

Homework 4

CS 354, BME 345

Due Tuesday Dec 4 at the beginning of class

1. (15 points) Consider a line from point  $(0.1, 0.7)$  to  $(5.3, 2.3)$ . Compute which pixels should be filled in according to Bresenham's algorithm by filling out the table below. Show your work.

k	x	d	y
0	1/2		
1	3/2		
2	5/2		
3	7/2		
4	9/2		
5	11/2		

2. (15 points) You wish to determine the two intersection points between a ray  $R$  and a sphere  $S$ . Ray  $R$  starts at  $(1, 2, 1)$  and heads in the direction  $(0.3, 0.8, 0.5)$ . Sphere  $S$  is centered at the point  $(6, 7, 4)$  and has a radius of length  $\sqrt{26}$ . At what two points does the ray intersect the sphere? Which point is closer to the origin of the ray? Hint: First parameterize the ray as  $R(t)$  and then solve for the value of  $t$  for each point of intersection.

3. (10 points) Consider 4 squares each with side length = 2. Their center points and normals are given below:

name	center	normal
A	(0, 1, 1)	(1, 0, 0)
B	(1, 0, 1)	(0, 1, 0)
C	(0, 3, 1)	(1, 0, 0)
D	(1, 1, 1)	(-1, 0, 0)

Let  $f_{AB}$  be the form factor between squares  $A$  and  $B$ . Let the other form factors be named similarly. Give  $f_{AB}$ ,  $f_{AC}$ , and  $f_{AD}$  in sorted order from least to greatest. Explain why they are sorted in that order. You do not need to compute the form factors.

4. (10 points) A quadratic Bezier curve has the form

$$P(t) = (1-t)^2 P_0 + 2t(1-t)P_1 + t^2 P_2 \quad \text{for } 0 \leq t \leq 1$$

Given control points  $P_0 = (0, 0)$ ,  $P_1 = (0, 1)$ ,  $P_2 = (1, 0)$ , sketch the Bezier curve. Label and give exact coordinates for points at  $t = 1/4$ ,  $t = 1/2$ , and  $t = 3/4$ .