CMSC 754 Computational Geometry

David M Mount, Fall 2016

Lecture 1: Introduction to Computational Geometry 2

Lecture 2: Warm-Up Problem: Computing Slope Statistics 6

Lecture 3: Convex Hulls in the Plane 11

Lecture 4: Convex Hulls: Lower Bounds and Output Sensitivity 17
Lecture 5: Line Segment Intersection 25
Lecture 6: Polygon Triangulation 32
Lecture 7: Halfplane Intersection and Point-Line Duality 39
Lecture 8: Linear Programming 45
Lecture 9: Trapezoidal Maps 53
Lecture 10: Trapezoidal Maps and Planar Point Location 57
Lecture 11: Voronoi Diagrams and Fortune's Algorithm 63
Lecture 12: Delaunay Triangulations: General Properties 70
Lecture 13: Delaunay Triangulations: Incremental Construction 74
Lecture 14: Line Arrangements: Basic De\_nitions and the Zone

Theorem 79
Lecture 15: Applications of Arrangements 83

Lecture 16: Hulls, Envelopes, Delaunay Triangulations, and Voronoi

Diagrams 90

Lecture 17: Well Separated Pair Decompositions 95

Lecture 18: Applications of WSPDs 102

Lecture 19: Geometric Sampling, VC-Dimension, and Applications 107

Lecture 20: Motion Planning 116

Lecture 21: Geometric Basics 126

Lecture 22: Planar Graphs, Polygons and Art Galleries 129

Lecture 23: Doubly Connected Edge Lists and Subdivision Inter-

Section 134

Lecture 24: Multidimensional Polytopes and Convex Hulls 137

Lecture 25: Kirkpatrick's Planar Point Location 144

Lecture 26: Minimum Enclosing Ball 148

Lecture 27: Topological Plane Sweep 152

Lecture 28: Ham-Sandwich Cuts 155

Lecture 29: Shortest Paths and Visibility Graphs 157

Lecture 30: Divide-and-Conquer Algorithm for Voronoi Diagrams 160

Lecture 31: Orthogonal Range Searching and kd-Trees 163

Lecture 32: Orthogonal Range Trees 169

Lecture 33: Interval Trees 174

Lecture 34: Hereditary Segment Trees and Red-Blue Intersection 178

Lecture 35: Coresets for Directional Width 183