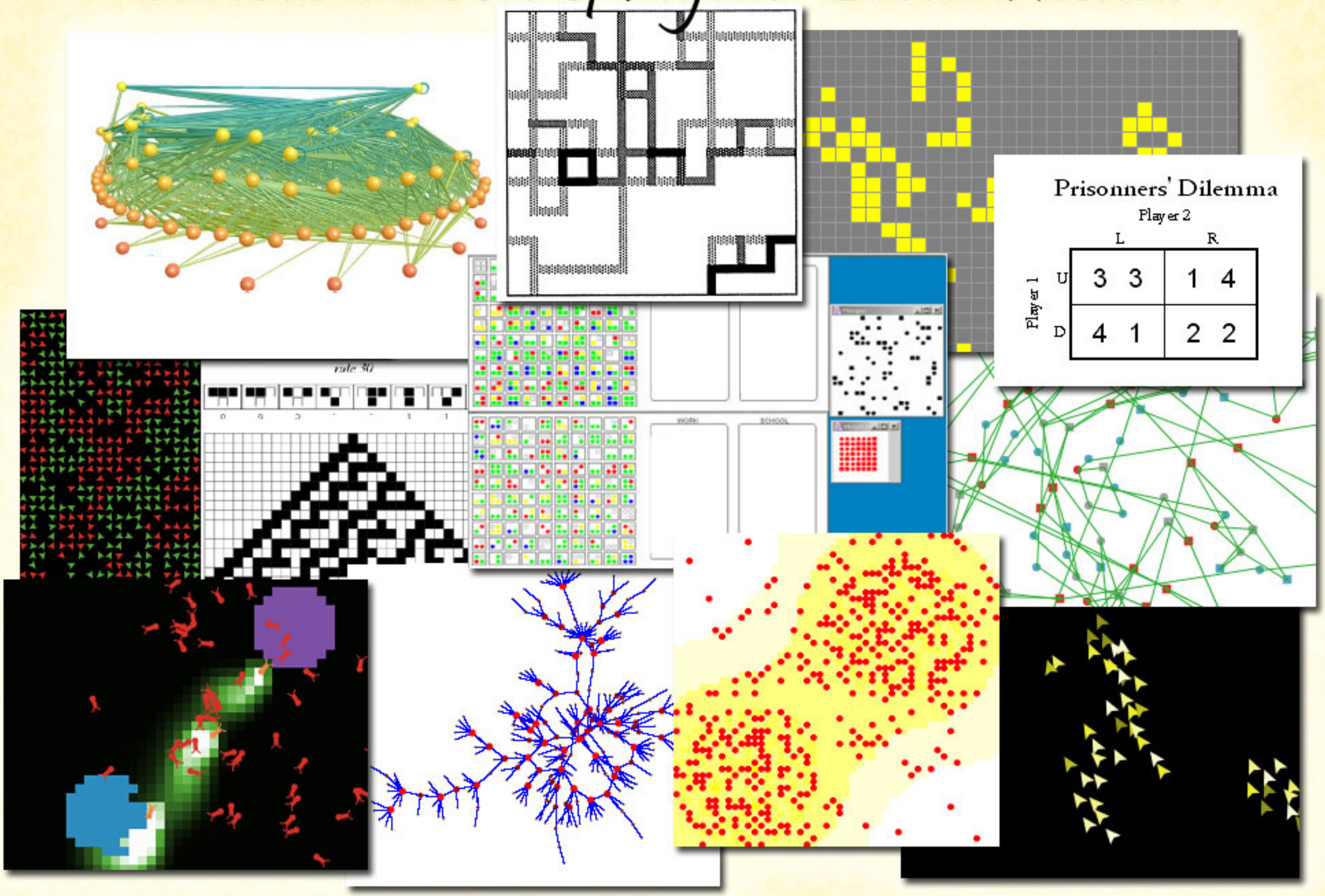
Aaron Bramson's

Introduction to Agent-Based Modeling

DAY 3

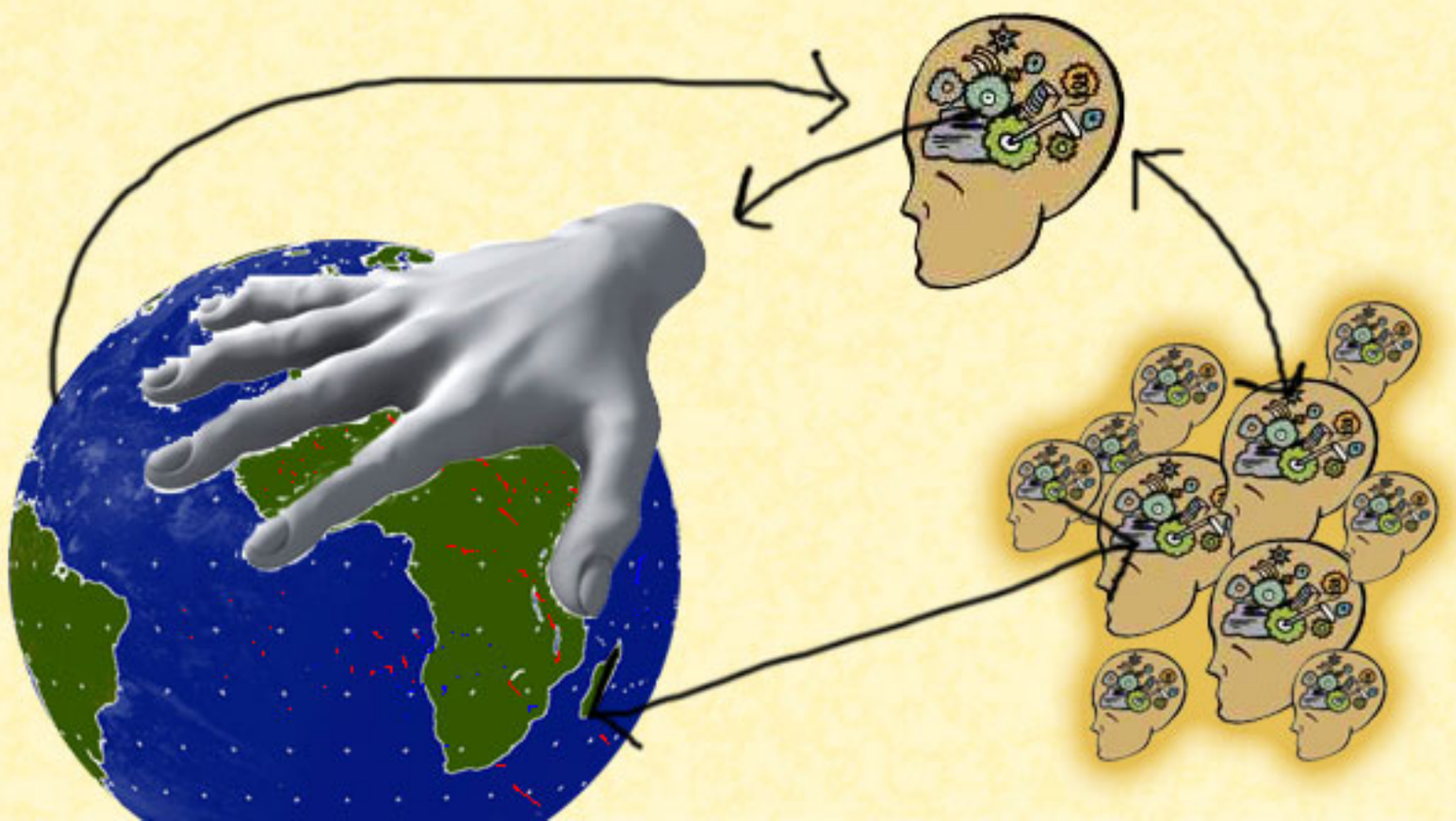
Various Flavors of Agent-Based Models



Components of Agent-Based Models

Agents

- Rule-Based Behavior (Possibly Learning & Adapting)
- Interact with the World and Each Other
- Between Two and One Duotrigintillion Agents

