Universität Zürich[UZH]

Introduction to Artificial Intelligence
Exercise Sheet 7

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Exercise 7.1

(a) Predicates: Properties of objects that we are interested in; can be true or false:
Let B = {Krämerbrücke, Schmiedbrücke, Honigbrücke, Holzbrücke, Grüne Brücke, Köttelbrücke, Hohe Brücke} be the set of bridges.
V = {crossedAtLeastOnce(b)| $\forall b \in B$} $\cup$ {crossedAtMostOnce(b) | $\forall b \in B$}

(b) Initial state (only predicates which are true are listed, because of closed-world assumption):
I = $\bigwedge_{b \in B}$ crossedAtMostOnce(b), $\forall b \in B$

(c) Goal state (both predicates have to be true in order to ensure that each Bridge is crossed exactly once):
G = $\bigwedge_{b \in B}$ (crossedAtLeastOnce(b) $\wedge$ crossedAtMostOnce(b)) , $\forall b \in B$

(d) A is a finite set of actions a = $\langle$pre, eff$\rangle$ with pre(a) and eff(a)
A = {crossFirstTime(b), crossAgain(b)}, $\forall b \in B$

action a crossFirstTime(b):
pre(crossFirstTime(b)) = $\neg$ crossedAtLeastOnce(b) $\wedge$ crossedAtMostOnce(b)
eff(crossFirstTime(b)) = crossedAtLeastOnce(b) $\wedge$ crossedAtMostOnce(b)
When the action crossFirstTime(b) is executed exactly once for every bridge the Goal state is reached.

action crossAgain(b):
pre(crossAgain(b)) = crossedAtLeastOnce(b)
eff(crossAgain(b)) = crossedAtLeastOnce(b)
We can ignore crossedAtMostOnce in the action crossAgain(b) as its state is irrelevant for this action, i.e. *crossedAtMostOnce* $\rightarrow$ *false* when crossing the same bridge numerous times.
The Goal state won't be reached when action crossAgain(b) is used.

Exercise 7.2

(a) *Insert graph*

(b) *Insert graph*

(c) PDB:

$\{ \text{loc} \to \text{B}, \text{treasure} \to \bot \} = \infty$

$\{ \text{loc} \to \text{A}, \text{treasure} \to \bot \} = \infty$

$\{ \text{loc} \to \text{C}, \text{treasure} \to \bot \} = \infty$

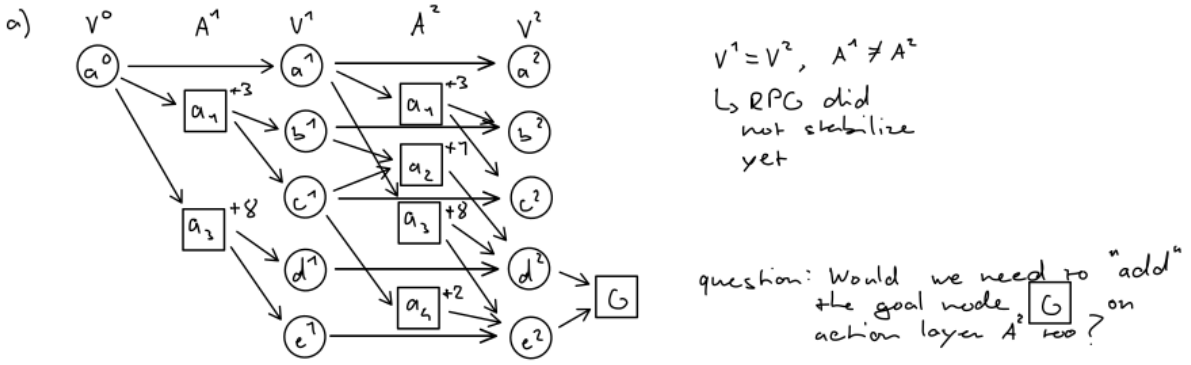
$\{ \text{loc} \to \text{A}, \text{treasure} \to \top \} = 2$

