AI - Assignment 3

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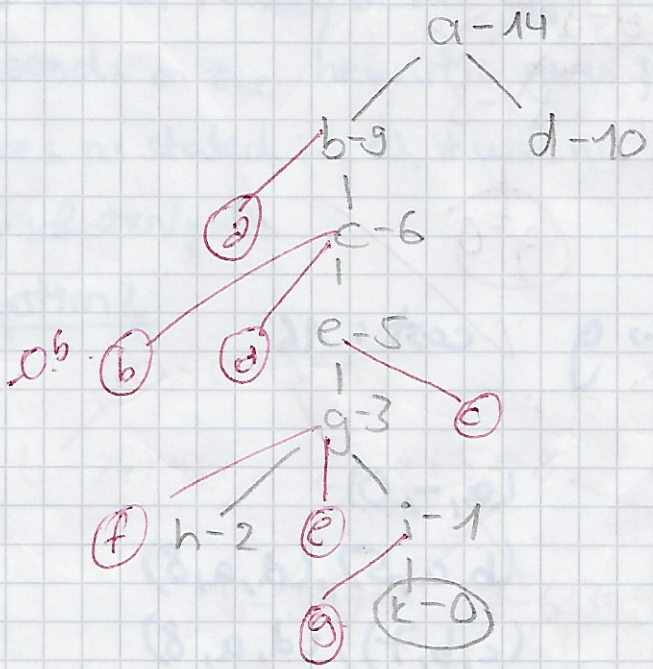
Question 1

a)

1	2	3	Σ
5.5	6	8	19.5



⇒ Path: a → b → c → e → g → i → k cost: 15

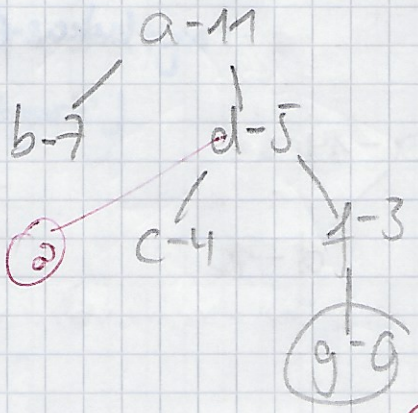
To check if Path is optimal, use Dijkstra and check if path cost is equal:

(a,-,0)	(a,-,0)
(b,a,5)	(b,a,5),(d,a,8)
(c,b,7)	(c,b,7), (d,a,8)
(d,a,8)	(d,a,8),(e,c,8)
(e,c,8)	(e,c,8),(f,d,11)
(f,d,11)	(f,d,11),(g,e,12)
(g,e,12)	(g,e,12)
(i,g,14)	(i,g,14),(h,g,15)
(k,i,15)	(k,i,15),(h,g,15)

⇒ Path: a → b → c → e → g → i → k

⇒ Dijkstra results in equal path ⇒ Path is optimal.

b)



⇒ Path: a → d → f → g cost: 16

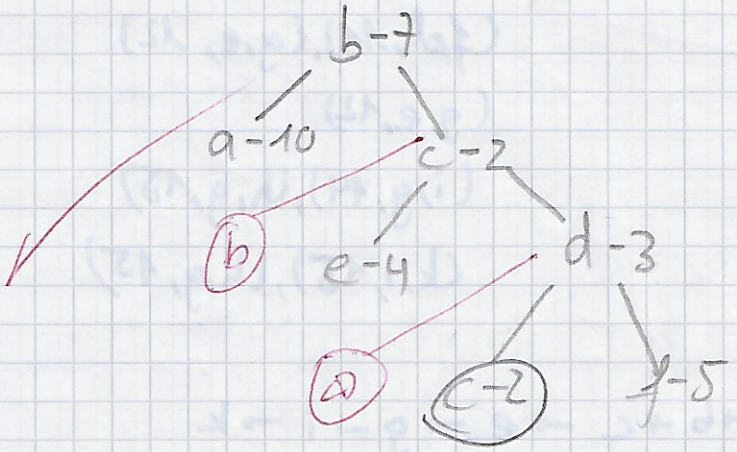
Dijkstra:

(a, –, 0)	(a, –, 0)
(b, a, 5)	(b, a, 5), (d, a, 8)
(c, b, 7)	(c, b, 7), (d, a, 8)
(d, a, 8)	(d, a, 8), (e, c, 8)
(e, c, 8)	(e, c, 8), (f, d, 11)
(f, d, 11)	(f, d, 11), (g, e, 12)
(g, e, 12)	(g, e, 12)

