FRACTALS

1979/1980 – Benoit Mandelbrot

Dynamical Systems – anything that moves or changes in time

* Weather prediction
* stock market
* chemical reactions

Iteration

$$\boxed{f(x) = x^2 + C}$$

$$f(x) = x^2 + 0 + 0i$$

$$\boxed{\text{Seed value } x_0 = 0}$$

$$f(0) = 0^2 + 0 + 0i = 0$$

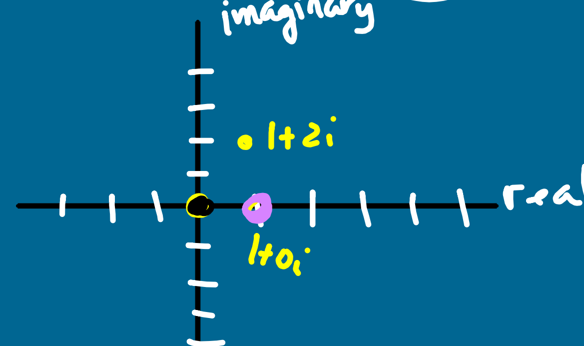
$$f(0) = 0$$

fixed point = iteration stays on same value

Orbit = the list of #'s that result from iteration

1, 2, 5, 26, ...

goes to ∞.



$$f(x) = x^2 + (1+0i)$$

$$f(0) = 0^2 + 1 = 1$$

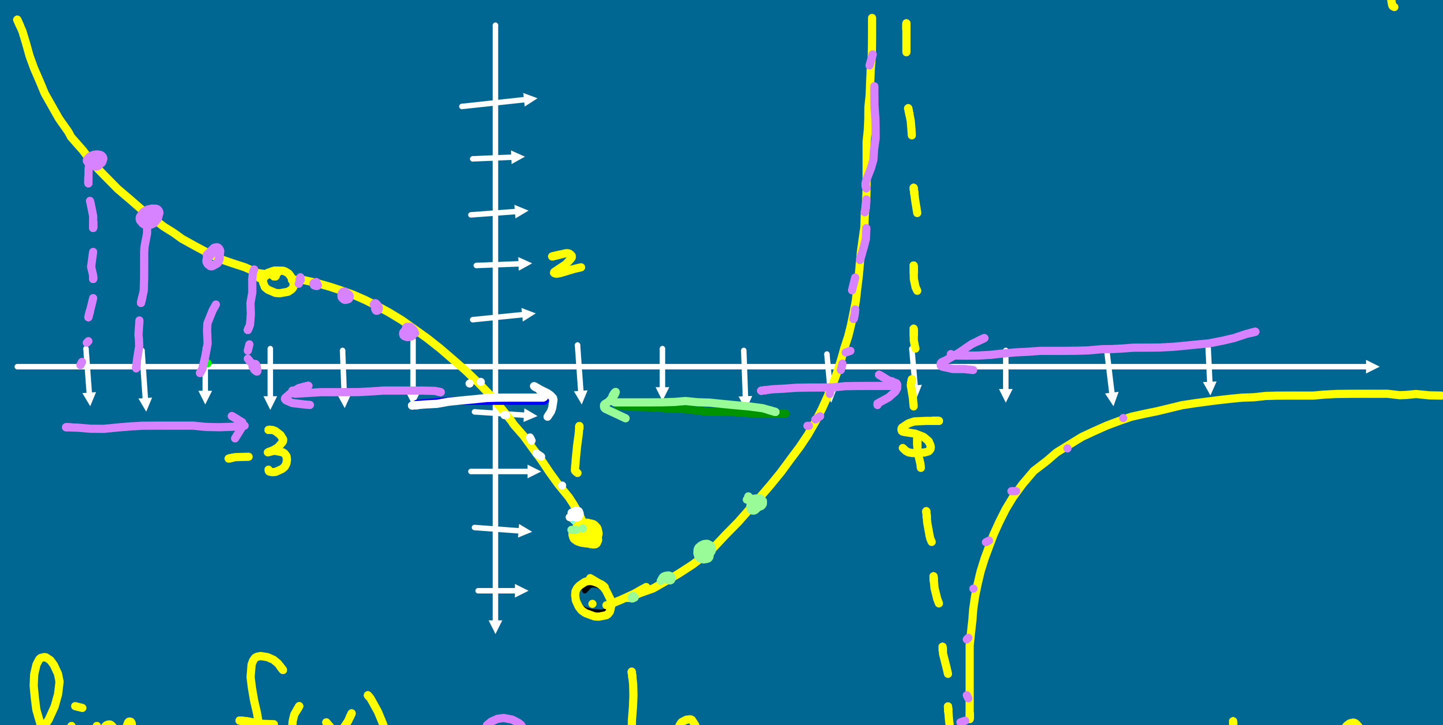
$$f(1) = 1^2 + 1 = 2$$

$$f(2) = 2^2 + 1 = 5$$

$$f(5) = 5^2 + 1 = 26$$

$$f(26) = 26^2 + 1 = \text{Big}$$

Intro To Calculus - Limits, Derivatives, Integrals



$\lim_{x\to -3^-} f(x) = 2$

$\lim_{x\to -3^+} f(x) = 2$

$\lim_{x\to -3} f(x) = 2$

$f(-3) = \text{undef.}$

$\lim_{x\to 1^-} f(x) = -3$

$\lim_{x\to 1^+} f(x) = -4$

$\lim_{x\to 1} f(x) = \text{DNE}$ does not exist

$f(1) = -3$

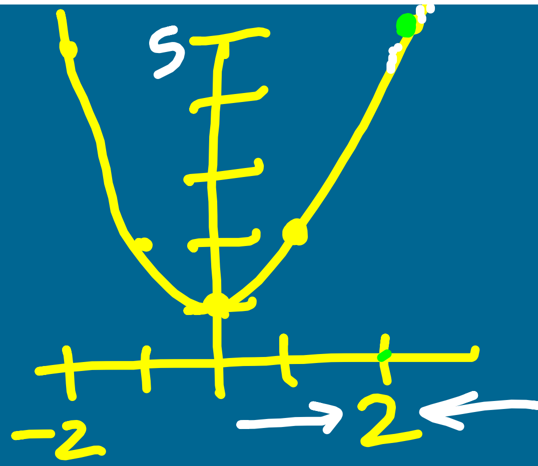