$\{ \text{loc} \to \text{B}, \text{treasure} \to \top \} = 1$

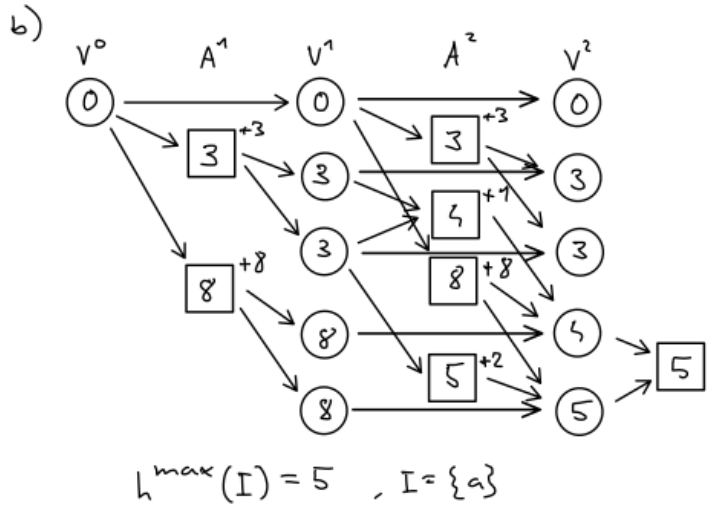
$\{ \text{loc} \to \text{C}, \text{treasure} \to \top \} = 0$

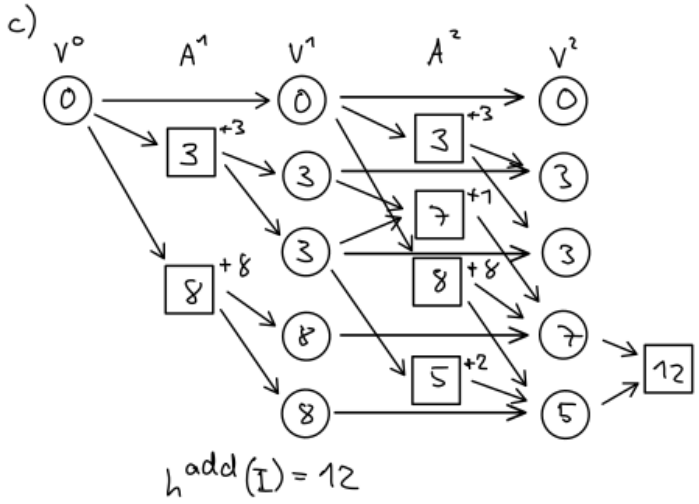
Exercise 7.3

(a)

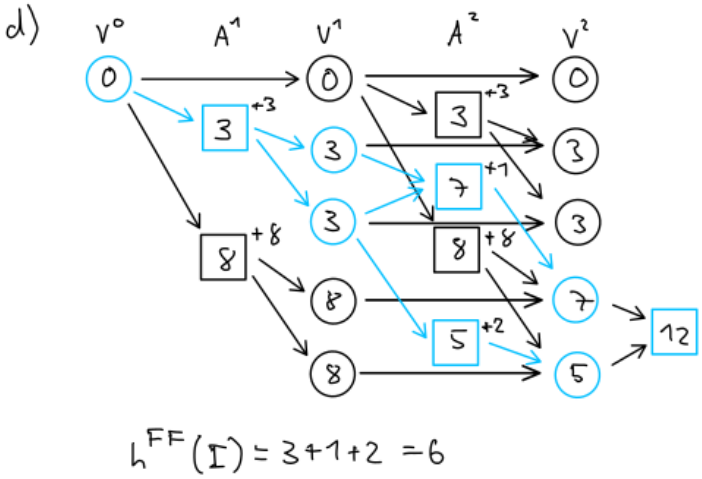


(b)




c)
V⁰
A¹
V¹
A²
V²
0
3
8
+3
+8
3
7
8
5
+1
+8
+2
0
3
3
7
8
5
12
h^add(I) = 12

(c)


d)
V⁰
A¹
V¹
A²
V²
0
3
8
+3
+8
3
7
8
5
+1
+8
+2
0
3
3
7
8
5
12
h^FF(I) = 3+1+2 = 6

(d)