



**Universität
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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 $B = \{\text{Krämerbrücke, Schmiedbrücke, Honigbrücke, Holzbrücke, Grüne Brücke, Köttelbrücke, Hohe Brücke}\}$ be the set of bridges.

$$V = \{\text{crossedAtLeastOnce}(b) \mid \forall b \in B\} \cup \{\text{crossedAtMostOnce}(b) \mid \forall b \in B\}$$

(b) Initial state (only predicates which are true are listed, because of closed-world assumption):

$$I = \bigwedge_{b \in B} \text{crossedAtMostOnce}(b), \forall b \in B$$

(c) Goal state (both predicates have to be true in order to ensure that each Bridge is crossed exactly once):

$$G = \bigwedge_{b \in B} (\text{crossedAtLeastOnce}(b) \wedge \text{crossedAtMostOnce}(b)), \forall b \in B$$

(d) A is a finite set of actions $a = \langle \text{pre}, \text{eff} \rangle$ with $\text{pre}(a)$ and $\text{eff}(a)$

$$A = \{\text{crossFirstTime}(b), \text{crossAgain}(b)\}, \forall b \in B$$

action a $\text{crossFirstTime}(b)$:

$$\text{pre}(\text{crossFirstTime}(b)) = \neg \text{crossedAtLeastOnce}(b) \wedge \text{crossedAtMostOnce}(b)$$

$$\text{eff}(\text{crossFirstTime}(b)) = \text{crossedAtLeastOnce}(b) \wedge \text{crossedAtMostOnce}(b)$$

When the action $\text{crossFirstTime}(b)$ is executed exactly once for every bridge the Goal state is reached.

action $\text{crossAgain}(b)$:

$$\text{pre}(\text{crossAgain}(b)) = \text{crossedAtLeastOnce}(b)$$

$$\text{eff}(\text{crossAgain}(b)) = \text{crossedAtLeastOnce}(b)$$

We can ignore crossedAtMostOnce in the action $\text{crossAgain}(b)$ as its state is irrelevant for this action, i.e. $\text{crossedAtMostOnce} \rightarrow \text{false}$ when crossing the same bridge numerous times.

The Goal state won't be reached when action $\text{crossAgain}(b)$ is used.

Exercise 7.2

(a) *Insert graph*

(b) *Insert graph*

(c) PDB:

$$\{\text{loc} \rightarrow \text{B}, \text{treasure} \rightarrow \perp\} = \infty$$

$$\{\text{loc} \rightarrow \text{A}, \text{treasure} \rightarrow \perp\} = \infty$$

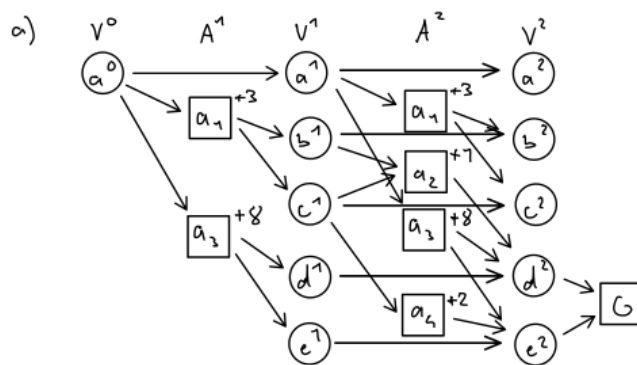
$$\{\text{loc} \rightarrow \text{C}, \text{treasure} \rightarrow \perp\} = \infty$$

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

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

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

Exercise 7.3



question: Would we need to "add" the goal node G on action layer A^2 too?

