Intermed. DiffEQ, Nonlinear Dynamics

Physics 413, Math 404 at University of Michigan

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Dealing with differential equations of the form $\dot{x}(t) = f(x(t))$ Fixed points can change, called bifurcation. Normal form of "Saddle Node" bifurcations is

$$\dot{x} = r + x^2$$

r is parameter, fixed points depend on r.

Transcrititcal bifurcations are when there must be a critical point, but the stability of that point can change. Normal form of transcritical bifurcations is

$$\dot{x} = rx - x^2$$

Normal form of supercritical pitchfork bifurcation:

$$\dot{x} = rx - x^3$$

Normal form of subcritical pitchfork bifurcation:

$$\dot{x} = rx + x^3$$

1 Systems

Fixed points are location of fixed points. Eigenvalues are stability, and corresponding eigenvalues are directions of flow (direction that the inward/outward flow determined by the eigenvalues travels). Complex eigenvalues are rotations!