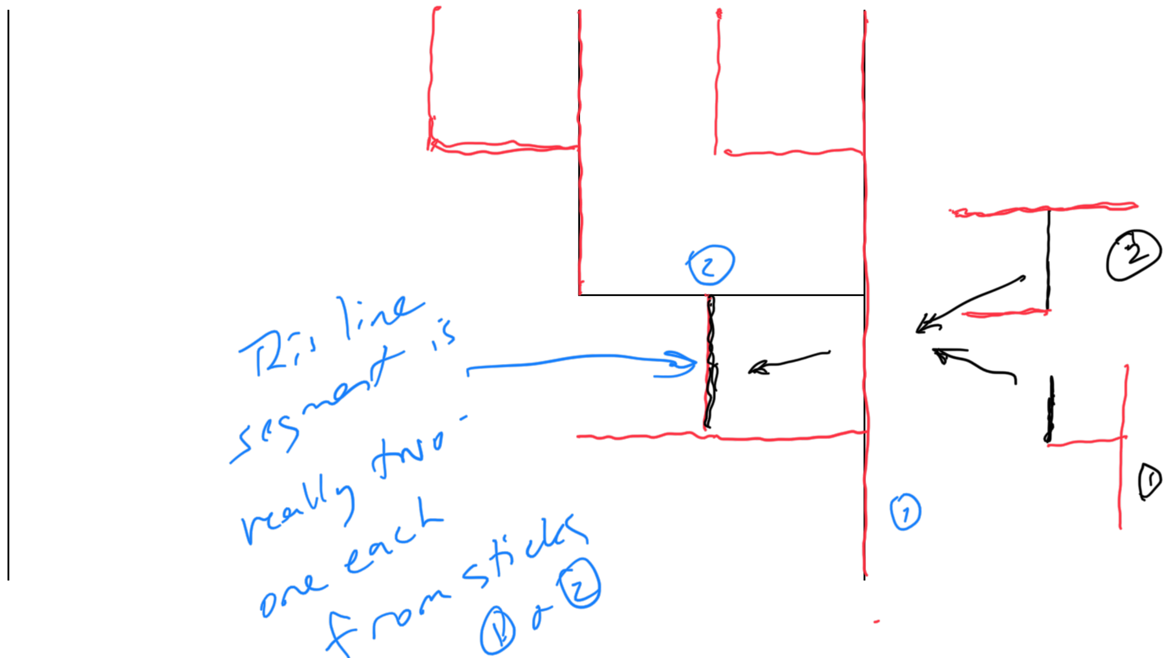
The following figure shows the initial line segment, and the line segment after application of a simple process. One could say that the initial stick has been broken into four equal sized line segments:



1. Perform the next iteration to the figure on the right.

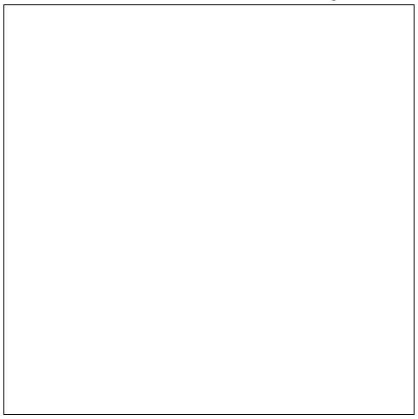
2. How many line segments will there be after n applications of the simple rule, starting from the single starting segment ($n = 0$)?

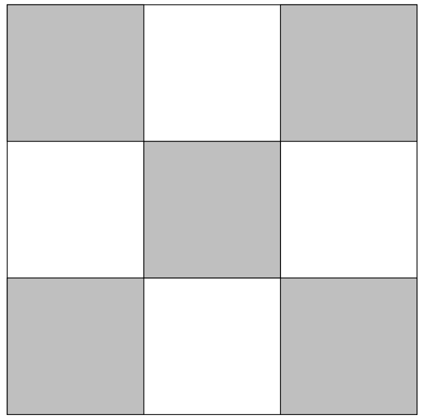
We should count the black stick above as 2; at each iteration there are four times as many sticks; $\boxed{4^n}$ sticks 1, 4, 16, 64, ...

3. If we continue this process forever, what will be the length of the resulting fractal?

The total length doubles at each step. One stick becomes 4 half sticks = 2 stick equivalents, The total length $\to \infty$, yet the fractal stays in a finite region. That's kind of mysterious!

