

CENG 570

Computational Geometry

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Spring 2016-2017

Course website

- http://www.ceng.metu.edu.tr/~tcan/ceng570_s1617/overview.shtml
- ODTU-Class for announcements, homework submissions, grade book.

Geometric preliminaries

- Scalars, vectors, vector operations, dot product, cross product
- Points in 2D, 3D space
- Distances: Euclidean, Manhattan distance
- Lines, line segments
- Planes, normal, plane equations, half spaces
- Parametric line equations
- Polygons: simple, convex/concave polygons, convex test
- Circles: circle center from 3 points
- Intersection tests, inclusion tests

Convex hulls

- Chapter 1 from the textbook

Additional slides

- By Prof Andy Mirzaian from Department of EECS York University, Canada.
 - COSC 6114 Computational Geometry Course
 - <http://www.cse.yorku.ca/~andy/courses/6114/index.html>

Landscape of Computational Geometry

Applications:

- Graphics
- Robotics
- Vision
- GIS
- CAD
- VLSI
- Pattern Recognition
- Optimization
- Transportation
- Statistics
- ...

Algorithmic Tools:

- general
- incremental
- divide-&-conquer
- space sweep
- topological sweep
- prune and search
- random sampling
- locus approach
- multidimensional search
- dynamization
- ...

Data Structures:

- general
- interval trees
- range trees
- segment trees
- priority search trees
- K-d trees
- fractional cascading
- persistent D.S.
- ...

Analysis Tools:

- general
- amortization
- Davenport-Schinzel
- ...

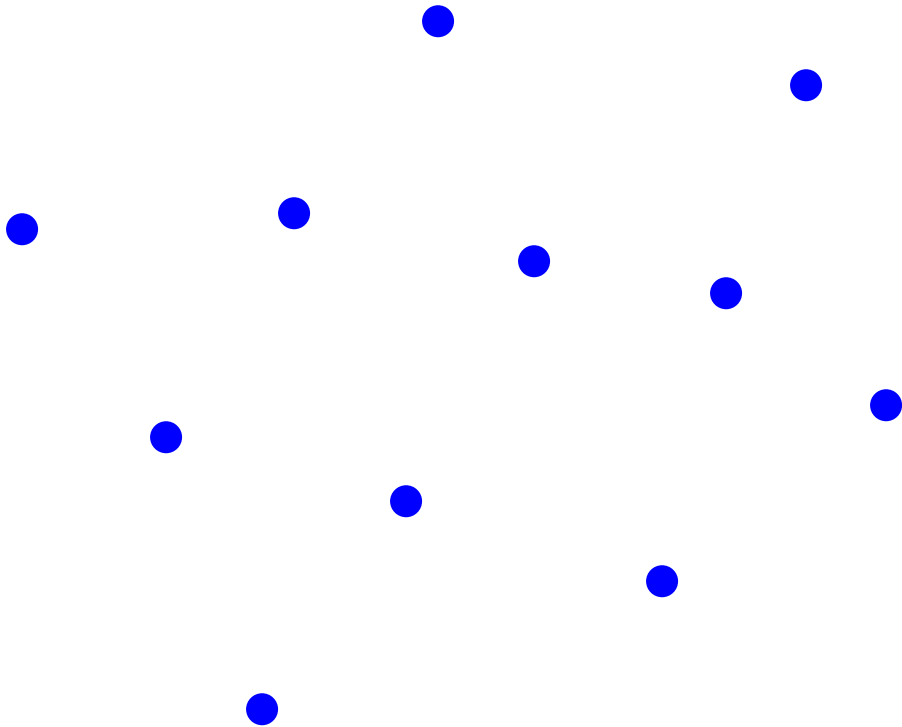
Geometric Tools:

- Convex Hull
- Space subdivision
- Arrangements
- Voronoi / Delaunay Diagram
- Triangulations
- Geometric Transforms
- Duality
- ...

