Assignment no. 2

given: March 27th, 2000
due: May 1st, 2000

In the programming exercises below you are encouraged to use ready-made software in the maps and arrangements part of CGAL as well as data structures from LEDA as much as possible. Do not however use the boolean operations package in CGAL.

Frame program files will appear in the coming days on the course's web site.

Exercise 2.1 (r) Write an interactive program whose input consists of two simple polygons P and Q. Upon request from the user, the program computes their union, intersection, or symmetric difference (namely, $(P \setminus Q) \cup (Q \setminus P)$). The program displays the two polygons on the screen and highlights the requested object (say $P \cap Q$) by coloring it differently from the background.

Exercise 2.2 Given a convex polygon with m edges (the robot), translating among polygonal obstacles with a total of n edges, describe an efficient algorithm to compute the free space of the robot. Analyze the running time and storage requirement of the algorithm.

Exercise 2.3 Consider a collection P of the graphs of n canonical parabolas (i.e., the functions $y = ax^2 + bx + c$). Efficiently find an axis-parallel bounding box of the arrangement $\mathcal{A}(P)$, namely a box that contains all the vertices of the arrangement as well as the extrema of the graphs.

Solve one of the following exercises:

Exercise 2.4 (r) Write a program to compute and display the lower envelope of an input set of circles in the plane.

Exercise 2.5 *** Show that the complexity of a single face in an arrangement of n rays is $O(n)$.