

Arctan from differential equation

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1 The exercise

My exercise is to use the differential equation for arctan to write an arctan function. This differential equation is

$$\arctan(x)' = \frac{1}{x^2 + h} \quad , \quad \arctan(0) = 0. \quad (1)$$

My function should be compared to the function from math.h or GSL.

2 Solving the Exercise

I solve the exercise by using the GSL ODE solver. I define my ODE function in the way required by GSL. I then define an arctan function, which should integrate the ODE and return the value at the endpoint, an x-value provided when calling my arctan function, making it work just like calling the math.h arctan.

The ODE system contains just a single ODE, the dimension is thus 1. I do not use a jacobian or any further params. I define a suitable precision and accuracy, in this case I define both as 10^{-6} . Now I just have to allocate a driver, in this case I use a GSL odeiv2 driver with a rkf45 stepper. It is then applied, calculating a y-value, and then freed. The function then returns this y-value.

My main function just consists of a for-loop calling my arctan function and the math.h arctan for a series of x-values. These results, along with the x-values are sent to the standard output.

When the makefile is run, this data is saved in data.out. I use gnuplot to plot the data to both an .svg and a .tex-file. The makefile then builds this report using the .tex plot.

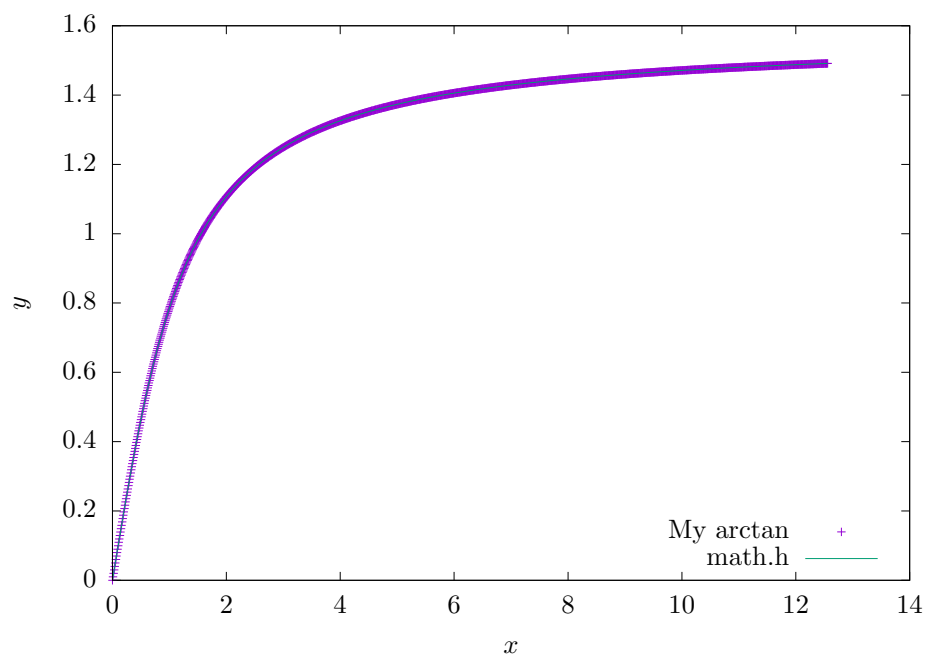


Figure 1: A plot of my arctan calculated from the differential equation along with the arctan from math.h.