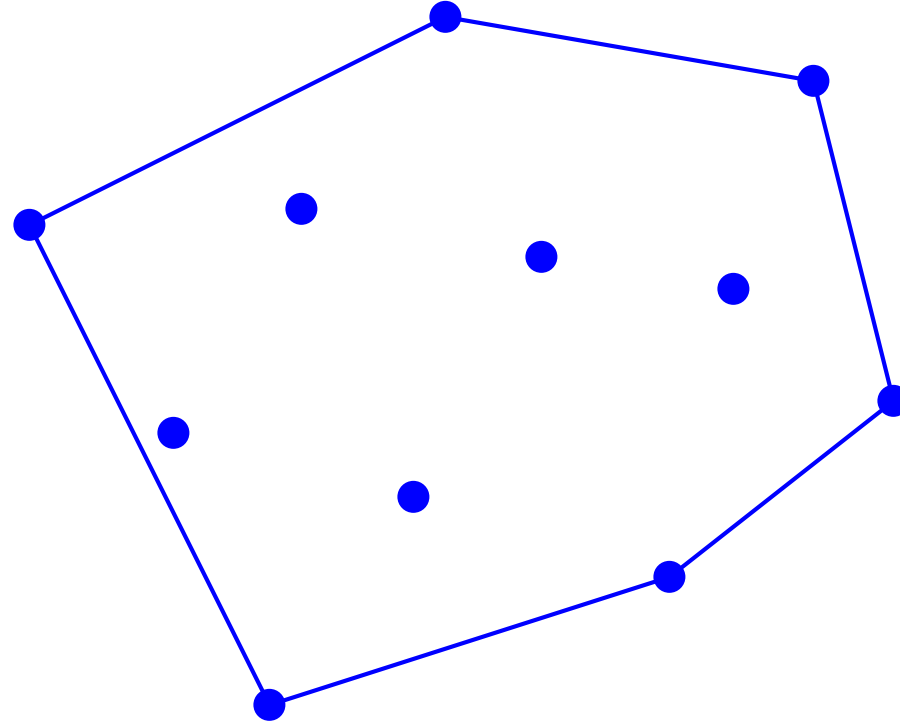
Implementation Issues:

- Degeneracy (symbolic perturbation)
- Robustness (inexact arithmetic)
- ...

