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Principles of AI Planning

Exercise Sheet 5

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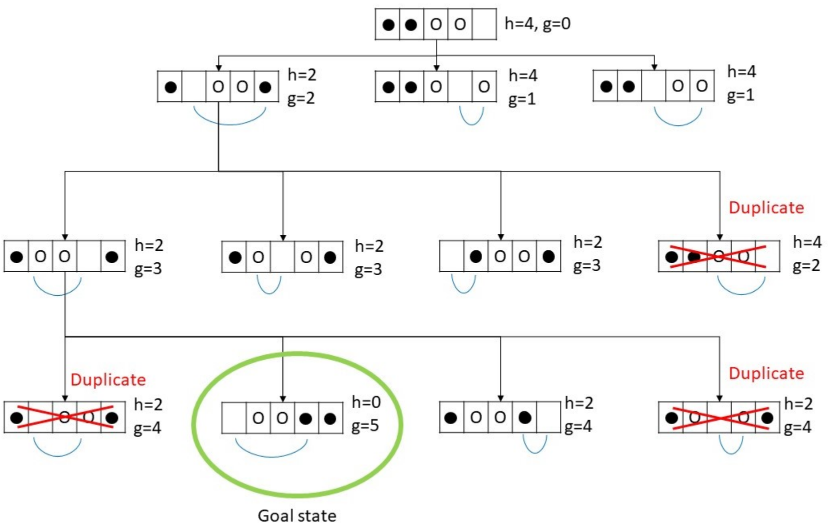
Exercise 5.1: A* search

a) Solve the puzzle with the A* algorithms

Using the heuristic as a tie breaker, favoring lower h values, we get the following tree. Where we find the optimal solution as the heuristic is admissible and because every other f value in the heap is bigger or equal to five.



b) show that h is admissible

Given an initial state with a black tile to the left of a white tile, the only way that a black tile can reach the goal state is if it jumps this white tile.
If it jumps through the white tile, this movement always causes a cost equal or bigger to 1 per white tile at the right side, this can be seen because the cost were established as following.
- The cost of jumping over one tile is 1.
- The cost of jumping over two neighboring tiles is 2.
Additionally it is not always equal, as movements without jumping are allowed and is not always possible to jump the tiles without additional movements.
This means that the sum of cost operations required for the black tile to reach a goal state, is **at least** the number of white tiles to the right, which is precisely our heuristic. Therefore $h(s) \leq h^*(s)$ and in consequence the heuristic is *admissible*

Exercise 5.2: Enforced hill-climbing

a) **For each invocation of the `improve` procedure, specify the state after improvement by giving the new coodinates**
The given coordinates will be expressed as H(Horizontal Coordinate, Vertical Coordinate), G(Horizontal Coordinate, Vertical Coordinate), where H is the position of Hansel and G is the position of Gretel

$$\begin{aligned}
h(\sigma_0) &= 5 \qquad & \sigma_0 &= H(1,2), G(4,4) \\
h(\sigma_1) &= 4 \qquad & \sigma_1 &= H(1,3), G(4,4) \\
h(\sigma_2) &= 3 \qquad & \sigma_2 &= H(2,3), G(4,4) \\
h(\sigma_3) &= 2 \qquad & \sigma_3 &= H(3,3), G(4,4) \\
h(\sigma_4) &= 1 \qquad & \sigma_4 &= H(3,3), G(3,2) \\
h(\sigma_5) &= 0 \qquad & \sigma_5 &= H(3,3), G(3,3)
\end{aligned}$$

b) **Record the solution plan**

$$north_H \rightarrow east_H \rightarrow east_H \rightarrow east_G \rightarrow south_G$$
$$\rightarrow south_G \rightarrow west_G \rightarrow west_G \rightarrow north_G$$