CENG 570

Computational Geometry

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Course website

• [http://www.ceng.metu.edu.tr/~tcan/ceng570_s1617/overview.shtml](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
- ...

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

#### 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
- ...

#### Implementation Issues:
- Degeneracy (symbolic perturbation)
- Robustness (inexact arithmetic)
- ...

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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 $180^\circ$. 
Example 3: Simple Polygon Triangulation
Example 4: Planar Line Arrangement
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Example 5: Voronoi Diagram & Delaunay Triangulation
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Nearest site proximity partitioning of the plane
Example 5: Voronoi Diagram & Delaunay Triangulation

Delaunay Triangulation = Dual of the Voronoi Diagram.
Delaunay triangles have the “empty circle” property.
Example 5: Voronoi Diagram & Delaunay Triangulation