Computer Graphics

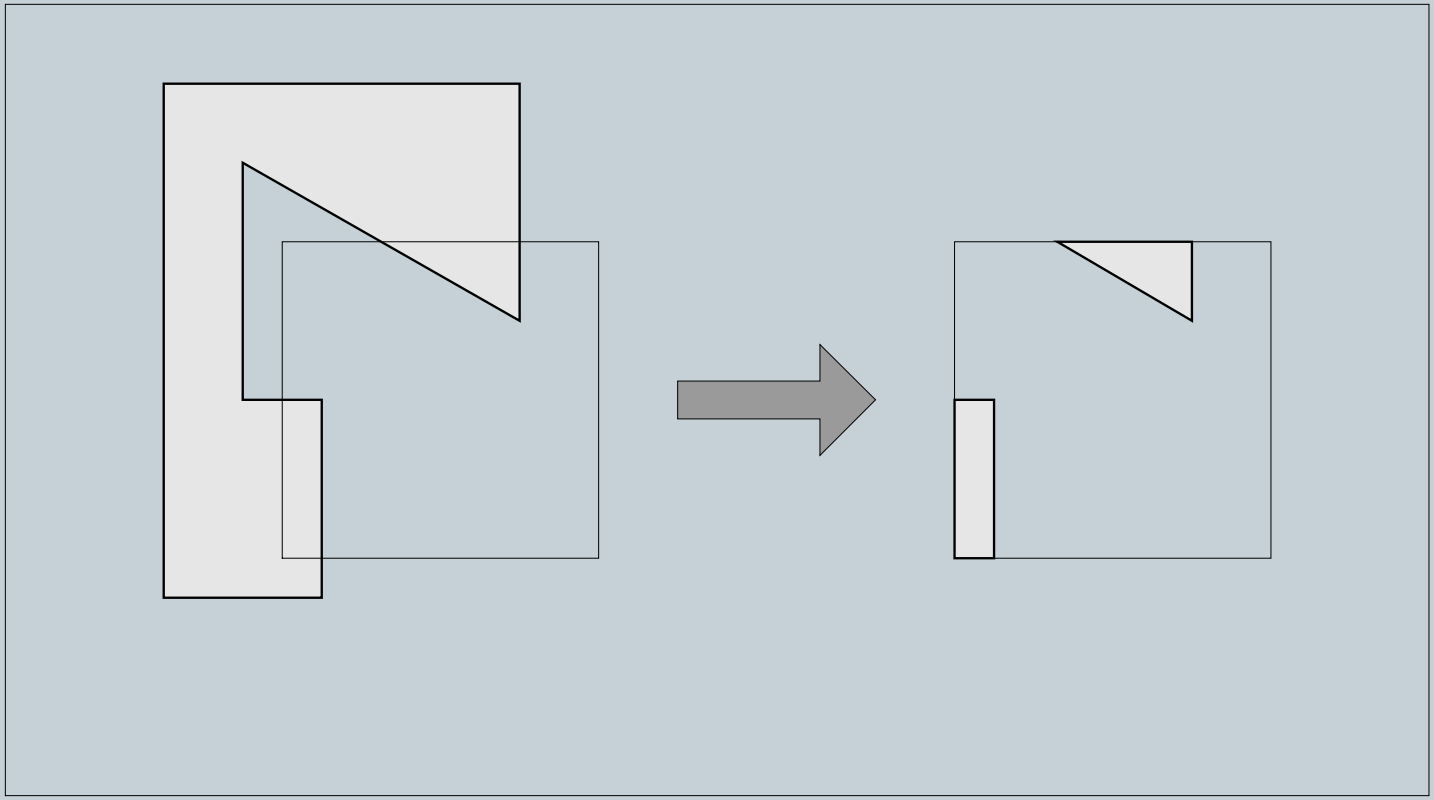
POLYGON CLIPPING

SUTHERLAN-HODGEMAN ALGORITHM

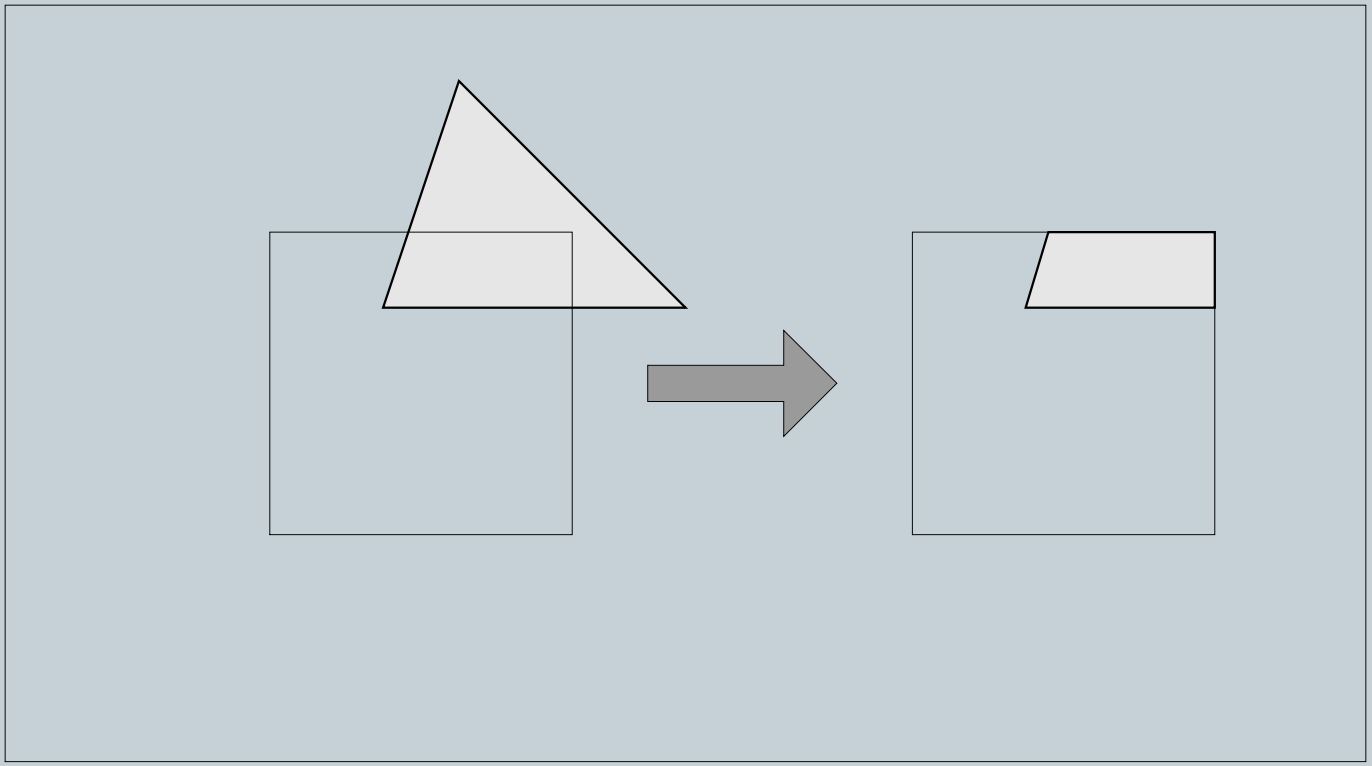
Important Criteria

- **Polygon Clipping (Sutherland-Hodgman):**
  - Window must be a convex polygon
  - Polygon to be clipped can be convex or not
  - Polygon must be positively oriented

