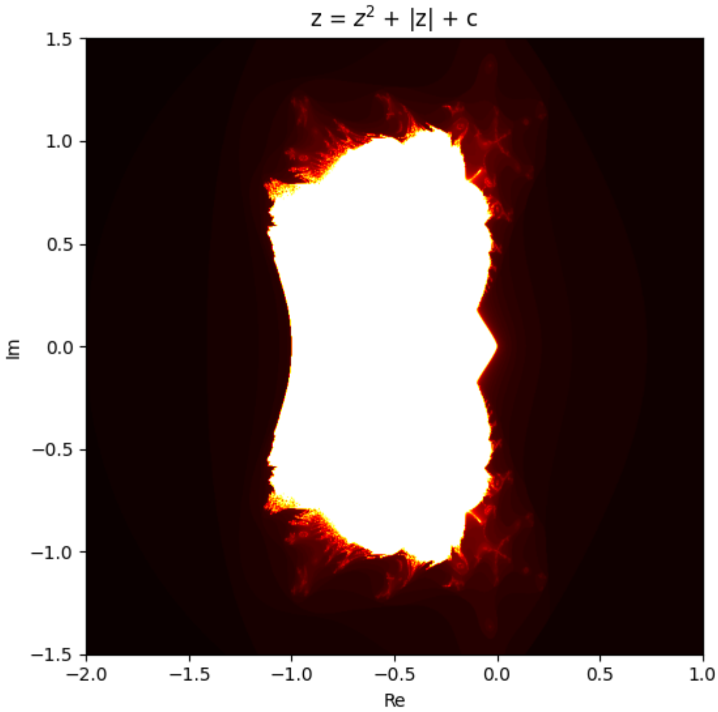
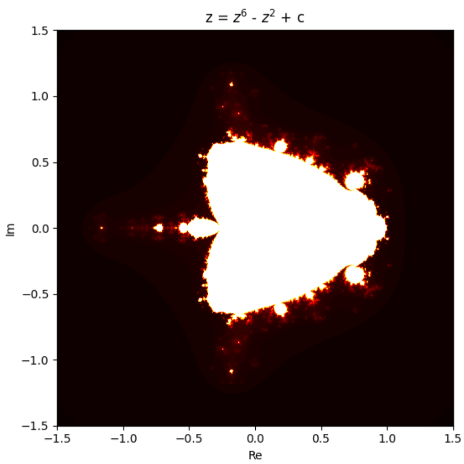
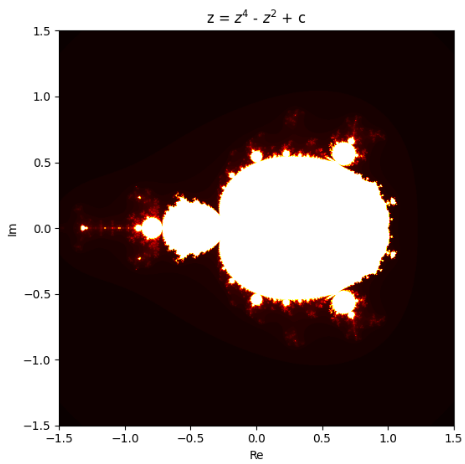
This document is not formatted well. enjoy :)

Mandelbrot type fractals. This first set are generated in a process similar to how the Mandelbrot set is generated, $z_{n+1} = f(z_n)$. For example, if $f(z_n) = z_n^2 + |z_n| + c$, you get the following set.

