Week 2 Day 1 Notes
EEET-427-01: Control Systems

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So... no one's ever gone skydiving before? Perfect time! Class trip! (sarcasm)

Lets say that you need to fall at a max speed of $6m/s$ when you hit the ground, so you can walk away from the experience. What would the drag coefficient have to be?

$$\begin{aligned} F_g = mg,\ m = 100kg,\ g = 9.8m/s^2,\ v_t = 6m/s \\ F_g - D_L(v(t)) = m\frac{d}{dt}(v) \\ F_g = D_L(v(t)) + m\frac{d}{dt}(v(t)) \\ F_g = D_L(V) + mV' \end{aligned} \tag{1}$$

Jargon time:
$R(s)$ is the target value, $C(s)$ is the current value, $G(s)$ is the system model.
The standard form for a first order system is $y' + by = ax$. So, our equation from earlier converts to:

$$V' + \frac{D_L}{m}V = g \tag{2}$$

Where $b = \frac{D_L}{m}$, $a = 1$, $x = g$, and $y = v(t) = V$ The shape only depends on the b value, in this instance. The initial slope is the time constant, which is the b value mentioned above.

$$\begin{aligned} y' + by = 0 \\ y = e^{at} \\ y' = ae^{at} \\ e^{at}(b + a) = 0 \\ b + a = 0 \\ a = -b \\ \therefore y = e^{-bt} \end{aligned} \tag{3}$$