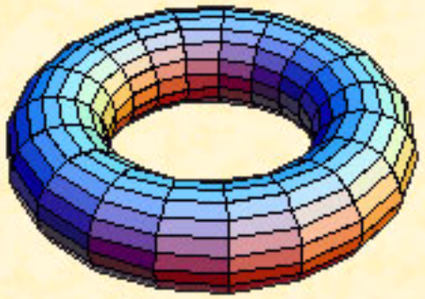


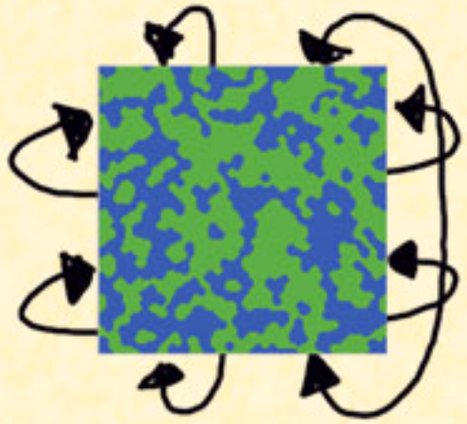
Components of Agent-Based Models

World

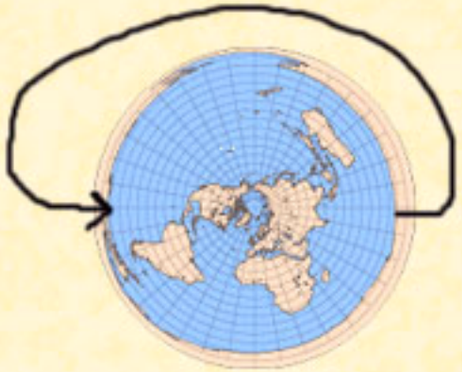
- Pick Your Dimensions: zero through infinity
- Bounded vs Wrapped (Rings and Toroids)
- Holds Values (Environment) which May Be Dynamic
- Divided into Discrete Space or Not

