2D Viewing

Polygon and Text Clipping

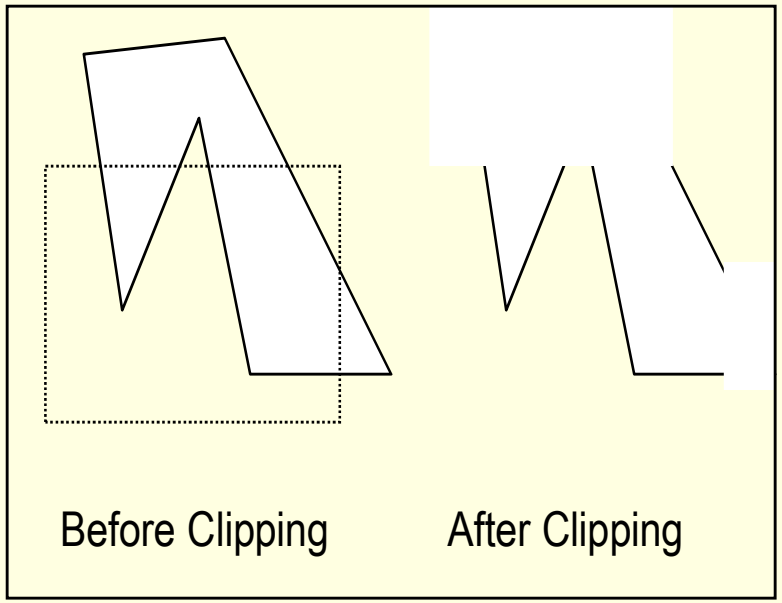
Overview

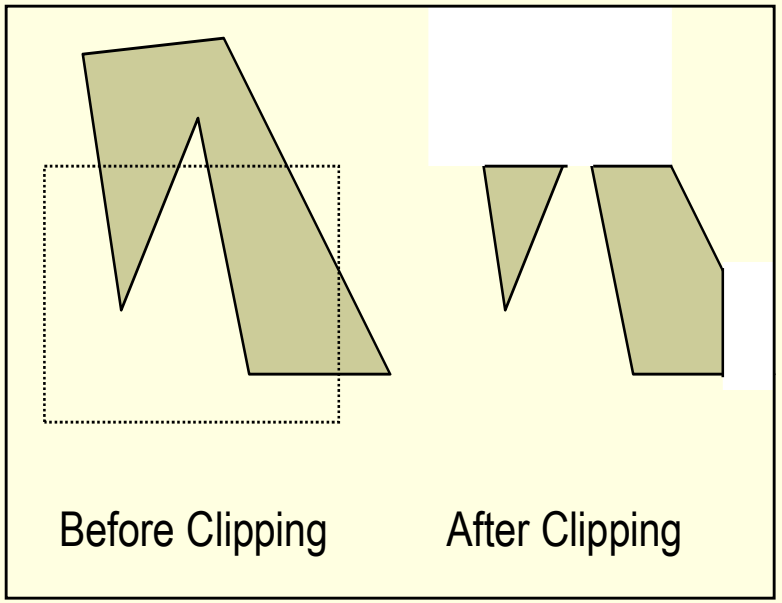
- Sutherland-Hodgeman Polygon Clipping
- Weiler-Atherton Polygon Clipping
- Text Clipping
- Exterior Clipping

Polygon Clipping

- To clip a polygon fill area, we cannot directly apply a line clipping method to the individual polygon edges.
- Because this approach would not, in general, produce a closed polyline.
- Instead, a line clipper would often produce a disjoint set of lines with no complete information about how we might form a closed boundary around the clipped fill area.

Sutherland-Hodgman Polygon-Clipping





Sutherland-Hodgeman Polygon Clipping Algorithm (A divide-and-conquer strategy)

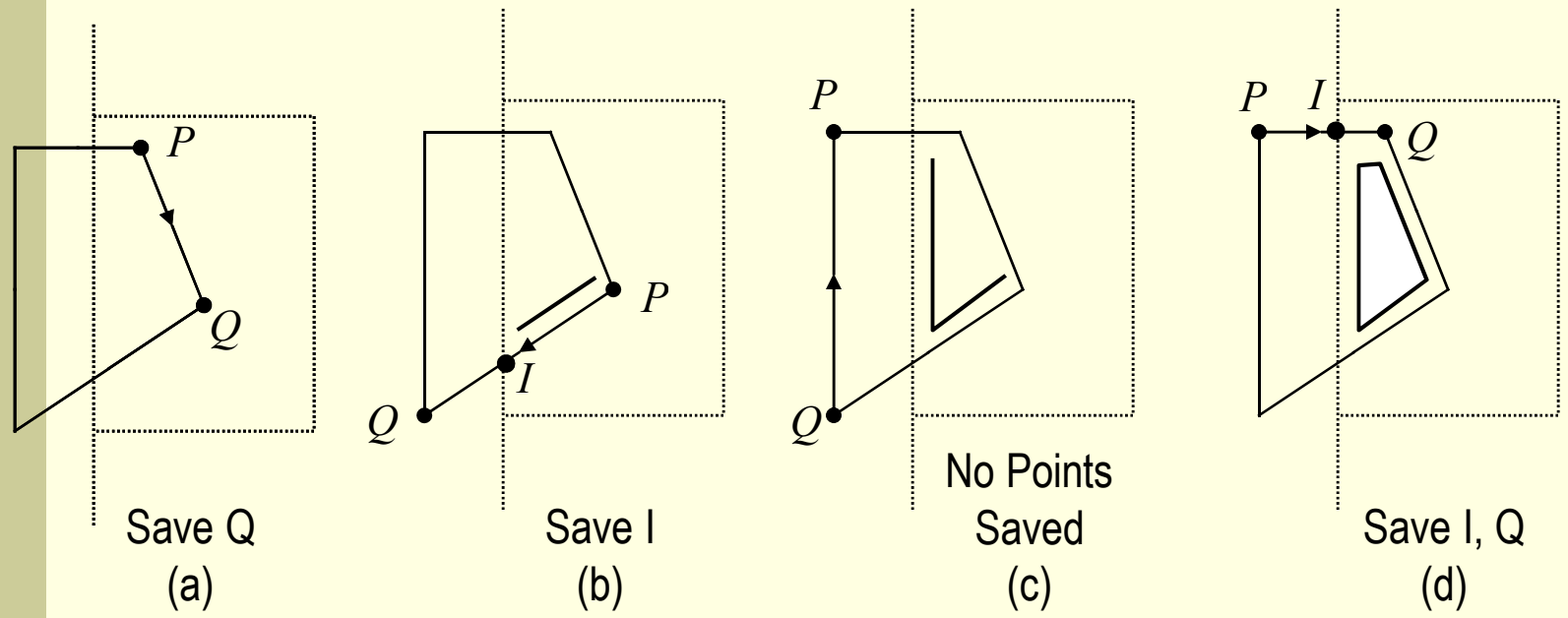
- Polygons can be clipped against each edge of the window one at a time.
- Clip the output polygon against the next edge.
- Repeat for all edges
- Edge intersections, if any, are easy to find since the *X* or *Y* coordinates are already known.
- Note that the number of vertices usually changes and will often increases.

