Technische Universität München
Fakultät für Informatik
Lehrstuhl für Theoretische Informatik
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Winter Semester 2017/18
Problem Set 7
December 4, 2017

Online and Approximation Algorithms

Due December 18, 2017 at 10:00

Exercise 1 (Navigation on a line – 10 points)

Propose a randomized algorithm for the navigation problem on a line and show that it is 7-competitive.

Exercise 2 (Room problem – 10 points)

In the lecture we saw an algorithm for the square room problem that achieves a competitive ratio of $\sqrt{n}$.
Modify the algorithm as well as its analysis for rooms of dimension $2N \times 2n$ where $N \neq n$. The starting point is $s = (0, 0)$, the target $t = (N, n)$.

Exercise 3 (Exploration on cellular environments – 10 points)

Consider a robot which moves in a rectangular grid environment similar to a chessboard. Each cell of the environment is either *free* and can be visited by the robot, or *blocked* and unaccessible by the robot. In one step, the robot is in some cell and it moves in one of the 8 neighboring cells. Of course, the new cell must be free. Starting from a cell s, we want to visit all the empty cells of the environment and return back to s assuming that the environment is not known by the robot in advance. The objective is to perform a minimum number of steps. Checking if one of the neighboring cells is free or blocked does not cost anything. Propose an online algorithm and show that it is 2-competitive.

Exercise 4 (Spiral – 10 points)

Imagine yourself standing on a 2-dimensional grid, searching for a point $t = (t_v, t_h)$ where t_v and t_h are the vertical and horizontal distances from your current position. You do know that t is finite, however you do not know the exact values for t_v and t_h. Develop an algorithm for reaching t and prove its competitiveness.