



**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:

$\forall b \in \text{SetOfBridges } B$, where $\text{SetOfBridges } B = \{\text{Krämerbrücke, Schmiedbrücke, Honigbrücke, Holzbrücke, Grüne Brücke, Köttelbrücke, Hohe Brücke}\}$

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

(b) Initial state (only predicates which are true are listed):

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

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

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

(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 $\text{crossedAtMostOnce} \rightarrow \text{false}$ 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

(a) (b) (c) (d)