Sutherland-Hodgeman Polygon Clipping Algorithm

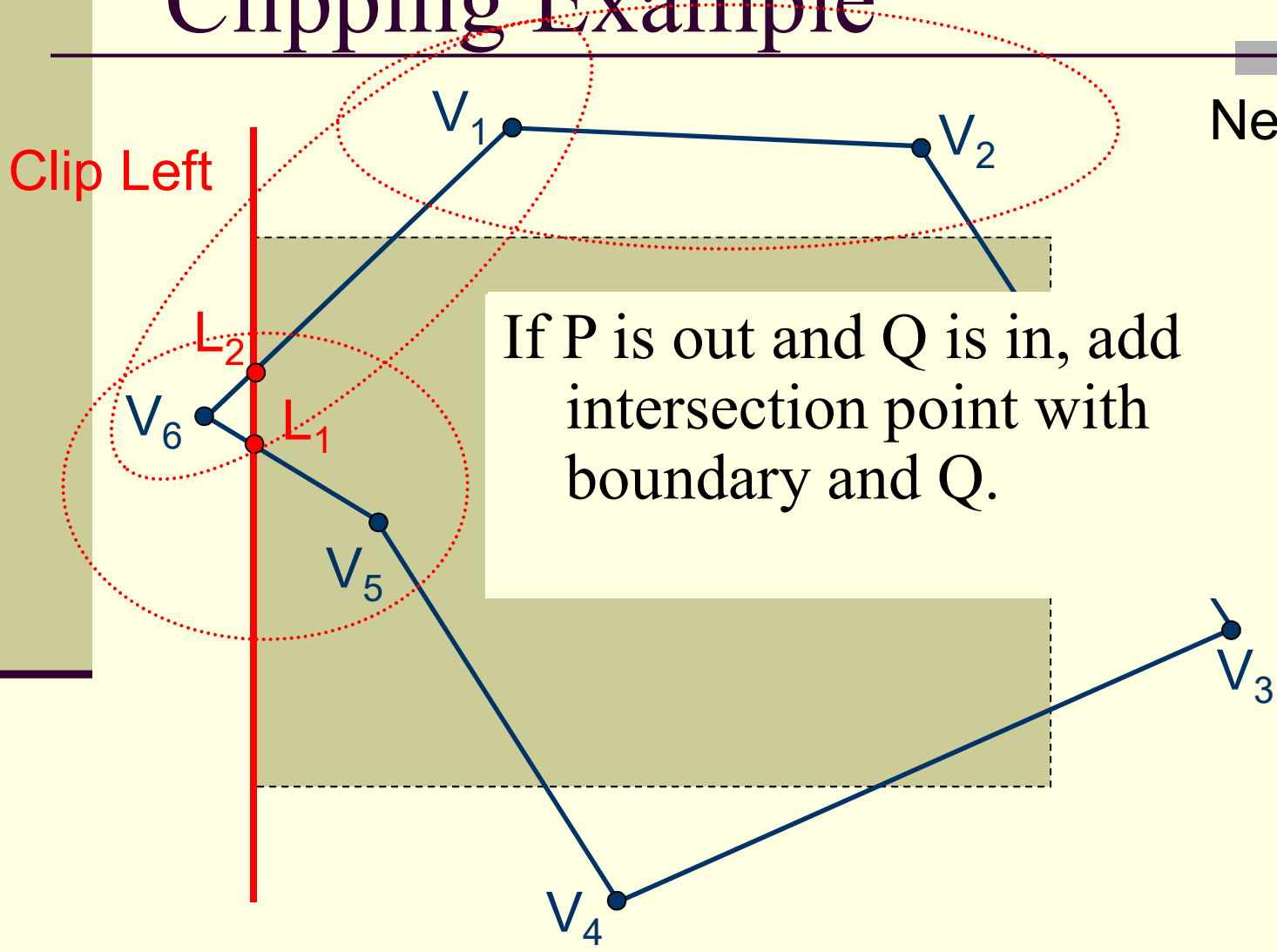
- Clip one boundary at a time: left, top, right, bottom.
- Check each adjacent pair of vertices (P,Q), in order to make a new vertex list.

1. If P and Q are in, add Q.
2. If P is in and Q is out, add the intersection point with boundary only.
3. If P and Q are both out, add nothing.
4. If P is out and Q is in, add intersection point with boundary and Q.

Sutherland-Hodgeman Algorithm(*cont.*)



Sutherland-Hodgeman Clipping Example



If P is out and Q is in, add intersection point with boundary and Q.