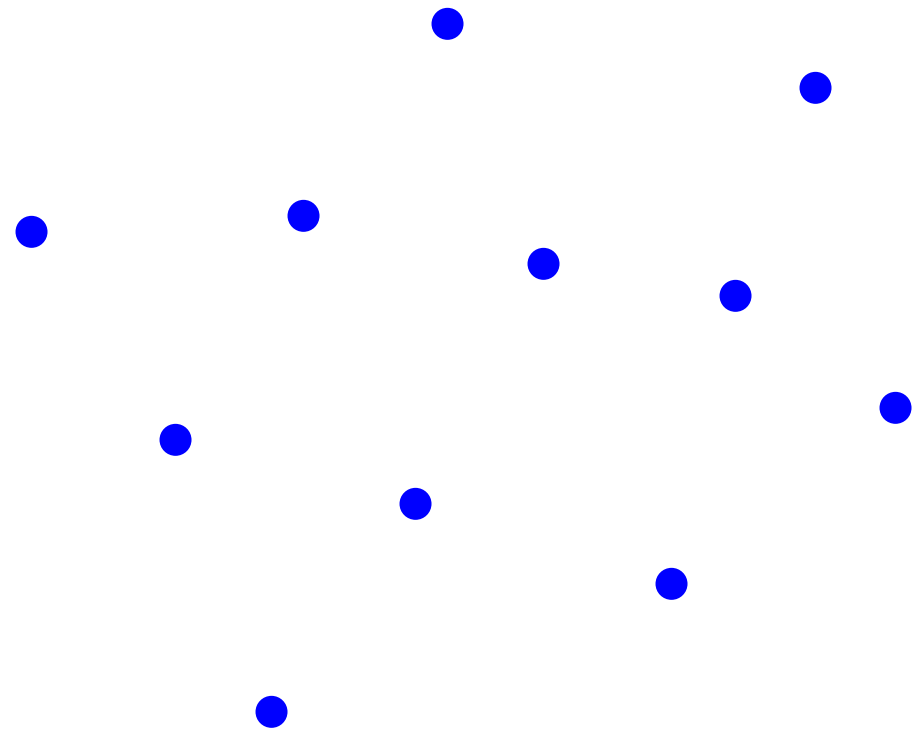
Example 1: Convex Hull



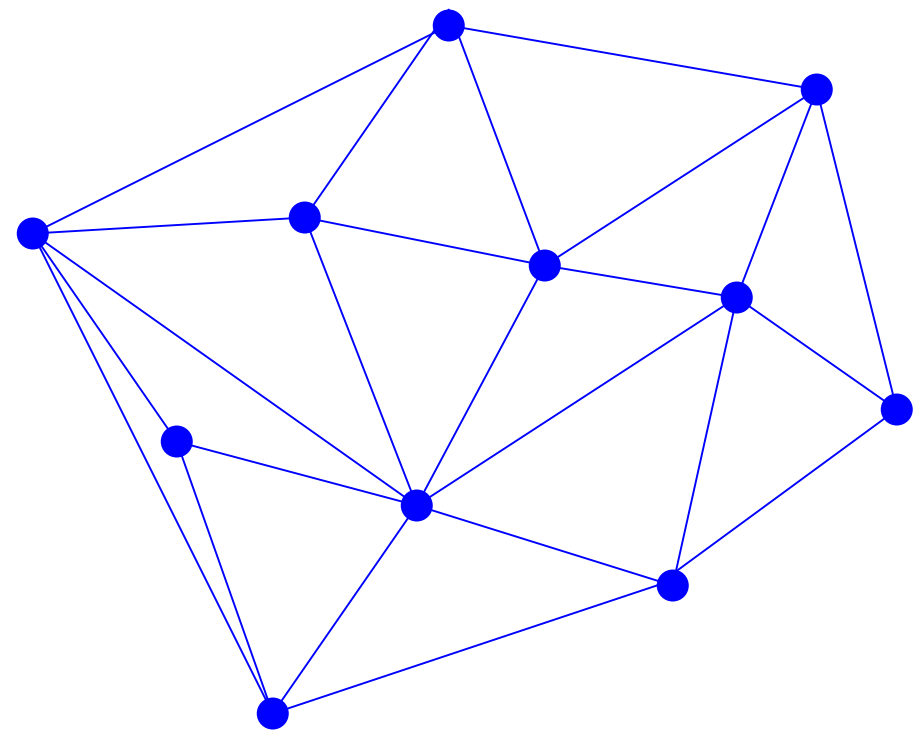
Example 1: Convex Hull



Example 2: Point set triangulation



Example 2: Point set triangulation

