

# The exponential function

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## 1 Introduction of the exponential function

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 is an important function in both mathematics and physics. It is defined in several different ways, but for this introduction the following definition is used:

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

Its value at 1,  $e = \exp(1)$  is a mathematical constant known as Euler's number.<sup>1</sup>

To implement the function, the code shown in figure 1 is used.

If the argument is below 0, the function returns  $1/e^x$  which is equivalent to  $e^{-x}$ . For relatively large  $x$  (i.e.  $x > 1/8$ ) the recursive definition  $\exp x = (\exp x/2)^2$  is used, while the Taylor expansion in equation 1 can be used for smaller, but positive values of  $x$ .

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<sup>1</sup>[https://en.wikipedia.org/wiki/Exponential\\_function](https://en.wikipedia.org/wiki/Exponential_function)

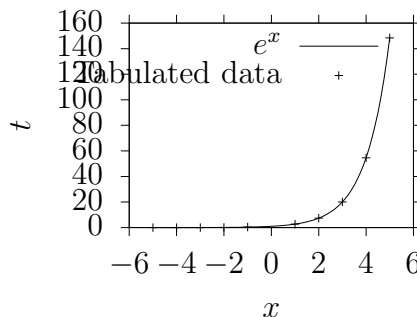


Figure 1: Plot of the exponential function by the code.

The implementation is then tested by plotting it against known table values, which is done in figure 1. And it works.

```
static double ex(double x){  
  if(x<0)return 1/ex(-x);  
  if(x>1.0/8)return Pow(ex(x/2),2);  
  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)))))))));  
}
```