Mandelbrot Set (more or less) - The Recursive Process

Start: Pick a point $s = (a, b)$ to be the seed.
Start: Write s as a complex number, $s = a + bi$
Next: Let $z_0 = 0$

1. $n = 0$
2. Add 1 to n
3. Let $z_n = z_{n-1}^2 + s$
4. Go to step 2

Form a list of the different values z takes on, beginning with s:

$$\{z_0, z_1, z_2, z_3, \ldots\}$$

This list is called the Mandelbrot Sequence for the seed s.

- If the seed grows to $\pm\infty$ (that is, if the terms in the Mandelbrot sequence increase (or decrease, or both, without bound), we say the seed **escapes**.
  - In that case, the seed is **not** in the Mandelbrot set.
  - We color the original point in space that corresponds to the seed a color. The color is determined by how fast the seed escapes.
- If the seed does not escape, whether its because the terms in the Mandelbrot sequence approach some finite number, or alternate between approaching a couple of finite numbers, then
  - the seed **is** in the Mandelbrot set
  - We color the original point in space that corresponds to the seed **black**.

Examples We've Seen So Far:

- $s = 1 + 0i$
  - Omitting 0, the Mandelbrot Sequence: $\{1, 2, 5, 26, 677, \ldots\}$
  - The seed $(1, 0)$ escapes
  - $(1, 0)$ is **not** in the Mandelbrot set. Color it some non-black color, based on how fast it escapes
- $s = 0$
  - Omitting initial 0, the Mandelbrot Sequence: $\{0, 0, 0, 0, \ldots\}$
  - The seed $(0, 0)$ is attracted
  - $(0, 0)$ **is** in the Mandelbrot set. Color it black
- $s = -0.5 + 0i$
  - Omitting 0, the Mandelbrot Sequence: $\{-0.5, -0.25, -0.4375, -0.3086, -0.4048, -0.3362, \ldots\}$
  - The seed $(-0.5, 0)$ is attracted
  - $(-0.5, 0)$ **is** in the Mandelbrot set. Color it black
- $s = 0 + i$
  - Omitting 0, the Mandelbrot Sequence: $\{i, -1 + i, -i, -1 + i, -i, -1 + i, \ldots\}$
  - The seed $(0, 1)$ is periodic
  - $(0, 1)$ **is** in the Mandelbrot set. Color it black