

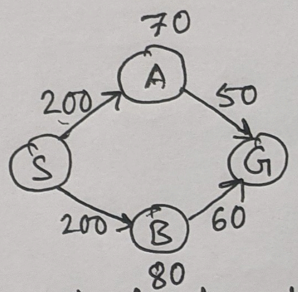


A, B are over-estimating. So, the path found is $S \rightarrow B \rightarrow G$, which is not optimal.

b) False.

In the previous image, both will find the same solution but the path may not be optimal.

c) True.



In this case, the first solution of DFBB will be optimal.

d) True.

Justification: Consider a binary tree of depth 'd' with all leaf nodes being goal, edge costs 1 and heuristic value 0.

Here IDA* will perform many iterations and its last iteration will be same as DFS.

e) False

Justification: IDA* expands the same nodes as in A*, sometimes more than once.

2. a)

Each node in the algorithm has a cost $g(n)$ and a heuristic estimate $h(n)$. $f(n) = g(n) + h(n)$. Assume all $c(n,m) > 0$

Step 1 [Initialize] Initially the OPEN list contains the start node s. $g(s) = 0$, $f(s) = h(s)$. CLOSED list is empty.

Step 2 [Select] Select the node n ~~on~~ on the OPEN list with maximum $f(n)$. If OPEN is empty, terminate with failure.

Step 3 [Goal Test, Terminate] If n is goal, then terminate with success and path from s to n.

Step 4 [Expand]

A) Generate the successors $n_1, n_2, \ldots, n_K$, of node n, based on the state transformation rules.

B) Put n in CLOSED list.

C) For each n_i, not already in OPEN or CLOSED, compute

$$g(n_i) = g(n) + c(n, n_i), \quad f(n_i) = g(n_i) + h(n_i)$$

Put n_i in the OPEN list.

D) For each n_i already in OPEN, if $g(n_i) < g(n) + c(n, n_i)$, then revise costs as:

$$g(n_i) = g(n) + c(n, n_i), \quad f(n_i) = g(n_i) + h(n_i)$$

Step 5 [Continue] Go to Step 2.

b) For minimization problem, in Step 2 minimum $f(n)$ will be chosen and in Step 4.D the condition will be $g(n_i) > g(n) + c(n, n_i)$

c) Conditions for optimality are:

Admissibility: Heuristic function is always over-estimating for maximization problem.

Monotonicity/Consistency: A heuristic $h(n)$ is consistent if, for every node n and every successor n' of n generated by any action a, the estimated cost of reaching the goal from n is no less than (the monotonicity of maximization problems will require a sign reversal) the step cost of getting to n' plus the estimated cost of reaching the goal from n': $h(n) >= c(n, a, n') + h(n')$.

The search graph has to be acyclic.

PART-B

3.a)

OPEN	CLOSE
A(66)	A(66)
B(65) C(56) D(38)	B(65)
C(56) D(38) E(37) F(46) G(28)	C(56)
D(38) E(37) F(48) G(29)	F(48)
D(38) E(47) G(32) I(37)	E(47)
D(38) G(32) I(46) J(42)	I(46)

As I ∈ Goal nodes and has maximum cost in OPEN, the algorithm will terminate.

b) Yes, we can say we obtained optimal cost solution as

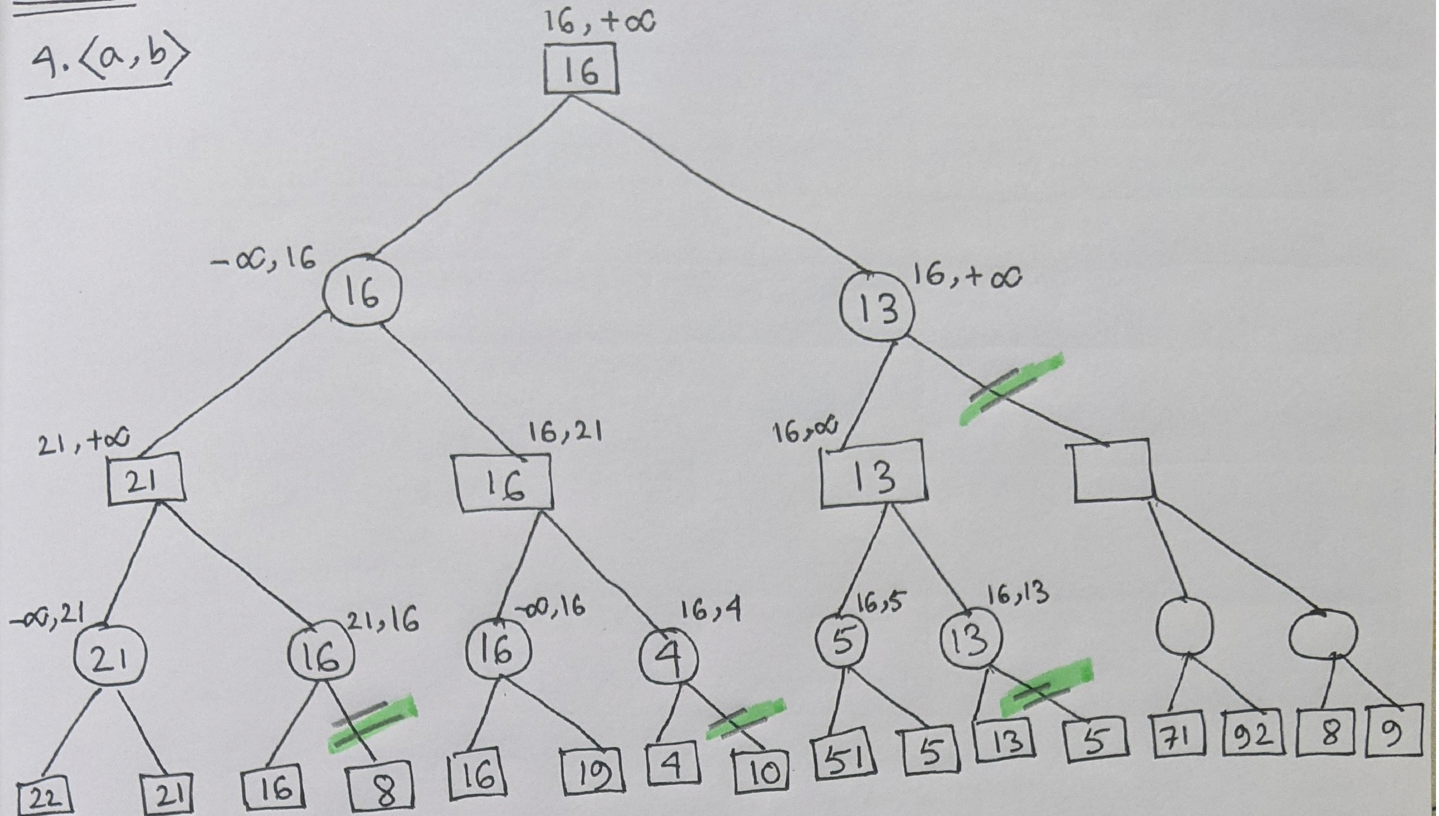
1. The heuristic is admissible.
2. In all paths from START to GOAL the heuristic is monotonic.

