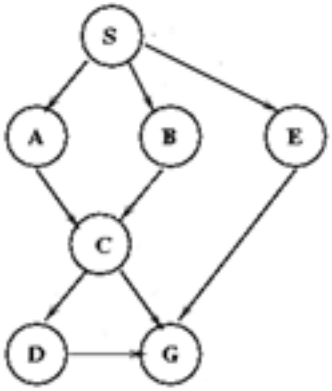
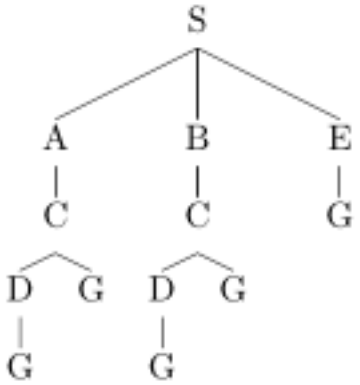
6.034 Recitation 4: Optimal Search Exercise Answers (9/25-26/03)





Link lengths:

S-A	1	C-D	1
S-B	2	C-G	6
S-E	5	D-G	2
A-C	2		
B-C	7		
E-G	7		

Estimates of distance to G from:

A	5
B	3
C	6
D	2
E	7
G	0
S	1

2. Using branch and bound without an extended list, identify the shortest path from S to G, enumerating in order the partial paths encountered and their lengths. (Note: This is a short cut to working through the branch and bound algorithm showing the contents of the queue after each node extension step. Either method should produce the same answer.) You may write partial paths in either direction (e.g. either (S A) or (A S)).

Partial path	Length	
(S A)	1	
(S B)	2	
(S A C)	3	
(S A C D)	4	
(S E)	5	
(S A C D G)	6	This is the shortest path from S to G.

(over)

3. Now search the above graph for the shortest path from S to G using A* and an extended list. Fill in the table below, enumerate the order in which nodes are extended, and give the path. Assume new nodes are added to the front of the queue in left to right order, and that ties in choice of which node to extend are broken by picking the node closer to the front of the queue.

Queue	Extended list	Next node to extend	Not extended
(1 S)	()	(1 **S**)	
(6 A S) (5 B S) (12 E S)	S	(5 **B** S)	
(15 C B S) (5 A S) (12 E S)	S, B	(5 **A** S)	
(9 C A S) (15 C B S) (12 E S)	S, B, A	(9 **C** A S)	
(6 D C A S) (9 G C A S) (15 C B S) (12 E S)	S, B, A, C	(6 **D** C A S)	
(6 G D C A S) (9 G C A S) (15 C B S) (12 E S)	S, B, A, C, D	(6 **G** D C A S)	
(9 G C A S) (15 C B S) (12 E S)	S, B, A, C, D, G	done, path = (**S A C D G**)	

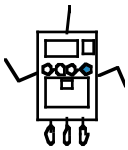
4. Which of the heuristic values for distance to G is inadmissible? Why?

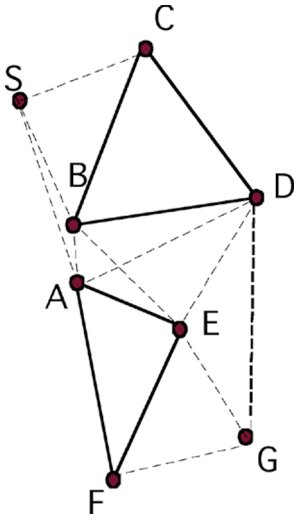
None, since all estimated h values are less than h*, the true path values remaining to the goal.

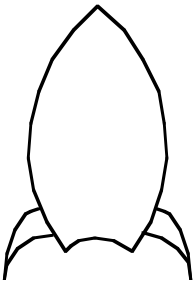
6.034 Recitation 4: Another Optimal Search Exercise Answer (9/25-26/03)

A* to the rescue!

Wallace and Gromit have just finished their vacation on the moon and are about to head back to Earth in their rocket ship (located at position G below). The local robot desperately wants to go back with them, but must hurry to get to the rocket ship in time. (He's at S below.) He has to navigate around two obstacles (shown as triangles AEF and BCD.) He uses his nifty A* search engine to find the best path. Which way does he go?







Link lengths:				Estimates of distance to G from:	
S-A	6	B-D	6	A	7
S-B	5	B-E	5	B	9
S-C	4	C-D	6	C	13
A-B	1	D-E	5	D	7
A-D	7	D-G	8	E	4
A-E	3	E-F	6	F	4
A-F	7	E-G	4	G	0
B-C	6	F-G	4	S	1

1. Assume his A* algorithm uses an extended list, adds new elements to the front of the queue, and breaks ties in choice of node to extend by picking the one closer to the front of the queue. Assume all heuristics are admissible (even if they aren't). What's the order of node extension, and what's the path? (And if you've seen the animation short, does he make it to the rocket ship in time?)

Queue	Extended list	Next node to extend	Not extended
1. (1 S)	()	(1 **S**)	
2. (13 A S) (14 B S) (17 C S)	S	(13 **A** S)	
3. (16 B A S) (20 D A S) (13 E A S) (17 F A S) (14 B S) (17 C S)	S, A	(13 **E** A S)	
4. (21 D E A S) (23 B E A S) (13 G E A S) (19 F E A S) (16 B A S) (20 D A S) (17 F A S) (14 B S) (17 C S)	S, A, E	(13 **G** E A S)	
5. (21 D E A S) (23 B E A S) (19 F E A S) (16 B A S) (20 D A S) (17 F A S) (14 B S) (17 C S)	S, A, E, G	done	

Node extension order: **S A E G**

Path: **S A E G**

END