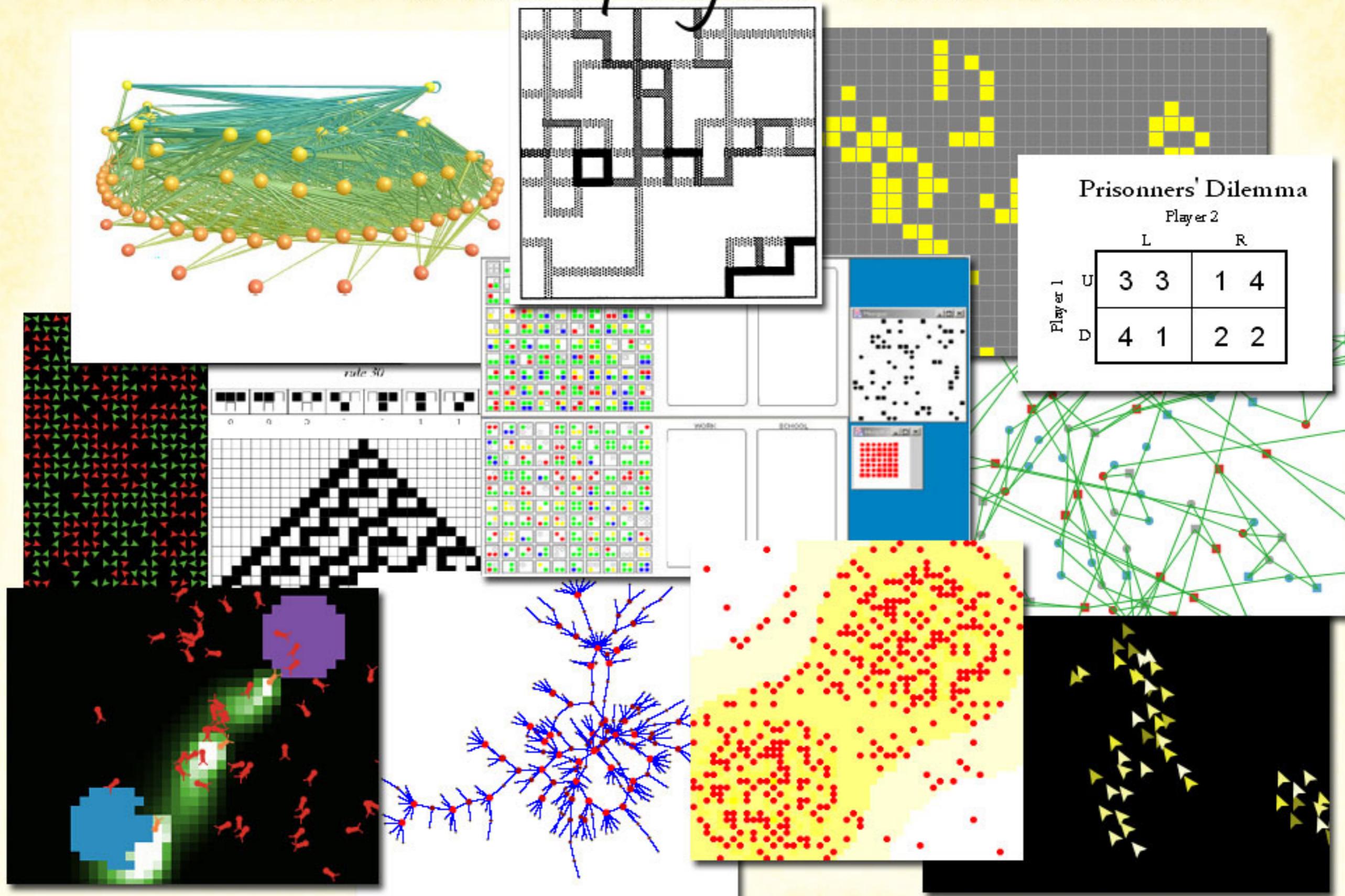


Aaron Bramson's Introduction to Agent-Based Modelling

DAY 3

INTRODUCTION TO AGENT-BASED MODELING

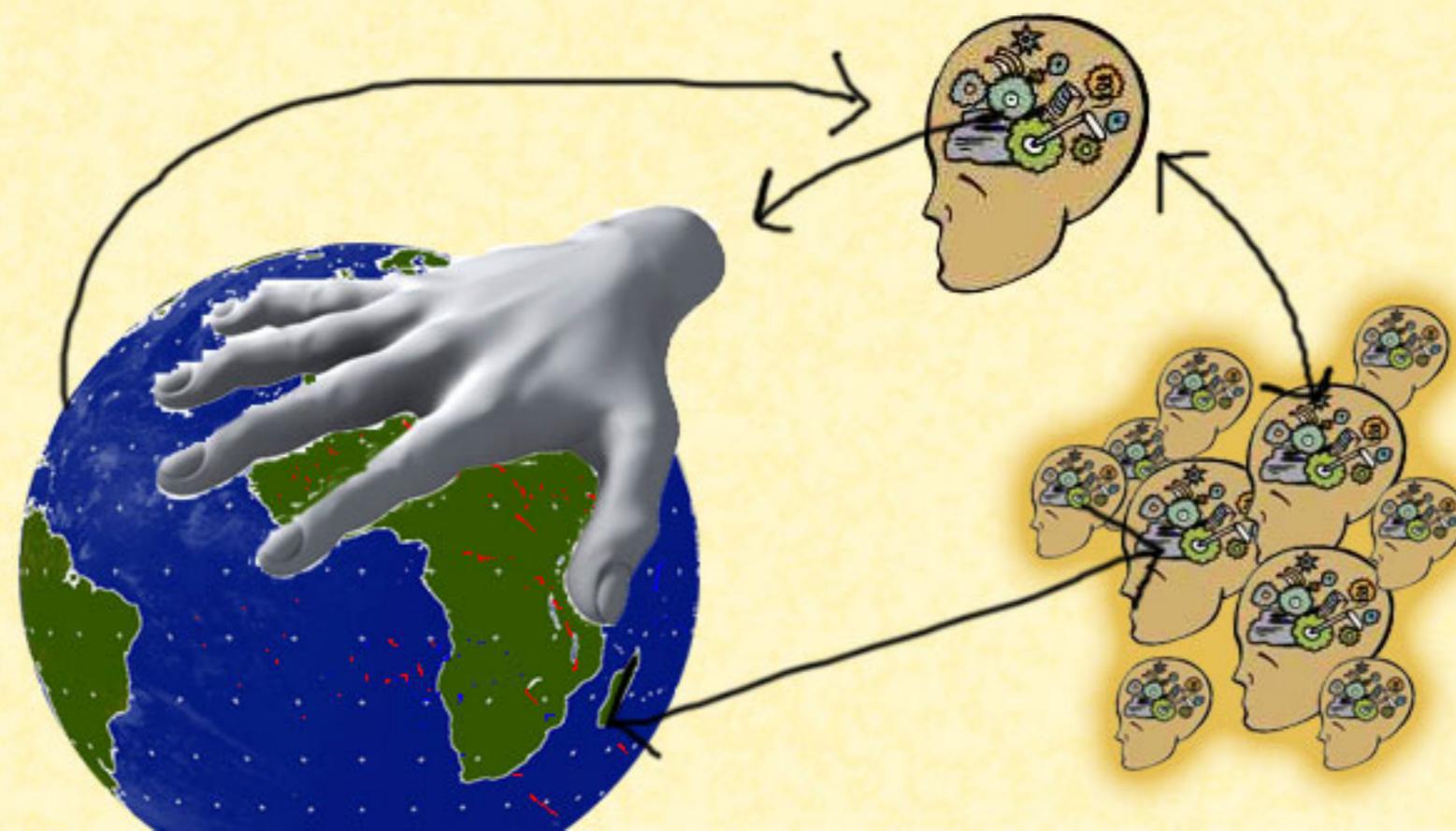
