Problem 1. *Draw each of the following fractals, using enough iterations to make it clear what the algorithm is used to produce it.*

(a) Von Koch snowflake

(b) Sierpinski gasket

(c) Sierpinski carpet

Problem 2. *Draw a* random *Sierpinski carpet. That is, instead of always removing the central square, you get to decide which squares get removed at each stage (flip a coin if you need a source of randomness). Drawing hint: use a pencil and shade squares that stay, shading darker for each stage.*

Problem 3. *A shape is said to be* connected *if you can draw a curve between any two points without leaving the curve.*

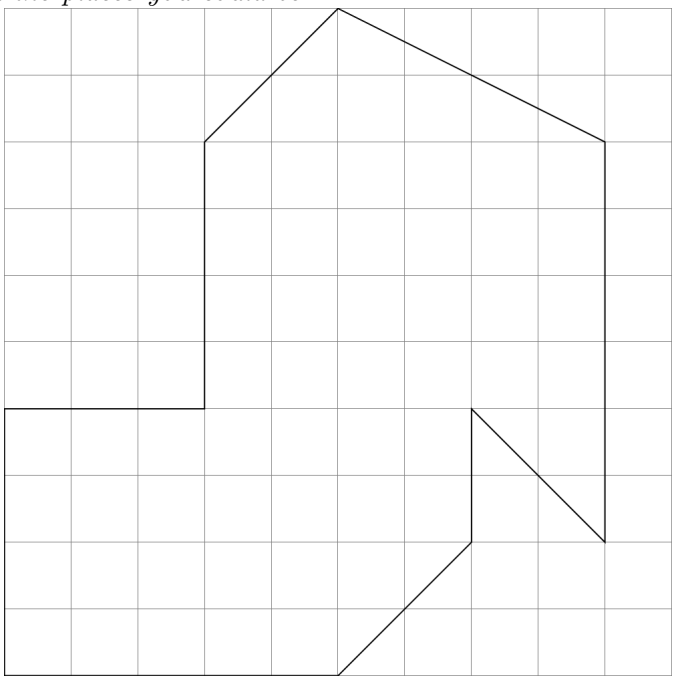
(a) Is your random carpet connected?

(b) Suppose that you draw a carpet so that there's only a 5% *chance each square will get removed. Do you expect the resulting carpet to be connected?*

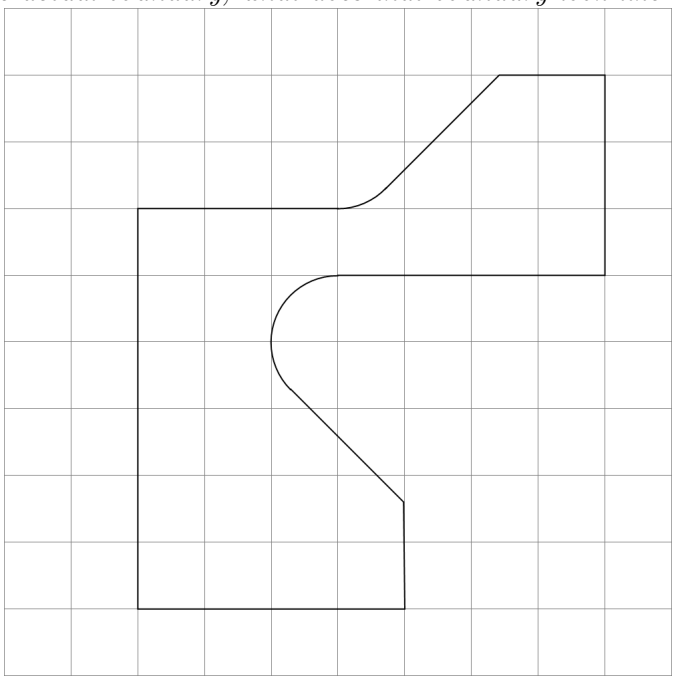
(c) Suppose that you draw a carpet so that there's a 95% *chance that each square will get removed. Do you expect the resulting carpet to be connected?*

(d) Somewhere between 5% *and* 95% *is a critical probability that separates connected carpets from disconnected ones. What would you guess it to be? Why? (Hint: my personal guess is that it's below 50%.)*

Problem 4. *Suppose you are inside the following curve and have to stay one unit away from the boundary. Shade in all the places you could be.*

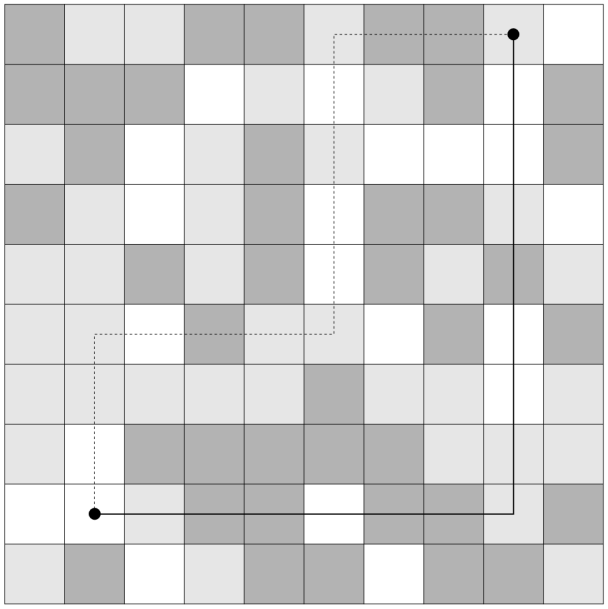


Problem 5. *Suppose we have the opposite situation: instead of knowing what the boundary is, we know where we can walk. If we can be anywhere in the region below and are trying to stay at least one unit away from the actual boundary, what does that boundary look like?*



Given this image, is it possible that we are trying to stay two units away from the actual boundary? If so, convince me you are right, otherwise draw the two-unit boundary.

Problem 6. *Suppose you are trying to travel between the two points in the map below, and the color of each square tells you how hard it is to travel in it (maybe it's a traffic map). Specifically, the light gray tiles are twice harder to travel on than the white ones, and the dark gray ones are three times harder to travel on than the white ones.*



(a) If turns are free, which path is more efficient? (Hint: figure out the length of each path.)

(b) If a right turn costs the same as going through a dark gray square, which path is more efficient?