CMPS 3120 Computational Geometry – Spring 13

Midterm Review

Relevant Material

- All material from 1/15/13 until 2/26/13 (inclusive)
- This includes homeworks 1 and 2. Homework 3 is useful for practice.
- The covered chapters in the book are 1, 2, 3, 6, 7.1, 7.2
- **Convex Hulls**
  - Practice problems from the book: Ch. 1, page 15; 1.1, 1.3, 1.5, 1.6a
  - Definition of convex set, and of convex hull of a set of points
  - Orientation test (halfplane test)
  - Algorithms: Jarvis' March, Incremental Algorithm, Divide and Conquer, Graham's Scan
  - $\Omega(n \log n)$ lower bound by reduction from sorting
- **Sweepline Algorithms**
  - Practice problems from the book: Ch. 2, page 41; 2.1, 2.2, 2.6, 2.7, 2.8, 2.9, 2.10
  - Structure of a sweepline algorithm: Cleanliness property, sweep line status, event queue and updates
  - Closest pair
  - Line segment intersection (output-sensitive algorithm)
- **Triangulation and Guarding**
  - Practice problems from the book: Ch. 3, page 60; 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.11, 3.12, 3.13, 3.14
  - Triangulation of simple polygons:
    - #triangles, dual graph, 3-coloring lemma, art-gallery theorem
    - $O(n^2)$ algorithm (based on earcutting / proof of theorem 1)
    - $O(n)$ algorithm for monotone polygons (definition of a monotone polygon)
    - $O(n \log n)$ algorithm for non-monotone polygons: Split into monotone pieces, then triangulate each monotone piece
  - Triangulation of point sets (homework 2)
- **Point Location**
  - Practice problems from the book: Ch. 6, page 144; 6.1, 6.4, 6.5, 6.6, 6.7, 6.8, 6.13

- Planar subdivision (definition, complexity), doubly-connected edge list
- Slab method for point location
- Kirkpatrick's algorithm: Build hierarchy by incrementally removing independent set of points and retriangulating
- Trapezoidal map; randomized incremental construction (need to know results, not details of analysis); DAG for point location

- **Voronoi Diagrams**
  - Practice problems from the book: Ch. 7, page 170; 7.1, 7.2, 7.3, 7.5, 7.7, 7.12
  - Definition, bisectors, complexity; applications
  - Fortune's sweep
    * Beach line consisting of sequence of parabolas stored implicitly in binary search tree
    * Site events, circle events

Not on the Test

- Master theorem, interlocking polygons slides, surface Fréchet slides, detailed analyses of randomized algorithms, linear algebra background