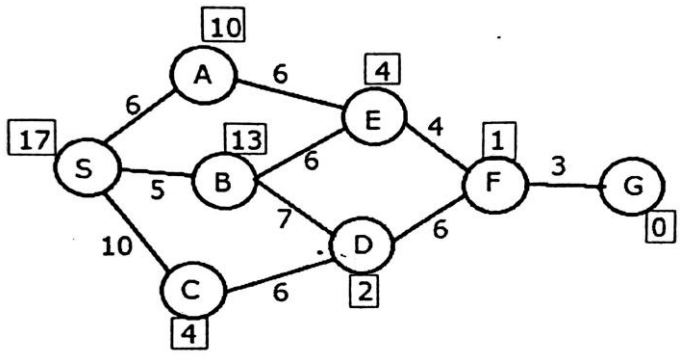
1.Consider the graph given below. Edge costs are given near edges. Heuristic value of a node is given in a square near each node. (i) Perform A* search algorithm to find path from S to G. Give trace of the search at each stage (i.e., show the open and closed lists along with appropriate entries). (ii) Is the given heuristic admissible? (You need to prove your answer formally). (iii) Is the given heuristic satisfy the monotone property? (You need to prove your answer formally). (3+2+2 = 7 marks)



(i)

Open List	Closed List
(S,-,17+0)	-
(C,S,4+10)(A,S,10+6)(B,S,13+5)	(S,-,17+0)
(A,S,10+6)(B,S,13+5)(D,C,2+16)	(S,-,17+0) (C,S,4+10)
(E,A,4+12)(B,S,13+5)(D,C,2+16)	(S,-,17+0) (C,S,4+10) (A,S,10+6)
(F,E,1+16)(B,S,13+5)(D,C,2+16)	(S,-,17+0) (C,S,4+10) (A,S,10+6) (E,A,4+12)
(G,F,0+19)(B,S,13+5)(D,C,2+16)	(S,-,17+0) (C,S,4+10) (A,S,10+6) ~~(E,A,4+12)~~ (F,E,1+16)
(E,B,4+11)(D,B,2+12)~~(D,C,2+16)~~ (G,F,0+19)	(S,-,17+0) (C,S,4+10) (A,S,10+6) ~~(F,E,1+16)~~(B,S,13+5)
(F,D,1+18)(E,B,4+11) (G,F,0+19)	(S,-,17+0) (C,S,4+10) (A,S,10+6)(B,S,13+5)(D,B,2+12)
(F,E,1+15)(~~F,D,1+18~~)(G,F,0+19)	(S,-,17+0) (C,S,4+10) (A,S,10+6) (B,S,13+5)(D,B,2+12) (E,B,4+11)
(G,F,0+18) ~~(G,F,0+19)~~	(S,-,17+0) (C,S,4+10) (A,S,10+6)(B,S,13+5)(D,B,2+12) (E,B,4+11) (F,E,1+15)

Path from S to G is **S-B-E-F-G**

(ii)Admissibility of the heuristic:

We know that, if there is a path from start to a goal node, A* terminates by finding an optimal path,Algorithm A* is admissible.

The following are the possible paths in the given graph:

S-A-E-F-G : 6+6+4+3=19

S-B-E-F-G : 5+6+4+3=18

S-C-D-F-G : 10+6+6+3= 25

S-B-D-F-G : 5+7+6+3 =21

The obtained path using the given heuristic is the optimal path. Hence we say that the heuristic is admissible.

iii)Consistency of the heuristic:

We know that for a heuristic to be consistent For every node m and for any successor n of

m, we have,

$h(m) \leq h(n) + k(m,n)$

where k(m,n) is the cost of the edge from m to n.

Lets start with the path

S-A-E-F-G:

$H(S) \leq h(A)+k(S,A)$

$17 \leq 10 + 6$ (FALSE)

S-B-E-F-G:

$H(S) \leq h(B)+k(S,B)$

$17 \leq 13+5$ (true)

$h(B) \leq h(E) +k(B,E)$

$13 \leq 4+6$ (False)

S-B-D-F-G:

$H(S) \leq h(B)+k(S,B)$

$17 \leq 13+5$ (true)

$h(B) \leq h(D) +k(B,D)$

$13 \leq 2+7$ (False)

S-C-D-F-G:

$h(S) \leq h(c)+k(S,c)$

$17 \leq 4+10$ (false)

We say that the heuristic is not consistent.

Another way :

If the heuristic is consistent then we never have to revisit the closed set. But in this case, we have revisited the nodes in the closed set, since their costs could be further lowered