

# Disturbing Mandelbrot



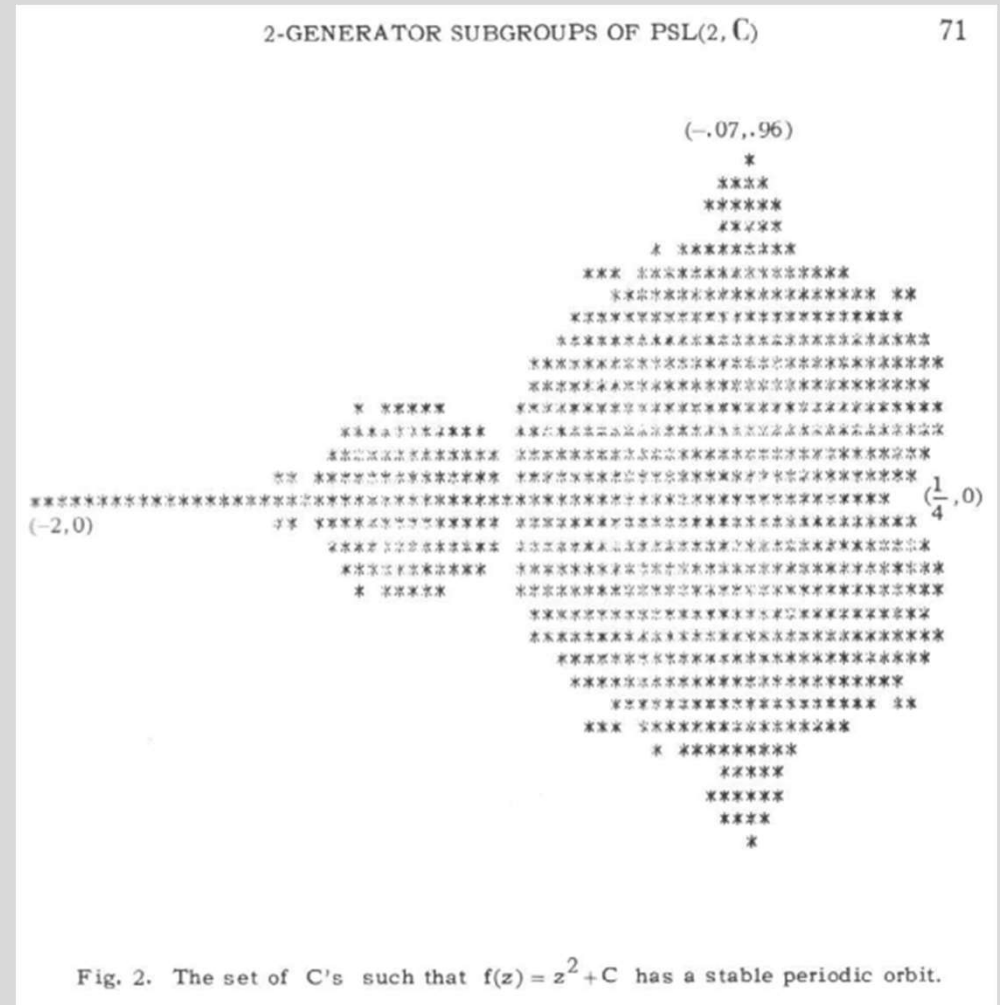
# Art first approach



# Algorithm

- Complex plane
- Favourite function  $f(z)$
- Take a point  $c$ , calculate  $f(c)$  and add  $c$ .
- Alternate: apply  $f$  and add  $c$ .
- If this sequence stays bounded: colour  $c$ .

Mandelbrot set: do that for squaring  
(First ever published picture, 1978)



# Any complex function will do (in theory)

$\sqrt{z}$  → picture is the full plane

$z^{2.01}$  → now we're talking

Animation: Running the exponents from 1 to 5.