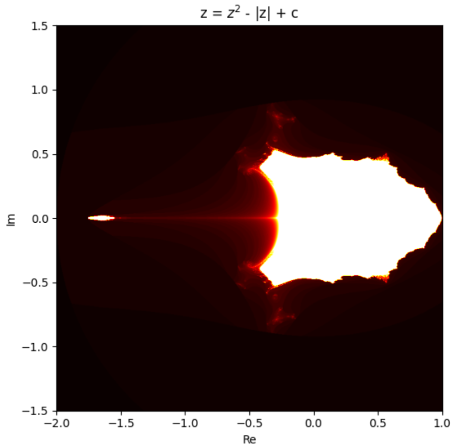


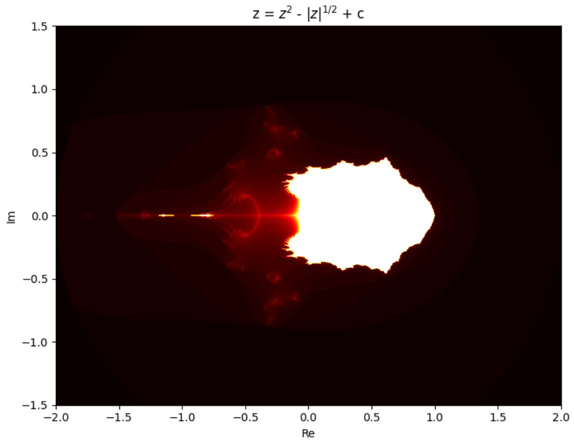
Where c is the complex number defined at each point on the plane. The gradient of white to red to black indicates the amount of time to diverge. So, white areas converge (at least after however many iterations I did), black diverges very quickly and shades of red are somewhere in between. From this process I mucked about with f(z) to create some cool looking fractals.

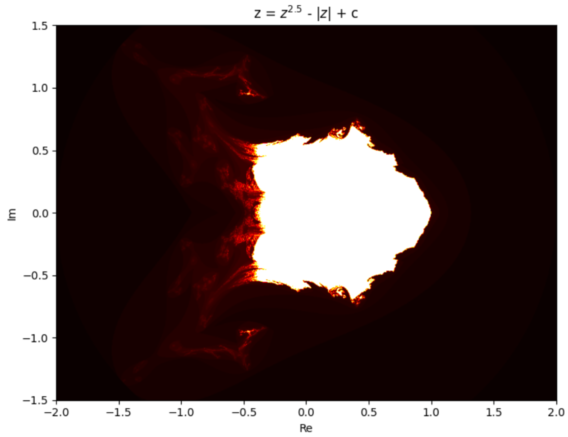


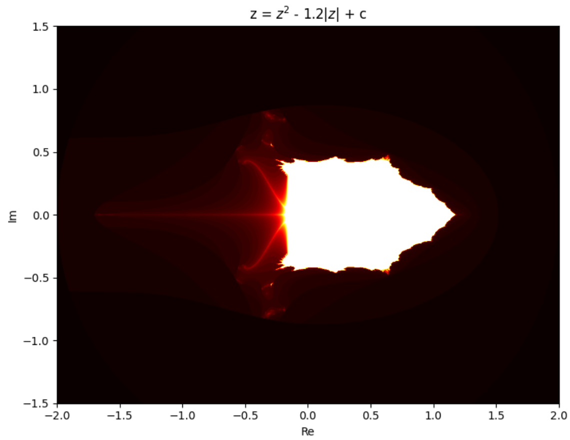


These two are very “mandelbrot-ty” and you can see the familiar bulbs and self-similarity which is present in the mandelbrot set. After this I tried messing about with absolute values.