$\lim_{x\to 5^-} f(x) = +\infty$

$\lim_{x\to 5^+} f(x) = -\infty$

$\lim_{x\to 5} f(x) = \text{DNE}$

$f(5) = \text{undef.}$

$$\lim_{x \to 2} x^2+1 = 2^2+1 = 5$$



1) Sub # in
2) If $\frac{0}{0}$, try factoring or conjugate

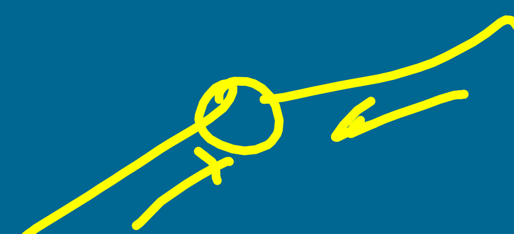
$$\lim_{x \to -4} \frac{x^2-3x}{\sqrt{x+8}} = \frac{16+12}{\sqrt{-4+8}} = \frac{28}{2} = 14$$

$$\lim_{x \to 3} \frac{x^2+4x-21}{x^2-3x} = \frac{9+12-21}{9-9} = \frac{0}{0}$$

indeterminate

$\frac{\infty}{\infty}$

$$\lim_{x \to 3} \frac{(x+7)\cancel{(x-3)}}{x\cancel{(x-3)}} = \frac{3+7}{3} = \frac{10}{3}$$



$$\lim_{x \to -5} \frac{x^3+125}{x^2-25} = \frac{0}{0}$$

$$\lim_{x \to -5} \frac{\cancel{(x+5)}(x^2-5x+25)}{(x-5)\cancel{(x+5)}} = \frac{25+25+25}{-10} = \frac{75}{-10} = \frac{15}{-2}$$

$$\lim_{x \to 64} \frac{\sqrt{x}-8}{x-64} \cdot \frac{(\sqrt{x}+8)}{(\sqrt{x}+8)} = \frac{8-8}{64-64} = \frac{0}{0}$$

$$\lim_{x \to 64} \frac{\cancel{x-64}}{\cancel{(x-64)}(\sqrt{x}+8)}$$

$$= \frac{1}{\sqrt{64}+8} = \frac{1}{16}$$