Torus

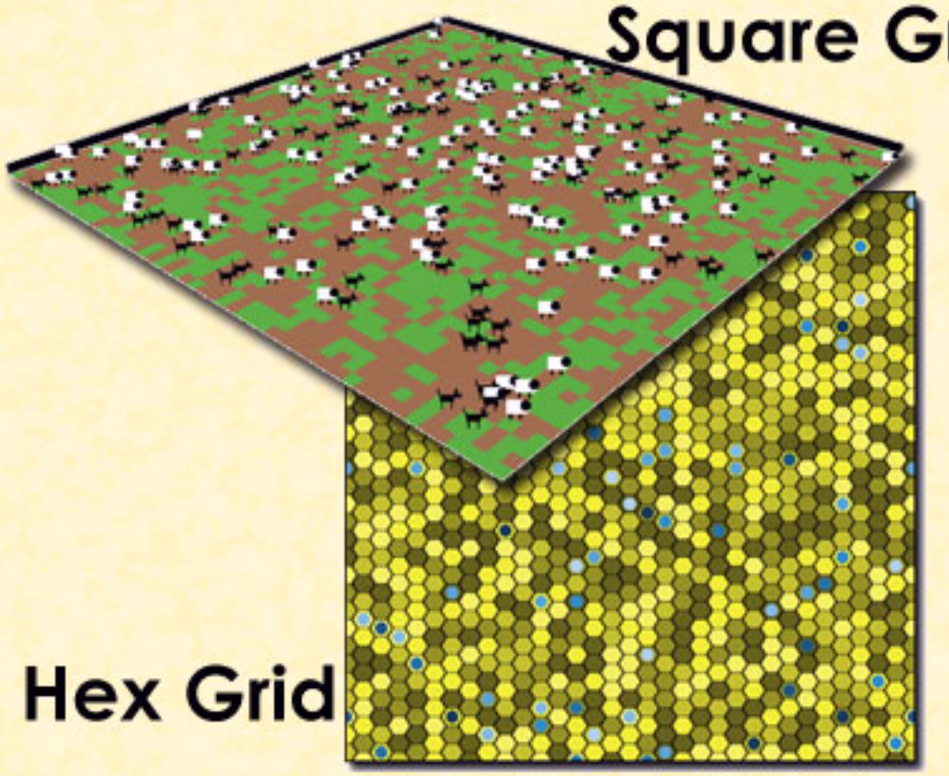




Sphere



Square Grid

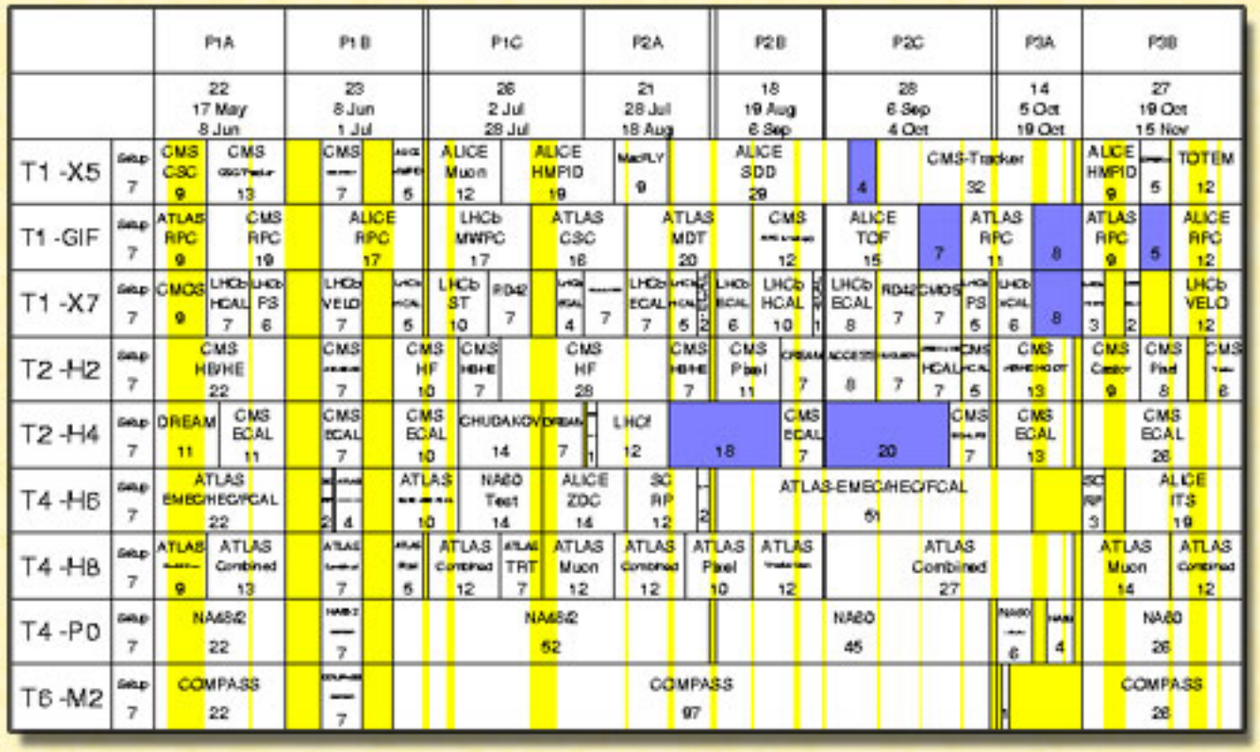


Hex Grid

Components of Agent-Based Models

Scheduler

- Determines Order of Execution of Events
- Discrete Time Steps vs Event-Driven Updates
- Synchronous vs Sequential AKA Parallel vs Serial
- How Does the Model Know When It's Done



Components of Agent-Based Models

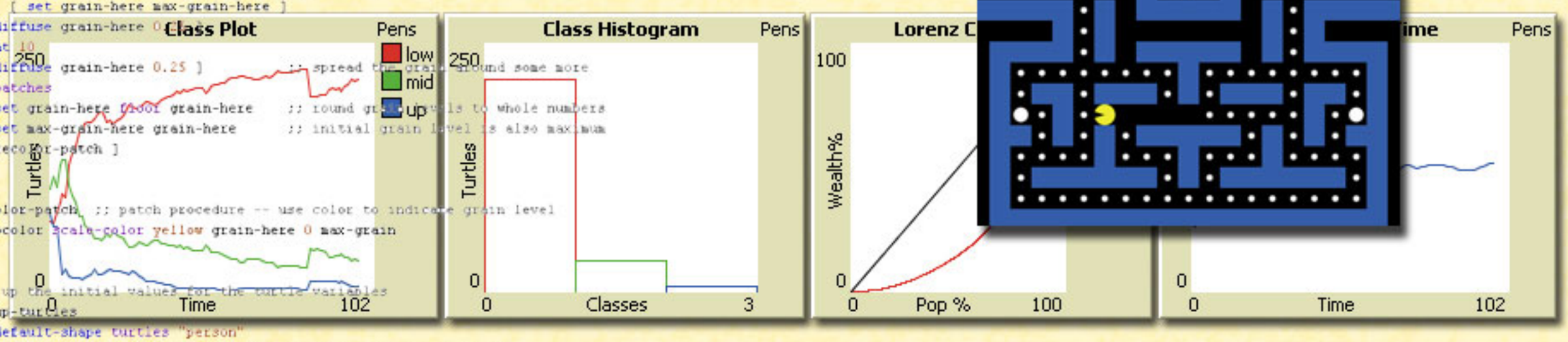
Other Common Elements

- Resources, Obstacles, Landmarks as "Agents"
- GUI, Graphs, Reports, Documentation, ...

```
;; these patches are the "best land"
ask patches
  [ set max-grain-here 0
    if (random-float 100.0) <= percent-best-land
      [ set max-grain-here max-grain
        set grain-here max-grain-here ] ]
  ;; spread that grain around the window a little and put a little back
  ;; into the patches that are the "best land" found above
  repeat 5
    [ ask patches with [max-grain-here '= 0]
        [ set grain-here max-grain-here ]
      diffuse grain-here 0.25 ]
  repeat 10
    [ diffuse grain-here 0.25 ]          ;; spread the grain around some more
  ask patches
    [ set grain-here floor grain-here    ;; round grain levels to whole numbers
      set max-grain-here grain-here      ;; initial grain level is also maximum
      recolor-patch ]
end

to recolor-patch  ;; patch procedure -- use color to indicate grain level
  set pcolor scale-color yellow grain-here 0 max-grain
end

;; set up the initial values for the turtle variables
to setup-turtles
  set-default-shape turtles "person"
  no-display  ;; so we don't see the turtles until they're recolored
  cct num-people
    [ setxy (random screen-size-x)
            (random screen-size-y)
      set size 1.5  ;; easier to see
      set-initial-turtle-vars
      set age random life-expectancy ]
  recolor-turtles
  display
```



What are Agents Based Models Made of?