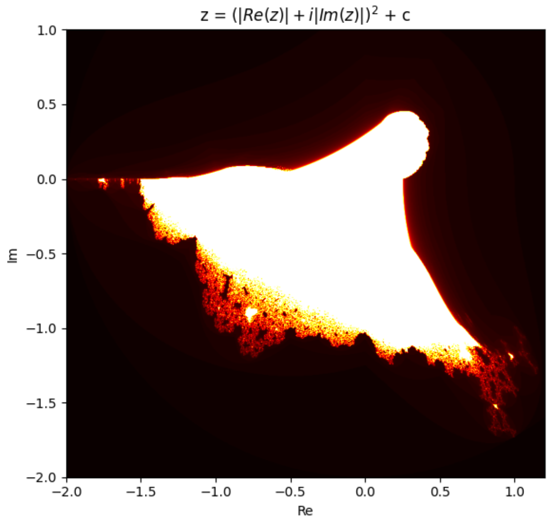


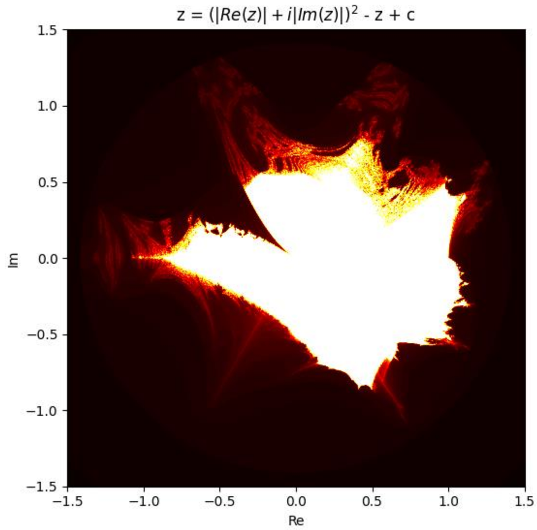


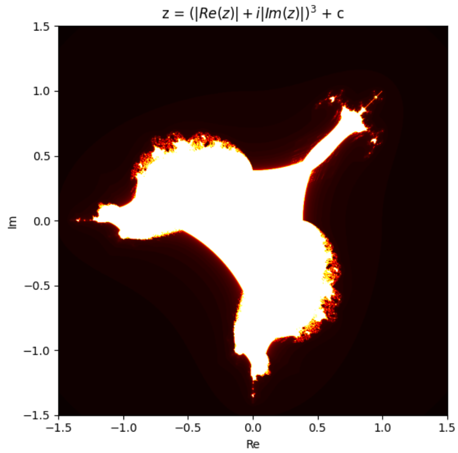


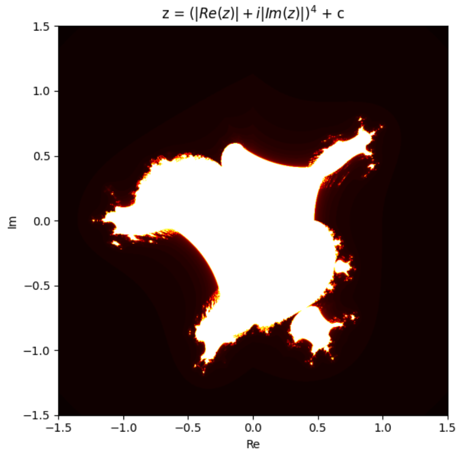
I like the top right one cos of the intracacies between real values of -0.5 and 0, I call that blowing O’s because of the O shapes which look like smoke rings. Also the bottom right one cos it looks like a rhino beetle and hence I’ve named it the rhino beetle. I have no idea if someone else has found these before me and I didn’t really look to be honest, but whatever I am claiming them (at least for now, would be happy to see someone elses).

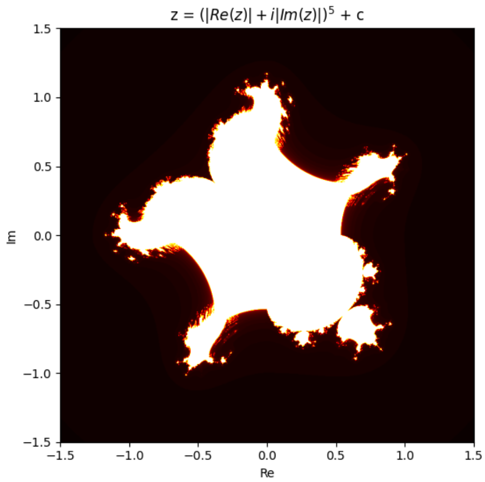
I started using *f(z)*’s which utilised the real and imaginary parts independently. A classic example is the burning ship fractal, pictured top left below. This gives rise to assymetric fractals. For these plots I was just making shit up and seeing what I thought looked cool, did notice some interesting patterns though.

