Polygons

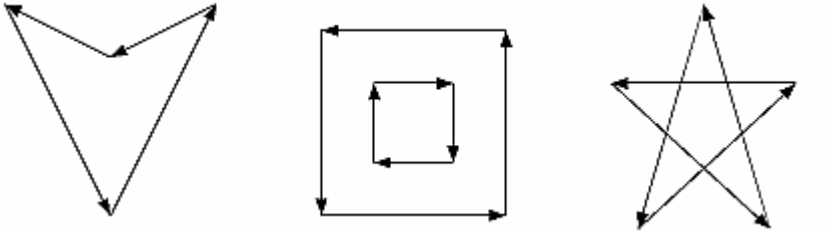
CSCI 4229/5229
Computer Graphics
Fall 2022

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

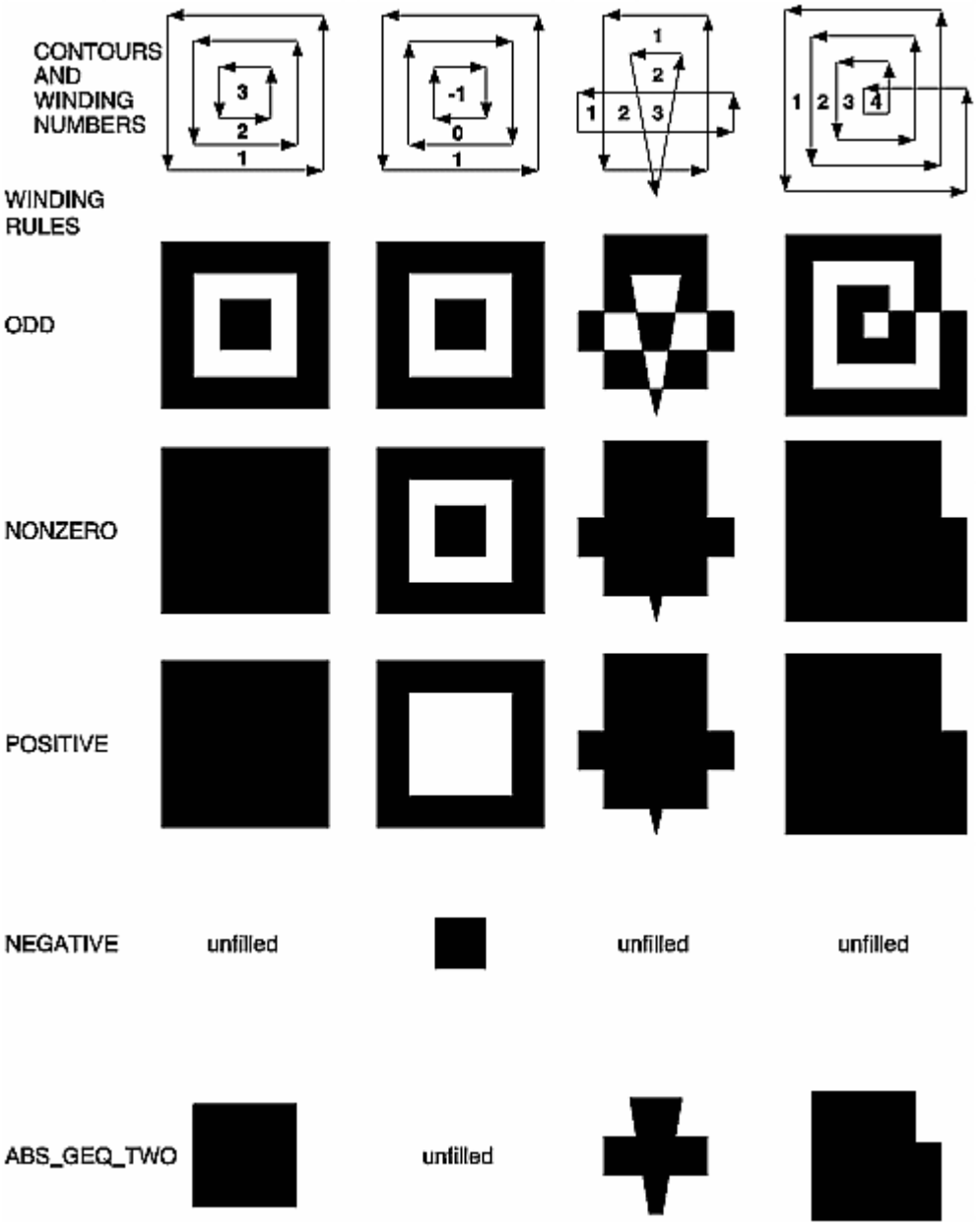
Convex vs. Concave

- 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:



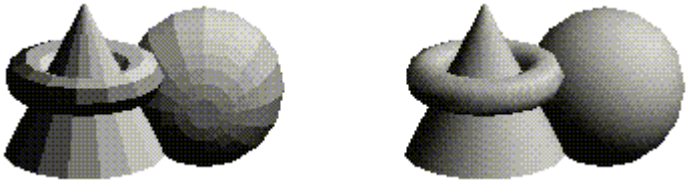
- OpenGL requires **convex** polygons

What is Inside?



Normals for Polygons

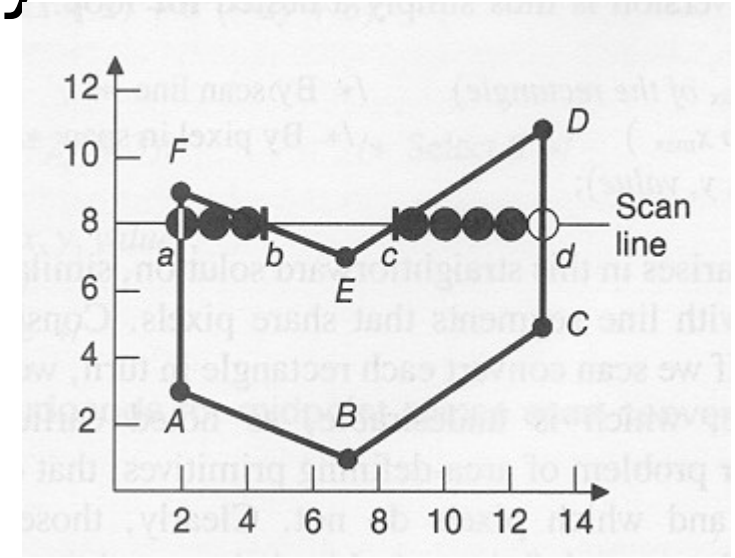
- Given 3 points in the plane P_1, P_2 and P_3
  - Normalize $(P_2\text{-}P_1)\times(P_3\text{-}P_1)$
  - Use any three distinct vertexes of the polygon not on a line
- True Gouraud shading



  - Calculate normals for all polygons
  - At common vertexes, average all the normals
  - Interpolate across polygons
- OpenGL normals are set at vertexes