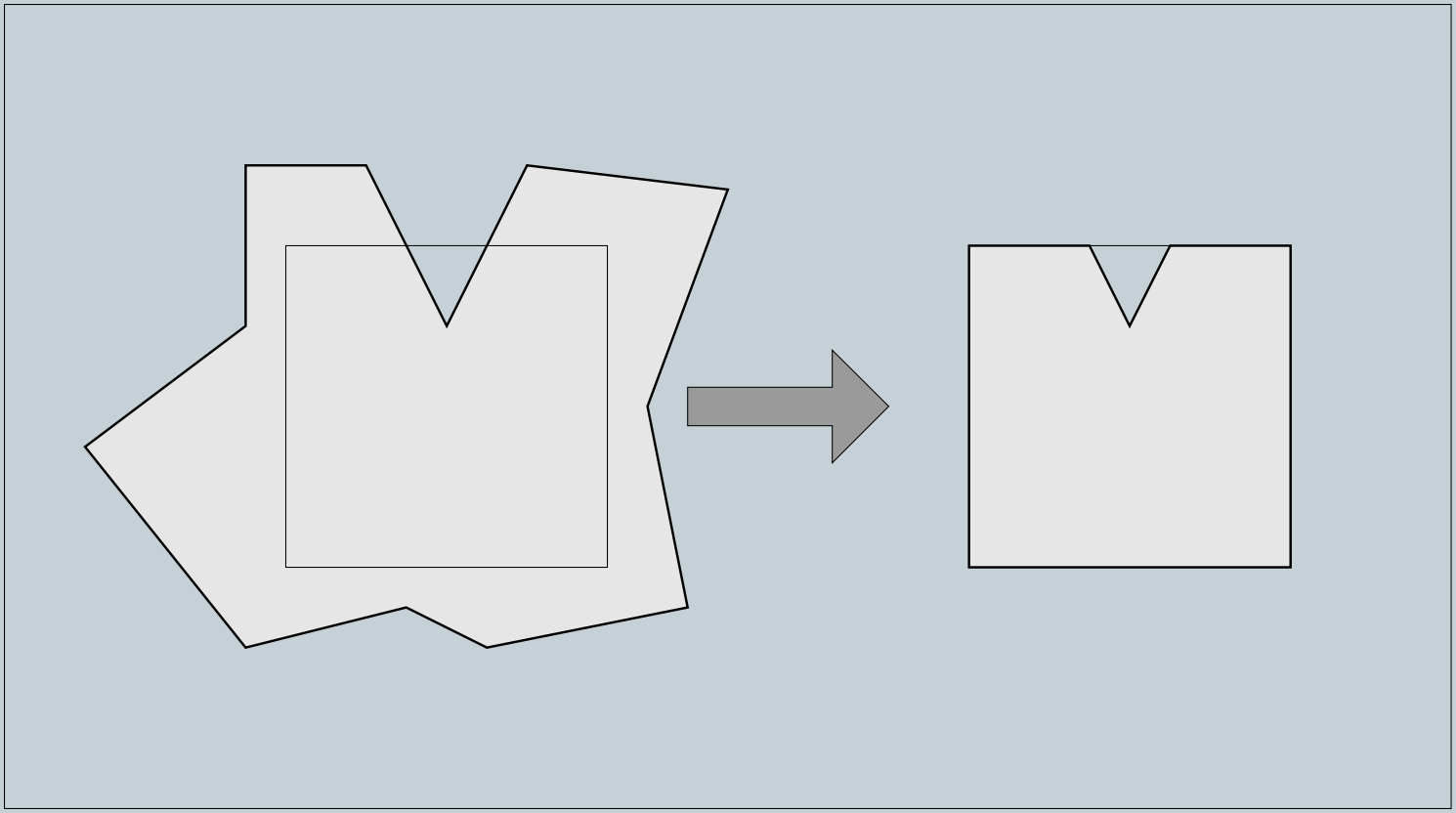
Polygon Clipping Example



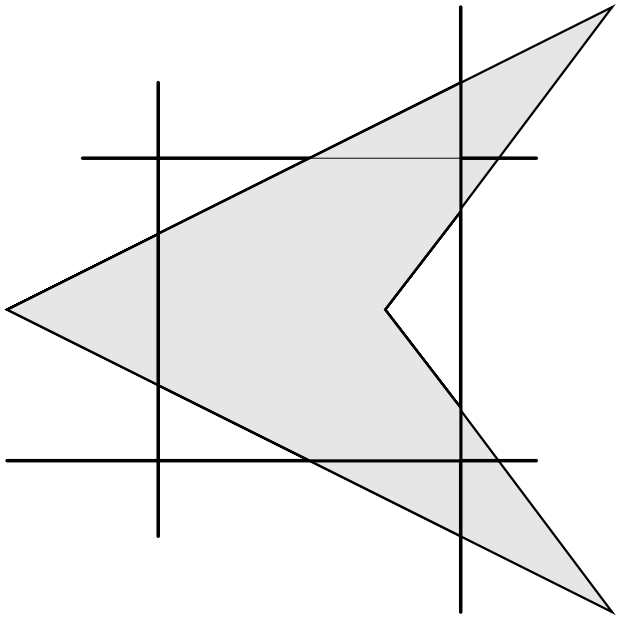
Polygon Clipping Example



Polygon Clipping Example



Sutherland-Hodgeman Algo.



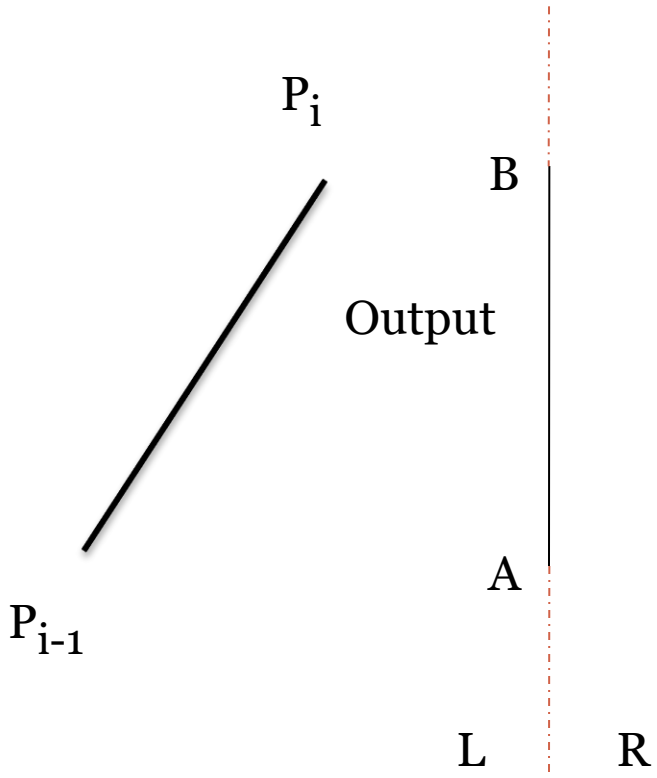
Clip Against Left Clipping Boundary

Initial Condition

Sutherland-Hodgeman Algorithm

Given a polygon with *n* vertices, v_1, v_2,..., v_n, the algorithm clips the polygon against a single, infinite clip edge and **outputs** another series of vertices defining the clipped polygon. In the next pass, the partially clipped polygon is then clipped against the second clip edge, and so on. Let's considering the polygon edge from vertex v_i to vertex v_{i+1}. Assume that start point v_i has been dealt with in the previous iteration, four cases will appear.

Case 1:



If both P_{i-1} and P_i are to the left of the edge, vertex P_i is placed in the vertex output list