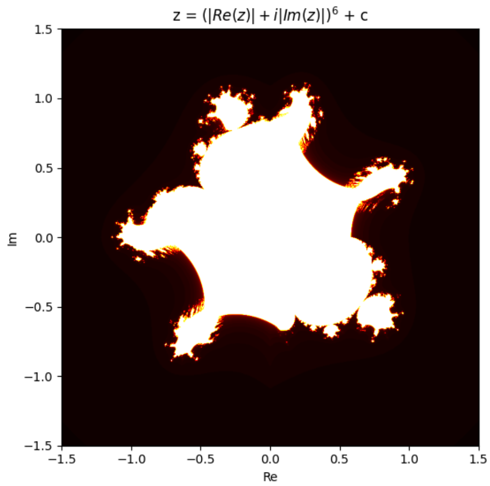




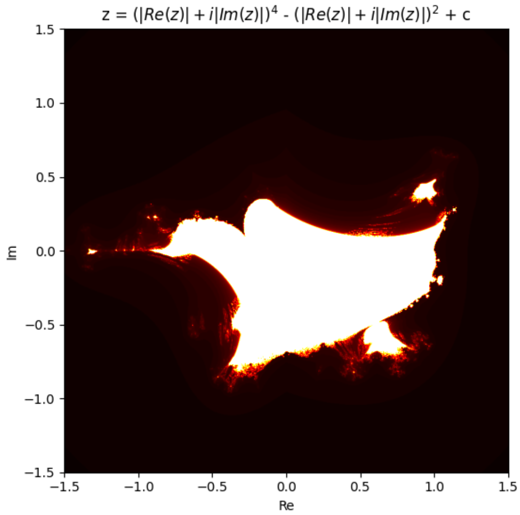




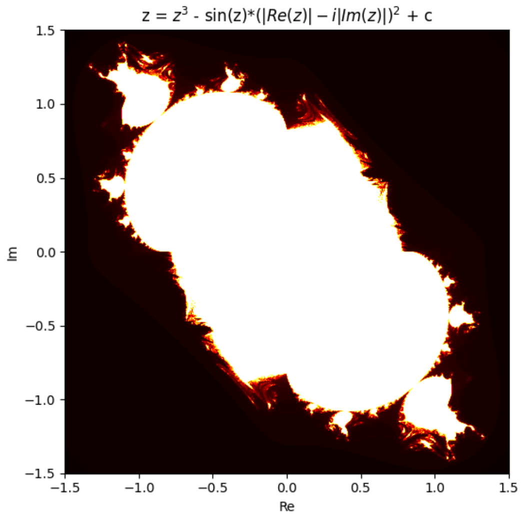


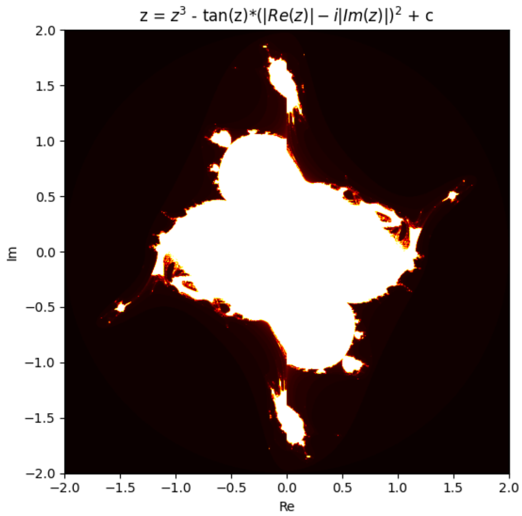


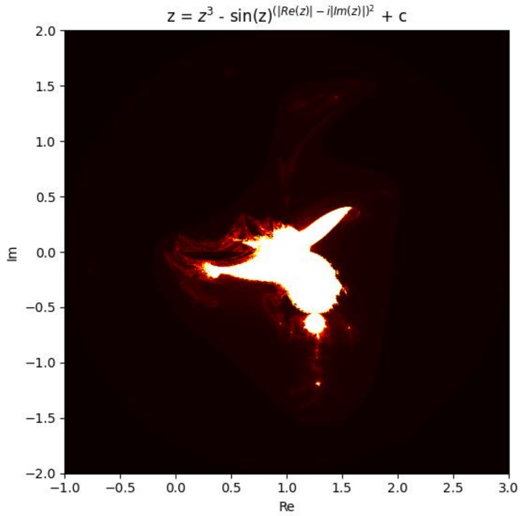
In the above 4 plots, each time the power increases by 1 the fractal "grows another limb" and shifts between symmetric and assymetric fractals for odd and even powers respectively.

