Review of some mathematical tools:

- Linear systems of differential equations
- Non-linear systems of differential equations
  - phase portrait
  - critical (or, equilibrium) points

- A linear system of ODEs has form

$$\boldsymbol{y}' = \boldsymbol{A}\boldsymbol{y} + \boldsymbol{p}$$

- Initial condition $\boldsymbol{y}(t=0) = \boldsymbol{y}_0$
- The solution can be written using the matrix exponential

$$\boldsymbol{y}(t) = e^{\boldsymbol{A}t}\boldsymbol{y}_0 + \int_0^t e^{\boldsymbol{A}(t-s)}\boldsymbol{p}(s)\,\mathrm{d}s$$

- Of particular interest are states of the system for which $\boldsymbol{y}' = 0$, known as critical or equilibrium points, obtained by solving a linear system

$$\boldsymbol{A}\boldsymbol{y} + \boldsymbol{p} = 0 \Rightarrow \boldsymbol{A}\boldsymbol{y} = -\boldsymbol{p}$$