CS106S: Week 5

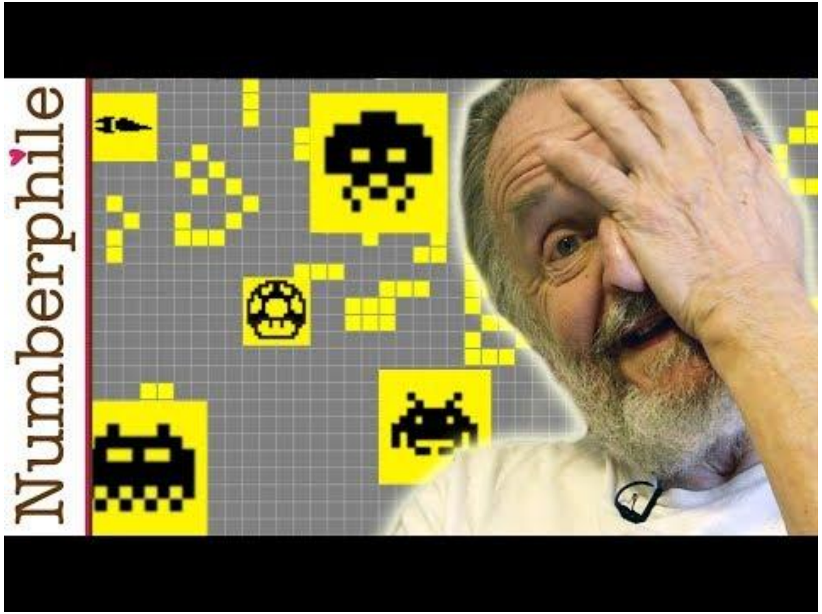
Automaton & Population Modeling

Download the starter code:
bit.ly/cs106sss

Plan For Today

1) Game of Life
2) What is Population Modeling?
3) Predator vs Prey Automaton

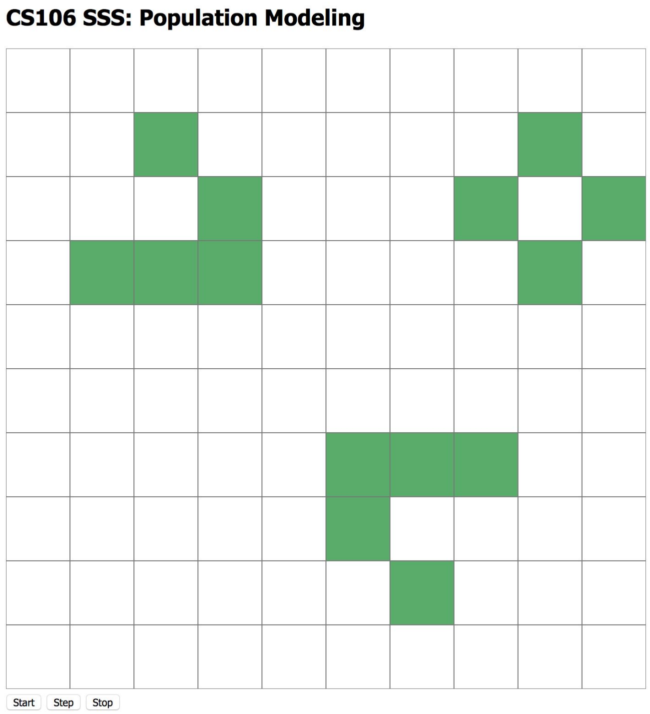
What is the Game of Life?



What are the rules?

1. If the cell is empty, and has 3 neighbors, it is born.
2. If it is alive, and has more than 3 neighbors, it dies from overpopulation.
3. If it is alive, and has less than 2 neighbors, it dies from isolation.
4. Otherwise, the cell remains the same.

How can we represent this on a computer?



Open the Starter Code, let's see it!

bit.ly/cs106sss

Subtle detail: why do we setNext, and then update?

Fill in the blanks, let's get it working!