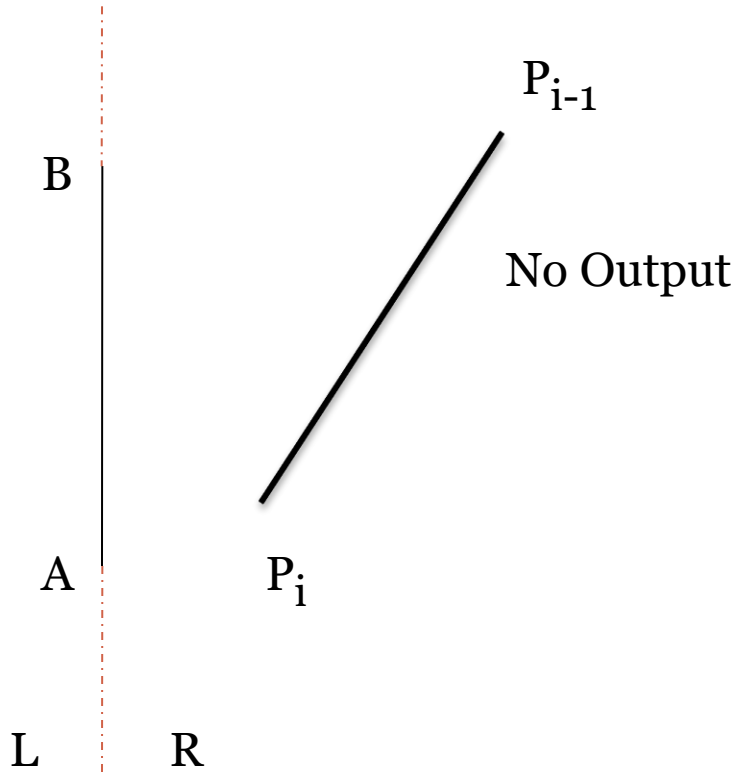
A point P(x,y) will be to the left of the line segment if the expression

C=(x2-x1)(y-y1)-(y2-y1)(x-x1)

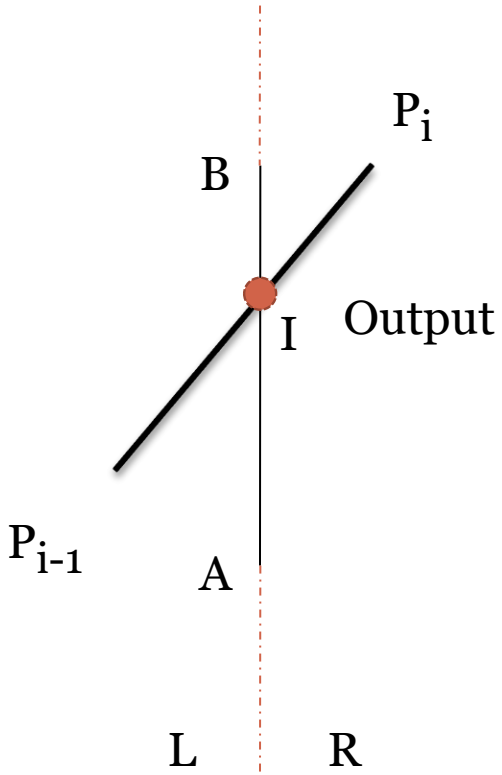
is positive.

Case 2:

If both P_{i-1} and P_i are to the right of the edge, nothing is placed in the vertex output list

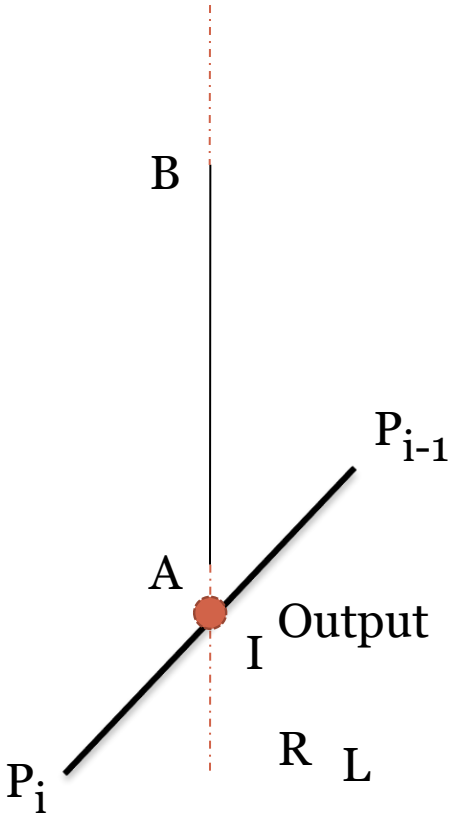


Case 3:



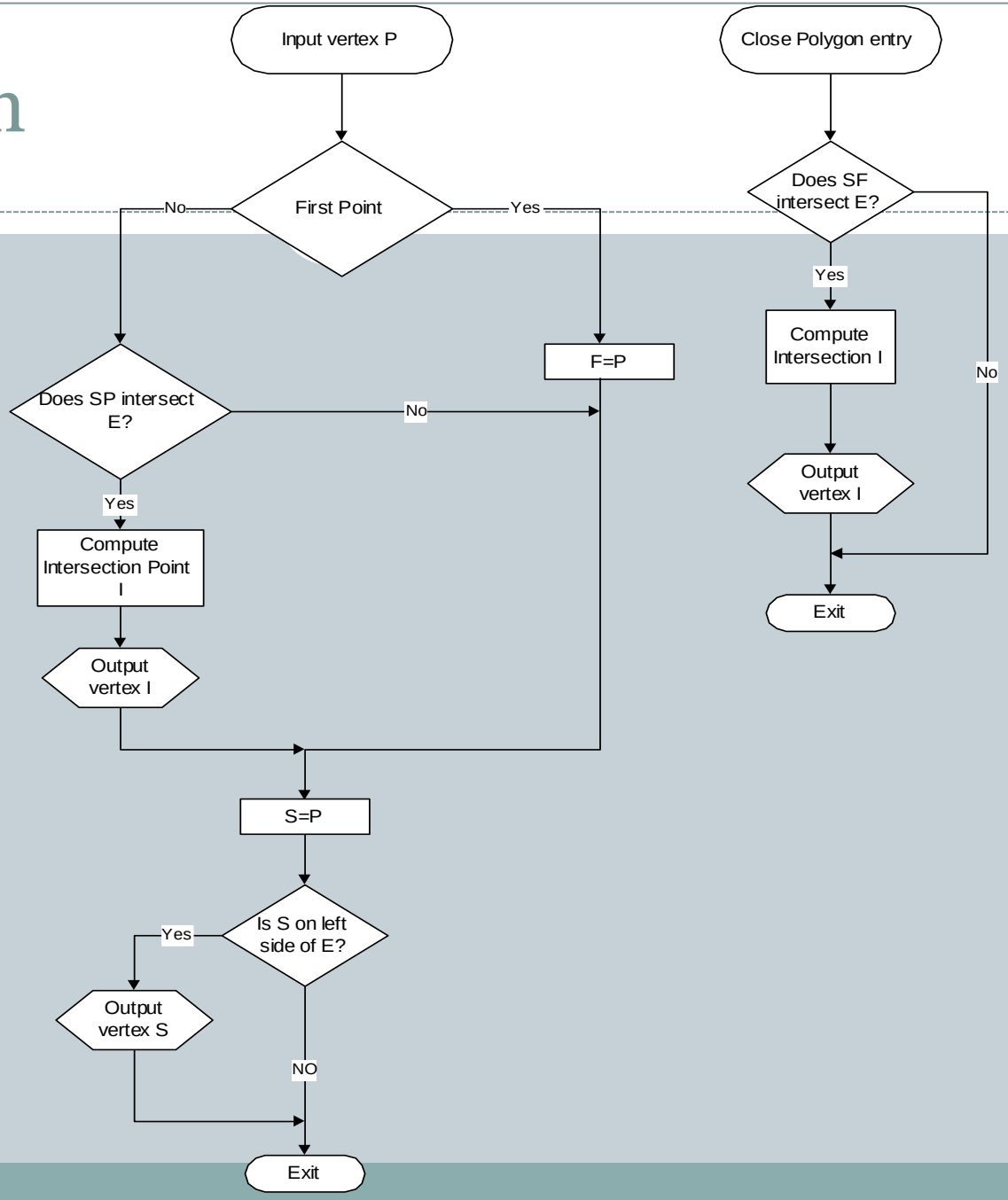
If P_{i-1} is to the left and P_i are to the right of the edge E, the intersection point I of the line segment with the extended edge E is calculated and placed in the vertex output list.