“multibrot”



# Enter the dragon

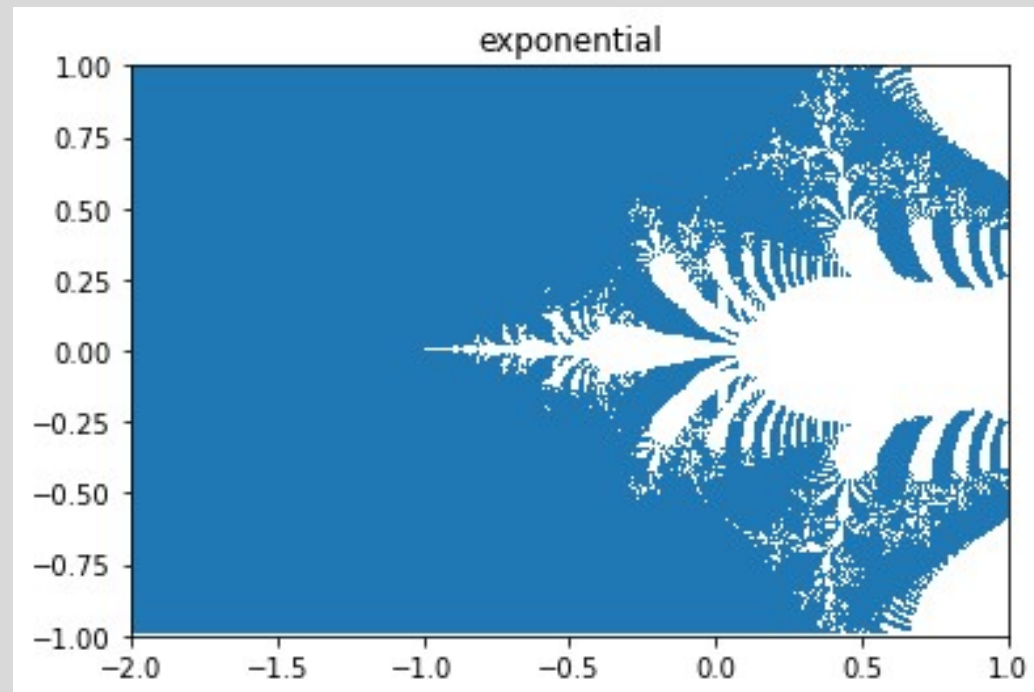
- Adding a linear term:  $f(z) = z^2 + tz$ , for any real parameter  $t$
- animation,  $t$  ranging from -4 to 4.
- Project: Let's make a 3d object and get it to the printer (-> Next year or tomorrow)



# real fun → complex fun

The python libraries come equipped with complex functions

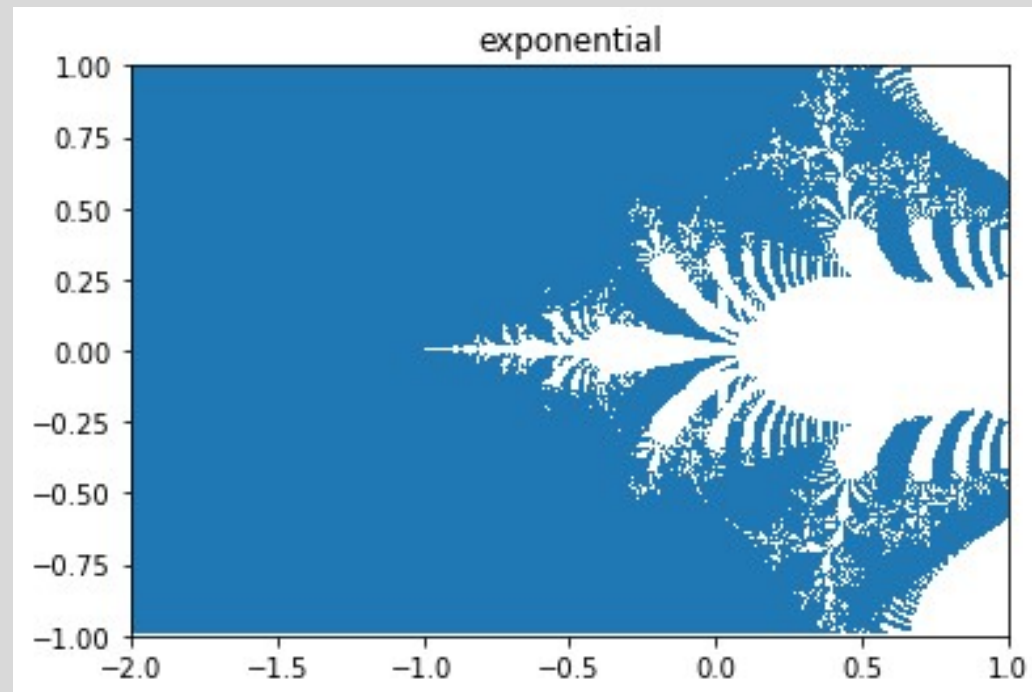
- $e^z = \sum \frac{z^n}{n!}$
- $e^{iz} = \cos(z) + i \sin(z)$
- Gamma function: extending !
- 1/Gamma
- Wright Omega function
- Zeta: Extending  $\sum \frac{1}{n^x}$



