

Midterm Review

Relevant Material

- All material from 1/13/15 until 3/5/15 (inclusive)
- This includes homeworks 1, 2, 3, 4.
- The covered chapters in the book are 1, 2, 3, 6, 7.1, 7.2, 9
- **Convex Hulls**
 - Practice problems from the book: Ch. 1, page 15; 1.1, 1.3, 1.5, 1.6a, 1.7
 - 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 (D&C based on ear cutting / 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
- **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
- **Delaunay Triangulation**
 - Practice problems from the book: Ch. 9, page 215: 9.2, 9.8, 9.12, 9.14, 9.15, 9.16
 - DT dual graph of VD
 - Different characterizations of DT (empty circumcircle, legal edges, angle-optimality)
 - Empty circle property
 - Randomized incremental constructions

Not on the Test

- Computational topology, detailed analyses of randomized algorithms