Various Flavors of Agent-Based Models



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



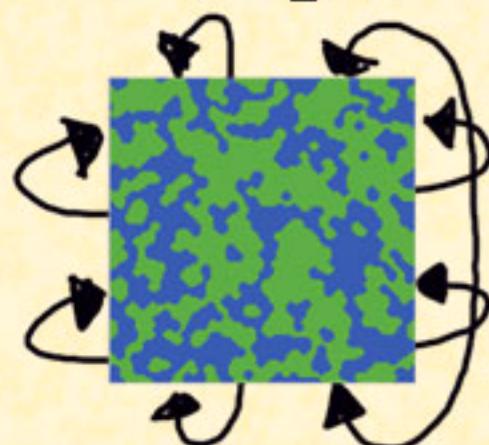
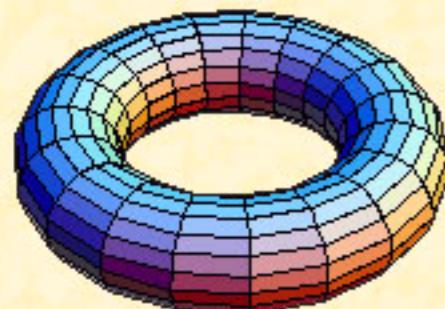
INTRODUCTION TO AGENT-BASED MODELING

