Point - in - Polygon
Ray Trace Method

Ω_s

Ω
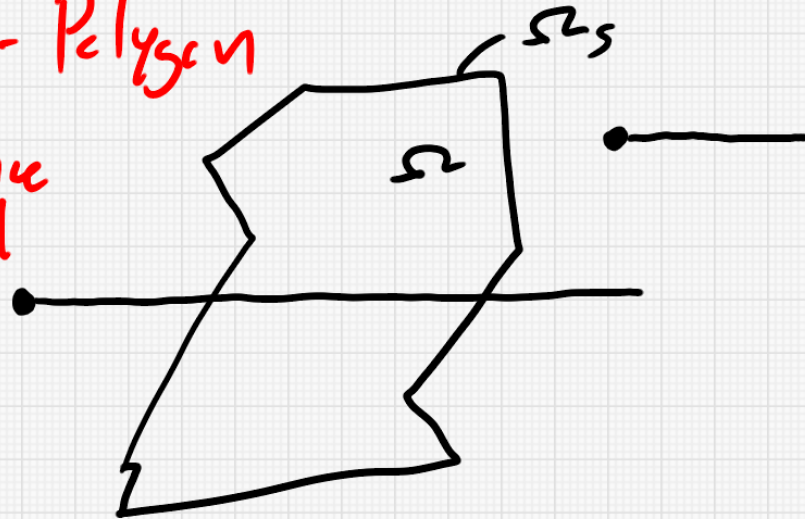
Points outside Ω cross Ω_s
an even number of times
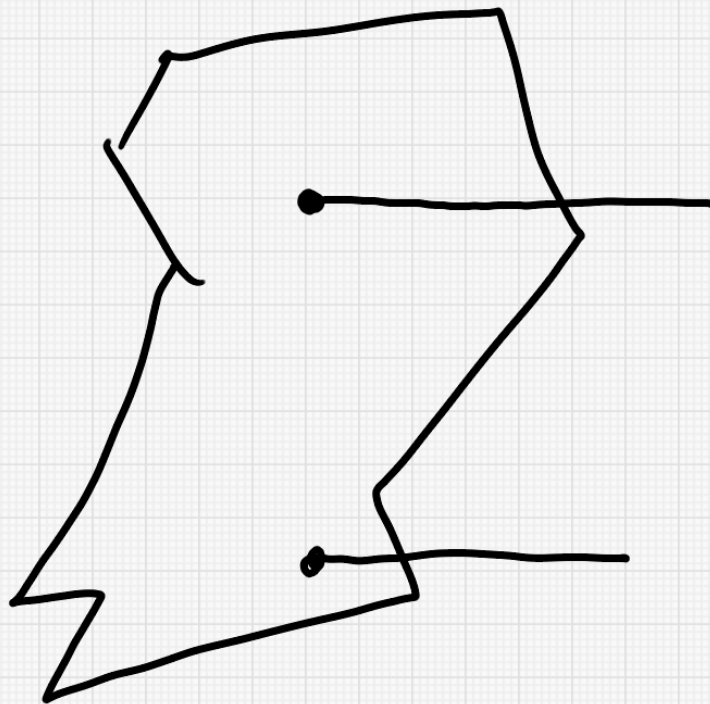
Points inside Ω cross Ω_s
an odd number of times

Class: Point

=> (x, y) coordinate

Class: Boundary

=> a "list" of consecutive boundary points in clockwise order

Property: Edges

define 'edges' as tuples of 2 consecutive points

Method: Contains

Algorithm that inputs a point and outputs a boolean based on whether the point is within or without the boundary

Ray Trace Algorithm

1. Input a boundary, Ω_S, and a point P, per last page

2. Initialize boolean as 'false', indicating the point is outside of Ω_S

3. Starting from P, draw an infinite ray, R, pointing to the right.

4. Loop through all edges in Ω_S and test whether or not R intersects with them. Everytime it does, toggle the value of the boolean.

5. Return the boolean.

~Test described in following~ pages

Edge intersection algorithm

Given P, A, and B where A and B are the vertices of the edge where $A_y < B_y$:
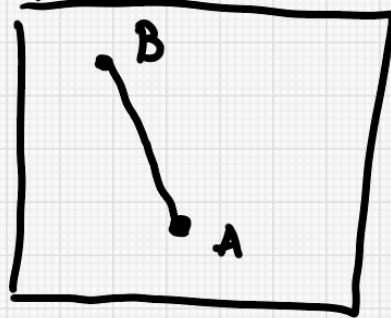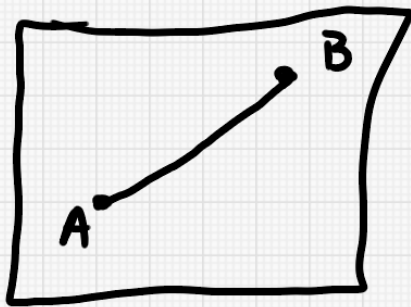
Check if P is at the same height as A or B and move it if so.

IF $P_y == A_y$ or $P_y == B_y$:
    $P_y += \varepsilon$

where ε is a small value.
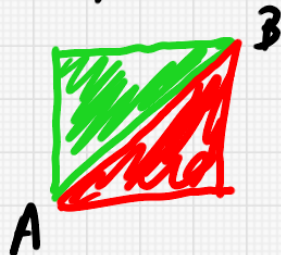
Next, check if P is above, below, or to the right of the edge

If $P_y > B_y$ or $P_y < A_y$ or $P_x > max(A_x, B_x)$
    Continue

Check if P is to the left of both
A and B (now that the other options have
been accounted for)

If $P_x < \min(A_x, B_x)$:
$\quad$ Toggle Boolean
$\quad$ Continue

This only leaves the following rectangle
for possible positions of P:

Calculate slope of $\overline{AB}$ and $\overline{AP}$

If $M_{\overline{AP}} > M_{\overline{AB}}$, then P is in the
green region and R intersects Ω_s,
thus toggling the boolean.