New Vertex List

V_2

V_3

V_4

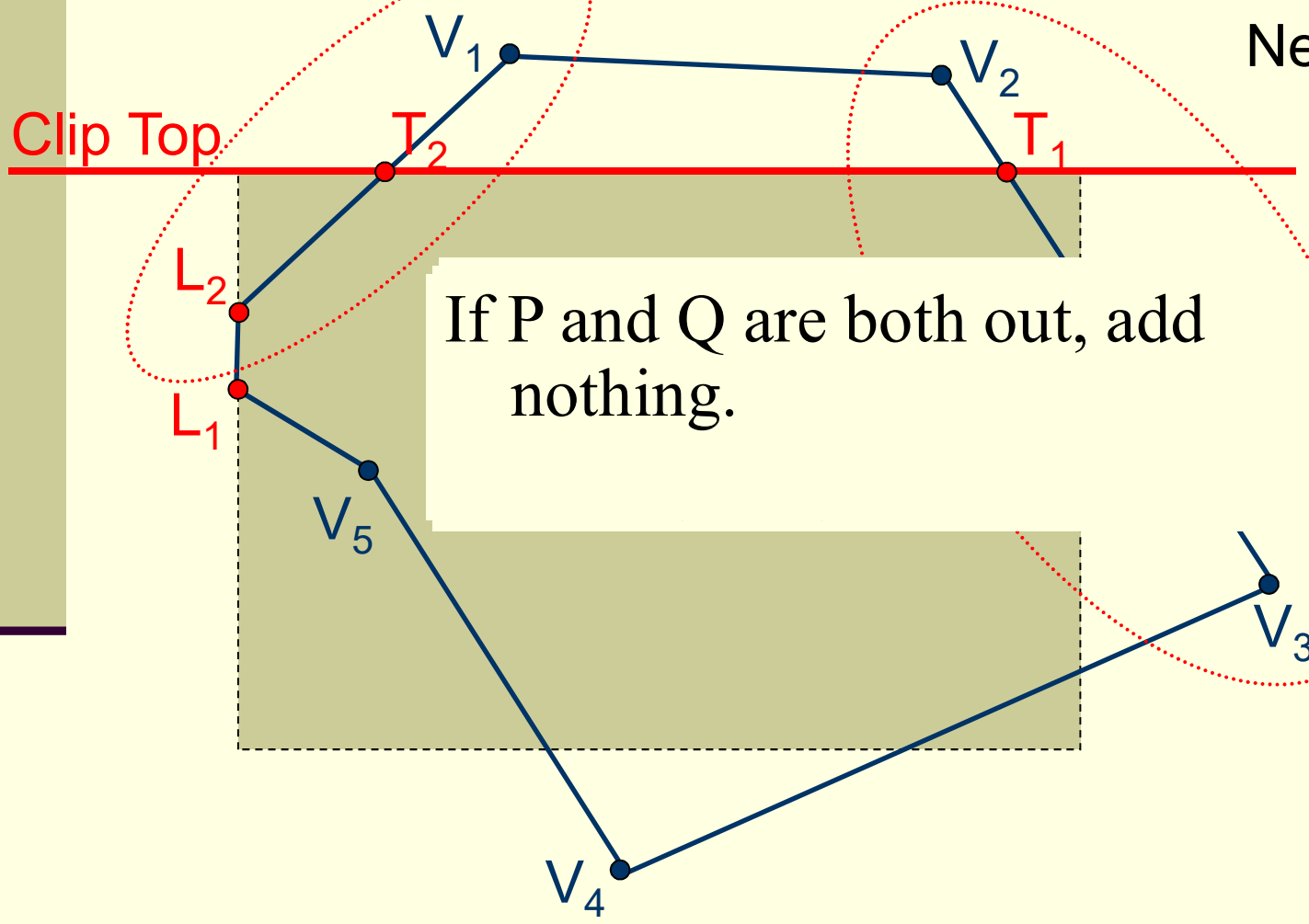
V_5

L_1

L_2

V_1

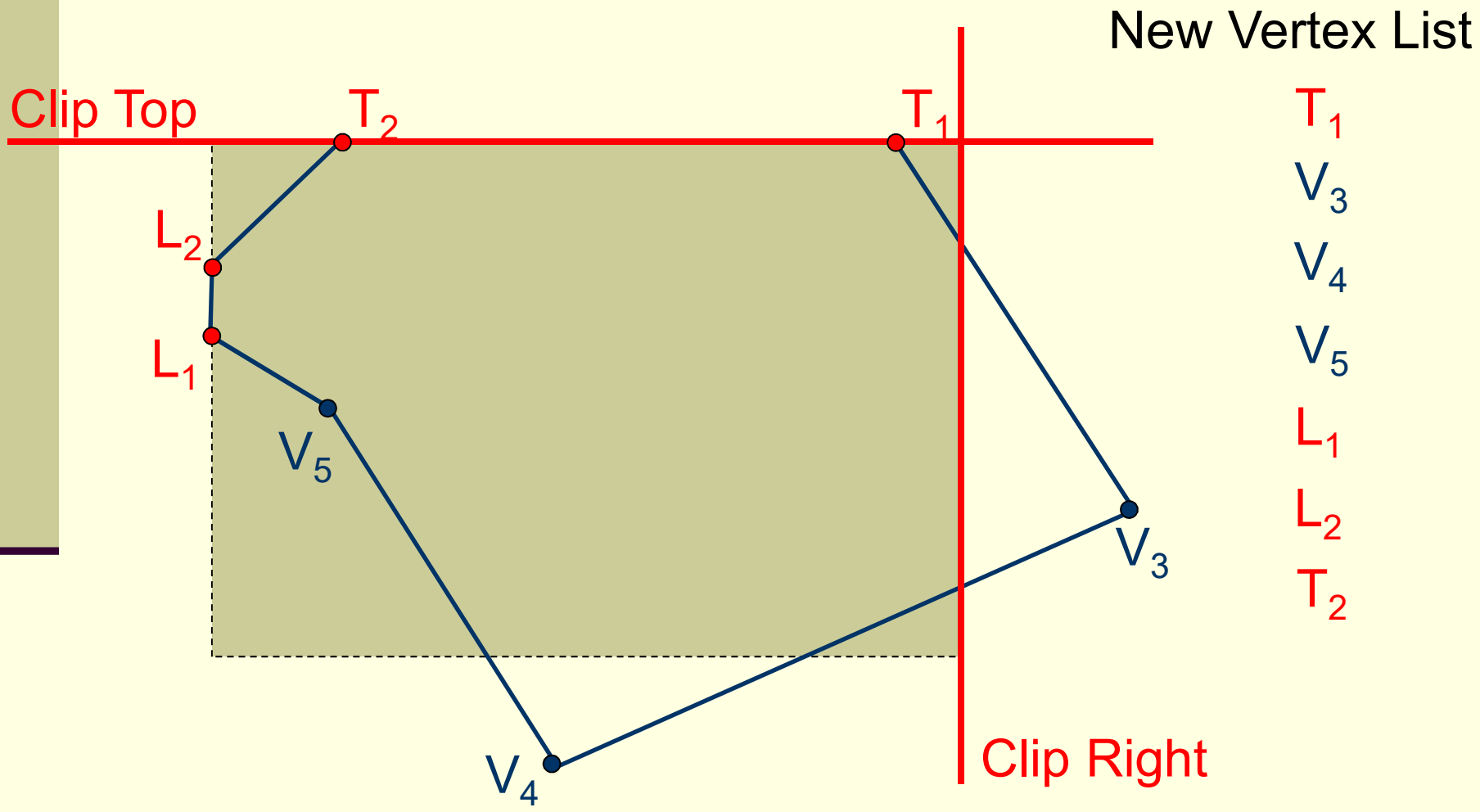
Sutherland-Hodgeman Clipping Example



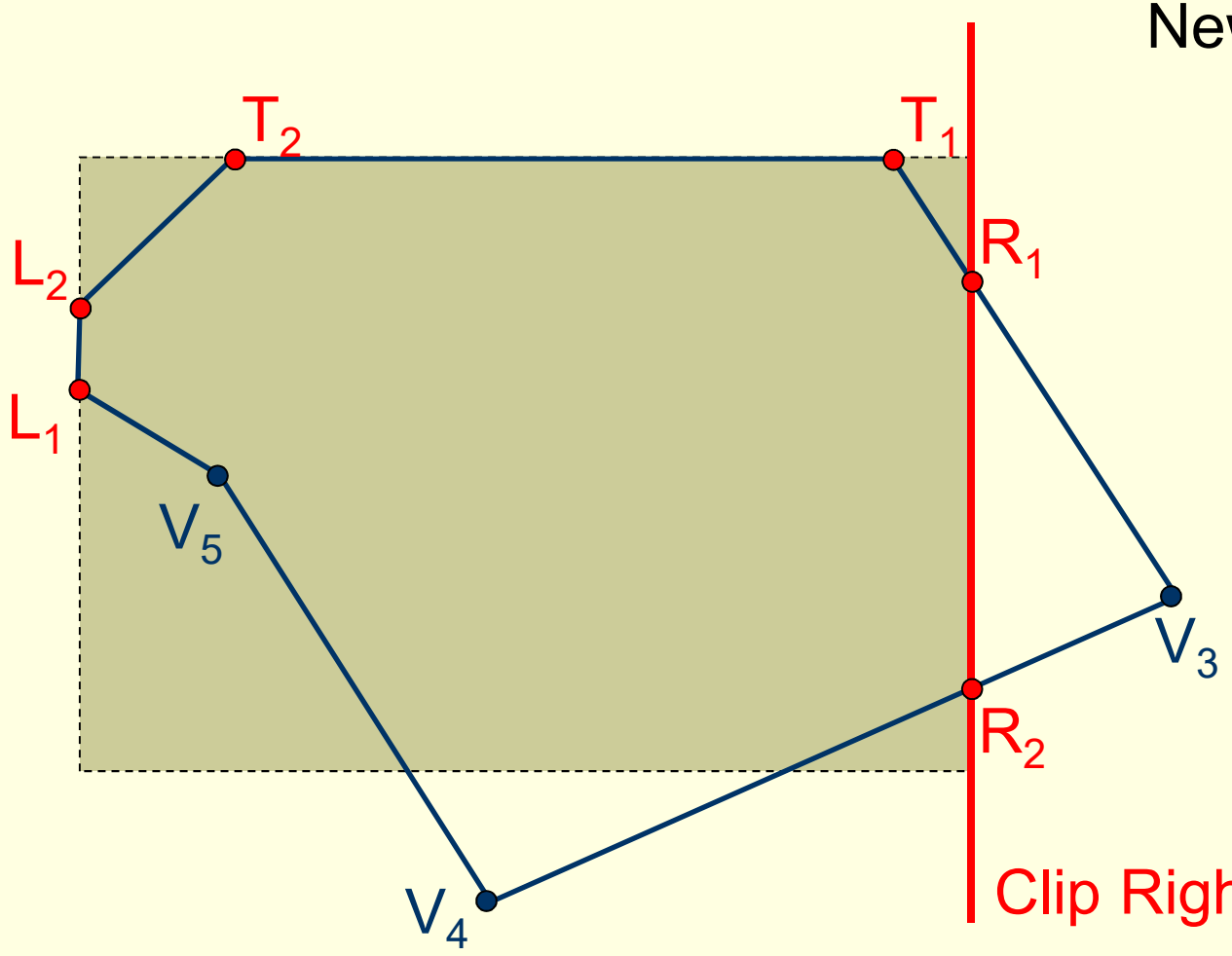
New Vertex List

T_1
V_3
V_4
V_5
L_1
L_2
T_2

Sutherland-Hodgeman Clipping Example



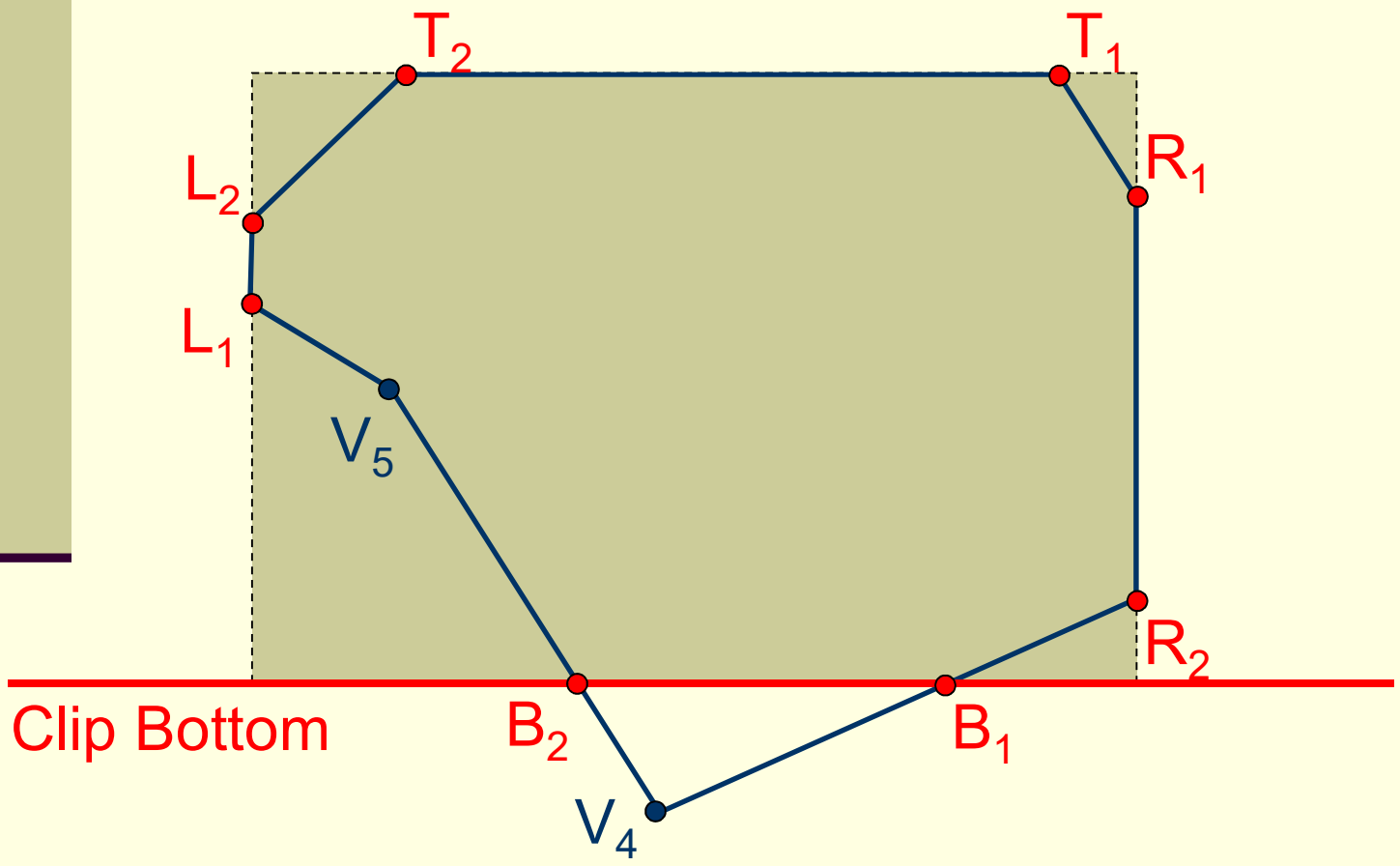
Sutherland-Hodgeman Clipping Example



New Vertex List

R_1
R_2
V_4
V_5
L_1
L_2
T_2
T_1

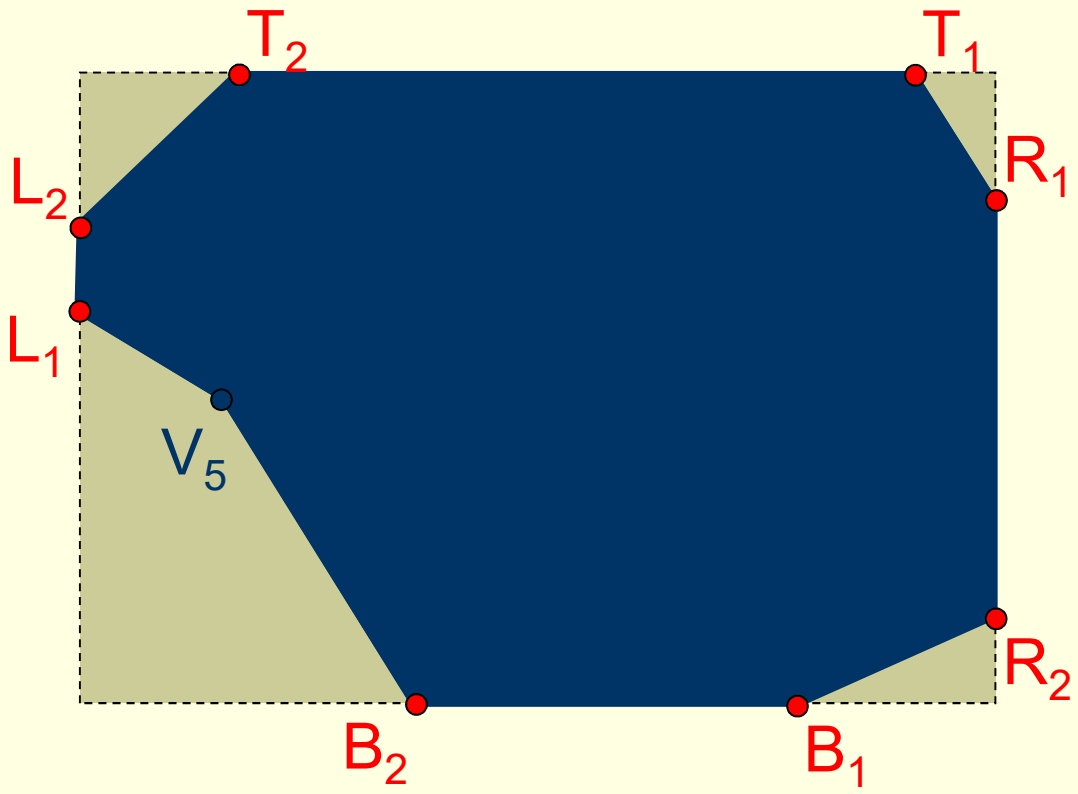