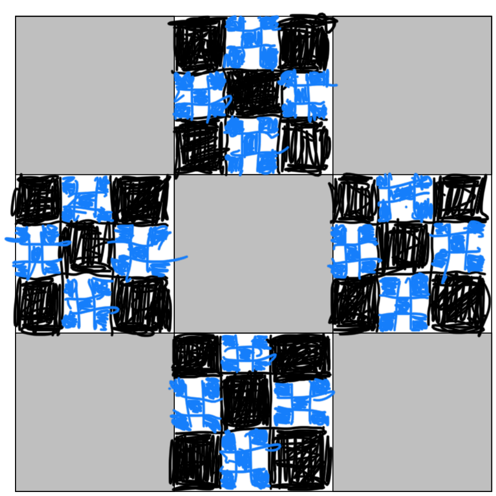
Below is shown a fractal process, determined by the changes from the first to the second stage. Draw the next two stages (I include two copies of the second stage for you to work on). Assuming the area of the first square is 1 unit, what is the area left at each successive step? white square → four white squares

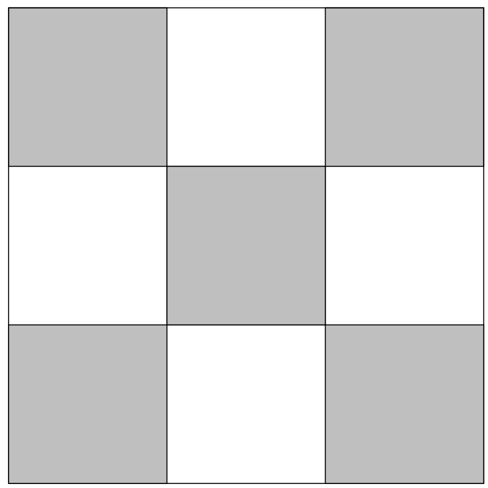




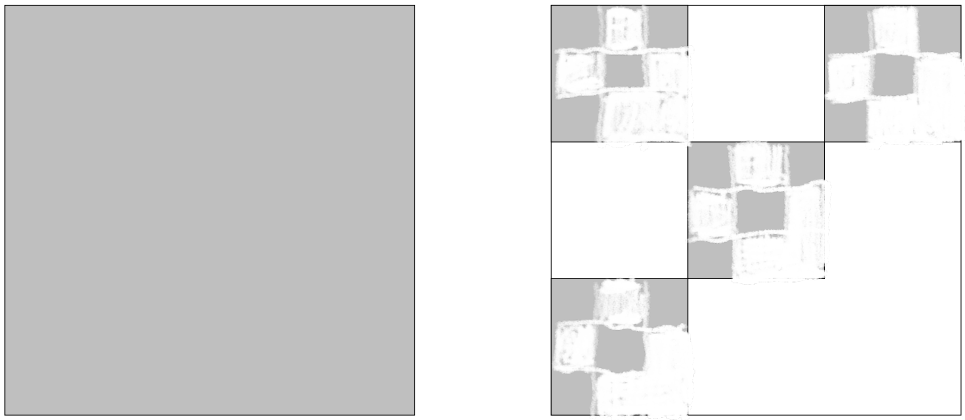
Area left after one step: $4/9$ of a unit.

$\left(\frac{4}{9}\right)^n$ after n iterations





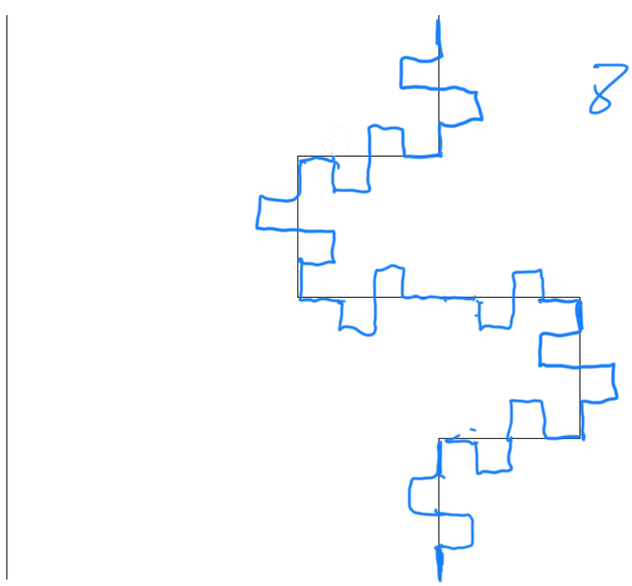
Below are shown two separate fractal processes. For each, draw the next stage. How does the area change at each step in the first case, and how does the length change from step to step in the second?



Area shrinks: $\frac{4}{9}$ of the area, again!

So $\left(\frac{4}{9}\right)^n$ is the area after the n^{th} go.

$n=0$



The length doubles: 8 quarter lengths = 2 lengths. Ooooohh!!

That one's fun! :)

So 2^n is the length.