

CS 461 - Computer Graphics

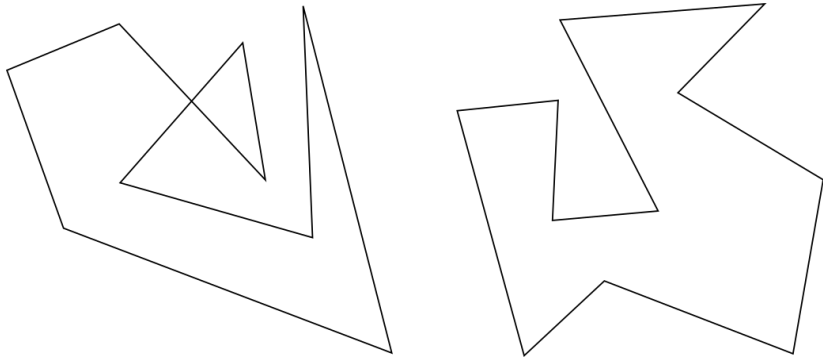
Introduction to Polygons

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Polygons

- ▶ A region of a plane bounded by a finite collection of line segments forming a simple closed curve



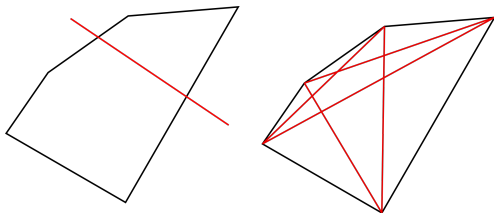
Convex Polygons

- ▶ A polygon with all its interior angles less than 180°
- ▶ Convex combinations of a set of points $\mathbf{x}_1, \mathbf{x}_2, \dots, \mathbf{x}_n$ is a point of the form

$$\alpha_1 \cdot \mathbf{x}_1 + \alpha_2 \cdot \mathbf{x}_2 + \dots + \alpha_n \cdot \mathbf{x}_n$$

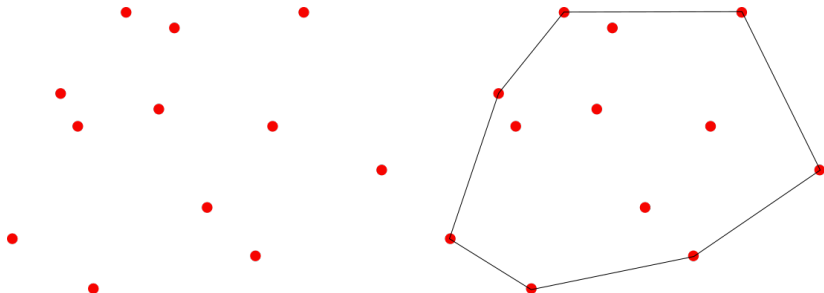
where $\alpha_i \geq 0$ and $\alpha_1 + \alpha_2 + \dots + \alpha_n = 1$

- ▶ Convex hull - Set of all convex combinations
- ▶ Concept of visibility



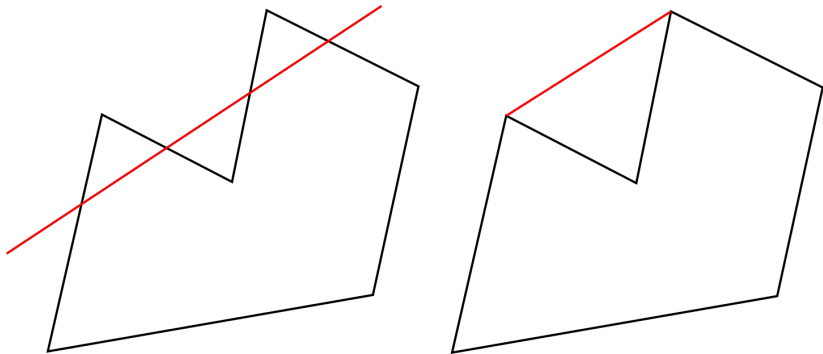
Convex hull

- ▶ Convex hull of a shape is the smallest convex set that contains it
- ▶ Collision avoidance, smallest box, comparison ...
- ▶ Gift wrapping algorithm



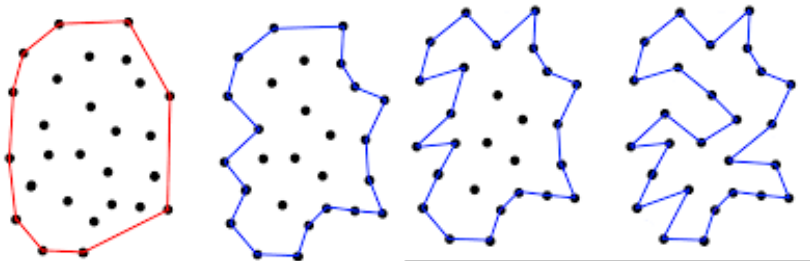
Non-convex (concave) Polygons

- ▶ A polygon with one or more interior angles greater than 180°



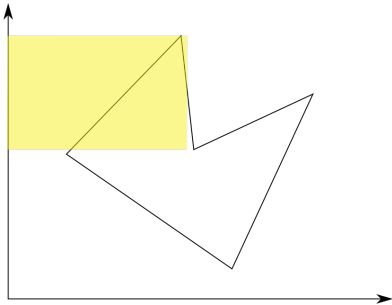
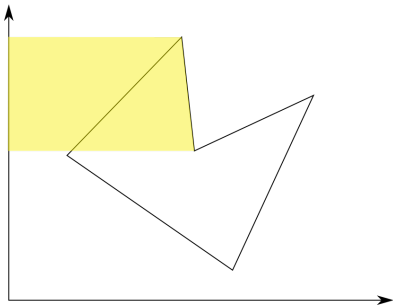
Concave hull?

- ▶ Concept??
- ▶ Non-uniqueness
- ▶ Example: α -shape



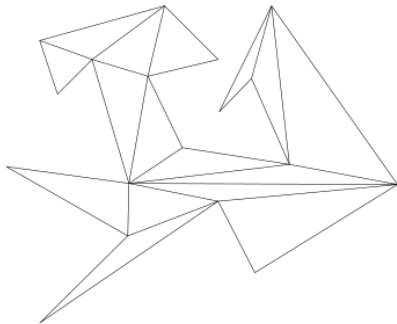
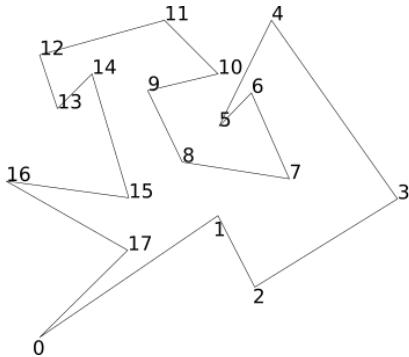
Area of a polygon

$$\text{Area} = \frac{(x_1+x_0) \cdot (y_1-y_0) + (x_2+x_1) \cdot (y_2-y_1) + \dots + (x_0+x_n) \cdot (y_0-y_n)}{2}$$



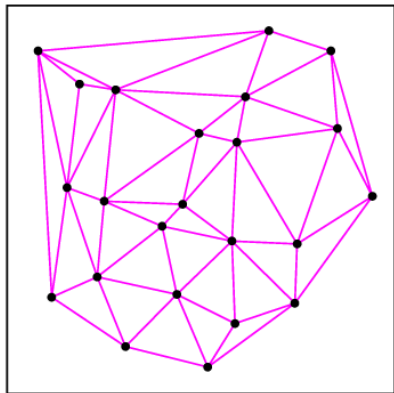
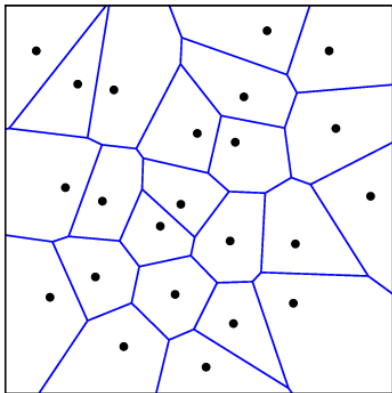
Triangulation

- ▶ Why triangles?
- ▶ Why triangulation?
- ▶ Ear removal



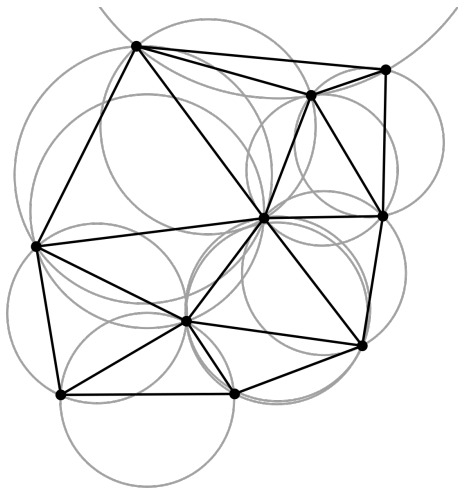
Voronoi Diagram and Delaunay Triangulation

- Definitions...
- Facility location
- Dual graph



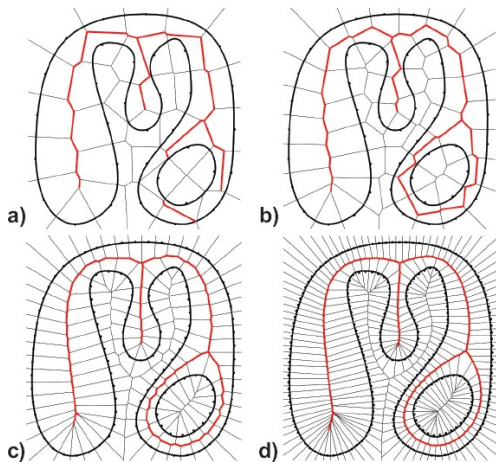
Properties of Delaunay Triangulation

- ▶ Circumcircle property
- ▶ Empty circle property
- ▶ Euclidean Minimum Spanning Tree



