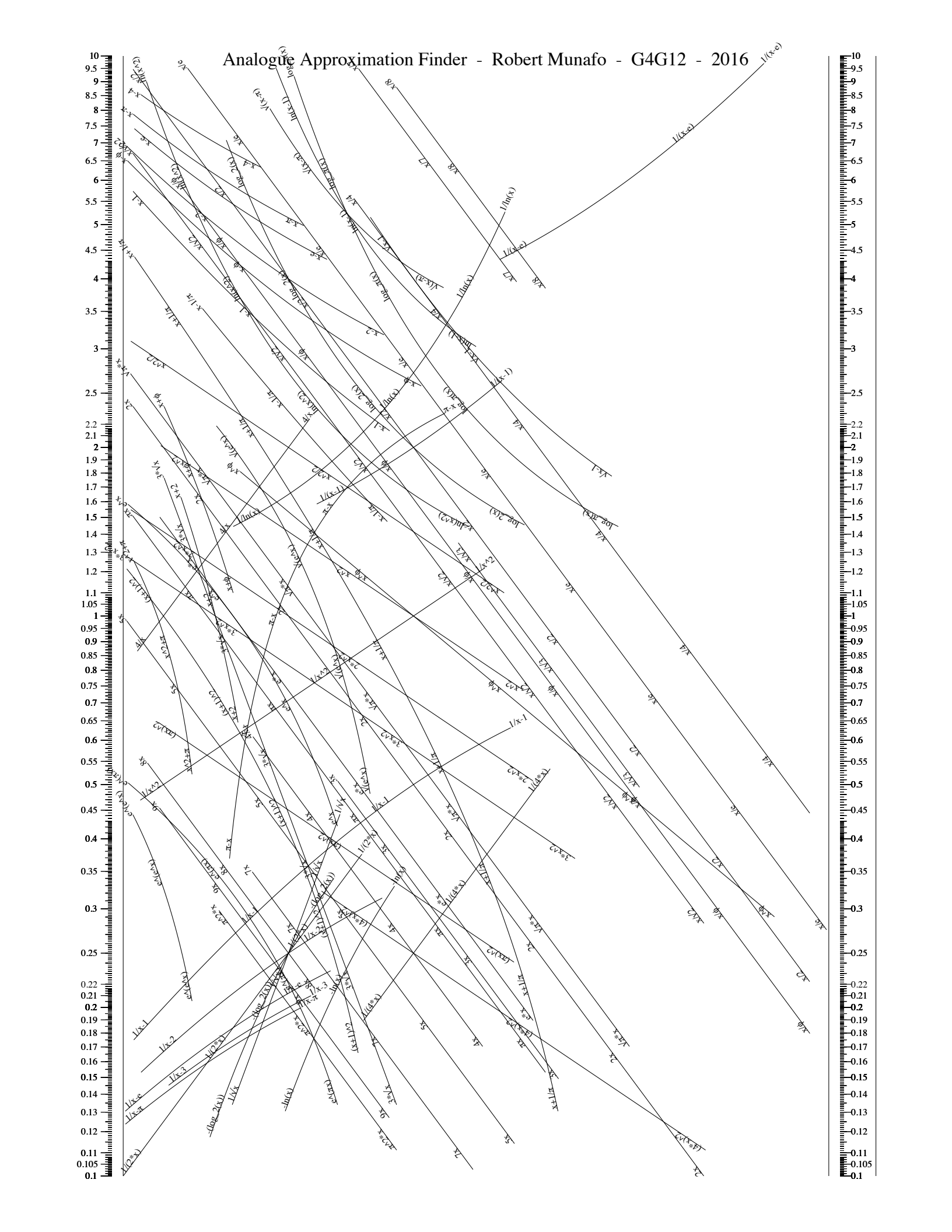
Analogue Approximation Finder - Robert Munafo - G4G12 - 2016

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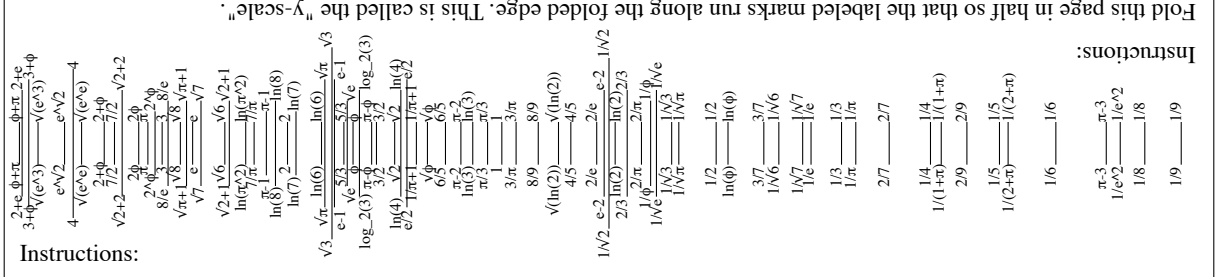

Instructions:

Fold this page in half so that the labeled marks run along the folded edge. This is called the "y-scale".

The other page is the "main chart". The main chart features a large number of curved and straight lines. These are graphs of functions of x. It also has two identical scales (labeled with numbers from 0.1 to 10) called the "x-scales".

To align the y-scale with the main chart you'll use the "registration lines". These are three plain lines running the length of the page. One registration line runs along one edge of the main chart, parallel to one of the x-scales; and the other two registration lines run along either side of the other x-scale. The y-scale (this page) also has three registration lines, one on the high end of the y-scale and two on the low end of the y-scale.

The two sheets together are an "analogue" calculating tool, the purpose of which is to find symbolic approximations of real numbers. To use it, you'll align the y-scale with the main chart in the following way:

Locate the number you wish to approximate on the x-scales. (It will usually be between two of the smallest ruler-marks).

Place the y-scale on the main chart so that all three registration lines match up, and move the y-scale up or down until its folded edge aligns as nearly as possible with the number you wish to approximate, on both of the x-scales. Double-check to see that the registartion lines are still aligned.

Scan along the y-scale to find a number whose mark touches (as nearly as possible) one of the labeled functions (curves) on the main chart. Since the y-scale marks are precisely vertical and the functions are all sloping to some degree or another, the y-scale mark and the function will always meet at an angle. You want to find one where they meet as "cleanly" as possible.

For example, this: __/ meets more "cleanly" than this: —/

Once you have found the "cleanest" match, look at the labels of the function (curve) and y-axis value that you matched. These are the left and right sides of an equation. Solve this equation for x. The answer is an approximation of your number.

Example:
The area of the Mandelbrot Set is about 1.51. Find an approximation of this. Align the y-scale's folded edge with 1.51 on both x-scales (as you go from 1.5 to 1.6 it is the first little ruler-mark). Make sure the three registration lines match up. Scan along the y-scale. You will see that "sqrt(7)" on the y-scale aligns with the function labeled "4/x". This suggests that 4/x equals the square root of 7. Solving for x gives: x = 4/sqrt(7). Using a calculator you can verify that 4/sqrt(7) is 1.5118... which is indeed a good approximation for 1.51.