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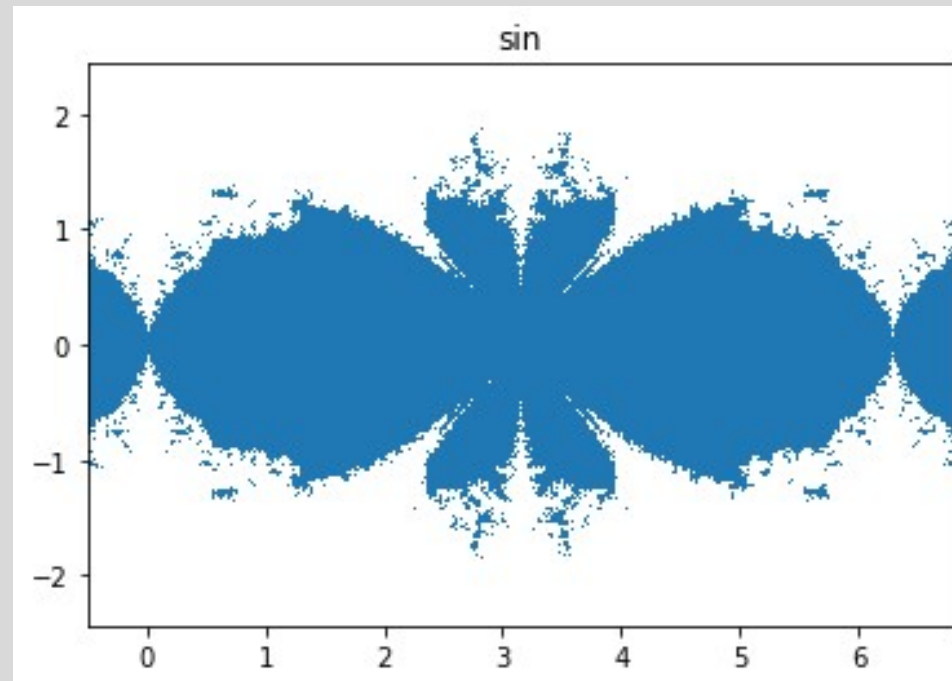
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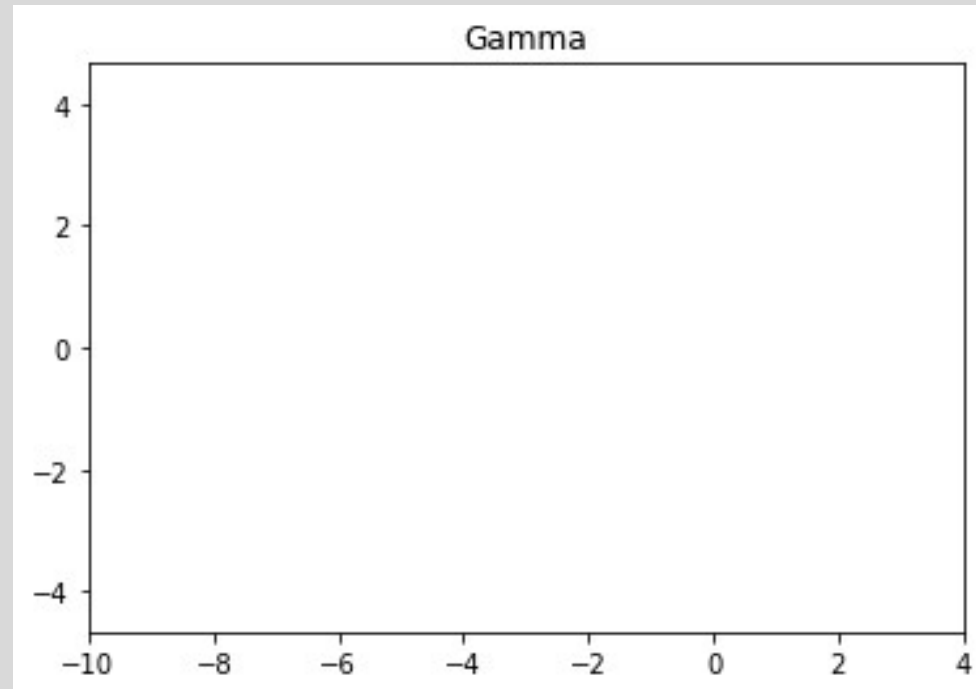
