CS 240: Computer Graphics – Handout 1

Suppose we want to draw a line with endpoints $p_1 = (0, 0)$ and $p_2 = (5, 3)$ using the simple line algorithm. On this sheet we will walk through all the steps of the calculation.

1. What is the slope of this line? (Give a simplified numeric answer.) Recall: $m = \frac{y_2 - y_1}{x_2 - x_1}$



- 2. What is the full equation of the line? (Simplify where possible.) Recall: $(y_1 y_2)x + (x_2 x_1)y + x_1y_2 x_2y_1 = 0$
- 3. We will loop over columns for this line. What are the x values of the column midlines?
- 4. Compute the intersection points of the column midlines with the line we are drawing. (Plug in the x and solve for y.)

5. Take the floor of these point coordinates to figure out which pixels to fill in. Darken them in the image above.

6. Suppose we want to use the incremental midpoint algorithm instead. Review the pseudocode below and fill in the actual numbers in the version on the right.

Recall
$$F(x_{2}y) = (y_{1} - y_{2})x + (x_{2} - x_{1})y + x_{1}y_{2} - x_{2}y_{1}$$

 $y \leftarrow y_{1}$
 $d \leftarrow F(x_{1}+1.5,y+1)$
 $for x = x_{1} to x_{2}-1 do$
 $ink(x,y)$
 $if d<0 then$
 $y \leftarrow y+1$
 $d \leftarrow d + (x_{2}-x_{1}) + (y_{1}-y_{2})$
 $else$
 $d \leftarrow d + (y_{1}-y_{2})$
 $else$
 $d \leftarrow d + (y_{1}-y_{2})$
 $d \leftarrow d +$
 $endfor$

7. Now fill in the table below by following the algorithm.

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8. Consider each of the pairs of endpoints below. For each one, state whether you would loop over x or y to render the line segment between them, and whether you should swap the order of the points in order to always loop upwards.

a.	$p_1=(0,0); p_2=(3,4)$	e.	$p_1=(0,0); p_2=(3,-4)$
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- b. $p_1=(4,3); p_2=(0,0)$ f. $p_1=(0,0); p_2=(4,-3)$
- c. $p_1=(0,0); p_2=(-3,4)$ g. $p_1=(0,0); p_2=(6,0)$
- d. $p_1=(0,0); p_2=(-4,3)$ h. $p_1=(0,0); p_2=(0,-6)$