Case 4:

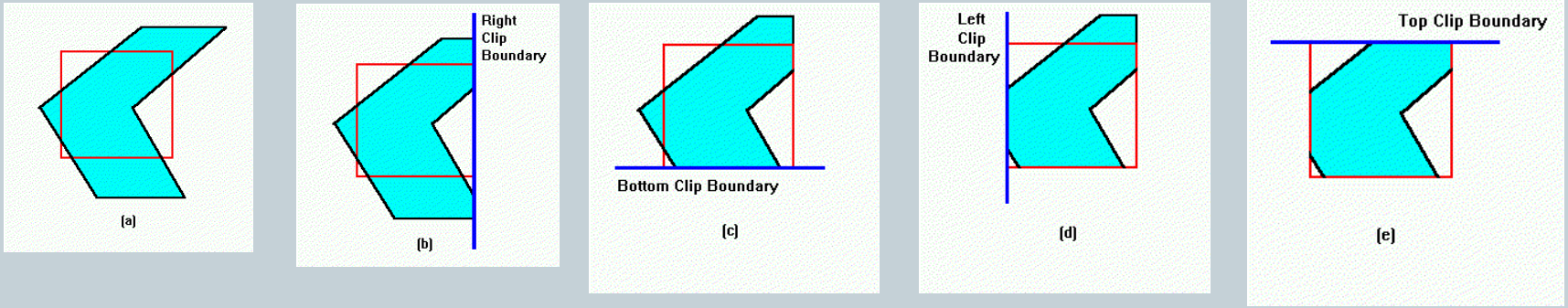


If P_{i-1} is to the right and P_i are to the left of the edge E, the intersection point I of the line segment with the extended edge E is calculated and both I and P_i is placed in the vertex output list.

Algorithm

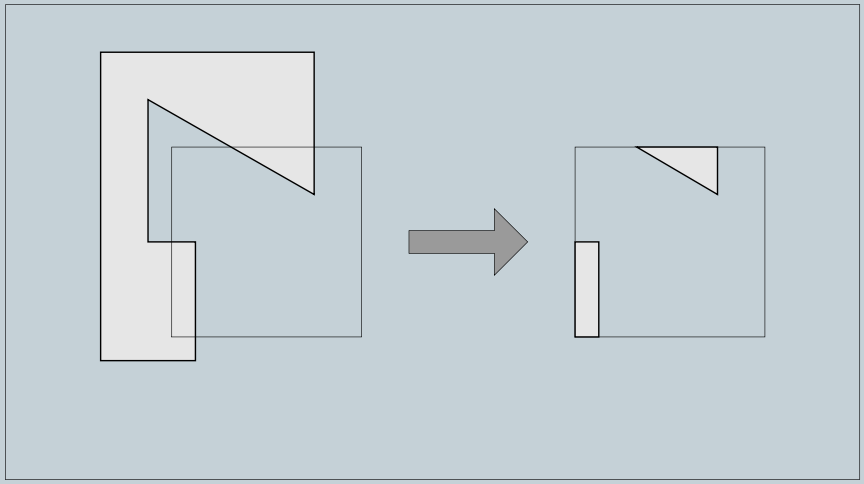

Input vertex P
First Point
No
Yes
Does SP intersect E?
No
Yes
Compute Intersection Point I
Output vertex I
F=P
S=P
Is S on left side of E?
Yes
Output vertex S
NO
Exit
Close Polygon entry
Does SF intersect E?
Yes
Compute Intersection I
Output vertex I
No
Exit

Polygon Clipping Example



Special Condition

- Special attention is necessary in using sutherland-hodgeman algorithm in order to avoid unwanted effect.
- Consider the example, the output will be like below:



- But the algorithm produces a list of vertices with extra edges

The fact that these edges are drawn twice in opposite direction

Solution: devise a post-processing step to eliminate them

An Example with a non-convex polygon