Exercise 1: Mobile Robot Path Planning

Assume a robot using the 5d-A* technique for path planning.

1. Construct a situation in a static environment without unknown obstacles in which the robot does not find a path close to the optimal solution.

2. Construct a situation in a dynamic environment with unknown obstacles in which the robot does not find a path close to the optimal solution.

Explain (in brief!), why the solutions are far away from being optimal.

Exercise 2: SVD

Suppose, we have two corresponding point sets in 2D:

\[
X : \{(x_1 = (2, 2)^T, x_2 = (6, 3)^T, x_3 = (5, 1))\}
\]

\[
Y : \{(y_1 = (-0.8, -1)^T, y_2 = (-3.7, 1.9)^T, y_3 = (-1.5, 2.1)^T)\}
\]

and we know, that \(x_i\) corresponds to \(y_i\). Please compute the translation \(t\) and rotation \(R\) that minimizes the sum of the squared error.

Exercise 3: ICP / SVD

Recall the formulas on the slides 5-7 of the ICP-lecture and prove the following:

\[
\text{If } X' = P' \text{ then } R = I .
\]

Hint: Find out, how singular value decomposition and eigen value decomposition are related to each other.