Overview:

These module sequence begins by drawing a horizontal line. The program is progressively modified to permit students to examine discrete slope as a sequence of equally sized steps and y-intercept as initial Y value at X=0 including examination of separate topics of step magnitude and sign.

Module 1: lines as staircases

Part 1:

Start with a program that draws a horizontal line:
```
def horiz():
  black=0,0,0; white=255,255,255; green = 100,255,100; blue=100,100,255;
red=255,100,100
  numCols, numRows = size = 100,100;

  img = Raster(size, black)
  img.setRangeCheckMode(False)

  row = 10

  for col in range(numCols):
    img.setRGB((col, row), white)

  img.write("demos-ccs0/horiz.jpg")
  return img
```

With students watching, modify the program to

1. copy; rename copy as new function "line"
2. include a "step" variable with value 1
3. after each iteration, increase row by step

As follows (changes are highlighted):

```
def line():
  black=0,0,0; white=255,255,255; green = 100,255,100; blue=100,100,255;
red=255,100,100
  numCols, numRows = size = 100,100;

  img = Raster(size, black)
  img.setRangeCheckMode(False)

  row = 10    # initial row
  step = 1    # height of each step
  for col in range(numCols):
    img.setRGB((col, row), white)
    row = row + step
  img.write("demos-ccs0/line.jpg")
  return img
```

Lead students though discussions on what they expect to see, and then have them run their programs and discuss.

Now have them experiment with:

- changing the initial row
- changing the step to: bigger numbers, and fractional values too (say. 0.1)
- drawing multiple lines at once with different slopes
    - using multiple row and slope variables
    - what would be good names for these variables?

Review of terminology from HS math:

- Instructor reminds students of mathematical conventions
    - Row number called Y; Column number called x
    - Axes at X=0 and Y=0
    - Value of Y when line crosses Y axis (at x=0) called Y-intercept

Student discussion and/or individual essay and/or UN-animated powerpoint (with student, and the instructor demo & discussion) on effects of

- effect of positive, zero, and negative slope
- having a larger positive slope
- having a smaller (more negative) negative slope
- changing initial value of row
- what would be a characteristic of parallel or perpendicular lines?
- Does iteration over X help when drawing vertical lines? Any other approaches?

Successor problems

- groups decide on good names for second row and step variable
- draw parallel and perpendicular lines where none are horizontal or vertical

Part 2:

For this activity, have students work individually.

Put up images of each graph,one at a time or a few at time:

For graphs:

1. row = 1, step = 1; (followed by image)
2. row = 50, step = 1;
3. row = 10, step = 2   *
4. row = 20, step = 10
5. row = -10, step = 2
6. row = -50, step = 1
7. row = 10, step = -1

This is an opportunity to see if students are having trouble and what kind of trouble they are having. If the whole class is struggling, it might be a good idea to repeat Module A again, focusing on practicing making different types of graphs. This can also be an opportunity for a quiz, or just to collect each student's work to see how they fared. To do this, have students create a folder labeled with their name. Change the path at the end of the function that img.write writes to to the folder they just created. Have each student (create a zip file? and) email it to you.

Present images to the students again, and have them give you the answers they got to those graphs (as a class). Split students up into groups of two or three and have them discuss similarities and differences between the graphs and write them down. (Answers should be something like "These graphs have negative step, and the rest of them don't", "These graphs have negative row values while those have positive row values", "These lines go from (about)the bottom left corner to the upper right corner, while these other lines tend to come more from the upper left corner towards the bottom right", etc.)

Individually, have students focus on drawing positive lines. Ask students to draw variations of graph #7.

Instructor-led discussion: (Line function provided is used here)

After a few minutes (five or ten), point out 7 again, and present a new problem to the students: If we wanted to draw an x-axis through the image, to indicate which part of the line is within the positive y range and negative y range, how would we do this? Students will answer with drawing a horizontal line through the middle of the graph. Ask them what row would be equal to to be in the middle of the graph, and then add the horizontal line into line.

Add a second line into line():

row2 = 50

(in loop, below initialization)
img.setRGB((col, row2), blue)

Load and run it. A blue line will draw itself through the middle of the Raster. In addition, the negative line will continue to be partially visible in the corner.

 Ask students for a way to move it up to the middle of the image space. Students should come up with the answer of "Make row = 50" or ask them questions that lead to that answer. (For an example, ask them how to make image 1 look the same as image 2 and go from there).

Reassign row1 = 50.

Change the size of the image (numCols=numRows=size=100,100;) to 200 by 200 (numCols=numRows=size=200,200;).
Load and run the program again. The horizontal axis is no longer in the middle of the graph, and the negative slope is no longer centered in the middle. How do you solve this problem?
Ask students for suggestions, and then introduce PosNegGraph.

Into the command line of JES, type in:
i = PosNegGraph(100,100)

The first parameter is the number of columns in the image, and the second parameter is the size of the space above the horizontal line, and the size of the space below the horizontal line.

Give students time to experiment with this, and then have them recreate a line2() function that implements this in the line function. Make sure line() remains the same, because they will be using this function again in the future.