CS 461: Problem Set Four

Due: Monday 2015-05-11

1. [5 points] What are the ray parameters (the ts) for the intersection points between ray \((1,1,1) + (-1,-1,-1)t\) and the sphere centered at the origin with radius 1? What are the intersection points?

2. [5 points] Consider a ray passing through a sphere. Find the point on this ray closest to the center of the sphere. Hint: Consider a line from the center of the sphere that is normal to the ray.

3. [5 points] What are the barycentric coordinates \(\alpha, \beta, \gamma\) and the ray parameter \(t\) where the ray \(R(t) = (1,1,1) + (-1,-1,-1)t\) hits a triangle with vertices \((1,0,0), (0,1,0), \) and \((0,0,1)\)? What is the intersection point?

4. [5 points] Given a view area that is 8x6, with lower left corner at \((4,10)\) and a line segment \([(14,19), (5,8)]\), use the Liang-Barsky clipping algorithm to find the visible portion of the line segment (if any). Visit the borders in the order left, right, top, bottom. For each pass, show the new \(t_{\text{min}}\) and \(t_{\text{max}}\), and then report on the end points of the new line segment.

5. [10 points] Our pseudocode for Bresenham’s algorithm is below. Extend this to remove the restriction that the line have a slope that is \((0,1]\) and \(x_0 < x_1\).

```plaintext
y = y0
d = -2\Delta y + \Delta x
for x in (x0 to x1)
    draw(x,y)
    if (d < 0)
        y = y+1
        d = d + 2(\Delta x - \Delta y)
    else
        d = d - 2\Delta y
```