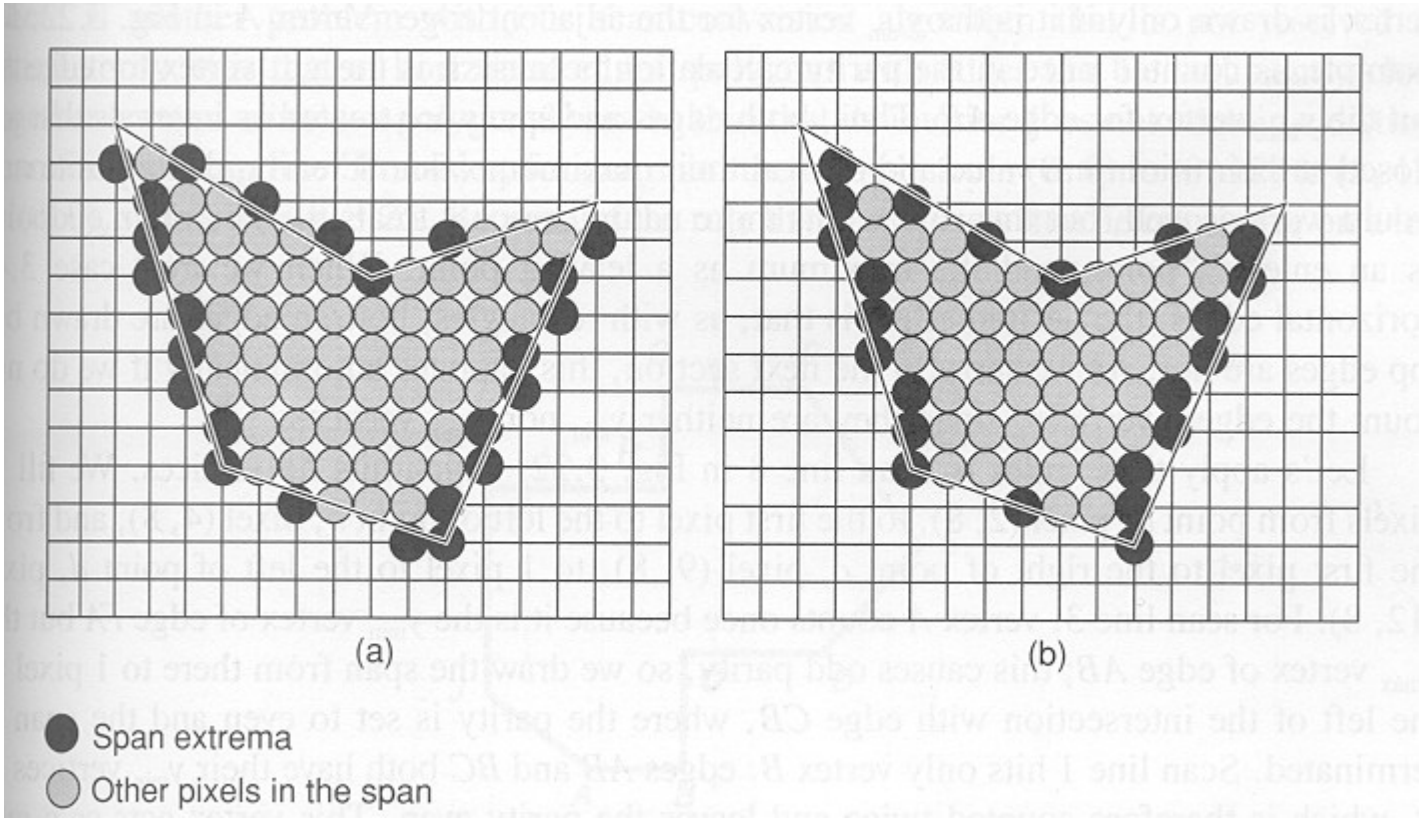
Scan Converting Polygons

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



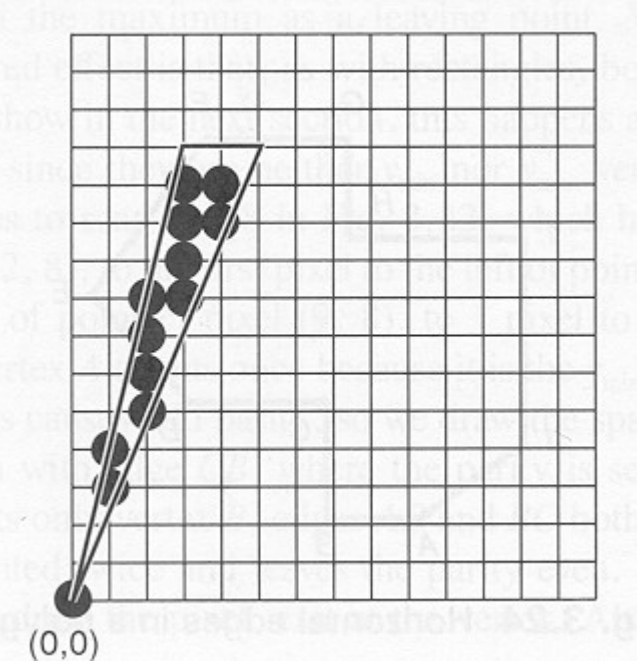
Deciding the Polygon Extent

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



Edge Coherence

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



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)