Tutorial 2. Polygon Clipping and Scan Conversion

1 Polygon Clipping

1.1 The Problem

- Input: (1) polygon to be clipped, corresponds to objects in the scene; (2) polygon to be clipped against, corresponds to the view volume.
- Output: Intersection of these two polygons.

The notion of "clipping" naturally extends to 3D, *e.g.*, clipping a polygon against a polyhedron.

1.2 The Sutherland-Hodgman Algorithm

Clips convex or concave polygons against convex ones.

Table 1: Rules for Sutherland-Hodgman clipping.

Case	1st vertex	2nd vertex	output
1	inside	inside	2nd vertex
2	inside	outside	intersection
3	outside	outside	none
4	outside	inside	2nd and intersection

Clip in the order T, L, B, R.
Original polygon: 1, 2, 3, 4

- Clip against T: 2, A, B, 4, 1
- Clip against L: A, B, 4, 1, 2
- Clip against B: B, 4, D, C, 2, A
- Clip against R: G, H, D, C, E, F, A, B

Problem: extraneous edge GH should not present.

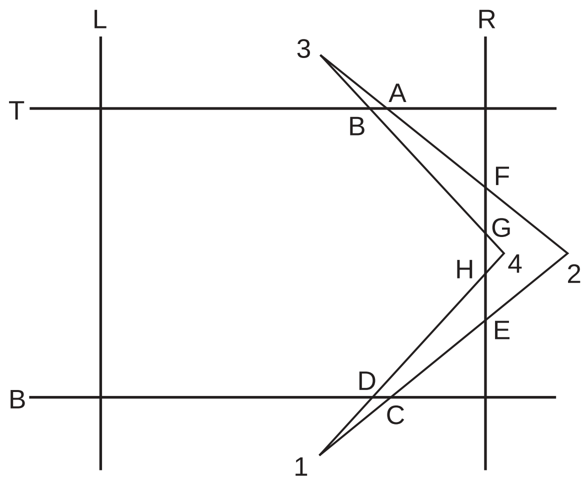

Figure 1: An example of Sutherland-Hodgman clipping.

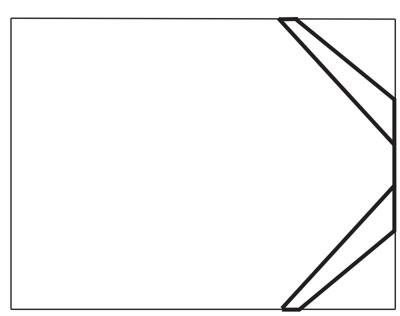

Figure 2: Result of the Sutherland-Hodgman clipping example.

1.3 The Weiler-Atherton Clipping Algorithm

More generic clipping algorithm, both the polygon to be clipped and the polygon to be clipped against can be either convex or concave, even containing holes are fine.
Also handles the "extraneous edge" problem.

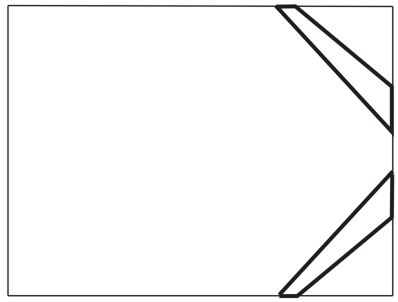

Figure 3: Result of Weiler-Atherton clipping.

Not our focus here. For details, refer to textbooks or Internet.

2 Scan Conversion using AELs (Active Edge List)

2.1 The Problem

Shade pixels within a closed polygon in a computationally efficient way.
Assume polygon is closed and has ordered edges.

2.2 Building the Edge Table

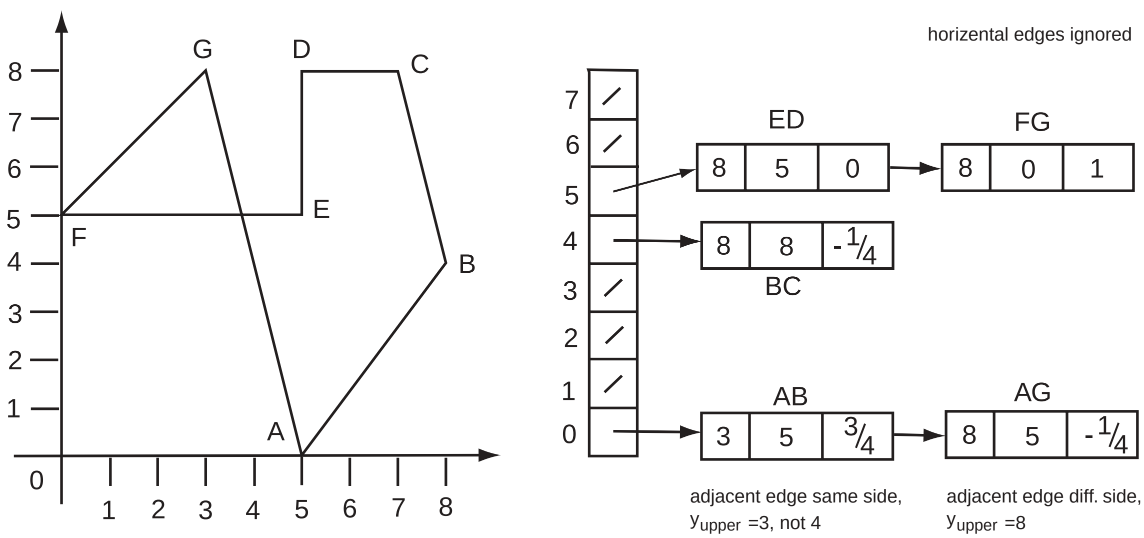

Figure 4: Building edge-table: an example.

Each entry in the edge table is of the form $(y_{upper}, x_{start}, \triangle x)$.

2.3 The AEL Algorithm

Scan conversion using AEL

```
for each scanline
    add edges in edge table to AEL
    if AEL <> NIL
        sort AEL by x
        fill pixels between edge pairs
        update each edge's x
```

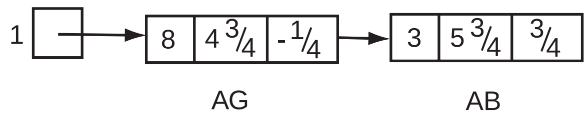

Figure 5: AEL at $y = 1$.