Space and Movement

- Space Measure (e.g. Distance) in 1D, 2D, or absent?
- Exogenous vs Endogenous Movers (Preferences vs Wind)

Complicated Agents

- CAs and Pure Networks Limit Agent Abilities
- Learning vs Adapting vs Evolving
- Agents using AI and internal models

Model Dynamics

- Agent Birth and Death
- Agents Exchanging Resourses and Information
- Agent-Environment Feedback

What are Agents Based Models Made of?

User-Defined

- Set by users during setup or dynamically
- Initial Conditions or Boundaries
- Takes a Range of Values (Sweepable)
- Define Range and Granularity

"Tweaked"

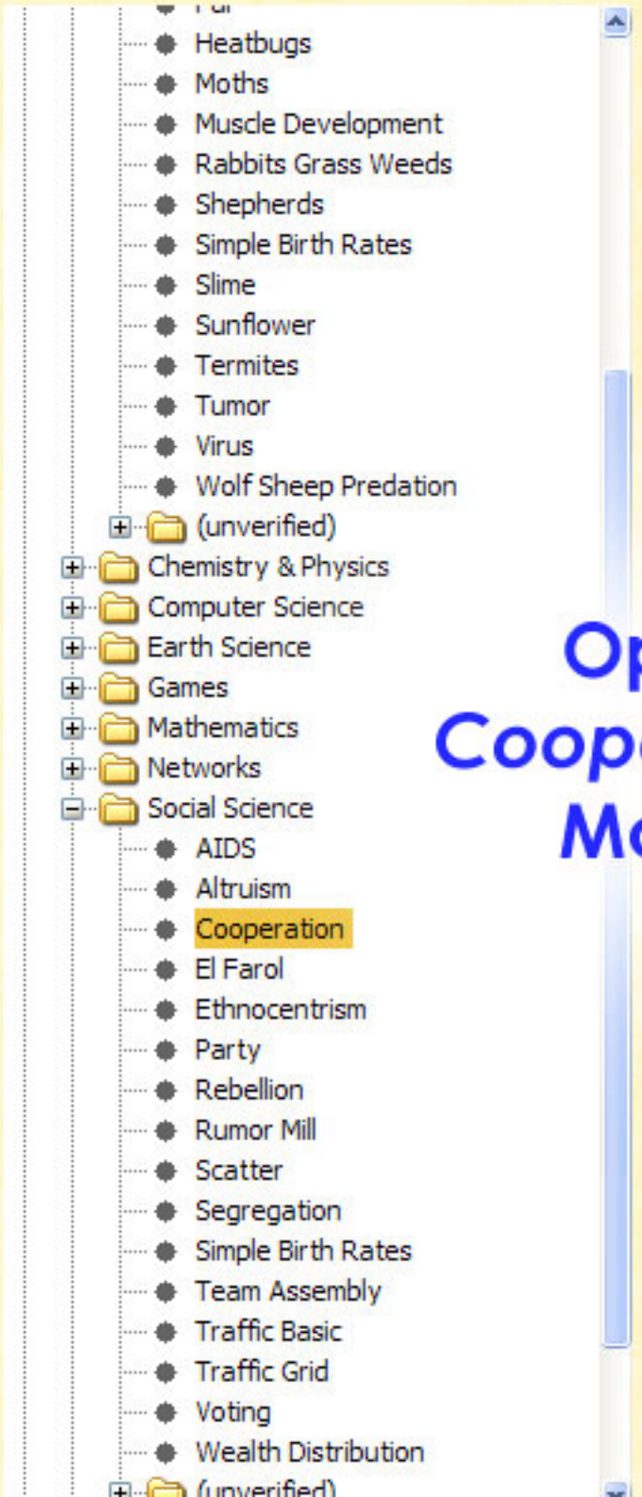
- Hidden Parameters (Hard-Coded)
- Set at Values that are Known to "Work"