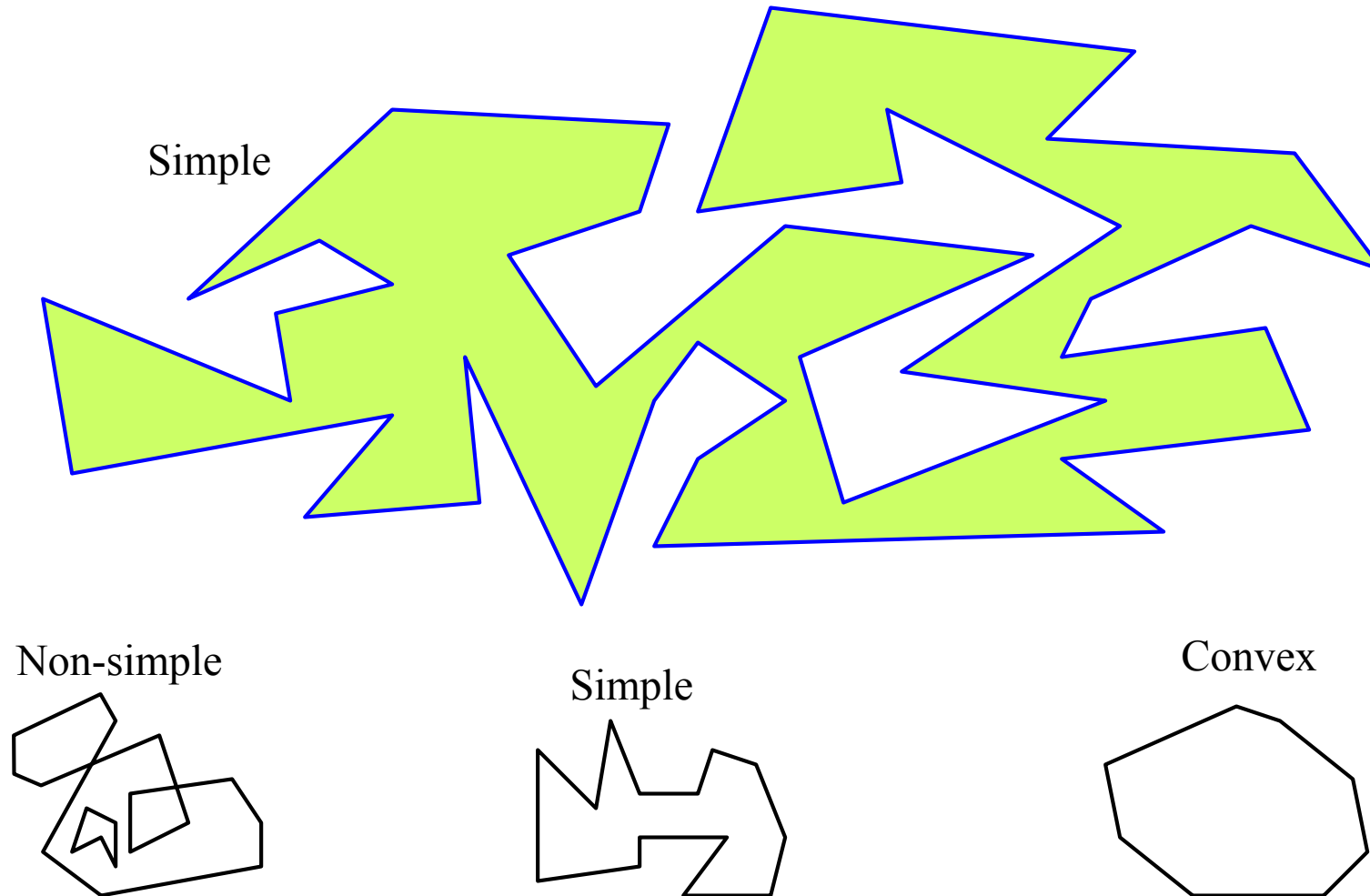


Example 3: Simple Polygon

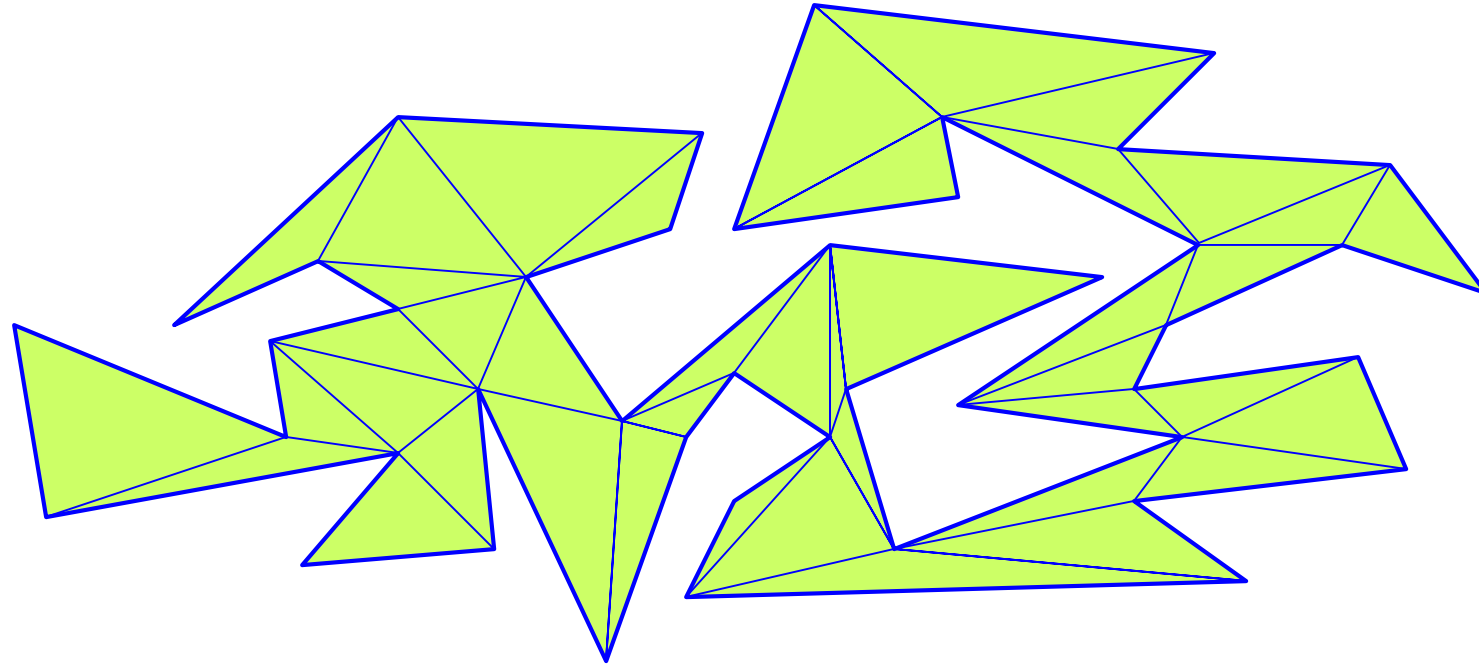
Polygon: A closed curve in the plane consisting of finitely many straight segments.

