A brief description of exponential function and implementation in C

P. A. Samu

Abstract

We shall introduce the exponential function and then implement it in the C programming language. In the end we shall compare the implementation with the exponential function already implemented in the math header file.

1 Exponential function

The exponential function, $\exp(x)$, can be defined in many ways. One of the ways is defining it by the following limit:

$$\exp(x) = \lim_{n\to\infty}(1+\frac{x}{n})^n \tag{1}$$

Another important characteristic of the exponential function, which also distinguishes it from every other function, is that the derivative is equal to itself.

$$\frac{d}{dx}\exp(x) = \exp(x) \tag{2}$$

2 Implementation

The way we have implemented the exponential function in C language, is to consider its power series expansion first and foremost.

$$\exp(x) = \sum_{n=0}^{\infty} \tag{3}$$

The way to implement this power series is to take a number of terms. More terms lead to more precision, but also longer compilation times. In this implementation we take the first eleven terms (so up to $n = 10$). Instead of writing it like this, we write the expansion in the following way.

$$\exp(x) = 1 + x(1 + \frac{x}{2}(1 + \frac{x}{3})) \tag{4}$$

This is just the first four terms, in the implementation we continue until we have ten terms. This way we get multiplication instead of powers, which is faster.

3 Plots

Here is a plot of the implementation of the exponential function in the C programming language. We plot it versus the built-in exponential function from the math.h headerfile.

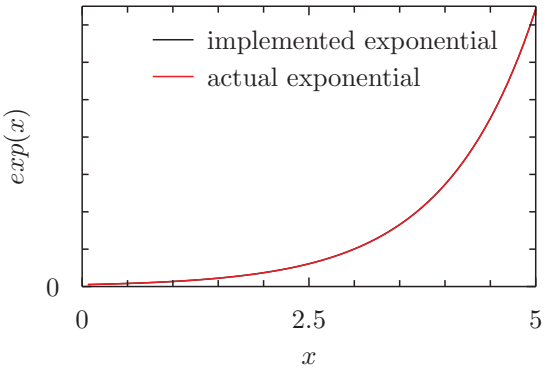

Figure 1: Plot of exponential function implementation via pyxplot "pdf" terminal.

We see that the graphs lay directly on top of eachother, which means our implementation works as intended.