Distribustions

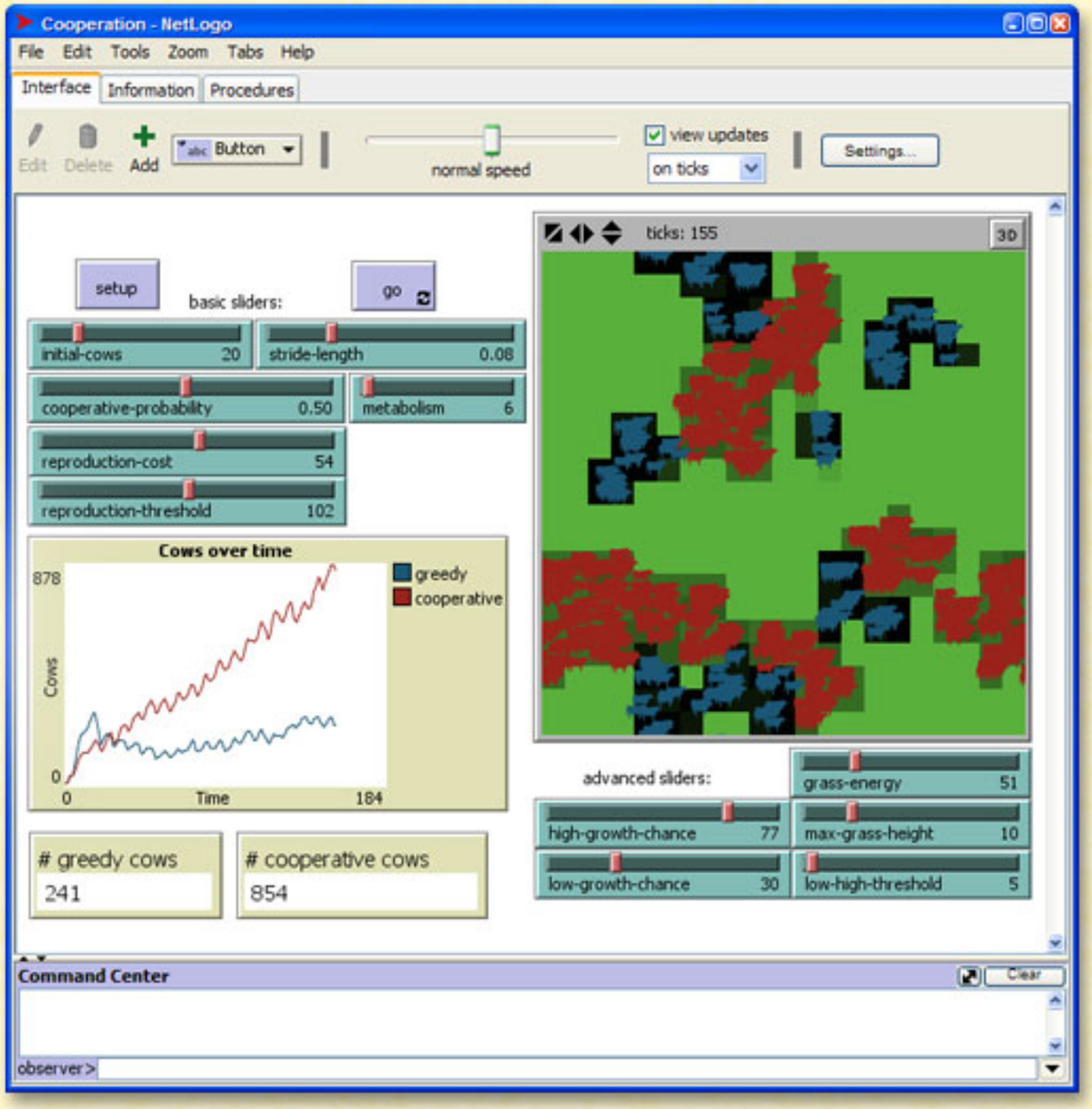
- Select Type of Distribution (Normal, Exp,...)
- Select Distribution Parameters

Everything Must Be Decided BY YOU!

