Introduction to MATLAB
HOMEWORK 3/Batted baseball.

Compute the fly path $s(t)$ of a batted baseball from the equation

$$F = ma(t), \quad a(t) = v'(t) = s''(t).$$

How long can a batted baseball fly with a given initial speed?

Let v_0 be the intial velocity, e.g. $v_0 = 50m/s$. Let α be the angle between the ground and the initial direction of the ball. The force in the equation consists of:

- Gravitational force downwards mg, $g = 9,81m/s^2$.
- Air resistance (drag) directed opposite to the velocity v:

  $$D(v) = c(v)mv^2,$$

  where

  $$c(v) \approx 0,004 + 0,006/(1 + \exp((v - 35)/5)), [v] = m/s,$$

  by [Computational Physics, Fitzpatrick, webpages].

Programming

- Write a code for the 1st order system

  $$s_x'(t) = v_x(t), \quad s_y'(t) = v_y(t),$$
  $$v_x'(t) = F_x(v,t), \quad v_y'(t) = F_y(v,t),$$

  and solve it with `ode23` with the given initial values. Use $s = (0,0)$ for the initial position. Mass ($m = 0,14kg$) of the ball cancels.
- Write a function that computes the length of the fly with given initial angle α. Use ode23. You can compute the fly long time enough and then find the solution for $s_y(t) = 0$ to get the length of the fly.
- Optimize α by calling `fminsearch`.
- Visualize!