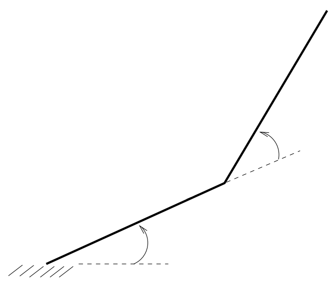
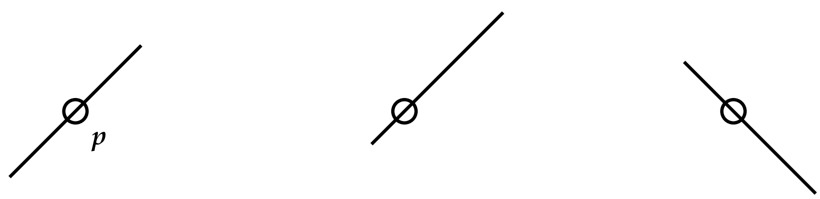
Assignment no. 2

due: Monday, April 4th, 2011

Exercise 2.1 **(a)** What is the maximum combinatorial complexity (give asymptotic lower and upper bounds) of the free space of the following planar motion-planning problem. An anchored 2-link arm consisting of two segments and two rotational degrees of freedom (see the figure) moving among polygonal obstacles with a total of n vertices.
(b) Devise an efficient algorithm to compute the free space.



Exercise 2.2 Answer the same questions as in Exercise 2.1, items (a) and (b) for the following motion planning problem. A robot arm with two degrees of freedom moving in the plane among polygonal obstacles with a total of n vertices. The arm consists of a line segment that passes through a point p in the plane. It can rotate around p and translate through p, but at all times it coincides with p. See the following figure for an illustration.



Exercise 2.3 (p2) Write a program that solves the following motion-planning problem. We are given a simple polygon A, the robot, which can translate in the plane, and a set of pairwise interior-disjoint simple polygons, the obstacles, which the robot has to avoid. We are also given a pair of planar points s and g denoting the reference point of A at a start position and a desired goal position respectively. The program decides whether a *semi-free path*[1] for A from start to goal exists and if so outputs such a path.

In the course's webpage you will find ample helpful information for solving this problem, as well as input/output format.

Exercise 2.4 is on the next page.

[1] Semi-free path means that the robot is allowed to touch the obstacles, but not to penetrate into them.

Exercise 2.4 (p2), optional (bonus) Same as Exercise 2.3, only this time you are required to produce a *good* path. Choose your criterion: length, clearance, smoothness, etc. and devise a path that is good according to this criterion; not necessarily optimal, but better than an arbitrary path that the method that puts a point inside each trapezoid and on each vertical edge produces.