Components of Agent-Based Models

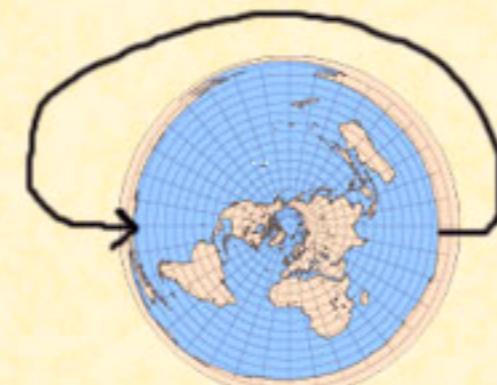
World

- 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

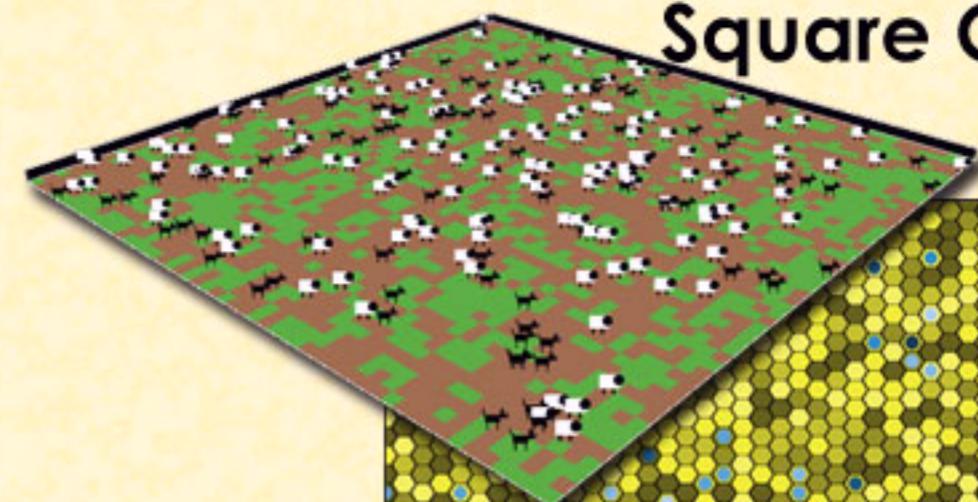
Torus



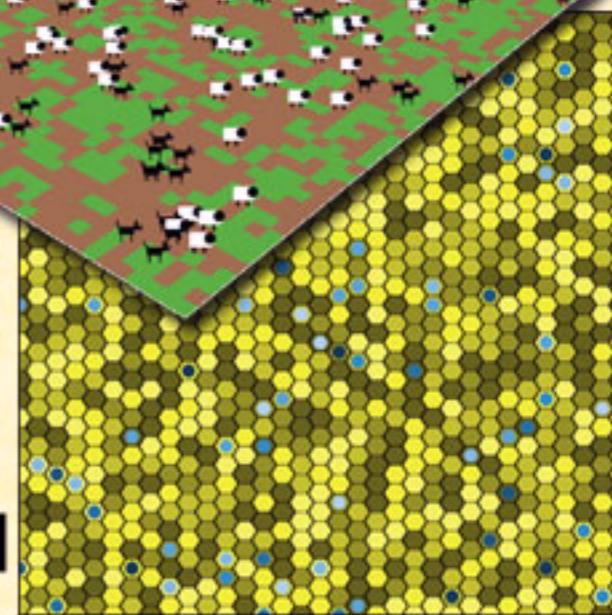
Sphere



Square Grid



Hex Grid



INTRODUCTION TO AGENT-BASED MODELING

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

		P1A		P1B		P1C		P2A		P2B		P2C		P3A		P3B	
		22 17 May 8 Jun		23 8 Jun 1 Jul		26 2 Jul 28 Jul		21 28 Jul 18 Aug		18 19 Aug 8 Sep		28 6 Sep 4 Oct		14 5 Oct 19 Oct		27 19 Oct 15 Nov	
T1-X5	Step 7	CMS CSC 9	CMS octoYear 13	CMS 7	Alice 5	ALICE Muon 12	ALICE HMPID 19	ALICE MDT 9	ALICE SDD 29	ALICE 4	CMS-Tracker 32		ALICE HMPID 9	TOTEM 5	TOTEM 12		
T1-GIF	Step 7	ATLAS RPC 9	CMS RPC 19	ALICE RPC 17	LHCb MWPC 17	ATLAS CSC 18	ATLAS MDT 20	CMS 12	ALICE TOF 15	ATLAS RPC 11	ATLAS RPC 8	ATLAS RPC 5	ALICE RPC 12				
T1-X7	Step 7	CMS 9	LHCb LHCb 7	LHCb VELO 6	LHCb VELO 5	LHCb ST 10	RD42 7	LHCb HMPID 4	LHCb ECAL 7	LHCb ECAL 6	LHCb ECAL 10	LHCb ECAL 8	RD42 CMS 7	LHCb ECAL 5	LHCb ECAL 6	LHCb ECAL 8	LHCb VELO 12
