Applications of Computational Geometry in Industry and Science

Prerequisite: Algorithms

Fall 1998
Monday 14–16, Wednesday 9–11

Dr. Matya Katz
Office hours: Wednesday 11:15–13

Course description. In connection with a few industrial and scientific domains including VLSI Circuit Design, Geographic Information Systems (GIS), Computer Aided Manufacturing, Mesh Generation, Molecular Biology, and Computer Graphics, the course will focus on a collection of key problems with geometric flavour. Efficient solutions will be presented using techniques from Computational Geometry. Specifically, the course will discuss most of the following issues:

- Chip design, geometric problems for collections of axis-parallel rectangles, VLSI circuit layout – placement and routing.
- Geographic Information Systems – overview, label placement, Voronoi diagrams, levels of detail, line simplification.
- Computer Aided Manufacturing – assembly planning, fixturing and grasping, robot motion planning.
- Mesh generation – quad trees.
- Computer graphics – hidden surface removal and other visibility problems, binary space partitions.
- Molecular biology – the hard sphere model, docking, drug design.

Necessary (basic) background from the theory of Computational Geometry will be provided whenever needed.

Course requirements. Final exam – 80% (or 70%, see below) of the final grade (no books, no notebooks).
About 4 individual homework assignments – 20%.
An optional programming assignment – 10%.

Bibliography. Some of the material is from research articles that will be made available. The rest of the material is from books, mainly from the book mentioned below.

Computational Geometry, Algorithms and Applications, M. de Berg, M. van Kreveld, M. Overmars and O. Schwarzkopf, Springer-Verlag, 1997.