A Seminar in
Computational Geometry and Random Algorithms
Fall 97
Alon Efrat

Below is a tentative list of the subjects of the seminar. Extra information can be found in my homepage http://www.math.tau.ac.il/~alone.

1 introduction

The seminar has four major parts:

- A Movie day - showing video(s) of CG.
- Introductory lecture (Alon).
- First 2—3 lectures - standard techniques in CG, listed in Section 2.
- (Main part of the seminar) techniques in Computational and Combinatorial Geometry that use randomness, listed in Section 3.

2 Topics of the course - deterministic techniques

2.1 Problems:

- Convex Hull in 2D and 3D + applications (e.g. finding a line approximating a set of points, linear programming in 3D).
- Point Location
- Voronoi Diagram
- Range searching

2.2 Techniques

All taken from Preperata & Shamus book [PS85] and / or from Guibas and J. Stolfi [GS88].

- Sweep line
- Divide and Conquer (e.g. for Convex Hull)
- Dual Transformations
- Decimation.
- Hierarchic data-structures
- Randomized incremental
2.3 Data Structures

- DCEL
- Interval/segment trees
- Treaps/SkipList (from any new Data-structure book, or from Mulmuly’s book [Mul94]).
- Persistent/augmented DS (e.g. first part of [ST86])
- Two-levels DS - orthogonal trees.

3 Random Algorithms in Computational Geometry

- Backward Analysis.
  - Finding closest pair in d-space.
  - Convex hull in 2D and 3D ([MP93], also in the random-algorithms book)
  - Incremental construction of Voronoi Diagram, [GKS90].
  - A simple and fast incremental randomized algorithm for computing trapezoidal decompositions and for triangulating polygons, [Sei91]
  - Linear programming all methods - depend on the level/motivation of the student. Start from Clarkson [Cla88] Matoušek et al. [MSW92] — up to Gurtner [Gâr92].
  - Randomized multidimensional search trees: Dynamic sampling (K. Mulmuley), [Mul91a, Mul91b, Mul91c]. Also in his book [Mul94].
  - Clarkson & Shor method [Cl87, CS89] (best explained in the first theorem of [Sha93])
  - $\varepsilon$-nets and range-searching , First study from some part of Pach’s book [MP93], then an application from Agarwal and Pach book [PA95].

4 Other (very interesting) talks that might be given

- M. H. Overmars and E. Welzl [OW88], Constructing the visibility graph in the plane.
- M. Sharir and E. Welzl, Rectilinear and Polygonal p-Piercing and p-Center Problems.
- M. T. Goodrich, J. S. Mitchell and M. W. Orleisky, Practical Methods for Approximate Geometric Pattern Matching under Rigid Motion [GMO94].
- A. Efrat and M.Sharir, Finding the segment center [ES94].
- D. P. Dobkin and D. G. Kirkpatrick, Determining the separation of preprocessed polyhedra – a unified approach. [DK90].

And many many more.
References


