■ MEGAMENGER

Fractals

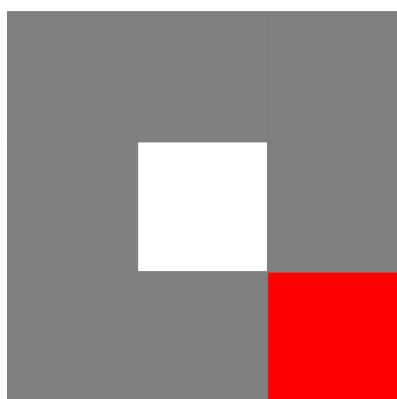Fractals are objects which:
- if you zoom in and look at one part of it, it looks the same as the whole
- have interesting structure, no matter how closely you look at them
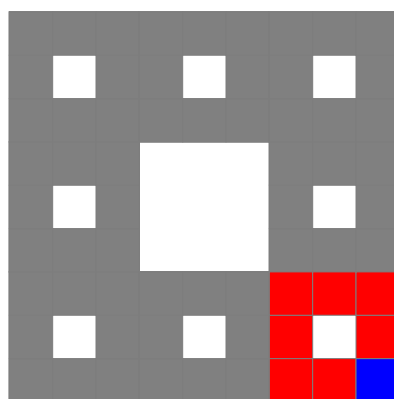
Sierpinski Carpet

A nice example of a fractal is called the Sierpinski Carpet. It's made by taking a square, dividing it into nine smaller squares, and removing the central square.

We can then repeat this process for the eight smaller squres left behind. We could then do this again to all of the even smaller remaining squares and so on. There will always be smaller squares left over.
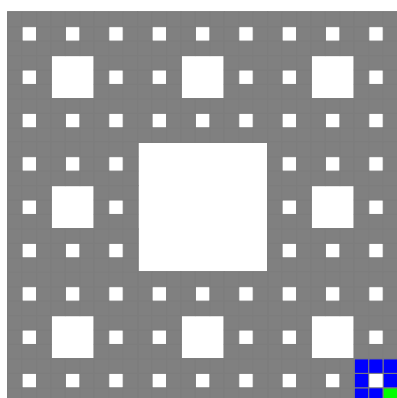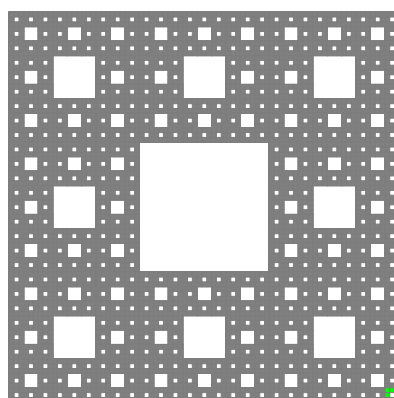
First stage

Second stage

Third stage

Fourth stage

If you repeat this process infinitely, the object you get is a fractal. If you look at any one part of it, the structure is the same as the whole set. Each of the smaller squares is a miniature version of the whole Sierpinski Carpet.

Because the process can go on for ever, no matter how much you zoom in on a Sierpinski Carpet, there will always be more pattern to see.

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Cantor Set

We can make a one-dimensional version of the Sierpinski Carpet by taking a horizontal line, removing the middle third, and then repeating this for each of the two remaining segments.

If we continue to repeat the process forever, we get the Cantor Set. As before, to do this would take an infinitely long time, so we have to imagine the object we'd get.

Like before, once you have removed infinitely many stages, each smaller section of this line is the same as the whole line. The process breaks the original line up into infinitely many pieces.

Questions:

1. Starting with a complete square, and removing squares to make a Sierpinski carpet, after three steps what percentage of the area is left?

2. How could you calculate the total perimeter (inside and out) of the "fourth stage" Sierpinski Carpet?

   - Bonus: Calculate the total perimeter of the sixth stage Sierpinski Carpet.

3. How many steps does it take until only one fifth of the Cantor Set is left?

4. In what way is this Romanesco broccoli (right) very like a fractal?

   Why is it not actually a true fractal?

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