Numerical Analysis and Programming

Lab Worksheet #10

1. In final presentation, we will use something like this: First, we know that the gravity is the constant g, and the constant of air resistance is b. Both $g \approx 9.8$ and $b \approx 0.1$ are unknown.

$$\begin{cases} \frac{d^2x}{dt^2} = -b\frac{dx}{dt} \\ \frac{d^2y}{dt^2} = -b\frac{dy}{dt} - g \end{cases} \tag{1}$$

$$\begin{cases} \frac{dx}{dt} = v_{x0}e^{-bt} \\ \frac{dy}{dt} = (v_{y0} + \frac{g}{b})e^{-bt} - \frac{g}{b} \end{cases} \tag{2}$$

$$\begin{cases} x = -\frac{v_{x0}}{b}e^{-bt} + \frac{v_{x0}}{b} \\ y = -\frac{(v_{y0}+\frac{g}{b})}{b}e^{-bt} - \frac{g}{b}t + \frac{(v_{y0}+\frac{g}{b})}{b} \end{cases} \tag{3}$$

At origin, if you shoot something in the air with velocity $v_0 = 15m/s$ angle $a = 45\,\mathrm{deg}$, then you got the data in `data_lab10.dat` in form `t x y`. Now you can use function `curve_fit()` to get g and b.
You can also compare the data and the fitting function by matplotlib.