Sutherland-Hodgeman Clipping Example



New Vertex List

R_2
B_1
B_2
V_5
L_1
L_2
T_2
T_1
R_1

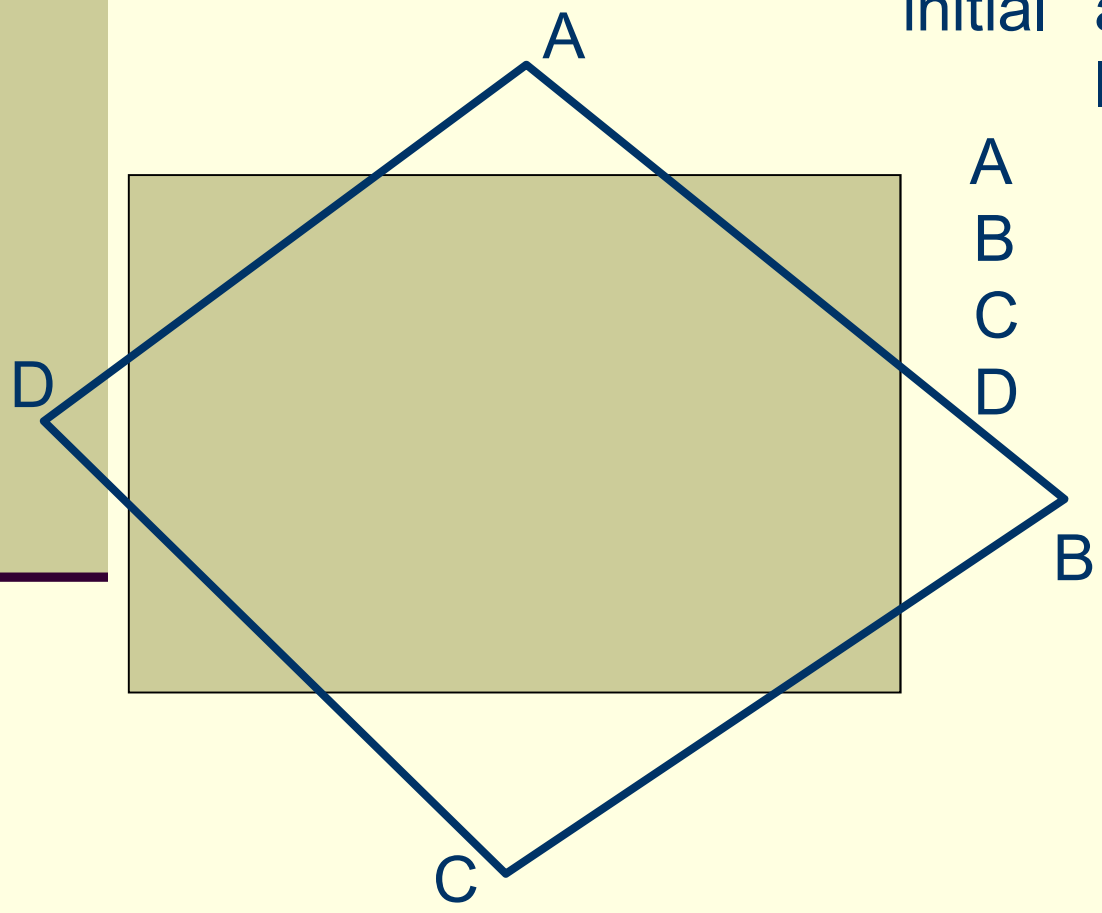
Sutherland-Hodgeman Clipping Example



New Vertex List

R_2
B_1
B_2
V_5
L_1
L_2
T_2
T_1
R_1

Sutherland-Hodgeman Exercise 1



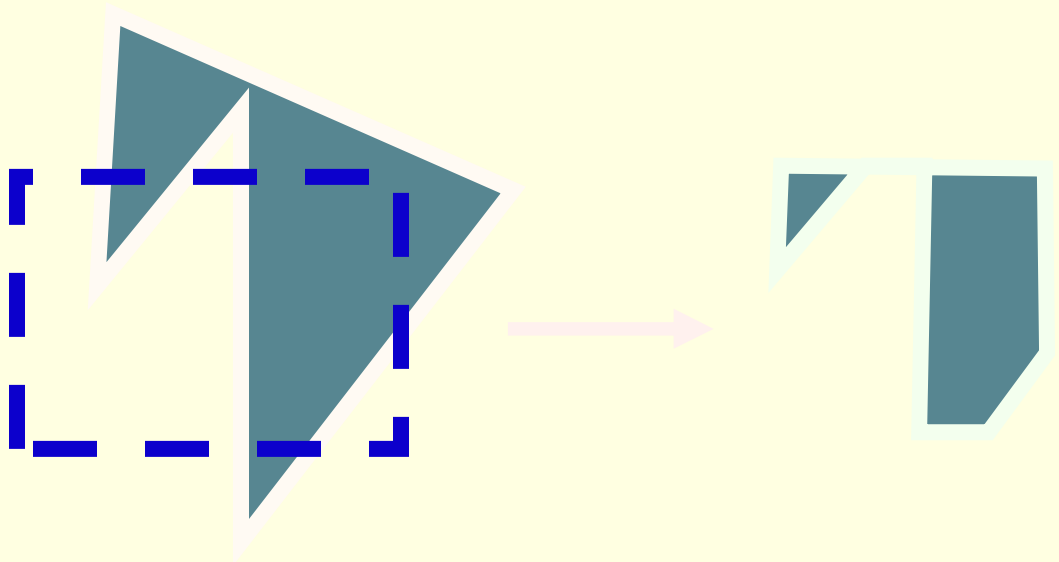
Vertex List

initial	after left	after top	after right	after bottom
A				
B				
C				
D				

Sutherland-Hodgeman Polygon Clipping Algorithm

- Convex polygons are correctly clipped by sutherland hodgeman algorithm
