State space representation – Tower of Hanoi

Complete the state space representation of the tower of Hanoi problem, where we have 4 disks. We denote the disks by A, B, C and D. The disks have different size: $A < B < C < D$.

Relevant properties

- disks in the 1st tower $\mathcal{H}_1 = \mathcal{P}(\{A, B, C, D\})$
- disks in the 2nd tower $\mathcal{H}_2 = \mathcal{P}(\{A, B, C, D\})$
- disks in the 3rd tower $\mathcal{H}_3 = \mathcal{P}(\{A, B, C, D\})$

State space

The state space is a real supset of the cartesian product $H_1 \times H_2 \times H_3$. The following members of the cartesian product are not real states.

- $(\{A, B\}, \emptyset, \emptyset) \notin \mathcal{S}$, because the disks C and D are missing.
- $(\{A, B, C, D\}, \{A, B\}, \emptyset) \notin \mathcal{S}$, because the disks A and B appear more then one tower.

Exercise 1. Please define the state space ($\mathcal{S}$).

Start state

Exercise 2. Please define the start state ($start$).

Set of goal states:

$\mathcal{G} = \{\ (\emptyset, \emptyset, \emptyset, \{A, B, C, D\})\ \}$

Set of operators:

$\mathcal{O} = \{o_{1,2},\ o_{1,3},\ o_{2,1},\ o_{2,3},\ o_{3,1},\ o_{3,2}\}$

Exercise 3. Please define the domain of the $o_{2,1} \in \mathcal{O}$ operator. The operator grab the smallest disk on the 2nd tower and put it to the top of the 1st tower.

Exercise 4. Please define the $o_{2,1} \in \mathcal{O}$ operator as a function.

Exercise 5. Can we apply the $o_{2,1} \in \mathcal{O}$ operator on the following states?

$$(\{A, C\}, \{B, D\}, \emptyset, \emptyset)$$

$$(\{B\}, \{C\}, \{A\}, \{D\})$$

Exercise 6. Can we access a goal state from ({B},{C},{A},{D})?