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 Wednesday,* 12.07., 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 8×8 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 4×4 grid. Provide a strategy π and prove that the SearchRatio of the strategy π is minimal.

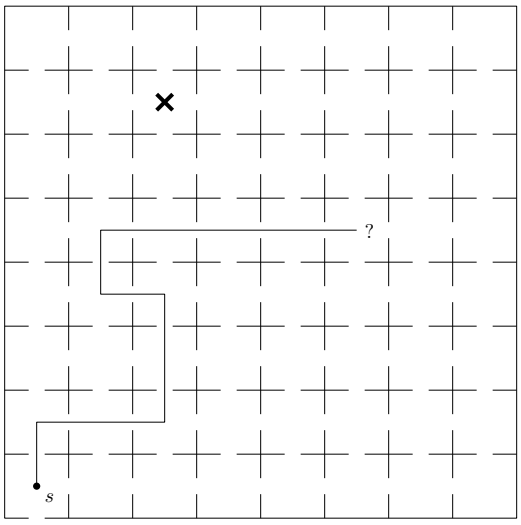

Figure 1: The $8 \times 8 = 64$ grid.

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 γ 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 γ.

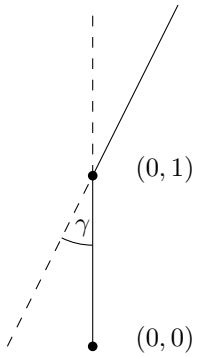

Figure 2: The angle γ.

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