CSC418 Computer Graphics

- Polygons
  - Triangulation
  - Scan conversion
  - Convex/Concave
  - clipping)
- 2D affine transformations and properties, Homogeneous coordinates

Scan Conversion

- Convex versus concave polygons?
- Triangulating a polygon
- Scan Converting a triangle
- Pattern Filling a polygon
- Flood filling a polygon

Polygon Clipping

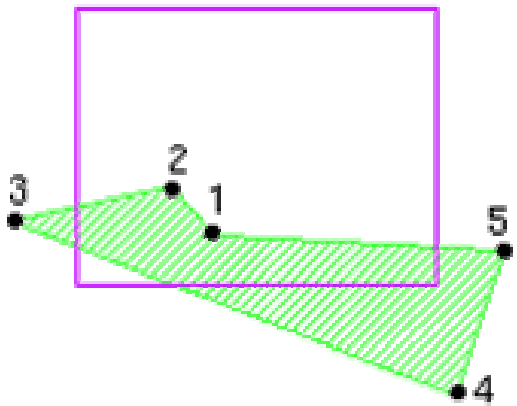
- **Clipping is a procedure for *spatially partitioning* geometric primitives, according to their containment within some region.**

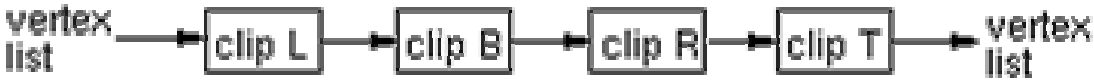
- **Why do we clip?**
  - **Distinguish whether geometric primitives are inside or outside of a *viewing region***
  - **Distinguish whether geometric primitives are inside or outside of a *picking region***
  - **Detecting intersections between primitives**
  - **Binning geometric primitives into spatial data structures.**
  - **Shadows.**

Sutherland-Hodgman clipping

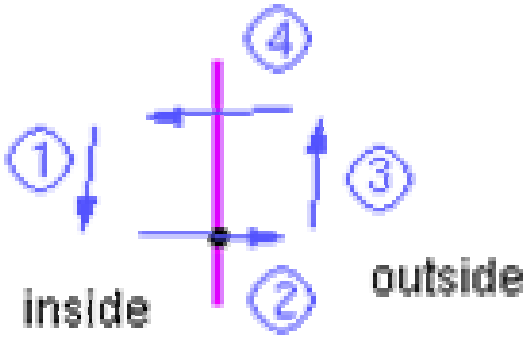
- Given: Polygon (list of vertices), clipping window (convex)

```
for each clip edge
    for each vtx and next in polygon
    {
        clip against edge
     }
```

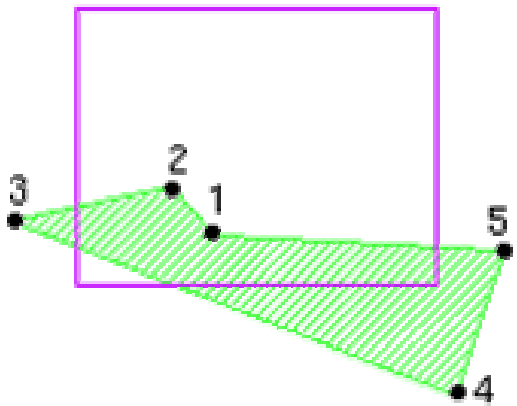


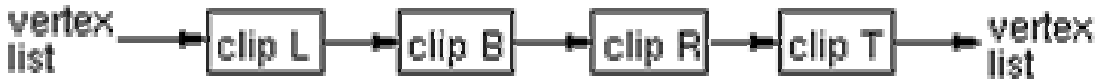


Sutherland-Hodgman clipping

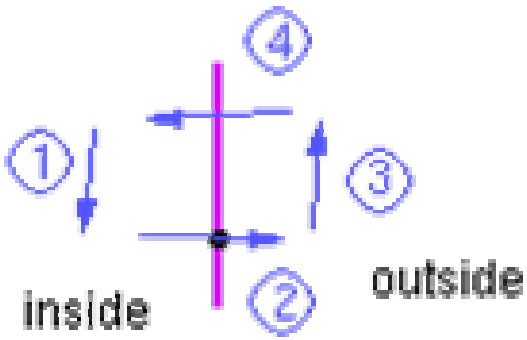


case #	first point	second point	output point(s)
1	inside	inside	second point
2	inside	outside	intersection point
3	outside	outside	none
4	outside	inside	intersection point and second point

