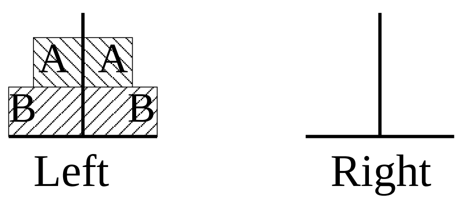
UNIVERSITY OF INNSBRUCK
MASTERSTUDIUM INFORMATIK VERTIEFUNGSMODUL (WM 9)
Automatic Planning
Lecturer: Jörg Hoffmann
Tutor: Adina Sirbu
Exercises Nr. 5. **To be returned on Tuesday, Nov 13**

Exercise 1. (6=2+4 points)

Consider a Towers-of-Hanoi problem with only two discs A and B, and two pegs $Left$ and $Right$. The facts are $clear(A)$, $clear(B)$, $clear(Left)$, $clear(Right)$, $on(A, B)$, $on(A, Left)$, $on(A, Right)$, $on(B, Left)$, and $on(B, Right)$. The initial state is $I = \{clear(A), on(A, B), on(B, Left), clear(Right)\}$. The goal state is $G = \{on(A, B), on(B, Right)\}$. The actions take the form $move(x, from, to) =$

$$(\{clear(x), on(x, from), clear(to)\}, \{on(x, to), clear(from)\}, \{on(x, from), clear(to)\}).$$

The "smaller(x,from)" and "smaller(x,to)" constraints are encoded in the action *set*, i.e., we have (only) the actions $move(A, B, Left)$, $move(A, B, Right)$, $move(A, Left, B)$ $move(A, Left, Right)$, $move(A, Right, B)$ $move(A, Right, Left)$, $move(B, Left, Right)$, and $move(B, Right, Left)$. Illustration:



1. Build a 1-planning graph for this task, i.e., write up the sets F_t and A_t until the algorithm ("The k-Subsets Relaxation", slide 34) terminates. Leave out the NOOP actions. You may use F_t in the write-up of F_{t+1}, and A_t in the write-up of A_{t+1}. What is the value of $PG^1(G)$?

2. Build a 2-planning graph for this task, i.e., write up the sets F_t, EF_t, A_t, and EA_t until the algorithm ("The k-Subsets Relaxation", slide 37) terminates. *Include* the NOOP actions. You may use F_t in the write-up of F_{t+1}, EF_t in the write-up of EF_{t+1}, A_t in the write-up of A_{t+1}, and EA_t in the write-up of EA_{t+1}. What is the value of $PG^2(G)$?

Exercise 2. (4=1.5+2.5 points)

Using the basic bitvectors as per ("The k-Subsets Relaxation", slide 47, give a bitvector expression that evaluates to TRUE iff:

1. a and a' have mutex preconditions at layer t (see "The k-Subsets Relaxation", slide 48)
2. p and p' are mutex at layer $t+1$ (see "The k-Subsets Relaxation", slide 49)