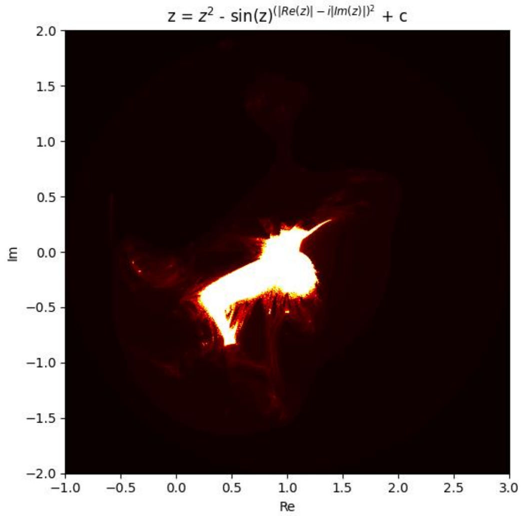


After this I started adding sins, raising stuff to the power of z and other stuff to get even more wild results.









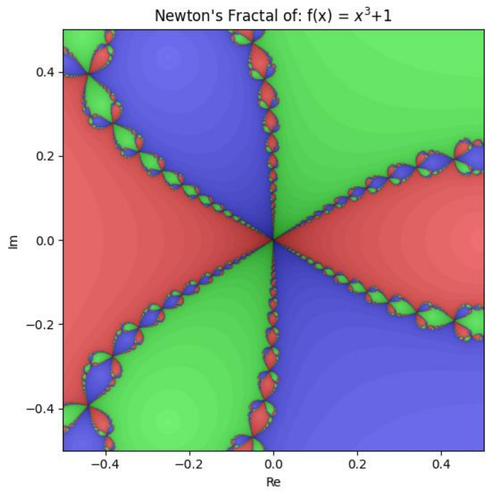
It was after a couple of these I started to question what I was actually doing. Do these fractals show examples of self-similarity? What the fuck is actually going on here? Is there even a way to decipher this in my feeble little brain? I quickly concluded I have no idea and moved on to a different type of fractal, maybe I will return and look at this again one day, but not now.

<u>Newton fractals</u>

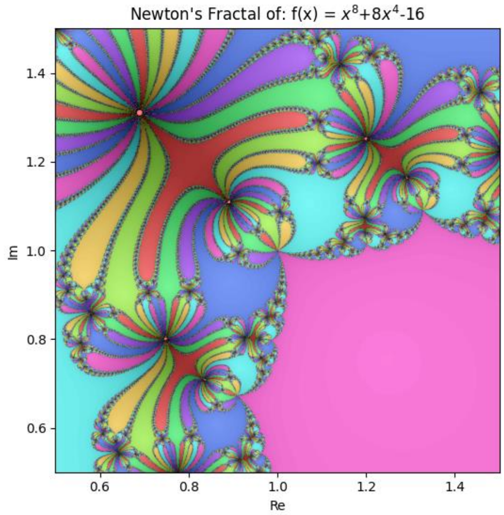
Next I started messing with Newton fractals. These are generated by applying the Newton-Raphson method to a complex plane of points and evaluating which root each point corresponds to. The Newton-Raphson method for a function *f* is as follows:

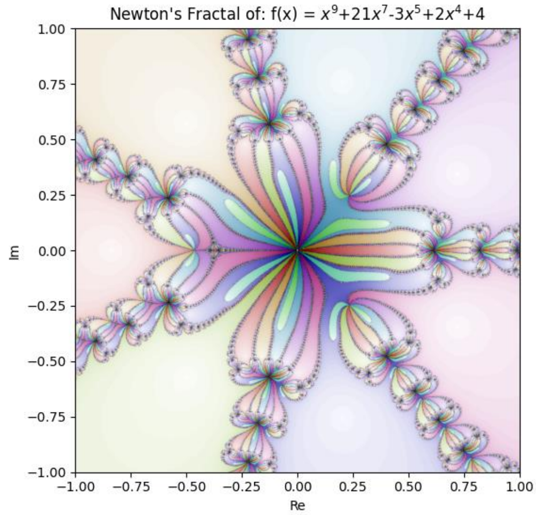
$$Z_{n+1} = z_n – f(z_n)/f'(z_n)$$

Until the point is sufficiently close to one of the roots. A classic exmaple is for the function cube roots of unity, $x^3 = 1$. Below I actually show $x^3 = -1$, but it is the same just flipped over x=0.



