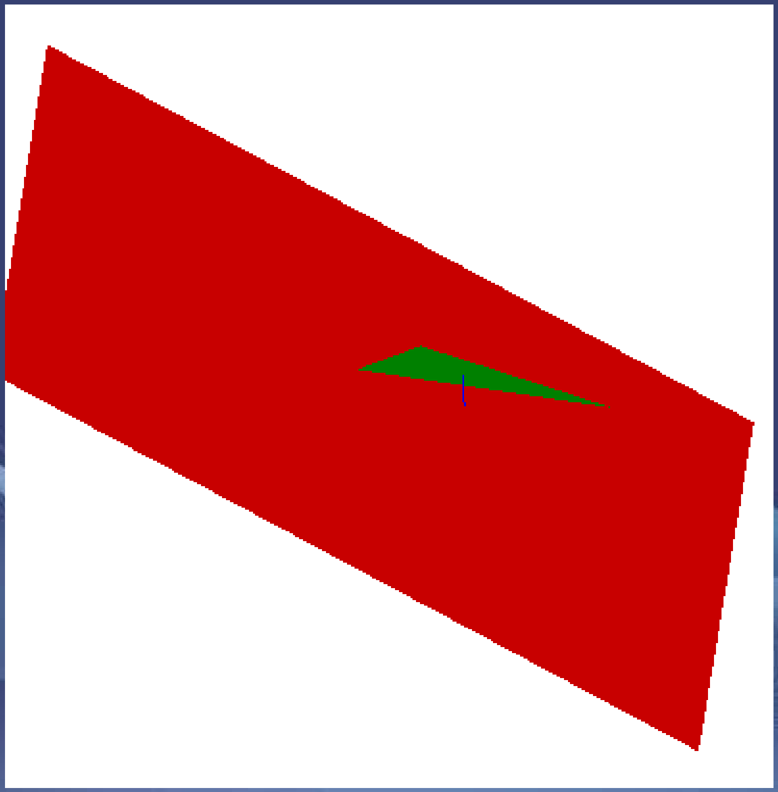
Point in a convex polygon

- Many routines and techniques exist to see if a single point is inside a polygon
  - Algorithm is repeated for every testing point and every polygon vertex
- I know of no methods that are optimized to see if multiple points are inside the polygon
- Credit where credit is due. Original idea as applied to triangles was developed by a friend of mine, Jerry Lefever
- Demonstration

The Key



- Turn the 2D problem into a 3D one!
- Every edge intersects a plane with a z value of 1

The Steps for a Single Triangle

- Calculate the distance along each edge segment
- Find the plane that passes through this line with a Z gradient of 1
  - dist1 = sqrt((x2 - x1)^2. + (y2 - y1)^2.)
  - a1 = (y2 - y1)/dist1
  - b1 = -(x2 - x1)/dist1
  - c1 = -a1*x1 - y1*b1
- Find the center of the triangle
  - xc = (x1 + x2 + x3)/3 & yc = (y1 + y2 + y3)/3
- Calculate the distance from the center to the plane, if it is negative then flip the normal and find the new plane
  - Do this so that later any positive distance values will have a certain meaning
- Repeat for other two edges
- When done we return a 3x3 array where each row has the coefficients for the equation of a plane

Steps (cont)

- For every point calculate the distance to each of the three planes. If all three distances are positive then point is inside the pyramid formed by the planes. If not, then it is outside
  - If any distance is negative then you can stop testing immediately
- Inside the triangle this distance is the distance to the closest edge
- Outside it is the perpendicular distance from the plane of the triangle to the closest plane
- Extending this method to any convex polygon is simple
- This also extends to a point in a convex polyhedron
  - Simple example
- Lesson: adding a dimension to a problem may actually make it easier to solve