Problem 3.1 (25 pts)
Recall that the similarity dimension of a self-similar set can be expressed as

$$\frac{\log (\text{Number-of-copies})}{\log (\text{Shrinking-factor})}$$

when the set itself can be represented as \text{Number-of-copies} non-overlapping or just-touching copies of the set in which linear distances have been shrunk by \text{Shrinking-factor}. Thus, the Cantor set (composed of 2 copies of itself shrunk by a factor of 3) has similarity dimension $\log 2 / \log 3$. Similarly, the unit square (composed of four copies of itself shrunk by a factor of 2) has similarity dimension 2.

Using Barnsley iterated function systems, create approximations to fractal sets with dimension:

- \((a)\) $\log 3 / \log 4$
- \((b)\) $\log 5 / \log 3$
- \((c)\) $3/2$ (note: \textit{not} $\log 3 / \log 2$, but $3/2$)

Hand in the specification of the maps you used, and pictures of the sets generated by iterating those maps.

Problem 3.2 (25 pts)
Consider the complex polynomial expression:

$$z^5 + 1$$

Find the five values at which this expression has value 0 (i.e., the five complex roots of -1). Using the code for the basins-of-attraction example (shown in class) as a foundation, create a picture in which points in the square region bounded by -0.5 - 0.5i and 0.5 + 0.5i have been colored according to which of the five roots of this expression they approach by iterating Newton's method. (You might, e.g., color a point red, green, yellow, blue, or gray if it approaches one of the five roots after, say, 40 iterations, and black otherwise.) Identify, on the picture that you have generated, where one would look for the Julia set of the iterated (Newton's-method) complex map.

Problem 3.3 (25 pts)
Make your own algorithmic variation on the basic Julia-set-generating algorithm to create a complex escape map. Hand in a description of the variation and (at least) one picture created by using your algorithmic idea.
Problem 3.4 (25 pts)

Do either Problem 3.9.3 (Diameter and width) or 3.9.4 (Onion Peeling) in O’Rourke.