CS 418 Interactive Computer Graphics
In-class Worksheet: Line Rasterization

TEAM (2 to 4 people):

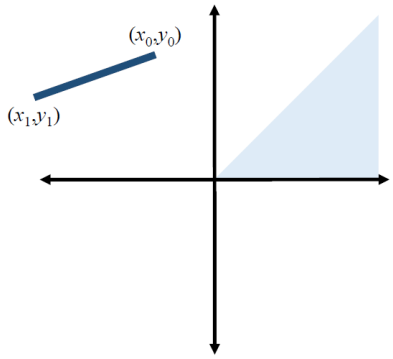
1. NETID: 2. NETID

3. NETID: 4. NETID

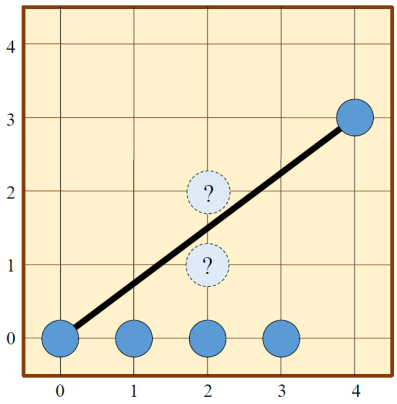
It is 1962. You are working in an IBM research lab in San Jose, California. Housing in the Valley is still affordable. If you are wise, you will invest in real estate. In the meantime, at work you have been tasked with developing an algorithm for an IBM 1401 computer that will plot a line.

The Problem: Suppose you have a grid of pixels with a width of W and height of H. Imagine the origin, pixel (0,0), is in the center of the grid, and that pixels can be addressed using negative or positive integers. You are given a start pixel (x0, y0) and end pixel (x1, y1) for a line segment. Which pixels should be lit up in between?

1. You decide to solve a simpler problem. How can you transform (x0,y0) and (x1,y1) so that the line segment starts at (0,0) and is contained in the first octant (x, y are positive and y < x)? Hint: First translate and the use negation or swapping x and y to come up with a set of rules.



2. Consider iterating over the iterating over x coordinates.

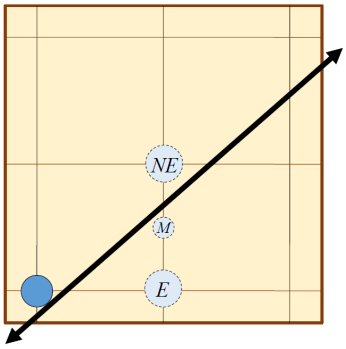


a. For x=0, which is the first pixel to plot?

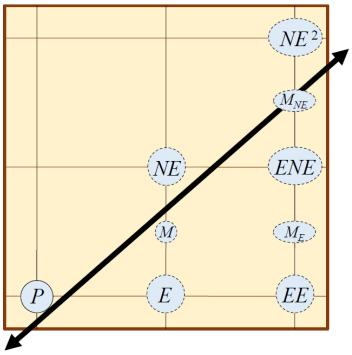
b. For each x, which y value should be chosen for the pixel to plot? Give a general rule in words.

3. Write the line equation $y = mx + b$ as an implicit function $f(x, y)$.

4. How can you use the implicit function to determine which y value to choose for an x?
   Hints: How could you check if the midpoint M falls above or below the line?



5. In the 1960s, every CPU cycle is precious. Let's see how to reuse computation from previous values of x as we loop.



   a. Express $f(M)$ as a function of $f(P)$ where $P = (x, y)$ and $M = (x + 1, y + \frac{1}{2})$

   b. Write $f(M_E)$ as a function of $f(M)$

   c. Write $f(M_{NE})$ as a function of $f(M)$

   d. Which pixels get lit up using your algorithm for (0,0) to (4,3)?