Simple Polygon: A connected non-self-crossing polygon.

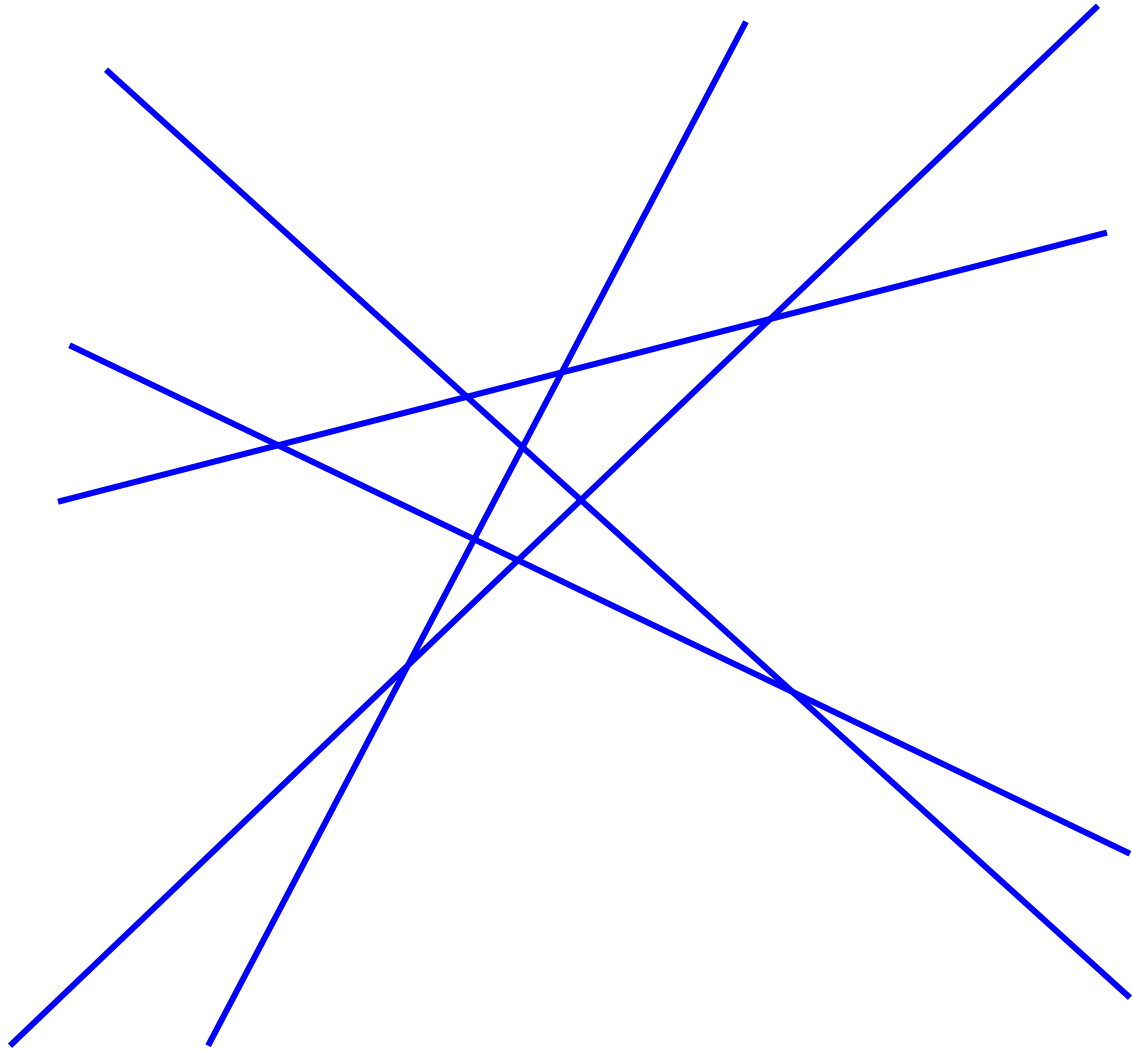
Convex Polygon: A simple polygon with no interior angle exceeding 180° .



