Assignment no. 1

due: January 22nd, 2024

The letter **(p)** after the exercise number indicates that this exercise has a programming component. The number **(2)** after the exercise number indicates that students may work in pairs on the exercise and submit their solution jointly.

Part I, warm-up

Exercise 1.1 (p) Write a program that solves Oskar's cube. The matrices that describe the faces of the cube appear in the course's website, together with specifications how to output a solution path from start to goal.

Wait until after the second class before approaching the remaining exercises.

Exercise 1.2 (2p) Write a program that solves the Roomba-in-the-cafe problem, using simple PRM. We are given a room with non-overlapping disc-like obstacles, and a Roomba robot (another disc) together with free start and goal positions for it. We wish to plan a collision-free motion for the Roomba from start to goal. The software environment for this exercise, DiscoPygalStarter, is linked to from the course's website, where you will also find input instances that you need to solve.

Part II

Exercise 1.3 We are given a convex polygonal robot P with m vertices that is free to translate inside a convex polygonal room Q with n vertices. The only obstacles to the motion of P are Q's walls. The polygon P is allowed to touch the walls of Q, but not to penetrate past the walls.
(a) What is the maximum combinatorial complexity of the free space in this case? Describe an efficient algorithm to compute a representation of the free space.
(b) (p) optional (bonus) Implement an algorithm to compute the free space in this case. The input to the program consists of two convex polygons P, Q as above. The output in general is polygonal. Report the vertices of the polygonal region, and display it graphically (see the website for a possible graphic procedure).