# Online Motion Planning, SS 17
# Exercise sheet 11
# University of Bonn, Inst. for Computer Science, Dpt. I

- *You can hand in your written solutions until Tuesday,* 11.07., 14:15*, postbox in front of room E.01 LBH.*

**Exercise 31: SearchRatio of a Grid (6 points)**

We are searching for an unknown goal in one cell of a fixed $8 \times 8$ cell environment, starting at some fixed point $s$ as given in Figure 1. The agent has no vision. We assume that moving from one cell to an adjacent cell always takes one step. We are looking for a search strategy that competes with the shortest path to an unknown goal in a cell.

*Please turn the page!*

Prove the following statements.

1. There is a search strategy that guarantees to find any goal with distance $x$ from the start in $7 \cdot x$ steps.

2. There is no strategy that guarantees to find any goal at distance $x$ with at most $5 \cdot x$ steps.

3. There is no strategy that guarantees to find any goal at distance $x$ with at most $6 \cdot x$ steps.

4. Consider a $4 \times 4$ grid. Provide a strategy $\pi$ and prove that the SearchRatio of the strategy $\pi$ is minimal.

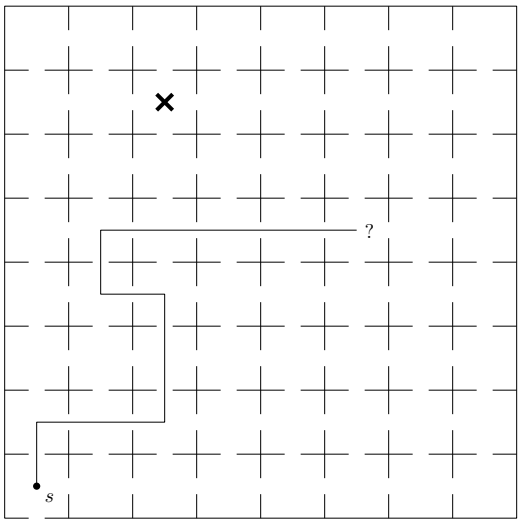


Figure 1: The $8 \times 8 = 64$ grid.

**Exercise 32: Looking around a corner (6 points)**

Compute the competitive factors of the following strategies for looking around a corner, given by the vertices of the exploration paths they specify. Here the starting point of our robot is the origin $(0, 0)$ of the coordinate system and the corner is at position $(0, 1)$.

a) $P_1 = (-1, 0)$, $P_2 = (-1, 2)$, $P_3 = (0, 2)$.

b) $P_1 = (-1, \frac{1}{2})$, $P_2 = (0, 1)$.

c) $P_1 = (-\frac{\sqrt{2}}{4}, \frac{2-\sqrt{2}}{4})$, $P_2 = (-\frac{1}{2}, \frac{1}{2})$, $P_3 = (-\frac{\sqrt{2}}{4}, \frac{2+\sqrt{2}}{4})$, $P_4 = (0, 1)$.

In part $c$), it suffices

- to provide a function that computes, for a given angle $\gamma$ at the corner (see Figure 2), the distance the robot moves before it can look around the corner for the first time.
- to determine the distance moved by the optimal offline strategy, depending on $\gamma$.

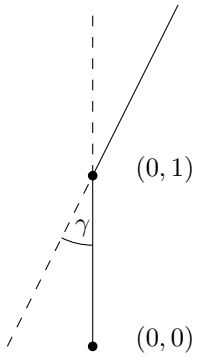


Figure 2: The angle $\gamma$.

Note that in this exercise we require that the additive constant, $\alpha$, in the definition of the competitive factor is 0.