T2-H2	Step 7	CMS HBHE 22		CMS 7	CMS HF 10	CMS HBHE 7	CMS HF 28	CMS HBHE 7	CMS Presh 11	CMS 7	CMS 8	CMS 7	CMS 7	HEC 5	HEC 13	CMS Castor 9	CMS Castor 8
T2-H4	Step 7	DREAM 11	CMS ECAL 11	CMS ECAL 7	CMS ECAL 10	GRUBAN DREAM 14	LHCf 7	DREAM 12	ATLAS 18	CMS ECAL 7	CMS ECAL 20	CMS ECAL 7	CMS ECAL 13			CMS ECAL 26	
T4-H5	Step 7	ATLAS EMEG/HEC/FCAL 22		ATLAS 24	ATLAS 10	NABO Test 14	ALICE ZDC 14	SC 12	ATLAS RP 2	ATLAS-EMEG/HEC/FCAL 51		SC 51	ATLAS RP 51	ALICE ITS 3	ALICE ITS 19		
T4-H8	Step 7	ATLAS 9	ATLAS Combined 13	ATLAS 7	ATLAS Combined 5	ATLAS TRT 12	ATLAS Muon 7	ATLAS Combined 12	ATLAS Pixel 10	ATLAS 12	ATLAS Combined 27		ATLAS Combined 27	ATLAS Muon 14	ATLAS Combined 12		
T4-P0	Step 7	NA680 22		NA680 7	NA682 52		NA682 52		NABO 45		NABO 45	NABO 6	NABO 4	NA680 26			
T6-M2	Step 7	COMPASS 22		COMPASS 7	COMPASS 97		COMPASS 97		COMPASS 97		COMPASS 97		COMPASS 26		COMPASS 26		

