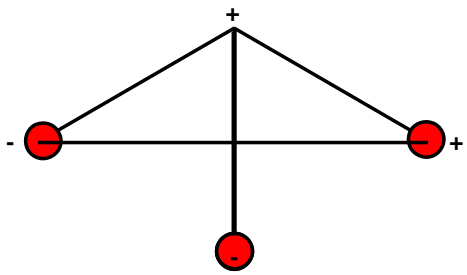
DYNAMICS & CHAOS



pendulum

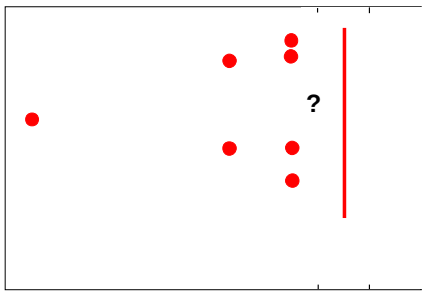
COMPLEX DYNAMICAL SYSTEM

complex

many parameters required to describe behaviour

dynamical

behaviour subject to lasting changes



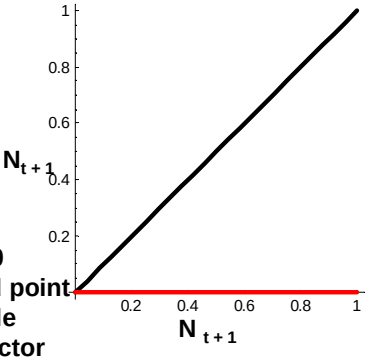
GRAPHICAL TECHNIQUE

$N_{t+1} = r_{\text{difference}} N_t (K - N_t)$

plot $\{N_t, N_{t+1}\}$ pairs

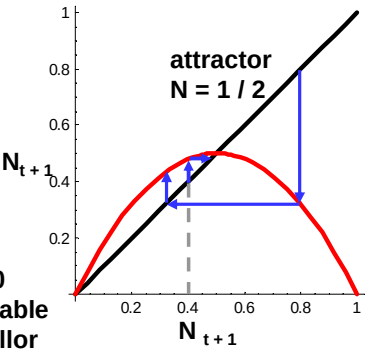
use line $N_{t+1} = N_t$ to link generations

$r_{\text{dfiference}} = 0.0$

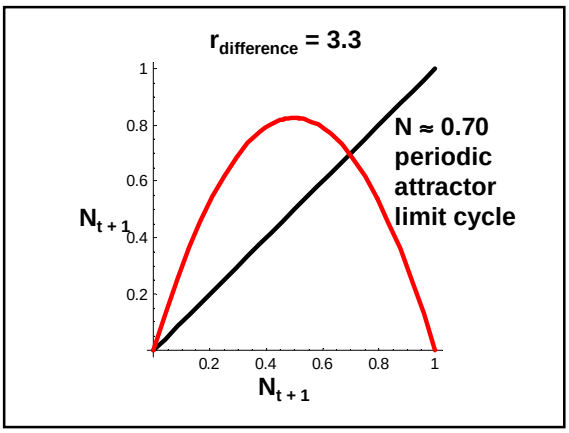


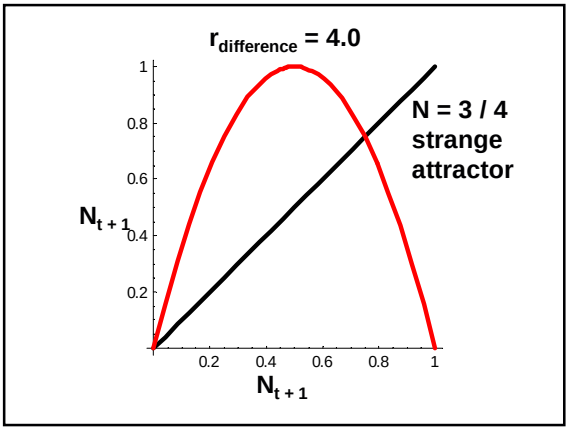
N = 0
fixed point
stable
attractor

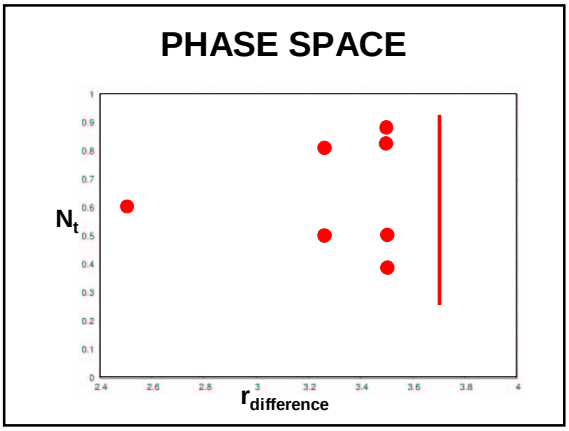
$r_{\text{difference}} = 2.0$



X = 0
unstable
repellor


$r_{difference}$ = 3.3
N ≈ 0.70
periodic
attractor
limit cycle
N_{t+1}
N_{t+1}
1
0.8
0.6
0.4
0.2
0.2
0.4
0.6
0.8
1


$r_{difference}$ = 4.0
N = 3 / 4
strange
attractor
N_{t+1}
N_{t+1}
1
0.8
0.6
0.4
0.2
0.2
0.4
0.6
0.8
1


PHASE SPACE
N_t
$r_{difference}$