- Concave polygons may be displayed with extraneous lines.
- Occurs when clipped polygon have two separate sections.
- Only one output vertex list, the last vertex in the list is always joined to the first vertex

Weiler-Atherton Clipping



- A different clipping algorithm, the Weiler-Atherton algorithm, creates separate polygons

Weiler-Atherton Clipping

- The vertex processing procedures for window boundaries are modified so that concave polygons are displayed.
- Consider the window boundaries along with the polygon edges.
- Which path to follow depends on the polygon processing direction.
- For clockwise processing of polygon vertices, use the following rules:
  - For an outside-to-inside pair of vertices, follow the polygon boundary
  - For an inside-to-outside pair of vertices, follow the window boundary in a clockwise direction

Weiler Atherton Clipping

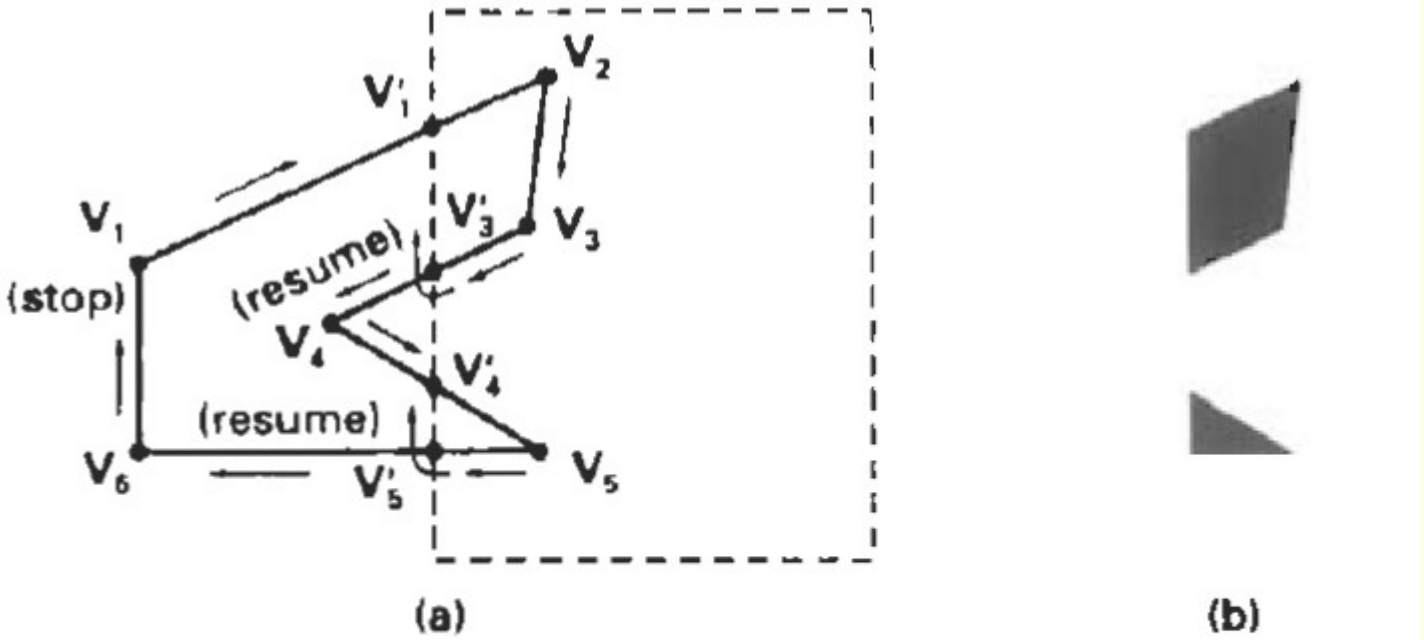
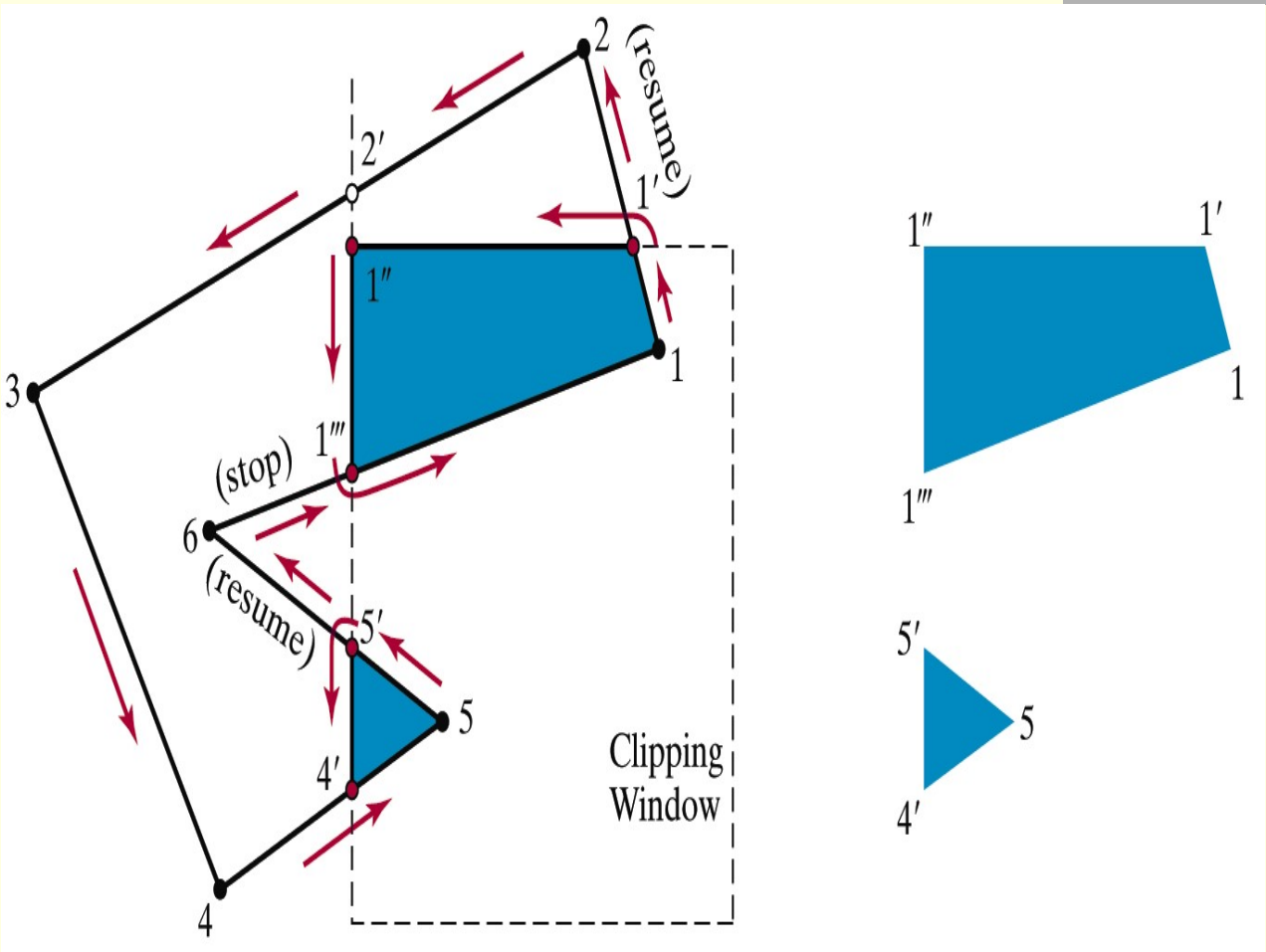


