

Assignment no. 5

Ex. 5.2 is due Thursday, June 7th, 2018

Ex. 5.1 is due Monday, May 11th, 2018

Ex. 5.3 is due Monday, May 11th, 2018 at 16:00

Exercises 5.1 and 5.2 are concerned with motion planning for two unit squares, a blue one and a red one, whose edges are parallel to the coordinate axes and which are translating in the plane among polygonal obstacles. A configuration of this moving system is a pair of points in the plane $(b_x, b_y), (r_x, r_y)$ describing the position of the center point of the blue square and the red square respectively. We assume that the square robots are open. A configuration is free if (i) the squares are disjoint, and (ii) each square is disjoint from the obstacles. Our goal is to plan a collision-free motion for this system between two valid configurations: start and goal.

Exercise 5.1 Assume further, in this exercise only, that the obstacles are rectilinear, namely their edges are parallel to the coordinate axes. Design an efficient complete algorithm for this problem, describe it in detail and analyze its time and space complexity.

Exercise 5.2 (p2) In this exercise the obstacles are arbitrary pairwise disjoint simple polygons. Additionally, the workspace where the robots move is itself a simple polygon, which contains all the other obstacles inside it. (See precise details about the input in the “additional information” webpage for this exercise.) Devise and implement an algorithm to find coordinated solution paths for the robots, such that the sum of the lengths of the paths is small.

Notice that there is no known efficient algorithm to find an optimal solution to this problem. You can opt for any reasonable solution that is valid, namely consists only of valid configurations.

There will be a contest among the different programs on a variety of instances. The programs will be measured for efficiency as well for the quality of the resulting paths (the total length of the two paths). The results of the contest will be reported in the last lesson of the semester. A small bonus in the final grade will be given to each member of the winning team.

Exercise 5.3 Choose a topic for your final personal assignment. It should include an experimental section. Write a short text, roughly 5 to 10 lines, about the problem you plan to address.