# Point Inside Polygon Test

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# Point Inside Polygon Test

• Given a point, determine if it lies inside a polygon or not



# Ray Test

- Fire ray from point
- Count intersections
  - Odd = inside polygon
  - Even = outside polygon



### Problems With Rays

- Fire ray from point
- Count intersections
  - Odd = inside polygon
  - Even = outside polygon
- Problems
  - Ray through vertex



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### Problems With Rays

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  - Ray through vertex
  - Ray parallel to edge

























• One winding = inside



























# Requirements

- Oriented edges
- Edges can be processed in any order



#### Computing Winding Number

- Given unit normal *n*
- Compute  $\frac{n \cdot ((p_1 - x) \times (p_2 - x))}{|p_1 - x||p_2 - x|}$   $= \frac{|n||p_1 - x||p_2 - x|\sin(\theta)}{|p_1 - x||p_2 - x|}$   $= \sin(\theta)$



# Computing Winding Number

- Given unit normal *n*
- $\theta = 0$
- For each edge  $(p_1, p_2)$  $\theta + = \sin^{-1} \left( \frac{n \cdot ((p_1 - x) \times (p_2 - x)))}{|p_1 - x||p_2 - x|} \right)$
- If  $|\theta| > \pi$ , then inside



#### Advantages

- Extends to 3D!
- Numerically stable
- Even works on models with holes (sort of)
- No ray casting

