

The stability of equilibria of a differential equation, analytic approach

$$\frac{dx}{dt} = f(x) \quad \text{Equilibria: } x_e \text{ where } f(x_e) = 0.$$

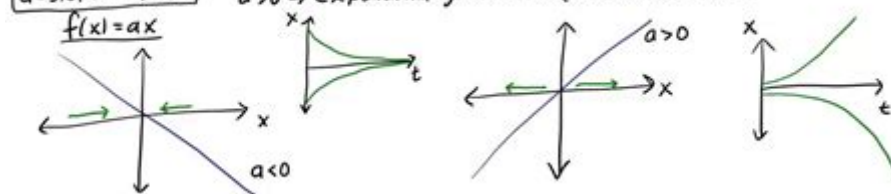
Determine stability of equilibria analytically

Linear:  $\frac{dx}{dt} = ax$  → Solution:  $x(t) = Ce^{at}$   
 where  $a$  is a parameter.  $a \neq 0$

Equilibrium:  $x = 0$

Stability:  $a < 0 \Rightarrow$  exponential decay. Equilibrium is stable. ←

$a > 0 \Rightarrow$  exponential growth. Equilibrium is unstable



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