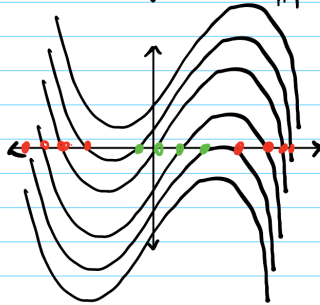
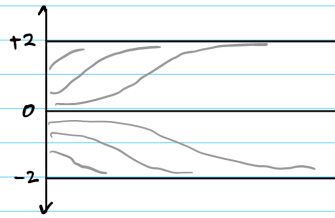
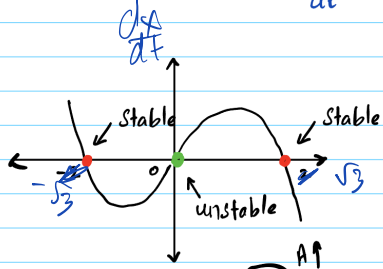


Bifurcations

Cubic kinetics

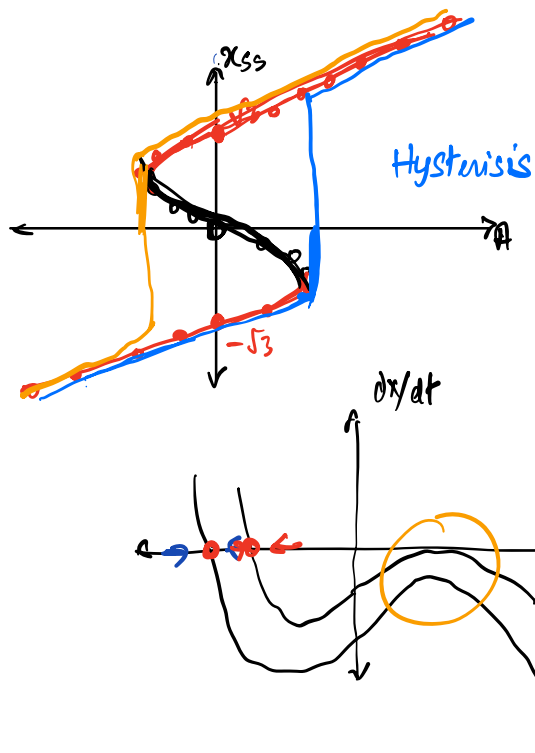
$$\frac{dx}{dt} = c \left(x - \frac{x^3}{3} \right) \equiv f(x) \quad c$$



$$\frac{dx}{dt} = c \left(x - \frac{x^3}{3} + A \right)$$

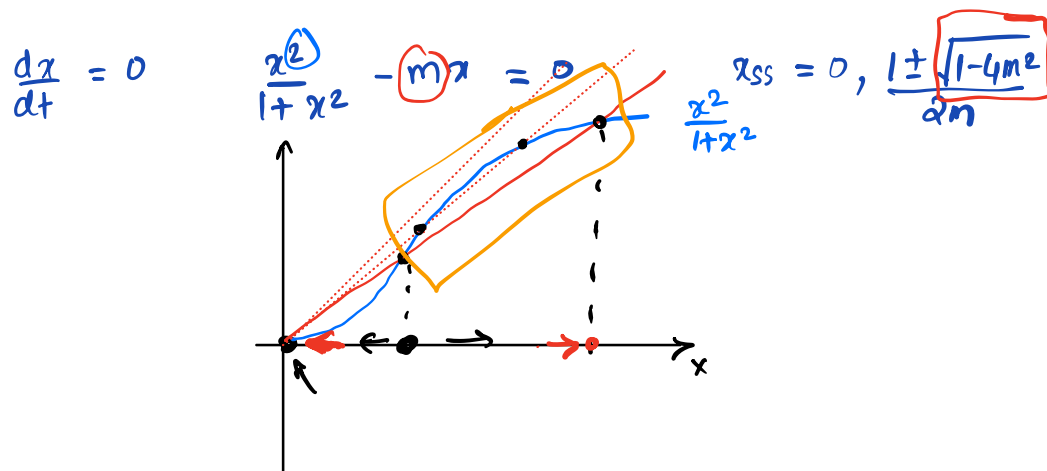
$$c \left(x - \frac{x^3}{3} + A \right) = 0$$

$$x_{ss}(A)$$



Biological Switch

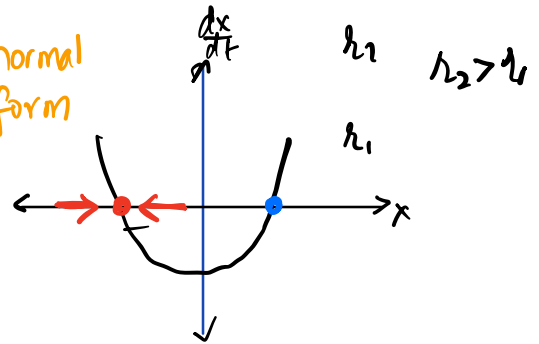
$$\frac{dx}{dt} = f(x) = \frac{\overbrace{x^2}^{\text{production}}}{\underbrace{1+x^2}_{\text{hills function}}} - \overbrace{mx}^{\text{degradation}}$$