⇒ Path: a → b → c → e → g cost: 12

⇒ Path is not optimal, Dijkstra results in path with lower cost.

c)



This heuristic function will never result in a path from b to g. It will always toggle between c and d, because d will always be better than e

and e will always be better than f. ! Dorotea Ukathij
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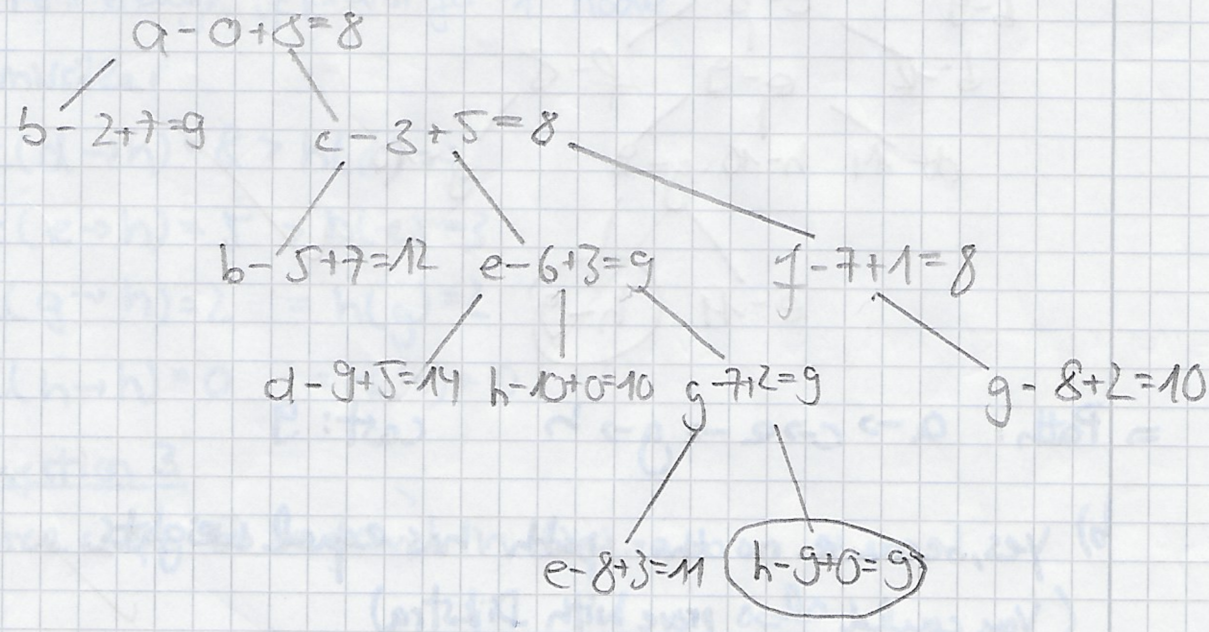
This example demonstrates how unstable Greedy best-first search really is. The efficiency of the algorithm depends on the heuristic given for the graph. In some cases as stated in c), it will not even be able to find any solution/path

Question 2

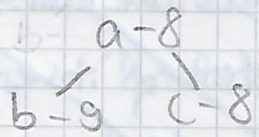
a)



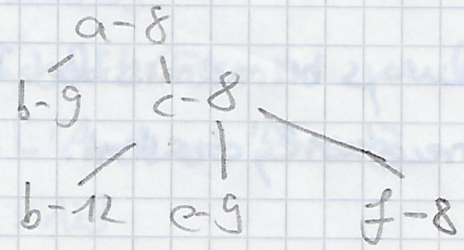
~~Paths~~

1.)

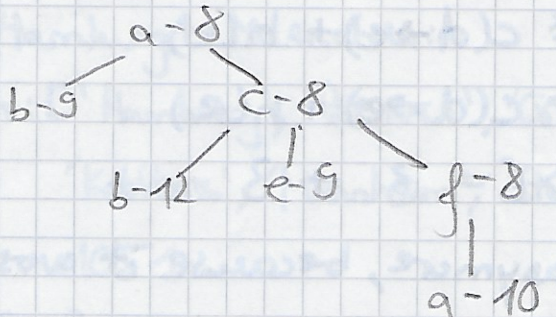
2.)



