Engineering Mathematics PA1

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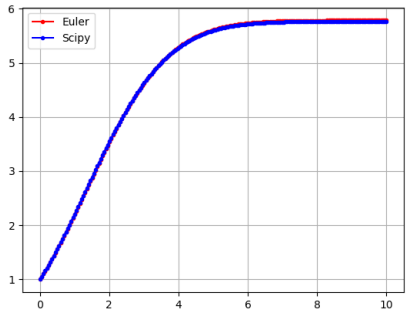
1 Problem

Solve the following first order nonlinear DE numerically.

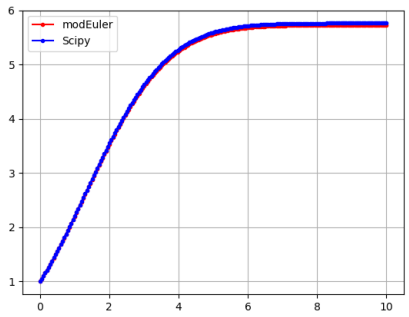
$$\frac{\partial y(x)}{\partial x} = \sqrt{y}e^{-0.1x^2},\ y(0) = 1,\ 0 \leq x \leq 10,\ x_{n+1} - x_n = 0.05 \tag{1}$$

The solution is from scipy.integrate.odeint which solve DE with RK45 method.

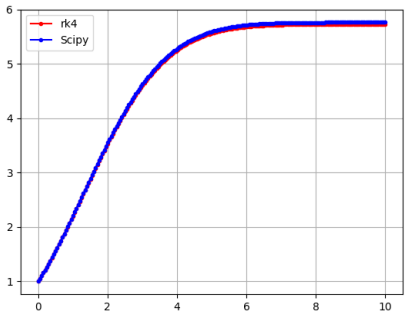
a. Euler method



b. Modified Euler's method



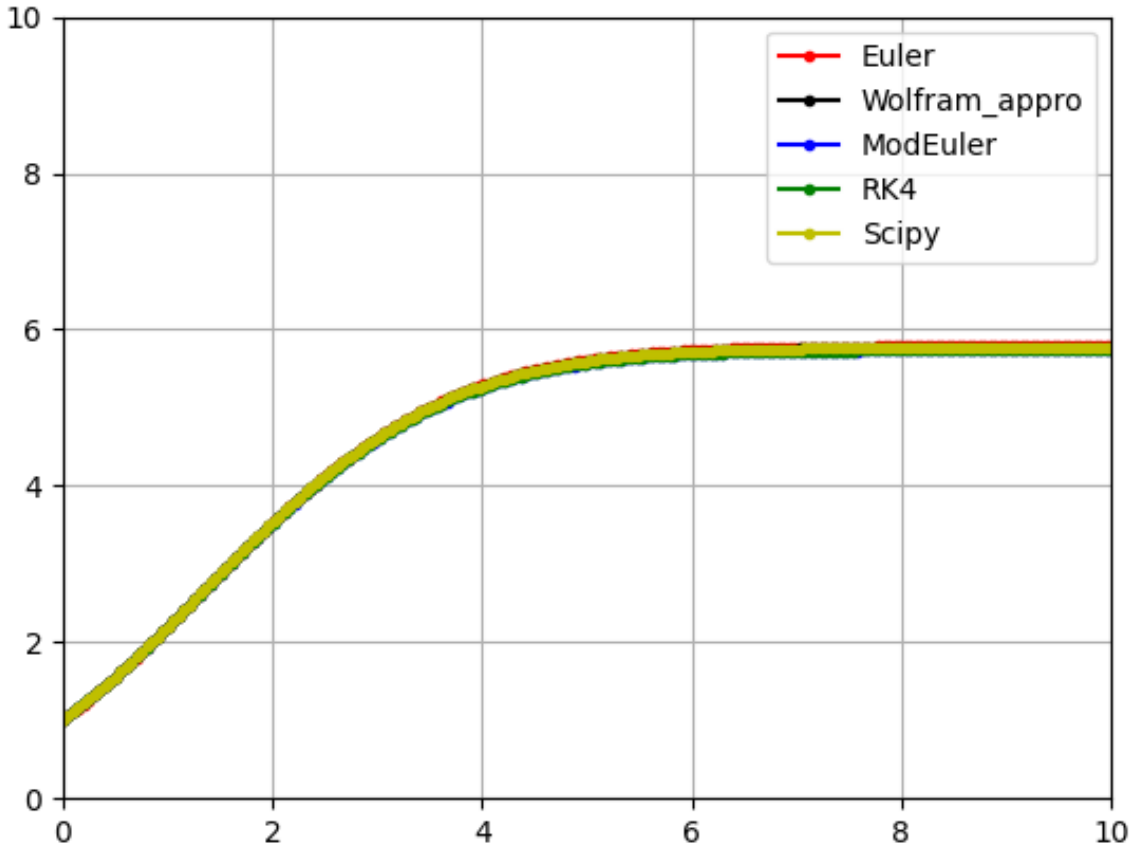
c. RK4 method



d. Additional discussion

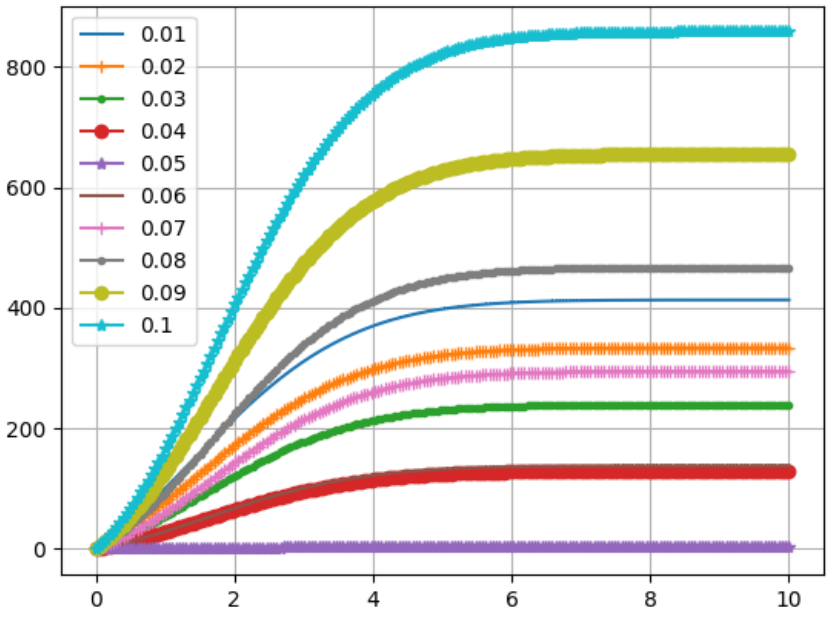
Comparing with Wolfram approximation solution,

$$y(x) = 1 + 2.8025 \times erf(0.316228x) + 1.9635(erf(0.316228x))^2 \tag{2}$$



e. Different h value in modified Euler's method and RK4 method

Modified Euler's method



RK4 method