

Exponential function

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1 Introduction

The exponential function is a mathematical Function denoted by $f(x) = \exp(x)$ or e^x (where the argument x is written as an exponentiation). It can be defined in Characterizations of the exponential function several equivalent ways. Its ubiquitous occurrence in pure mathematics and applied mathematics led mathematician Walter Rudin to opine that the exponential function is "the most important function in mathematics" Its value at 1, $e = \exp(1)$ is a mathematical constant called Euler's number.

The graph of $y = e^x$ is upward-sloping, and increases faster as x increases. The graph always lies above the x -axis, but becomes arbitrarily close to it for large negative x ; thus, the x -axis is a horizontal asymptote. The equation 1 means that the slope of the tangent to the graph at each point is equal to its y -coordinate at that point.

$$\frac{d}{dx}e^x = e^x \quad (1)$$

To implement this function, we use the following code shown in figure 1. If the argument is below 0 it will return $1/e^x$ equivalent to e^{-x} . If, however, the argument is larger than 0 and then finally returns the

first few terms of the definition of the exponential function, given by the power series in equation 2

$$\exp x := \sum_{k=0}^{\infty} \frac{x^k}{k!} = 1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \frac{x^4}{24} + \dots \quad (2)$$

We can now test this implementation by plotting it against known table values. This is done in 1. It works wooho!

```
static double ex(double x){
    if(x<0)return 1/ex(-x);
    if(x>1.0/8)return Pow(ex(x/2),2); // explain this
    return 1+x*(1+x/2*(1+x/3*(1+x/4*(1+x/5*(1+x/6*(1+x/7*(1+x/8*(1+x/9*(1+x/10)))))))));
}
```

Figure 1: Code used to implement exponential function

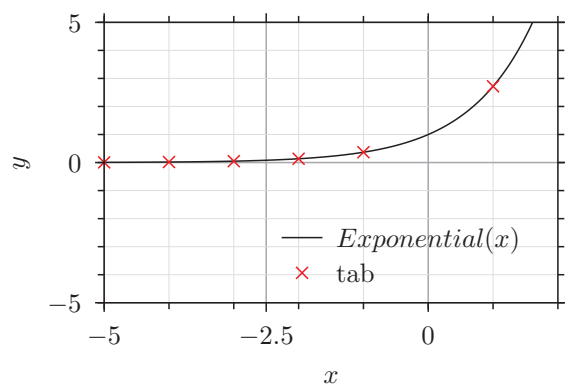


Figure 2: plot of the exponential function made by the code.