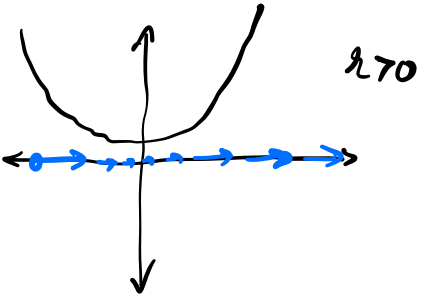
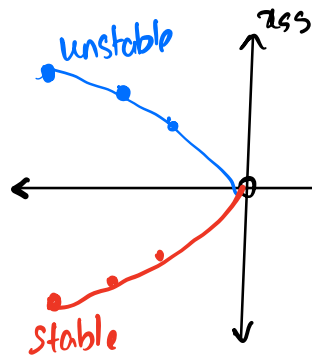
Types of bifurcations

$$\frac{dx}{dt} = f(x) = \mu + x^2$$

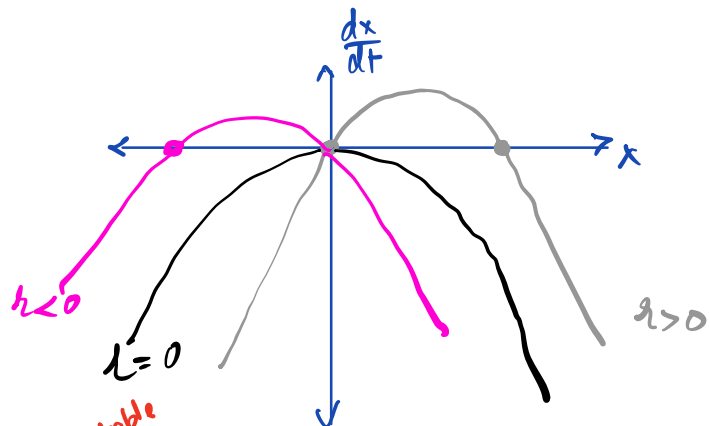
normal form



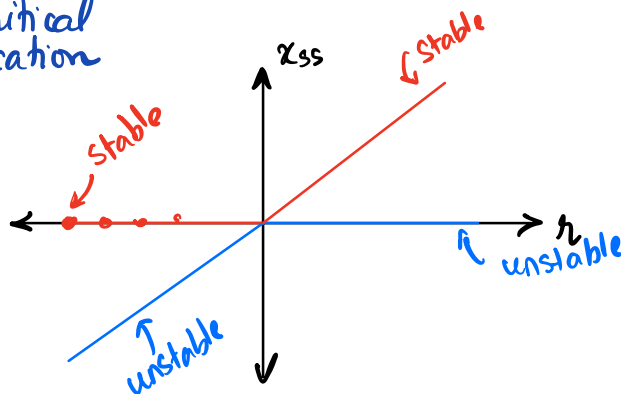
Saddle-node bifurcation.



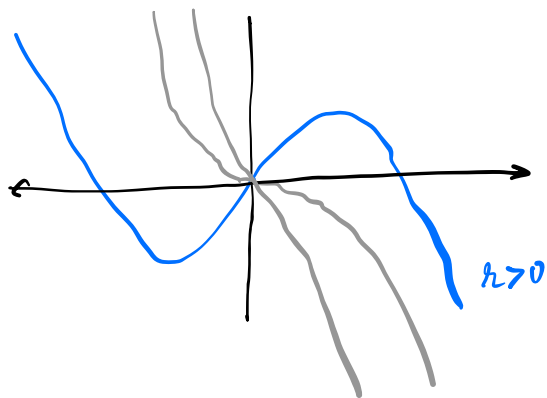
$$\frac{dx}{dt} = \mu x - x^2$$



Transcritical bifurcation



Pitchfork bifurcation



$$\frac{dx}{dt} = rx - x^3$$