c) No.

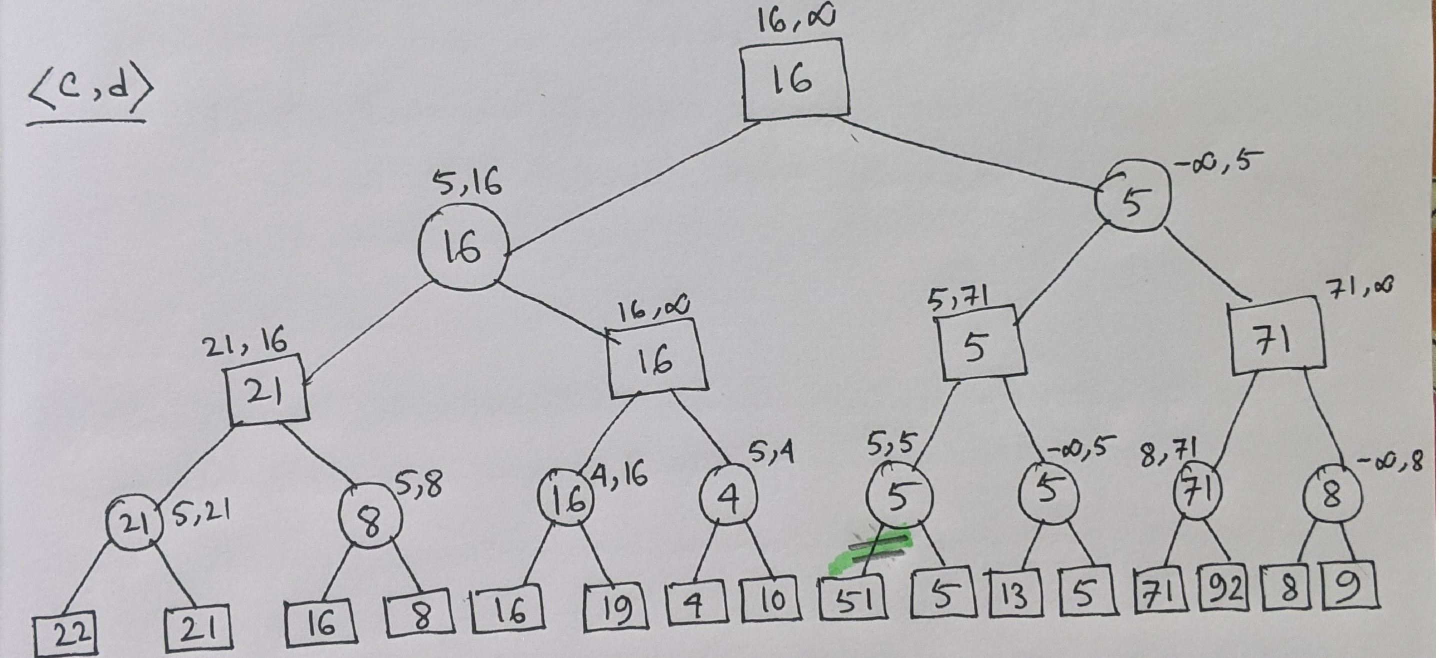
d) Increasing the heuristic value beyond 55 will not change the sequence of nodes expanded. Reducing the heurist value below 36 will result in the node not being expanded. In ~~#~~ between these, the node will be expanded at some point in time but will not change the solution.

PART-C

4. <a,b>



<c,d>



<e> Yes, it is possible. e.g: