Polygons

## CSCI 4229/5229
Computer Graphics
Summer 2022

Polygon Definitions

- A polygon is strictly a planar object
  - Plane defined as $ax + by + cz = 1$
    - Three distinct (x,y,z) points
    - One (x,y,z) point and a normal vector
  - Finite subset of plane defined by set of vertices
  - Vertexes **must** be in the plane
- In OpenGL you can specify 3D vertices
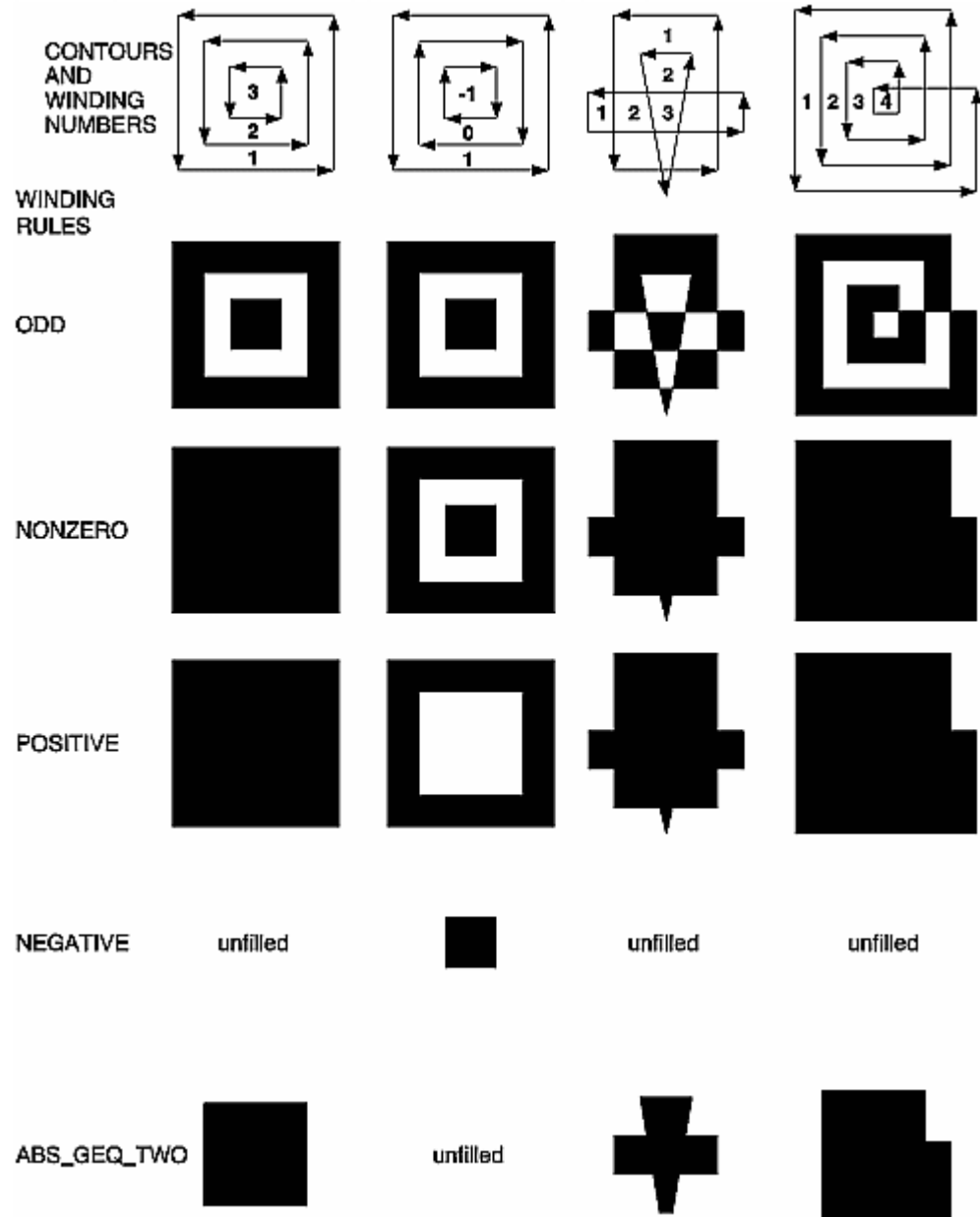 - When vertexes are not in a plane, the results are implementation dependent

Convex vs. Concave

- Convex polygons: Given any two points **a** and **b** in the polygon **c** = f**a** + (1-f)**b** is also inside the polygon for any f in (0,1)

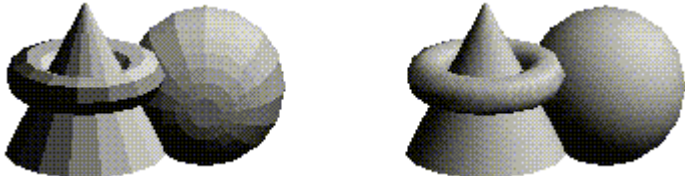- Concave polygons: Some **c** is outside the polygon

- Concave examples:
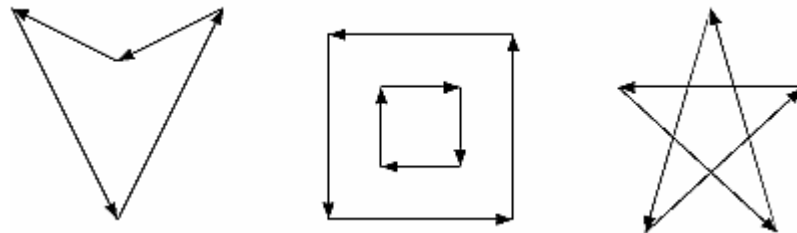
- OpenGL requires **convex** polygons

What is Inside?

Normals for Polygons

- Given 3 points in the plane P_1, P_2 and P_3

  - Normalize $(P_2-P_1) \times (P_3-P_1)$

  - Use any three distinct vertexes of the polygon not on a line

- True Gouraud shading

  - Calculate normals for all polygons

  - At common vertexes, average all the normals

  - Interpolate across polygons
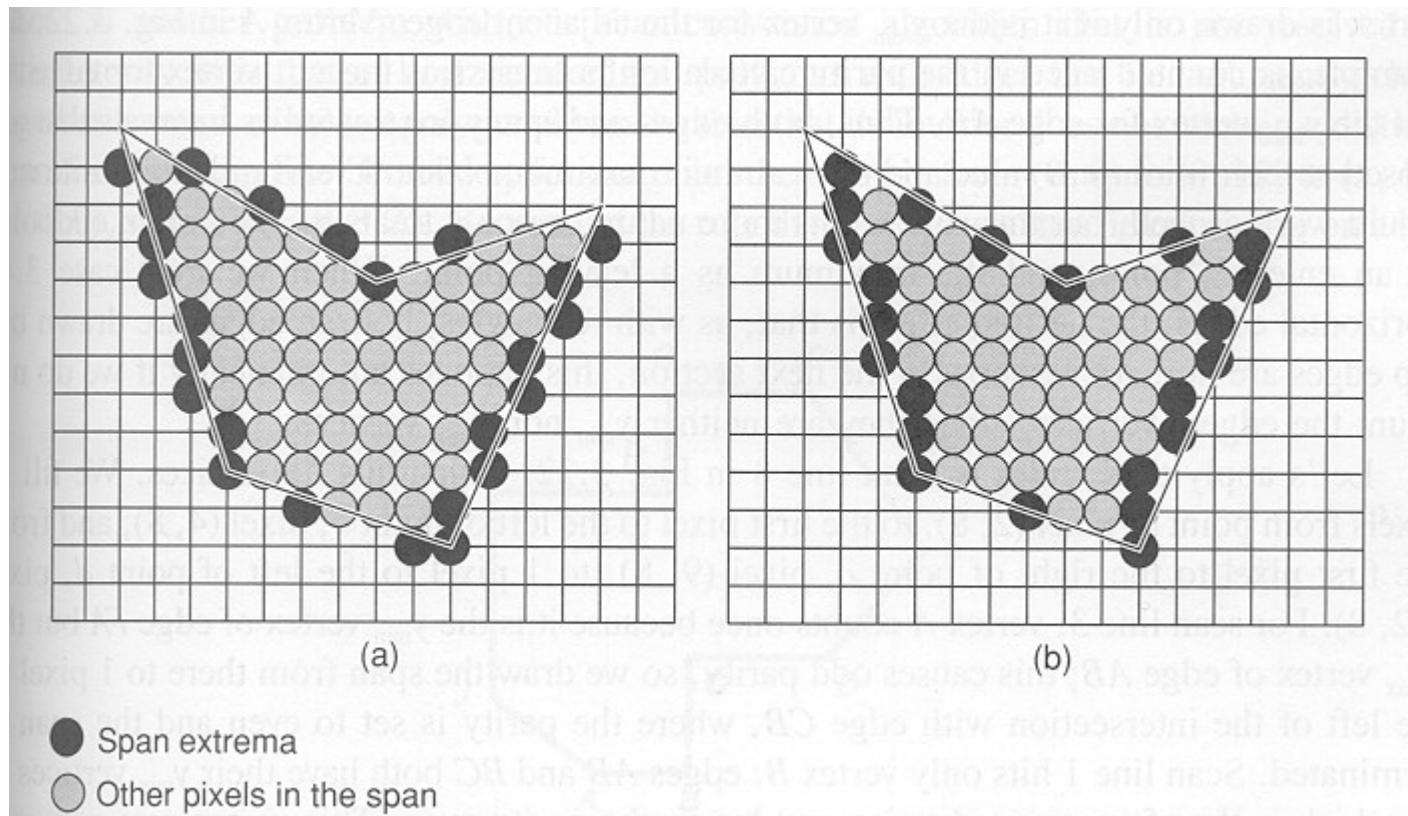
- OpenGL normals are set at vertexes

Scan Converting Polygons

- Draw horizontal lines to fill the polygon
- Pairs of points are interior
- Vertexes on a scanline is a problem
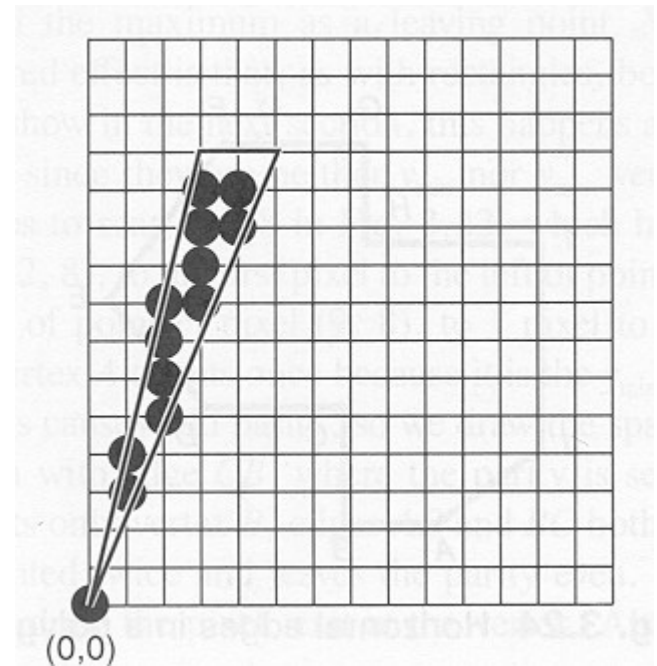- Convex polygons are easy
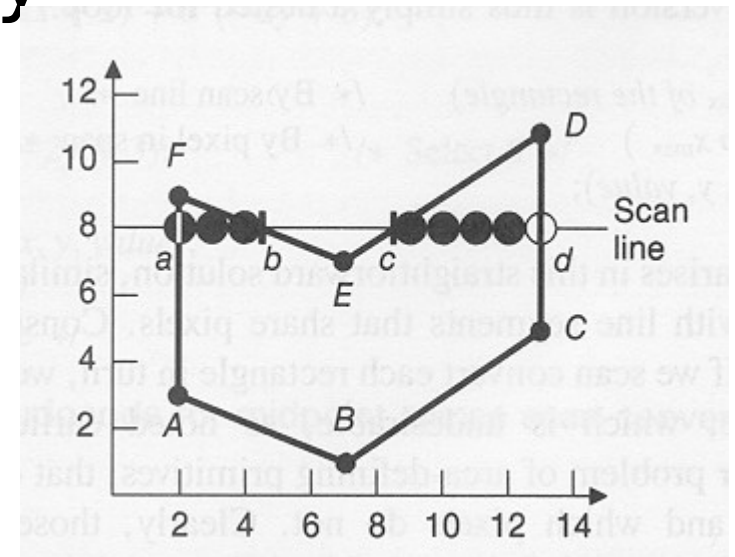
Deciding the Polygon Extent

- (a) Bresenham Outline
- (b) Strictly Interior Outline

(a)

(b)

● Span extrema
○ Other pixels in the span

Edge Coherence

- Scan lines intersects near the last scanline
- Slivers may be just a line

(0,0)

OpenGL Polygons

- glPolygonMode(type)
  - GL_POINT draws vertexes
  - GL_LINE   draws outline
  - GL_FILL   fills polygon
- glPolygonStipple(mask)
  - 32x32 pixel (byte) mask
  - glEnable(GL_POLYGON_STIPPLE)