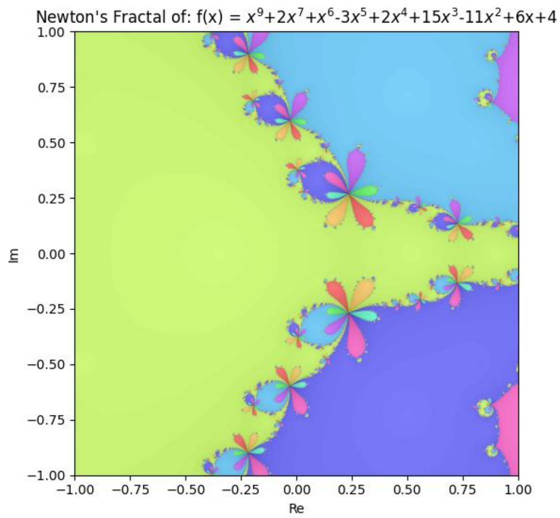
Lighter shades indicate the point converged to a root quickly. 3blue1brown (the G.O.A.T.) did an awesome video on this highly recommend if you have not seen it. But it can be applied to any polynomial to get some stunning images.

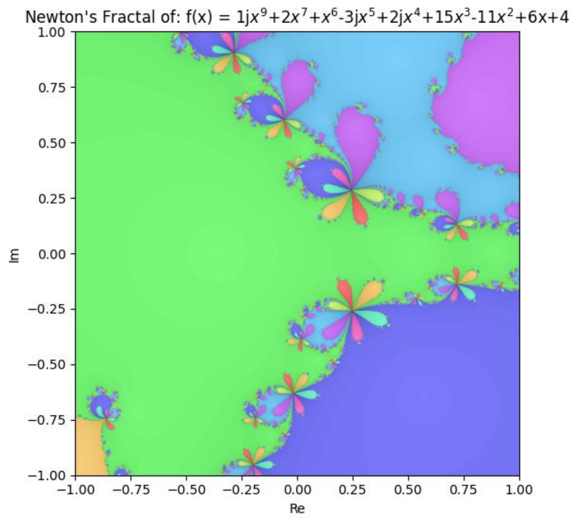




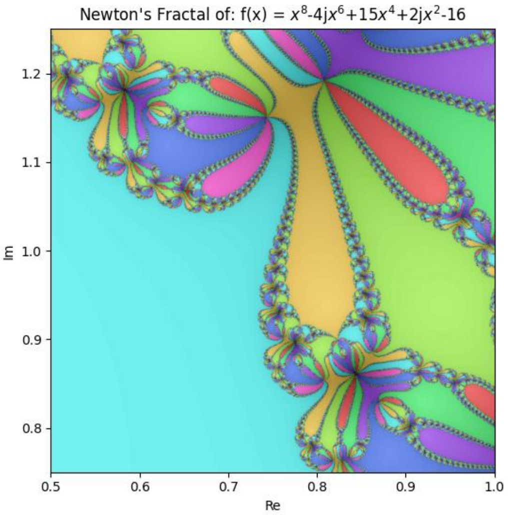
I was messing with some colour schemes Im not sure which one I like more, left shows the roots clearly, while right shows how long it takes to get there more clearly. The red circles in the left image are areas where the iteration limit was reached :(but I couldn't be bothered to improve.

