

# Function Documentation

This file will list out the functions and give a description of them. This can be used as a reference file so that you don't have to lumber through Julia.R if you have any questions about which function you want to use.

Some notes on notation:

1.  $z$  will be used to represent a complex value. In much of this code, if you apply a function to a numeric or integer, it will be coerced into a complex value in the process.
2.  $f(z)$  is the function we will use for the Julia set.
3.  $f_2(z)$  will be shorthand for  $f \circ f(z)$  and inductively  $f_n(z) = f_{n-1} \circ f(z)$ .

## About Julia Sets

For many of our examples, we'll look be using the function  $f(z) = z^2 - 0.4 + 0.6i$ . In reality, we can take  $f$  to be any rational function (quotient of two polynomials). As we apply  $f$  over and over again, i.e., create a sequence  $\{f_n(z)\}$ , either the values will remain bounded or will tend towards infinity,  $|f_n(z)| \rightarrow \infty$ .

We'll use the notation  $J_f$  to refer to the Julia set associated with  $f$ . A complex number,  $z$ , is said to belong to  $J_f$  if  $|f_n(z)|$  remains bounded. Often times,  $J_f$  is referred to as the filled Julia set while the "true" Julia set is the boundary of  $J_f$ .

We aren't going to make much of a big fuss about the distinction between the filled and true Julia sets. Our plots will often color code based on how many iterations it takes for  $|f_n(z)|$  to become very large (determined by the bound parameter of our R function). In this case, the color black will be used for the filled Julia set. There are some cases where the filled Julia set is color coded while the unbounded points are set to a constant color.

For each plot, I'll try to include information about the color coding. If it's unclear (or I haven't documented it yet), feel free to ask and I'll put it at the top of my priority list and get back to you as quickly as possible.

## Most Useful Functions

This section will contain the functions that you see the most.

These last two sections are incomplete. As I find the time, they will get better.

- thefunction:
  - Takes in a value  $z$  (numerics or ints coerced to complex) and outputs  $f(z) = z^2 - 0.4 + 0.6i$ .
  - If you want to change the function, you'll need to copy and manually edit the code of "thefunction". Every .R script in this repo should start with "thefunction" being called outside of Julia.R for added specificity.
  - If there is a way around manually editing the code, please let me know. I would really like to have "thefunction" to be a function of  $z$  and " $f(z)$ ".
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## Less Used Functions

- iterating
  - Takes in a complex value and the number of iterations you want to apply.
  - Outputs the value returned after applying thefunction that many times.

- `in.Julia2`
  - Determines if  $z$  belongs to the Julia set.
  - Applies thefunction a fixed number of times. If the output is too large (determined by bound), then FALSE is returned.
  - Otherwise, TRUE is returned because  $z$  likely belongs to Julia set.
- `iteratingbound`
  - Same as `in.Julia2` but was designed to be quicker.

*iterboundn* Like `in.Julia2` and `iteratingbound`, the main purpose is to determine if  $z$  belongs to the Julia set.

\* This also tests for convergence and outputs  $n$  when  $z$  and  $f(z)$

\*`iterboundnsecond`