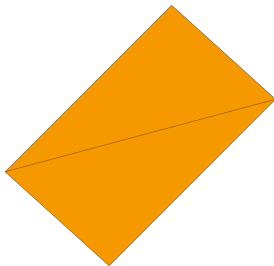
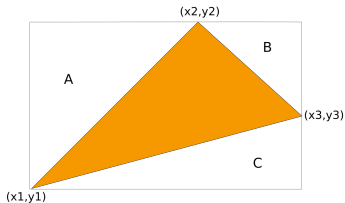
Medial axis and the skeleton

- ▶ Medial balls and medial axis (external and internal)
- ▶ Filtering medial axis



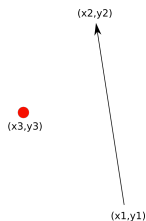
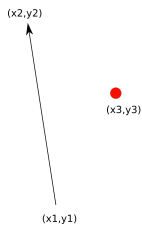
Area of a triangle

- ▶ Simple logic
- ▶ Relation to determinant
- ▶ Finding area of a polygon



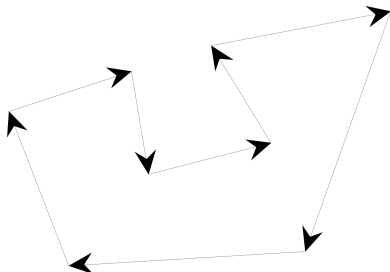
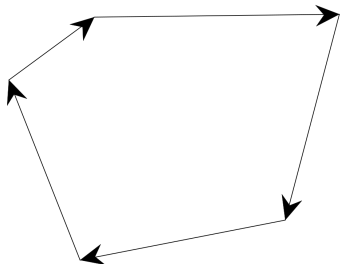
Concept of left predicate

- ▶ Interchanging the rows in a determinant?
- ▶ Order matters



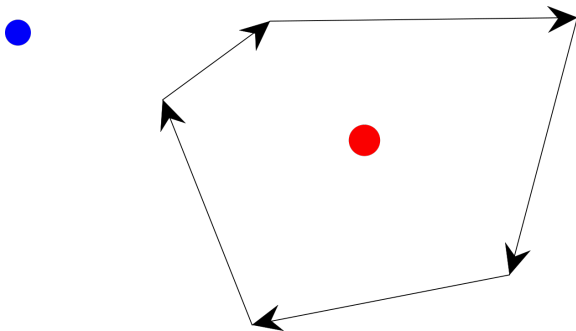
Revisiting convex/concave polygons

- ▶ How to test whether a given polygon is convex or not?



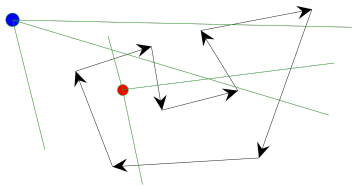
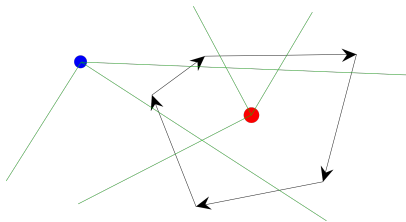
Modifying the question

- ▶ How to check whether a point is inside a convex polygon?



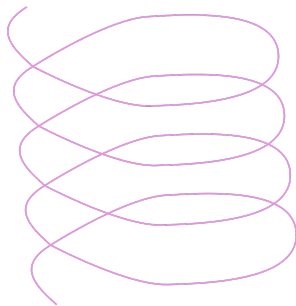
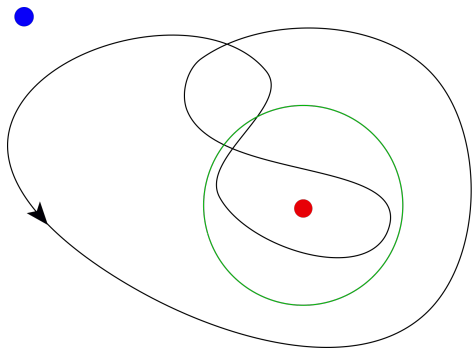
Generalizing

- ▶ Given a point, how to check whether it is inside or outside a polygon?
- ▶ Simple solution



Introduction to winding number

- ▶ An integer representing the total number of times that curve travels counterclockwise around the point



Today's seminar topics

- ▶ 39 - Modeling plants
- ▶ 26 - A general and efficient way for finding cycles in 3D curve networks
- ▶ 46 - High Resolution neural Face Swapping For Visual Effects
- ▶ 80 - Automatically modeling piecewise planar furniture shapes from unorganized point cloud

Next class

- ▶ Time: 14th Sep, Monday : 9 - 10
- ▶ Topic: Polygon filling and clipping algorithms
- ▶ Next set of seminars: 14th Sep, Monday : 10 - 11
- ▶ Lab assignment submission deadline: 13th midnight