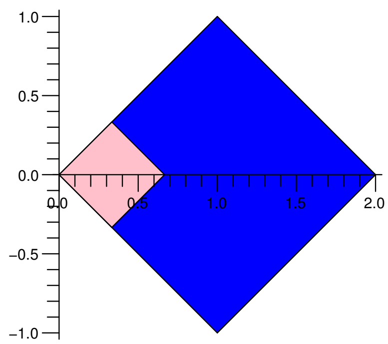
Math 331, Spring 2006, Problems

26. Create a procedure that takes a polygon and a **linear** transformation yields as output the result of applying the transformation to the polygon. Find the coordinates of the linear transformation that sends the blue (larger) square to the pink (smaller) square. Apply the transformation to the blue square. Test your result by plotting the two squares in the same graph. (Remark: In this exercise, you are asked to work with a *linear* transformation, in class we worked with affine transformations.)



27. Create a procedure that takes as input a positive integer and two real numbers a and b and produces as output (the list of points corresponding to) an n-gon centered at (a, b). Using this procedure, obtain a list of 21 decagons centered in $(0, 0), (1, 1), ..(20, 20)$ and plot them all in the same graph.

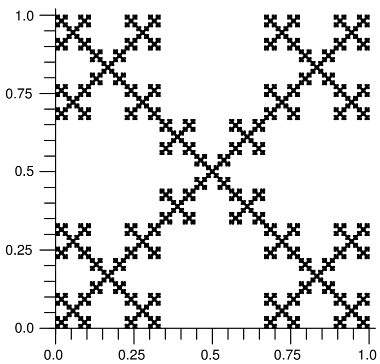
28. Create a procedure that takes a list of decagons and a linear transformation gives as output the result of applying the linear transformation to all the decagons. Using your procedure, rotate each of the decagons of your list by an angle of $\pi/4$. Plot the decagons and their images in the same graph.

29. (a) Measure the length at each stage in constructing the Cantor set. Since the Cantor set is made by removing intervals, each of our measurements exceeds the length of the Cantor set, but we can look for a pattern and deduce the actual length. To begin, we cover the Cantor set with one interval of length 1. Next, we cover it with two intervals of length 1/3, so its length is less than 2/3. Continue this line of reasoning and make some conclusion about the length of the Cantor set.

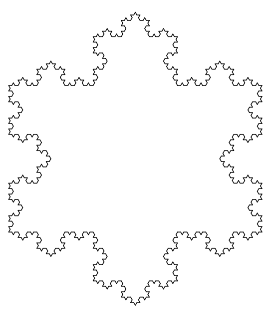
    (b) Now measure the lengths of the intervals removed in forming the Cantor set and see what remains. For example, first we remove one interval of length 1/3, then two intervals of length 1/9, and so on. Using a calculator, add up the lengths removed (1/3 + 2/9 + ...). What do you get for the length of the Cantor set?

    (c) Do your answers for (a) and (b) agree?

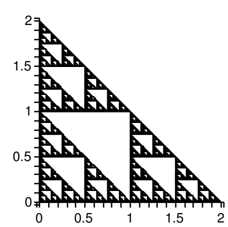
30. Compute IFS parameters and the similarity dimension of the following fractal.



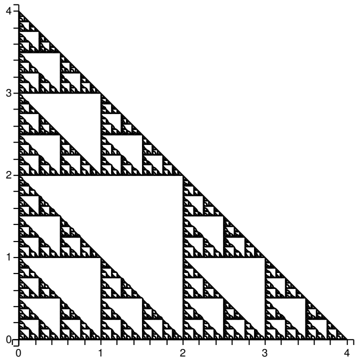
31. Compute perimeter and area of the snowflake



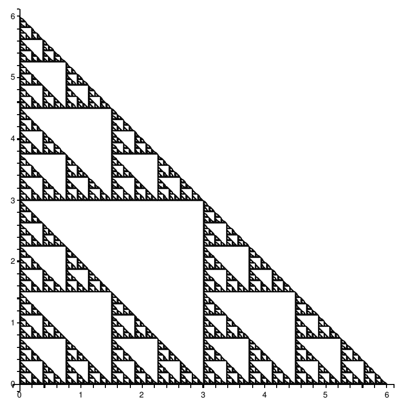
32. (a) Find the IFS parameters to generate atractor of the Picture: a right gasket of side length 2 and compute the similarity dimension.



(b) Find the IFS parameters to generate atractor of the Picture: a right gasket of side length 4 and compute the similarity dimension.



(c) Find the IFS parameters to generate atractor of the Picture: a right gasket of side length 6 and compute the similarity dimension.



(d) Find the IFS parameters to generate a right gasket of side length s (where s is any positive integer) and compute the similarity dimension.

(e) Do the e and f parameters (the ”translation part ” of the parameters of the similarity) have any effect on the dimension of the resulting fractal?

33. (a) Compute the similarity dimension of the Cantor set formed from the unit interval by removing the middle half of the interval (as opposed to removing the middle third, in the usual construction).

(b) Compute the similarity dimension of the Cantor set formed from the unit interval by removing the middle 2/3 of the interval.

(c) Compute the similarity dimension of the Cantor s set formed from the unit interval by removing the middle 1/5 of the interval.

34. Compute the similarity dimension of the Cantor set formed from the unit interval by removing the middle segment of length t, where t is any number $0 < t < 1$.