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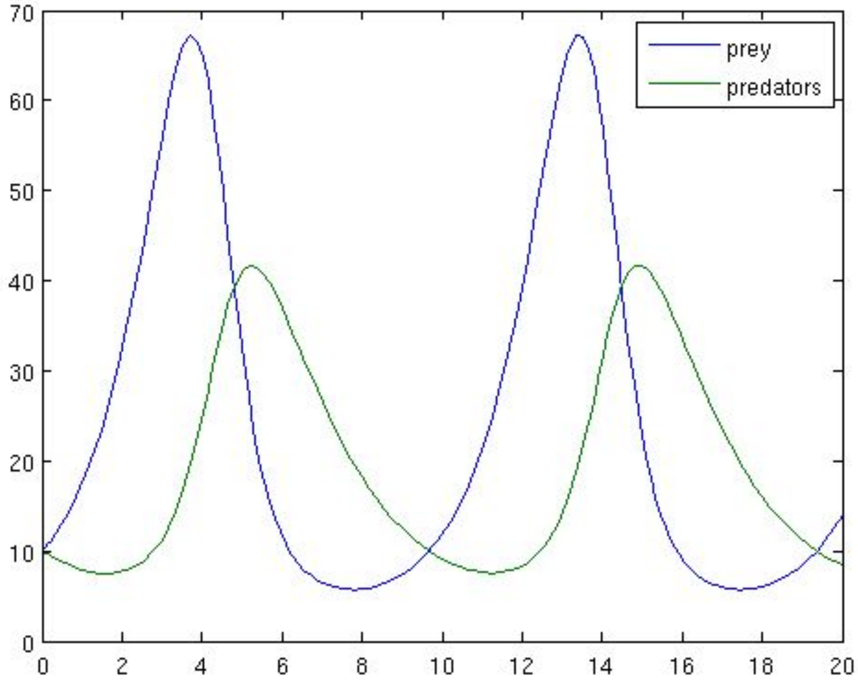
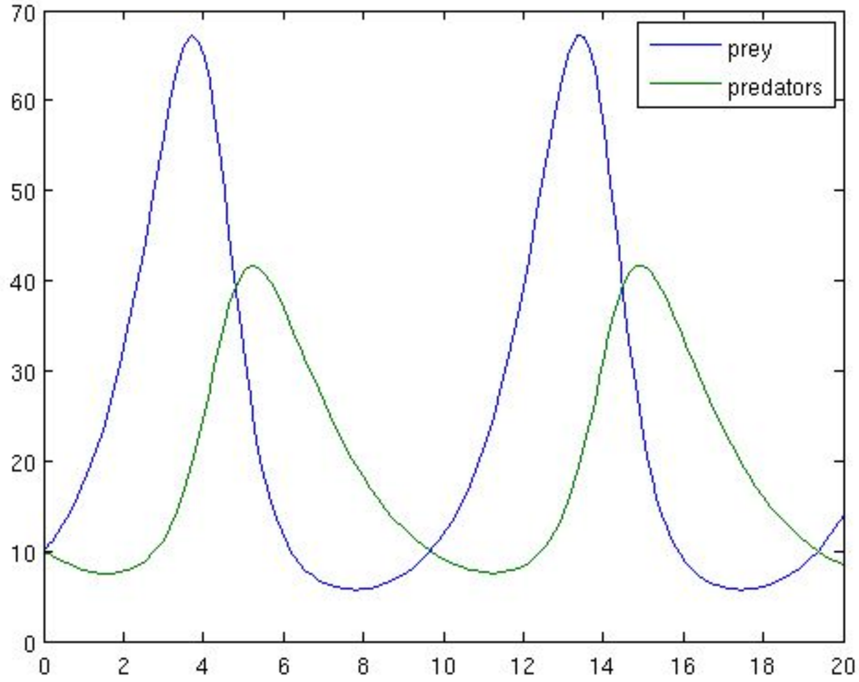
Predator v. Prey Modeling



1. The prey population finds ample food at all times.
2. The food supply of the predator population depends entirely on the size of the prey population.
3. The rate of change of population is proportional to its size.
4. During the process, the environment does not change in favour of one species, and genetic adaptation is inconsequential.
5. Predators have limitless appetite.

Lotka Volterra Equations



$$\frac{dx}{dt} = \alpha x - \beta xy,$$
$$\frac{dy}{dt} = \delta xy - \gamma y,$$

What do they mean?

reproduction

predation

Prey:

$$\frac{dx}{dt} = \alpha x - \beta xy,$$

Pred:

$$\frac{dy}{dt} = \delta xy - \gamma y,$$

competition

hunting

Can we adapt the Game of Life to model this, and take into consideration space, with roughly the same results?

http://www.vuuren.co.za/Theses/Project2.pdf

Algorithm 3.1 Simple predator-prey rules

```
procedure ApplyRules
    d_p is prey death rate
    b_p is prey birth rate
    d_h is predator death rate
    b_h is predator birth rate
    for all cells do
        x ← next cell
        Evaluate state of x
        if x is prey then
            r ~ U(0,1)
            Evaluate Moore neighbourhood M of x
            nPred = number of predators in M
(1)         if r < (1 − d_p)^{nPred} then
                Hunt failed/no predators, cell stays prey
            else
                r_h ~ U(0,1)
(2)             if r_h < b_h then
                    Cell becomes predator by breeding
        else if x is predator then
            r ~ U(0,1)
(3)         if r < d_h then
                Cell becomes empty due to predator death
            else
                Cell stays predator
        else if x is empty then
            Evaluate Moore neighbourhood M of x
(4)         nPred = number of predators in M
            nPrey = number of prey in M
            if nPrey = 0 or nPred > 0 then
                Cell remains empty
            else
(5)             r ~ U(0,1)
                if r < (1 − b_p)^{nPrey} then
                    Cell becomes prey by breeding
```

(1) prob. prey survives *nPred* attacks

(2) prob. predator reproduces

(3) prob. predator dies

(4) no reproduction if predators around

(5) prob. *nPrey* reproduces if no predators around

First, switch the logic files!

```
<!-- Logic for Game: choose one of the below -->
<!-- <script type="text/javascript" src="life.js"></script> -->
<script type="text/javascript" src="prey.js"></script>
```

Remainder of Class: Prey v. Pred

Your Final Goal: Look into possible extensions and implement/try to implement a feature that would augment our current app.

Check-Off

Announced in Class