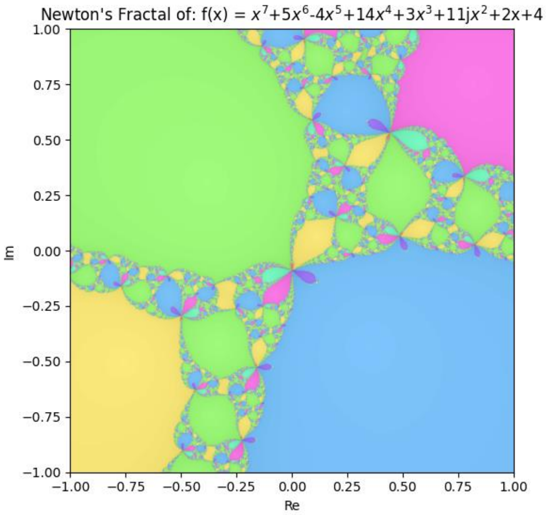
The fractals often (I don't know if always) have some sort of symmetry if only real coefficients are used. However, using complex coefficients distorts this. See below 2 fractals with same coefficients but some of the right images coefficients and complex instead.

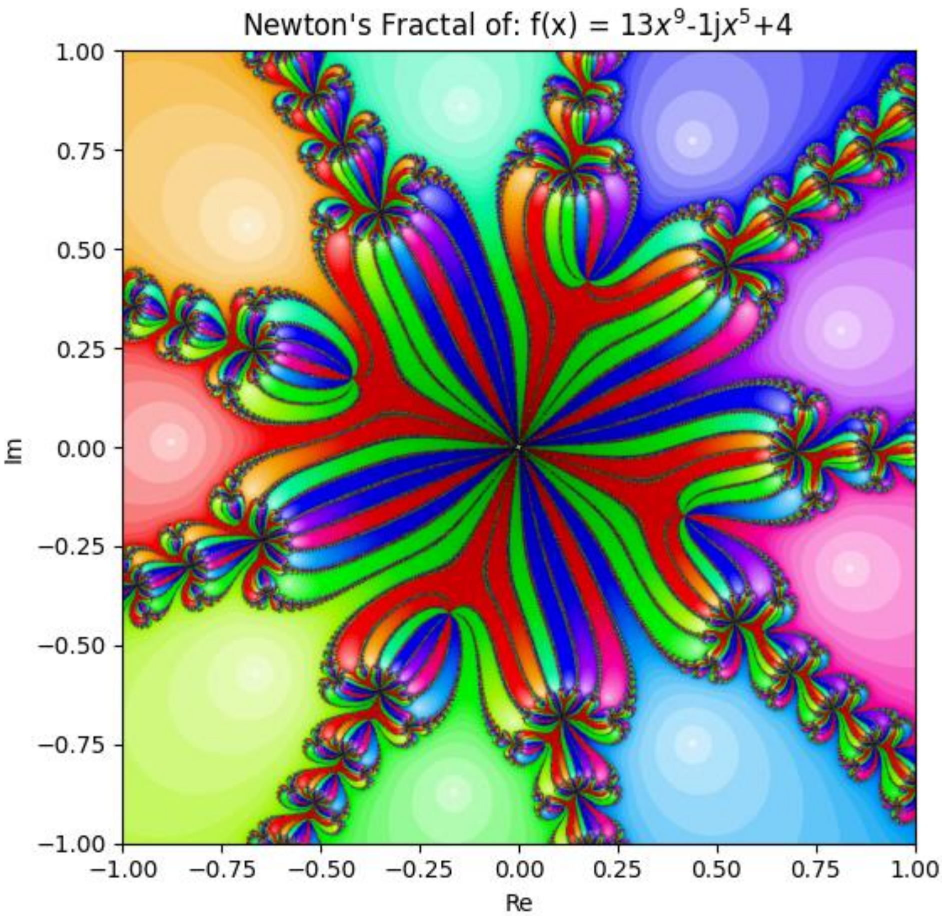




Notice the symmetry across y=0 on the left and the distortion on the right. Most of these examples I pulled the coefficients out of my ass, no rhyme or reason but still look cool.







I just reckon it so mad that you can adjust the coefficients of a polynomial and end with radically different fractals from this simple algorithm.

What more can I explore? What other types of funcitons can you apply newtons method too? Is it just limited to polynomials? **– research more**