Hands-On Modeling Examples



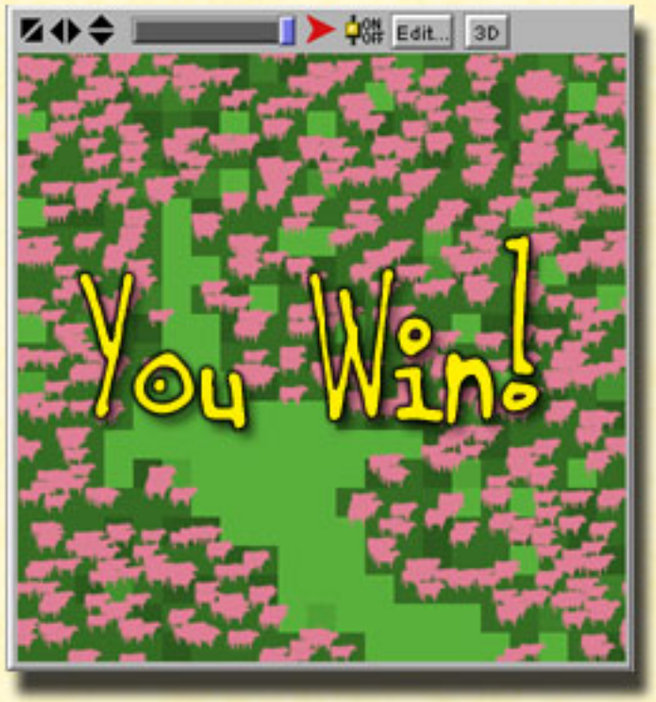
Open Cooperation Model

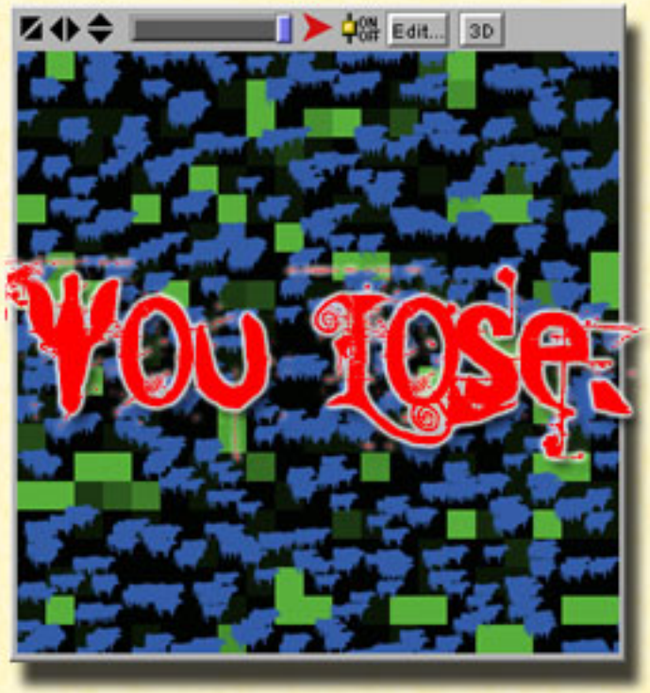


Hands-On Modeling Examples

Adjust Parameters to Achieve Cooperative Outcome

- How do the Parameters Effect Agent Behavior?
- How do the Parameters Effect World Behavior?
- Are there Long Term/Short-Term Trade Offs?
- What Set(s) of Parameters Yield the Cooperative Outcome?
- Would Looking at the Code Make this Easier?



