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Artificial Intelligence
Assignment 3

27. November 2020

A1	A2	A3	A4	Σ

Task 1 Iterative deepening depth-first search

- Limit = 0: 1
- Limit = 1: 1, 2, 3
- Limit = 2: 1, 2, 4, 3, 5, 6
- Limit = 3: 1, 2, 4, 7, 8, 9, 3, 5, 10, 11, 6, **12**

Task 2 Greedy best-first search

a)

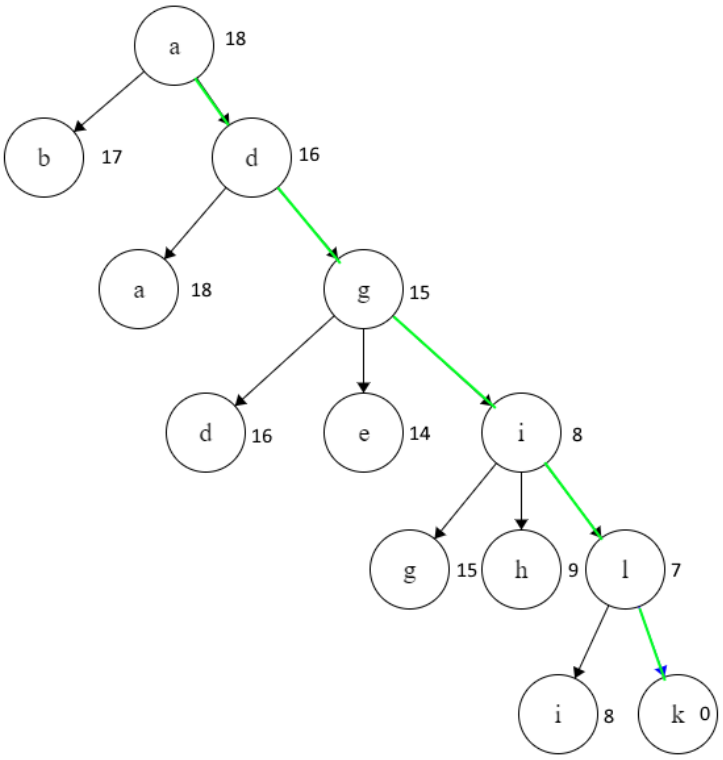

Abbildung 1

This path is not optimal, i.e. the path a-b-c-e-f-k has a path cost of 12, whereas the Greedy BFS path has a cost of 25. Greedy BFS does not take the accumulated path distance into account.

b)

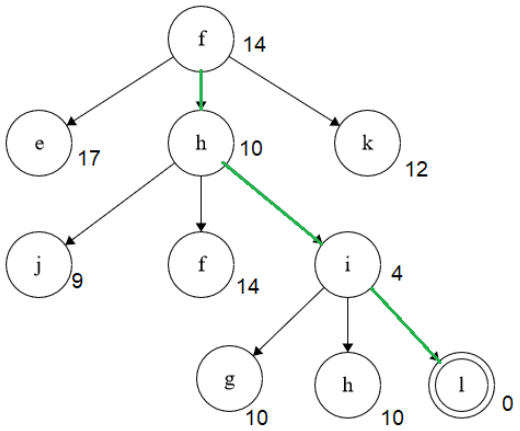

Abbildung 2

This path is optimal as it also has the shortest path, taking f-h-i-l, with a total cost of 6. There is no shorter path from f to l.

Task 3 Pathfinding with A*

a)

node	g	h	f	priority queue	(expansion node, f-value, predecessor)
a	0	10	10	(a, 10)	(a, 10, -)
b	3	4	7	(b, 7)	
c	3	7	10	(b, 7), (c, 10)	
d	5	3	8	(b, 7), (d, 8), (c, 10)	(b, 7, a)
d*	6	3	9	(d, 8), (c, 10)	(d, 8, a)
e*	8	1	9	(e, 9), (c, 10)	
f	7	2	9	(e, 9), (f, 9), (c, 10)	(e, 9, d)
h	11	0	11	(f, 9), (c, 10), (h, 11)	(f, 9, d)
c*	12	7	19	(c, 10), (h, 11)	
g	10	1	11	(c, 10), (g, 11), (h, 11)	
h	10	0	10	(c, 10), (h, 10), (g, 11)	(c, 10, a)
f	7	2	9	(h, 10), (g, 11)	(h, 10, f)

The last column can be treated as a kind of 'confirmed-stack'. Every node here has already a possible shortest path and does not need to be expanded upon discovering them through a different path. All sections marked with * also discover already confirmed nodes that don't get mentioned once more in the table. In the last row, we discover a path to f that has the same cost as the already confirmed path, thus gets not added to the priority queue. h is expanded with a total cost of 10 and the algorithm terminates. The found path is a-d-f-h.

b)

node	g	h	f	priority queue	(expansion node, f-value, predecessor)
a	0	10	10	(a, 10)	(a, 10, -)
b	3	4	7	(b, 7)	
c	3	7	10	(b, 7), (c, 10)	
d	5	3	8	(b, 7), (d, 8), (c, 10)	(b, 7, a)
d	6	3	9	(d, 8), (c, 10)	(d, 8, a)
a**	11	10	21	(c, 10)	
b**	8	4	12	(c, 10)	(c, 10, a)
a**	6	10	16		
f	7	2	9	(f, 9)	(f, 9, c)
g	10	1	11	(g, 11)	
h	10	0	10	(h, 10), (g, 11)	(h, 10, f)

**Those are actual already confirmed nodes and dont get added to the priority. They are just mentioned for completeness. The found path is a-c-f-h

c)

No, the shortest path in the left graph from a to h is not unique. The paths a-c-f-h and a-d-f-h both have the lowest cost of 10.

d)

Admissible means that the heuristic always assumes a shorter or equal distance than the real one. Consistent in this case is a synonym to monotic, meaning that the heuristic for a successor node keeps growing or stays equal, but never gets smaller.
But, when the triangle inequality formula

$$cost(a \to c) \leq cost(a \to b) + cost(b \to c)$$

is not applicable for every states a, b, c of the given heuristic, the heuristic is admissable but inconsistent

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Space for comments