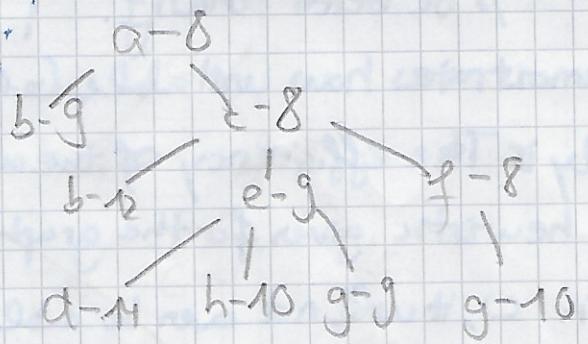
3.)



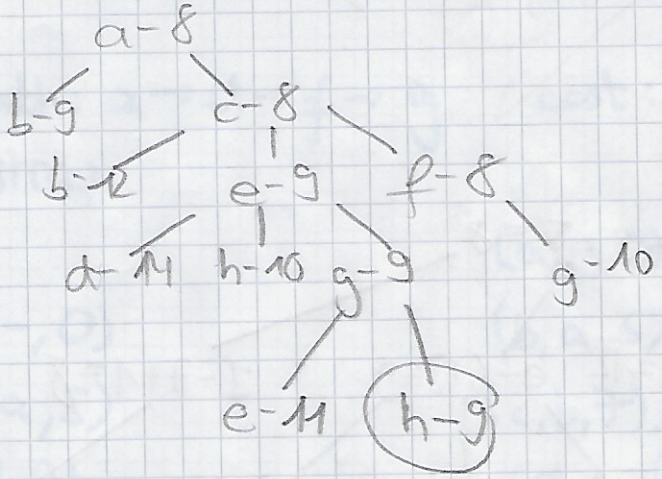
4.)



5.)



6.)



⇒ Path: a → c → e → g → h cost: 9

b) yes, because no other path has equal weights.
(You could also prove with Dijkstra)

c) An admissible heuristic never overestimates the cost of reaching the goal. A heuristic is consistent if its estimate is always.
A consistent heuristic will always be admissible. But an admissible heuristic is not necessarily consistent.

d) consistent: $h(d) \leq c(d \to c) + h(e)$
inconsistent: $h(d) > c(d \to e) + h(e)$
$h(d) > 6 = 3 + 3$

⇒ It is not admissible anymore, because it overestimates the cost to reach h: estimate: 7 or higher
actual cost: $d \to e \to g \to h) = 6$

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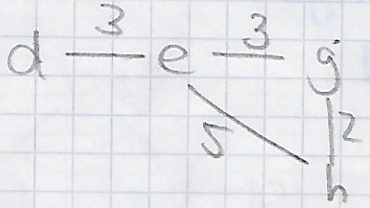
d)

n	h(n)
d	7
e	3
g	2
h	0



inconsistent:

$h(d) = 7 > 3 + 3 = c(d \to e) + h(e)$

⇒ It's enough if proven for 1 node.

admissible:

$c(d \to h) = 8 > h(d) = 7$

$c(e \to h) = 5 > h(e) = 3$

$c(g \to h) = 2 = h(g) = 2$

$c(h \to h) = 0 = h(h) = 0$

Question 3

Source code to be found in Ilias.

e)

(i) Rostock to Lindau:

Path: ['Rostock', 'Hamburg', 'Bremen', 'Osnabrueck', 'Muenster', 'Koeln', 'Koblenz', 'Mannheim', 'Stuttgart', 'Ulm', 'Lindau']

cost: 1203

(ii) Aachen to Essen:

Path: ['Aachen', 'Essen']

cost: 123

(iii) Hamburg to Muenchen:

Path: ['Hamburg', 'Bremen', 'Osnabrueck', 'Muenster', 'Koeln', 'Koblenz', 'Mannheim', 'Stuttgart', 'Ulm', 'Muenchen']

cost: 1051

(iv) Berlin to Freiburg

Path: ['Berlin', 'Magdeburg', 'Hannover', 'Osnabrueck', 'Muenster', 'Koeln', 'Koblenz', 'Mannheim', 'Karlsruhe', 'Freiburg']

cost: 1049

(v) Stuttgart to Stuttgart:

Path: ['Stuttgart']

Cost: 0