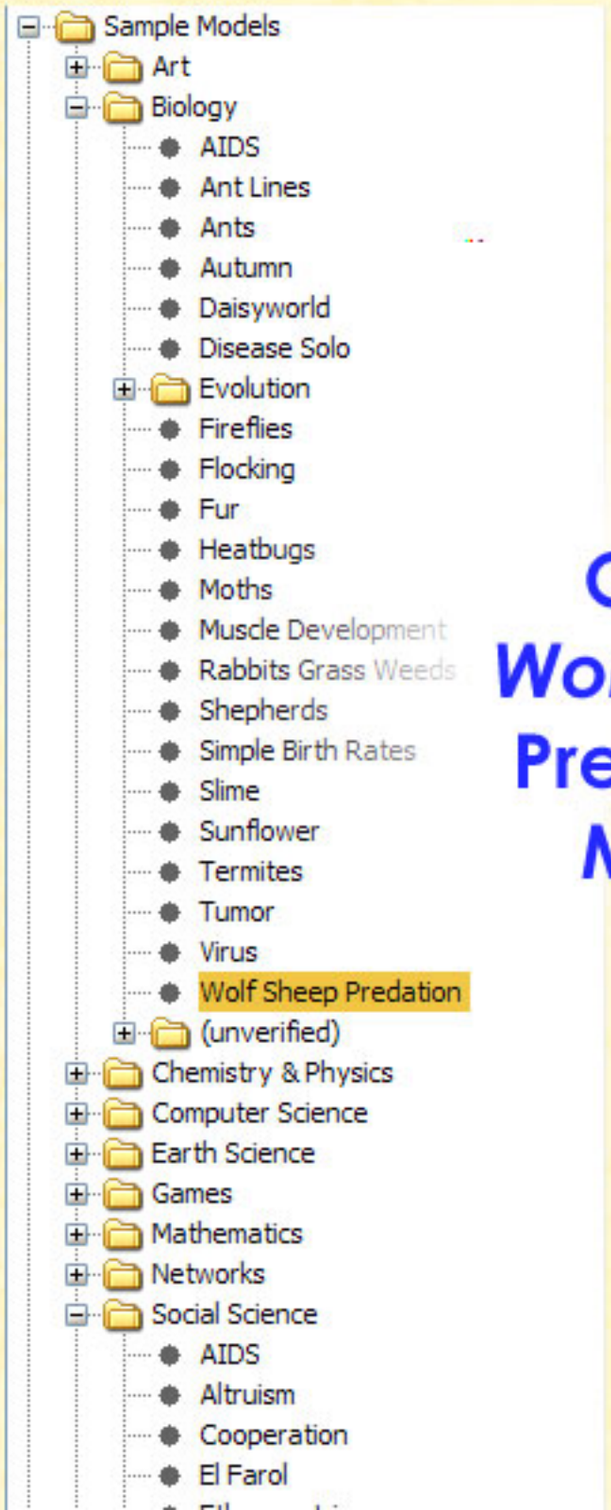


Hands-On Modeling Examples

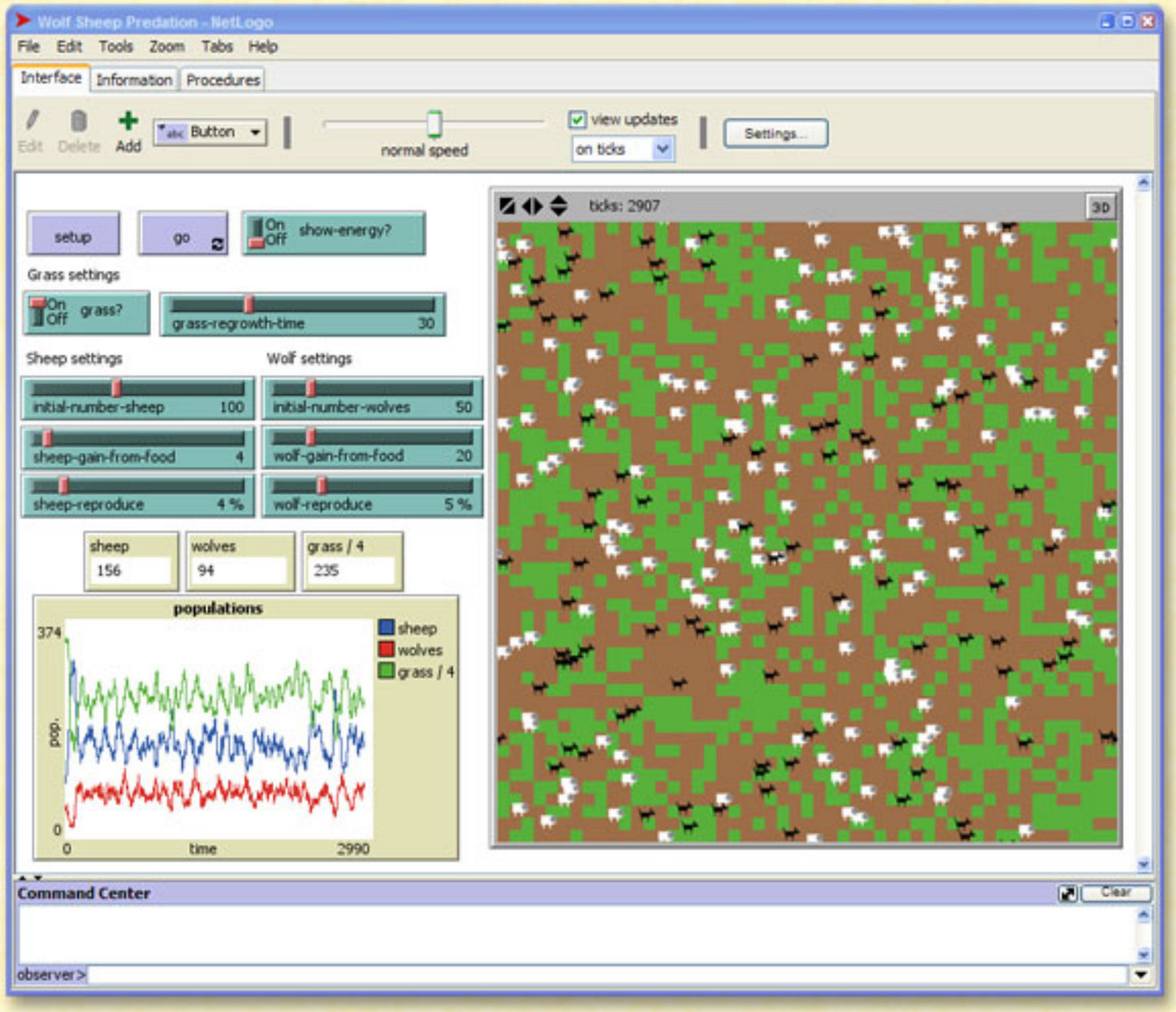
Optional Homework: Identify Characteristics of *Cooperation*

- What Type(s) of Models? CA, Free Agents, Network, Hybrid
- What Kinds of Agents Are there?
- Any Agent-Agent Interaction? Describe.
- Any Agent-World Interaction? Describe.
- Bounded or Toroidal World? Does the World Hold Values?
- What Are the Parameters? Any Hidden Parameters?
- What Does the Model Report?
- How Does Changing the Parameters Affect Model Behavior?
- How Does It Affect Model Performance?
- What Else Could You Use this Model for (in Whole or Part)?

Homework Assignment #1



Open *Wolf Sheep* Predation Model



Homework Assignment #1

Go to

tinyurl.com/mscz9w

and download

ICPSR09_HW1_YourLastName.doc

just follow the instructions