Figure 6-25
Clipping a concave polygon (a) with the Weiler–Atherton algorithm generates the two separate polygon areas in (b).

Weiler-Atherton Clipping



Weiler-Atherton Clipping

- Polygon clipping using nonrectangular polygon clip windows

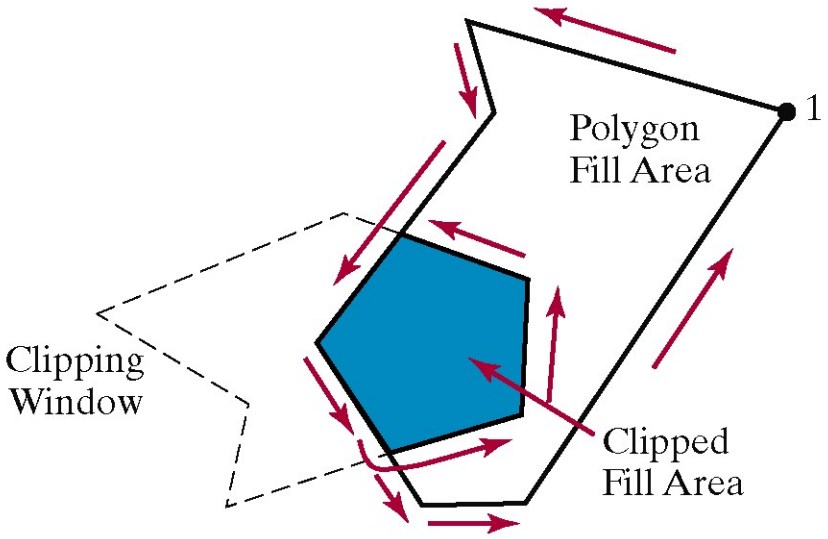


Figure 6-30

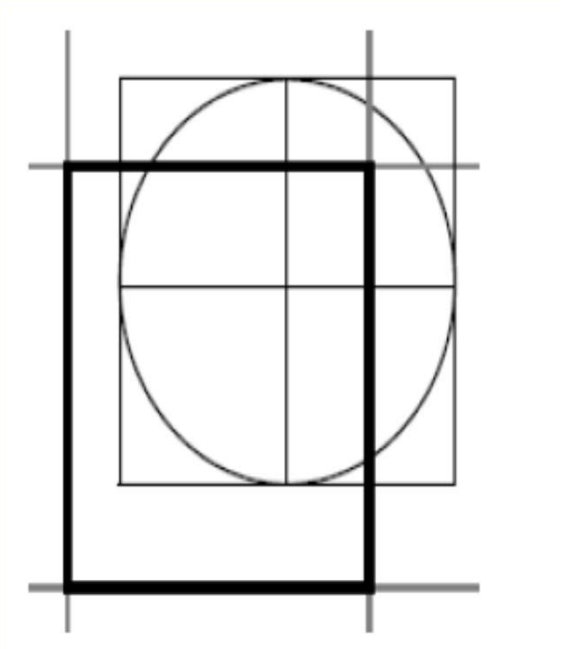
Clipping a polygon fill area against a concave-polygon clipping window using the Weiler-Atherton algorithm.

