

# LOGISTIC MAP

Differential equations:  $\frac{df}{dx} = r f(1-f)$   
 Model for population growth with carrying capacity

Discrete Model:  $x_n$  is relative population size at time  $n$   
 $r$  is some constant  $\rightarrow$  ratio  $\frac{\text{current size}}{\text{max size}}$

recurrence:  $x_{n+1} = r x_n (1-x_n)$

INVESTIGATE: Choose  $0 < x_n < 1$  and  $0 < r < 4$   
 Iterate, and see what happens.

## OBSERVATIONS:

$r = 3.9$  — no convergence?

$r = 3.2$  — alternating

$2 < r < 3$  convergence to a single value

$3 < r$  cycles or chaos

$3 < r < 3.5$  seem to get 2-cycles

near 3.5 4-cycles

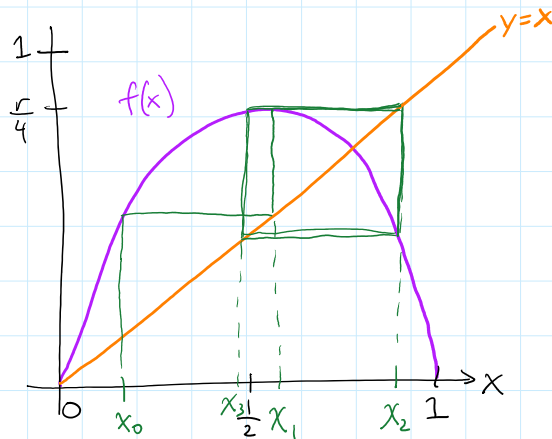
$r = 3.84$

3-cycle

$r = 3.9$  no pattern

## COBWEB PLOTS:

$$f(x) = r x (1-x)$$



# BIFURCATION DIAGRAM