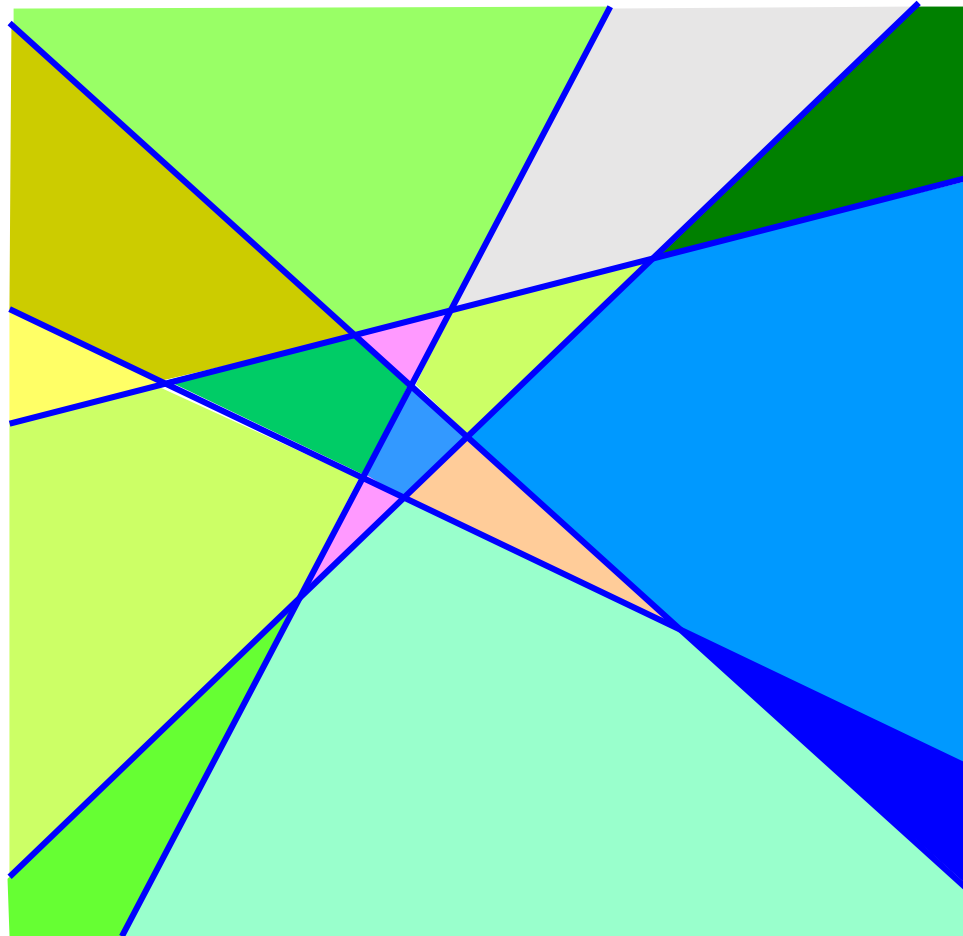
Example 3: Simple Polygon Triangulation



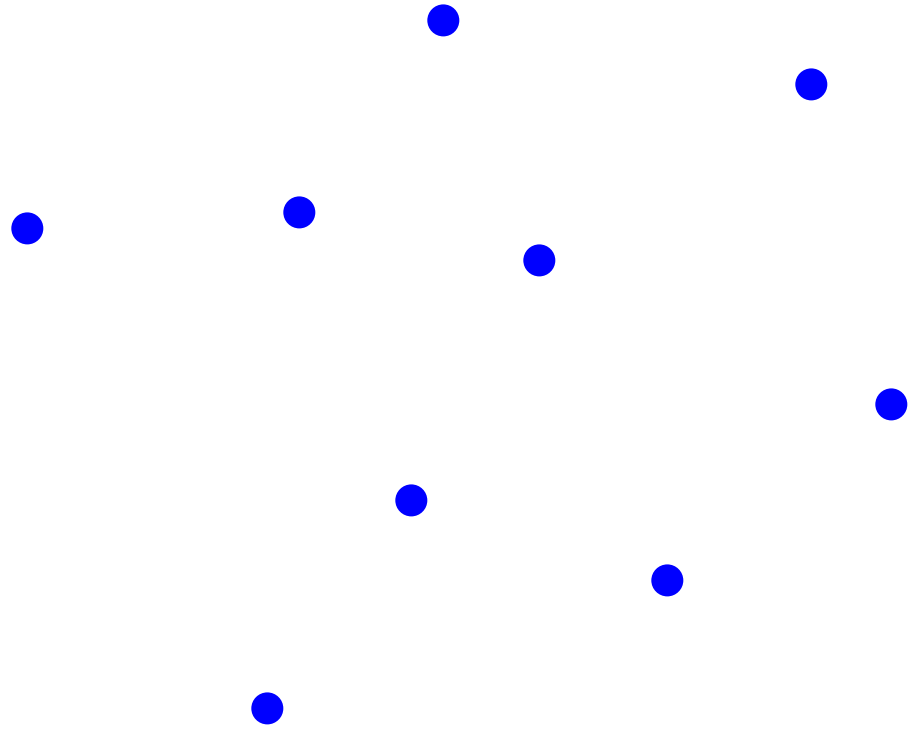
Example 4: Planar Line Arrangement



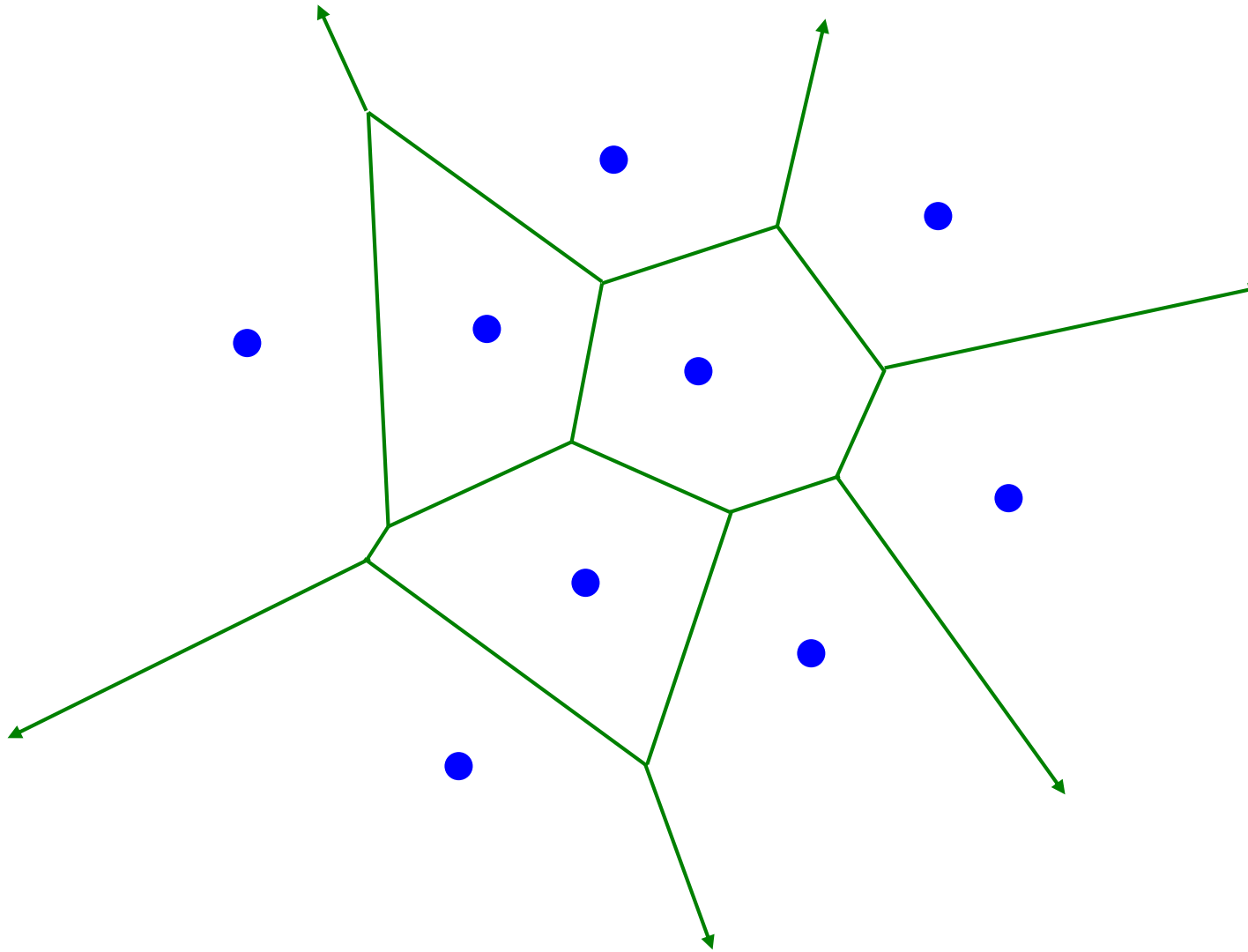
Example 4: Planar Line Arrangement