Curve Clipping

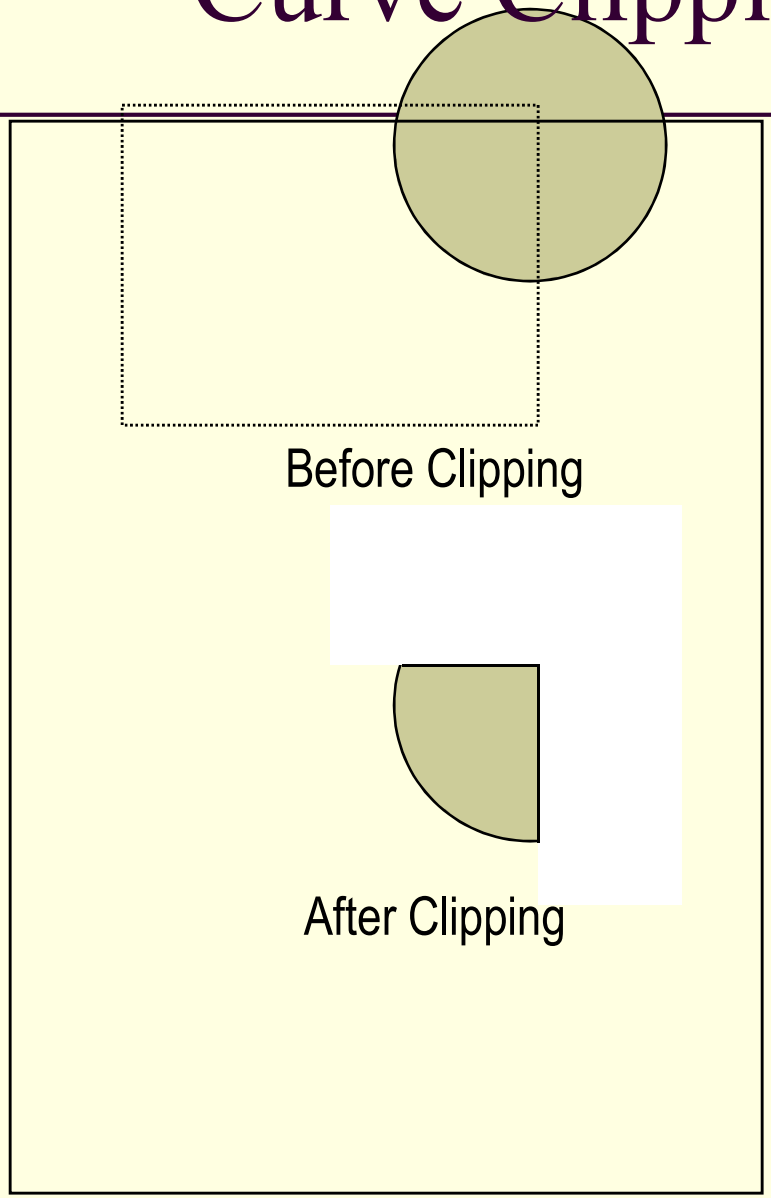
- A good strategy to deal with areas with curved boundaries is to utilize bounding information, e.g.:
- Check bounding box for trivial accept/reject
- Either case , no computation is required.

Before calculating the intersection test analytically :

- Use coordinate extension of individual quadrants.
- Use coordinate extension of individual octants



Curve Clipping



Text clipping

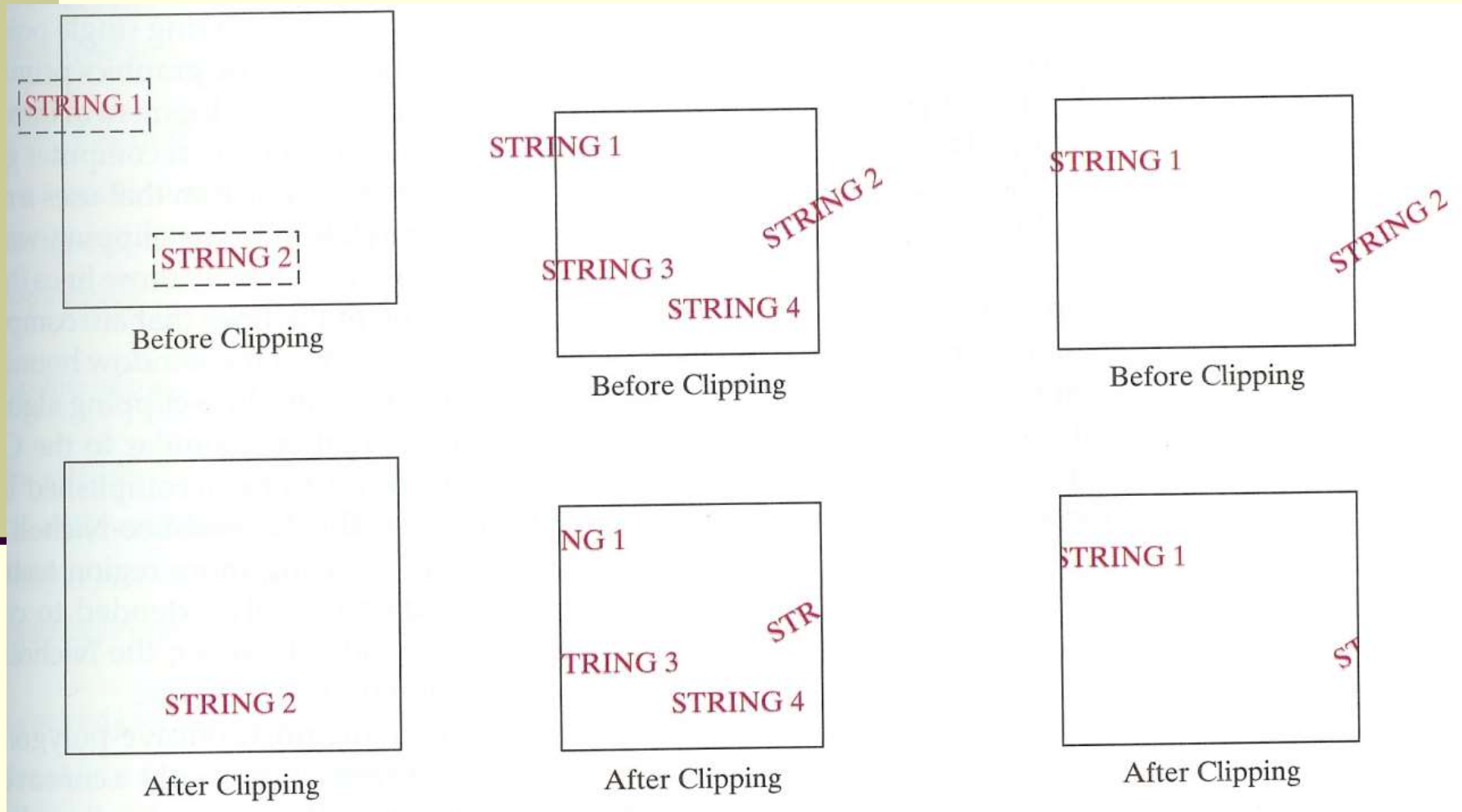
Text Clipping

- Several techniques used to provide text clipping in a graphics package.
- Technique depends on the methods used to generate characters and applications
- **All-or-none text clipping**
  - Using boundary box for the entire text
  - If all text inside the clip window , keep it
  - String is discarded if there is any overlap of bounding rectangle with window boundary.

Text Clipping

- **All-or-none character clipping**
  - Using boundary box for each individual character
  - The boundary limits of the individual characters are compared to the window.
  - Any character which is outside or overlaps a window boundary is clipped.
- **Character Component Clipping**
  - If individual character overlaps a clip window boundary clip off the parts of the character that are outside the window.
  - Vector font: Clip boundary polygons or curves
  - Bitmap font: Clip individual pixels

Text Clipping



Exterior Clipping

- When we want to clip a picture to the exterior of a specified region .
- The picture to be saved are those that are outside the region, known as exterior clipping.
- Example : Multiple window systems
- Objects within the window are clipped.
- Other high priority windows overlap these objects , they are clipped to the exterior of the overlapping windows.

- Thank You