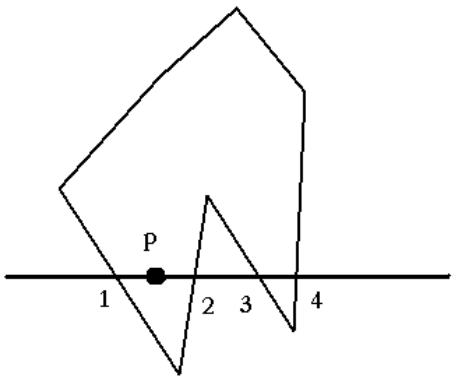
CS 370 - Assignment 1

1. The main advantage to a pipeline architecture is performance. The hardware is optimized to operate on particular primitives in a parallel fashion thus significantly enhancing rendering speed. Also all the objects within the scene do not need to be stored in memory, but can be generated and processed as needed. Unfortunately this architecture does not allow for global aspects of the scene to be incorporated into the rendering, e.g. reflections, shadows, etc. Such global effects are necessary to produce truly photorealistic images.

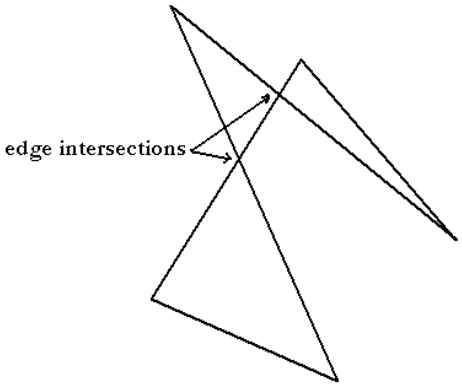
2. For film with a resolution of 2000x3000 gives 6M pixels (at a pixel depth of 24-bits requires 18MB of memory per frame). For VGA resolution of 640x480 gives 300k pixels (at a pixel depth of 24-bits requires 900kB of memory per frame). This is roughly a factor of 18 less than film resolution. For UXGA resolution of 1600x1200 gives 1.9M pixels (at a pixel depth of 24-bits requires 5.7MB of memory per frame). This is roughly a factor of 3 less than film resolution. Therefore there is substantially more computations per frame (particularly at the pixel level) to generate images approaching film resolution which limits real-time rendering given today's hardware.

3. Using a scanline (or pixel row) through the point of interest, the intersections of the scanline with the edges of the polygon determine interior and exterior locations. The first intersection is where the scanline enters the polygon (assuming the polygon is entirely within the window), the second intersection is where the scanline leaves the polygon, the third is where the scanline re-enters the polygon, etc. The desired point is then compared to these intersections to determine whether it is inside or outside the polygon as illustrated in the following figure.

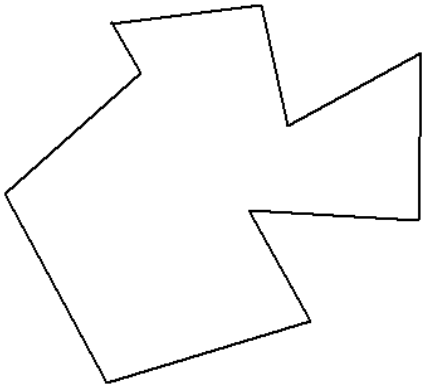


Points to the left of 1 are outside, between 1-2 are inside, between 2-3 are outside, between 3-4 are inside, and to the right of 4 are outside. So the point p is inside the polygon since it lies between 1-2.

4. One easy test to determine whether or not a polygon is simple is to evaluate the intersections of all pairs of edges. For simple polygons, these intersections must occur only at vertices (or not intersect at all), whereas non-simple polygons will have edges that intersect on the edges themselves. See the example below.



Non-simple
polygon



Simple polygon
no edge intersections