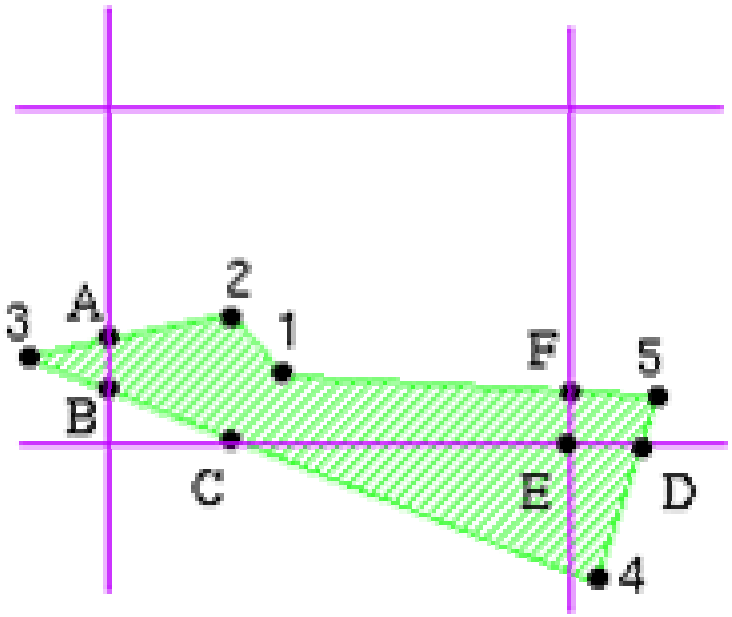




Sutherland-Hodgman clipping



case #	first point	second point	output point(s)
1	inside	inside	second point
2	inside	outside	intersection point
3	outside	outside	none
4	outside	inside	intersection point and second point

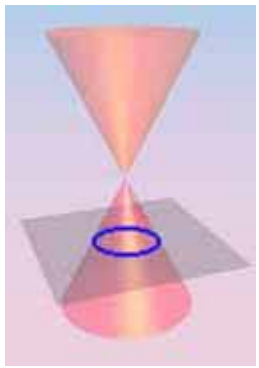


original: 1,2,3,4,5,1

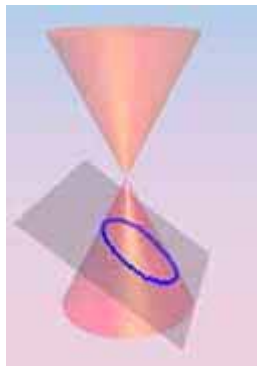
clip L: 1,2,A,B,4,5,1
clip B: 1,2,A,B,C,D,5,1
clip R: 1,2,A,B,C,E,F,1
clip T: (same)

2D Primitives

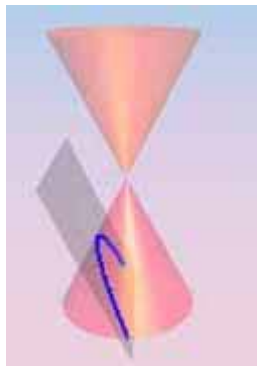
- **Conic Section: Defined as the intersection of an ellipse and a plane.**



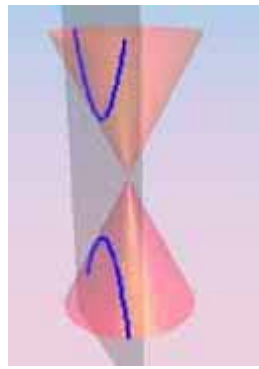
Circle



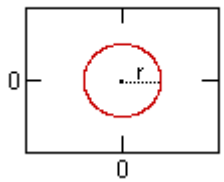
Ellipse (h)

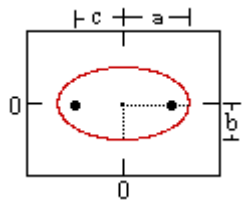


Parabola (h)

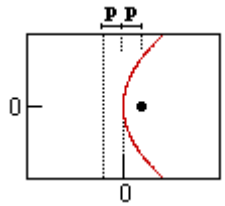


Hyperbola (h)

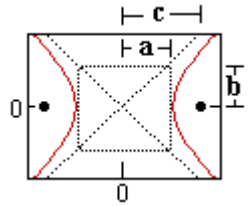




Ellipse (v)



Parabola (v)



Hyperbola (v)

Conics

- **The General Equation for a Conic Section:**
  $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$

- **The type of section can be found from the sign of: B^2 - 4AC**
- If B^2 - 4AC is
  - < 0ellipse, circle, point or no curve.
  - = 0parabola, 2 parallel lines, 1 line or no curve.
  - > 0hyperbola or 2 intersecting lines.

2D Transformations

- Live maya demo
- Coord-free Geom.
- Translate/Rotate/Scale
- Rotate about a point
- Transform Matrices
- Composition/Inversion of Transforms
- Homogeneous Coordinates, Affine Transforms
- Hierarchies