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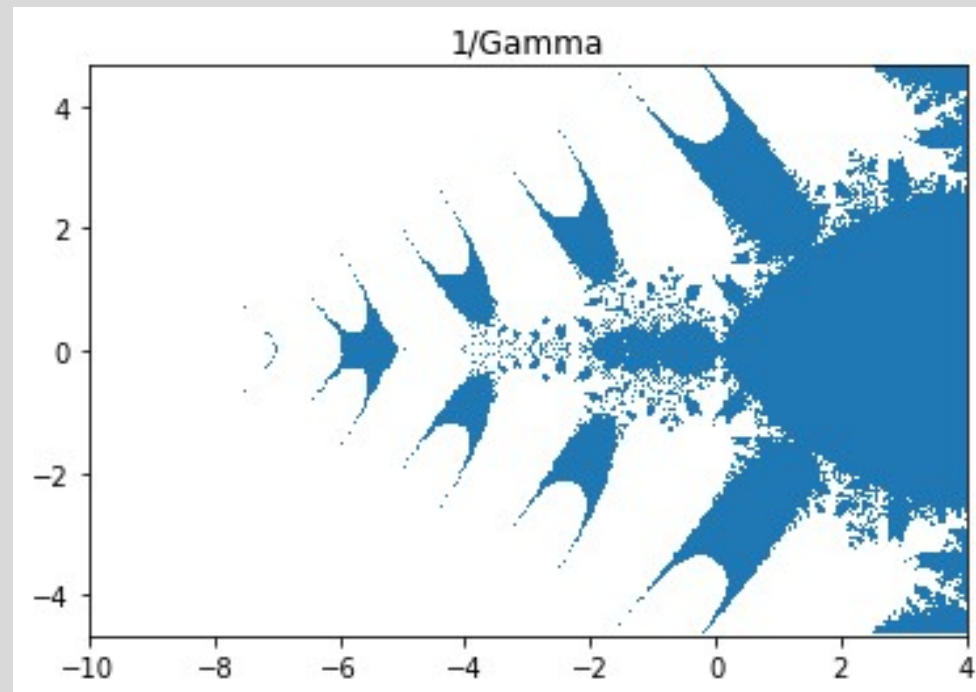
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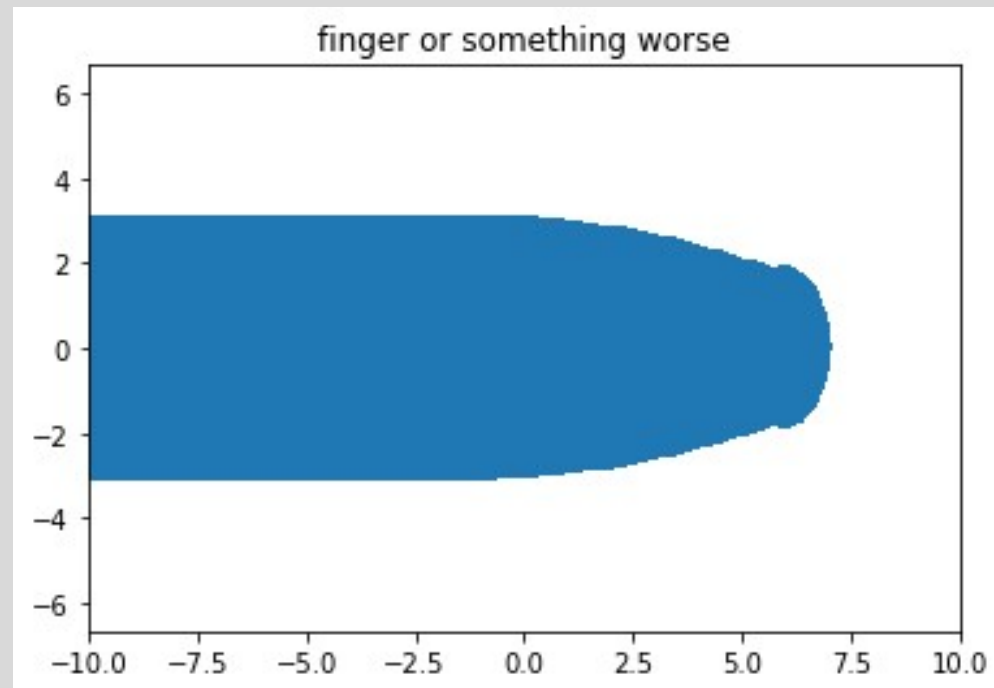
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