Example 5: Voronoi Diagram & Delaunay Triangulation

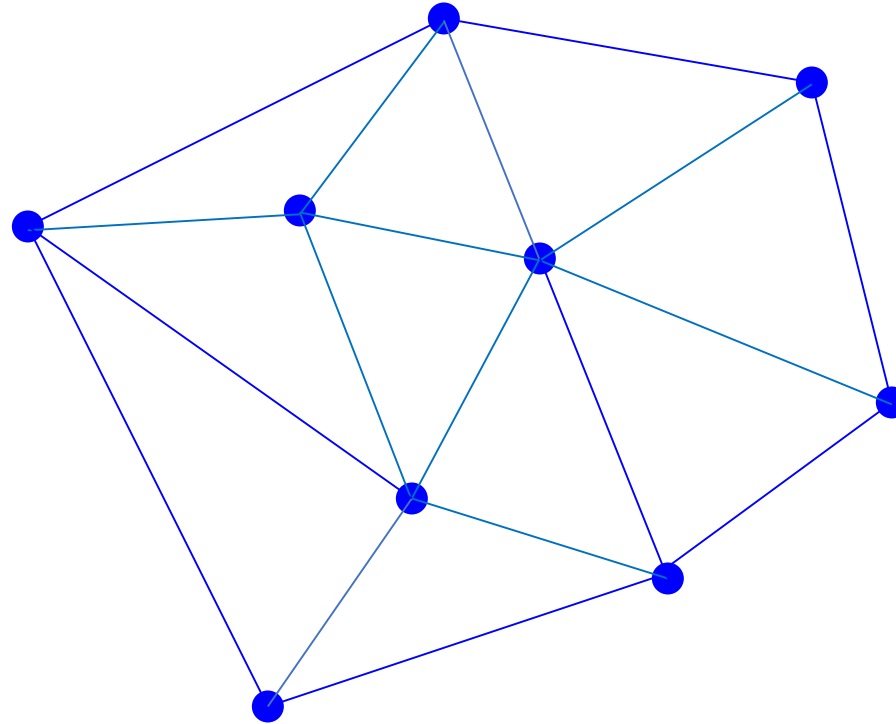


Example 5: Voronoi Diagram & Delaunay Triangulation



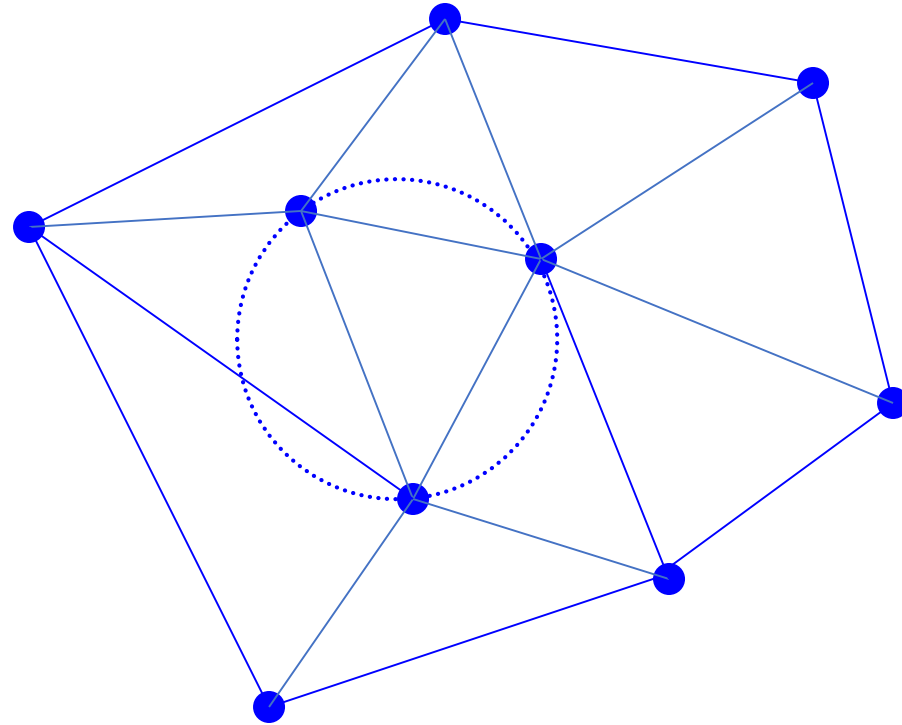
Nearest site proximity partitioning of the plane

Example 5: Voronoi Diagram & Delaunay Triangulation



Delaunay Triangulation = Dual of the Voronoi Diagram.

Example 5: Voronoi Diagram & Delaunay Triangulation



Delaunay triangles have the “empty circle” property.

Example 5: Voronoi Diagram & Delaunay Triangulation