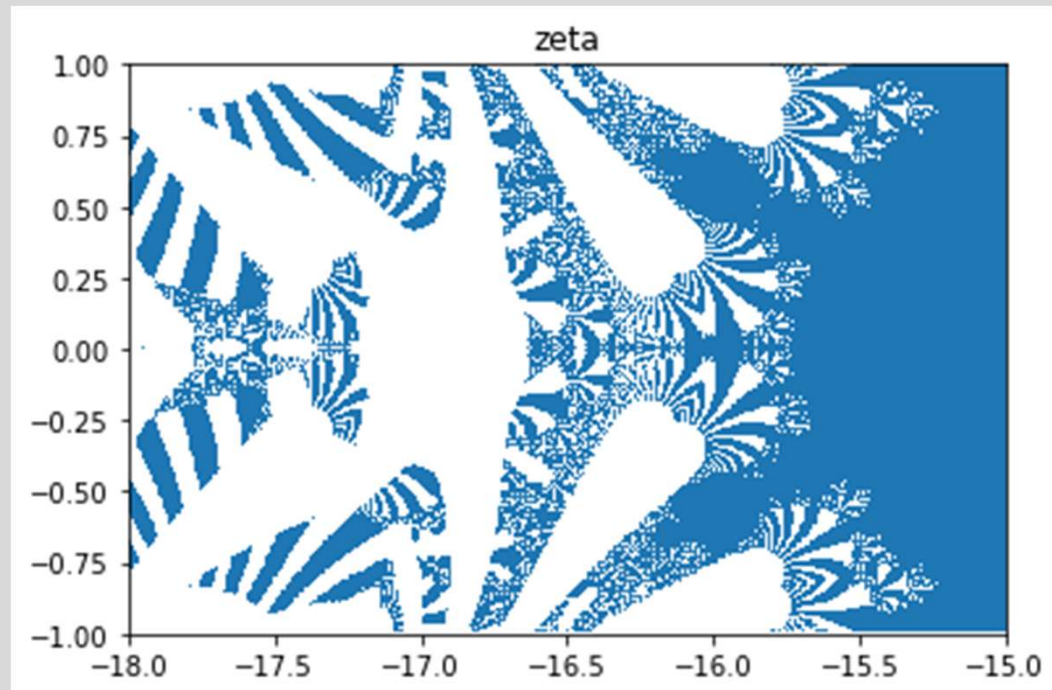
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# What counts as infinity

	Mandelbrot	Zeta function
How many iterations	30	200
Outside of what radius	2	$10^{100}$