Components of Agent-Based Models

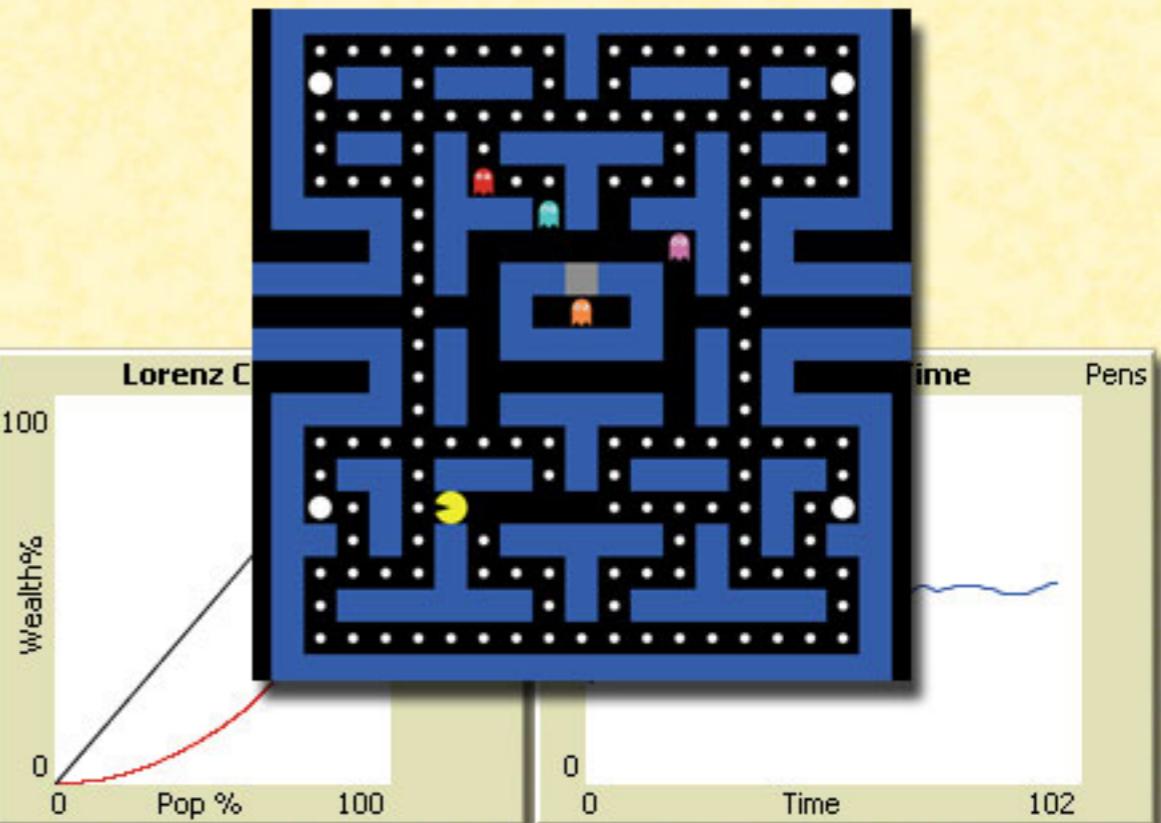
Other Common Elements

- 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
    ; Class Plot
    repeat 10
      [ diffuse grain-here 0.25 ]
    end
    ask patches
      [ set grain-here floor grain-here
        set max-grain-here grain-here
        round-grain-up ]
      ; Class Histogram
      ; spread the grain around some more
      ; round grain levels to whole numbers
      ; 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
    end
  ]

```



INTRODUCTION TO AGENT-BASED MODELING

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 Resources 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"

Distributions

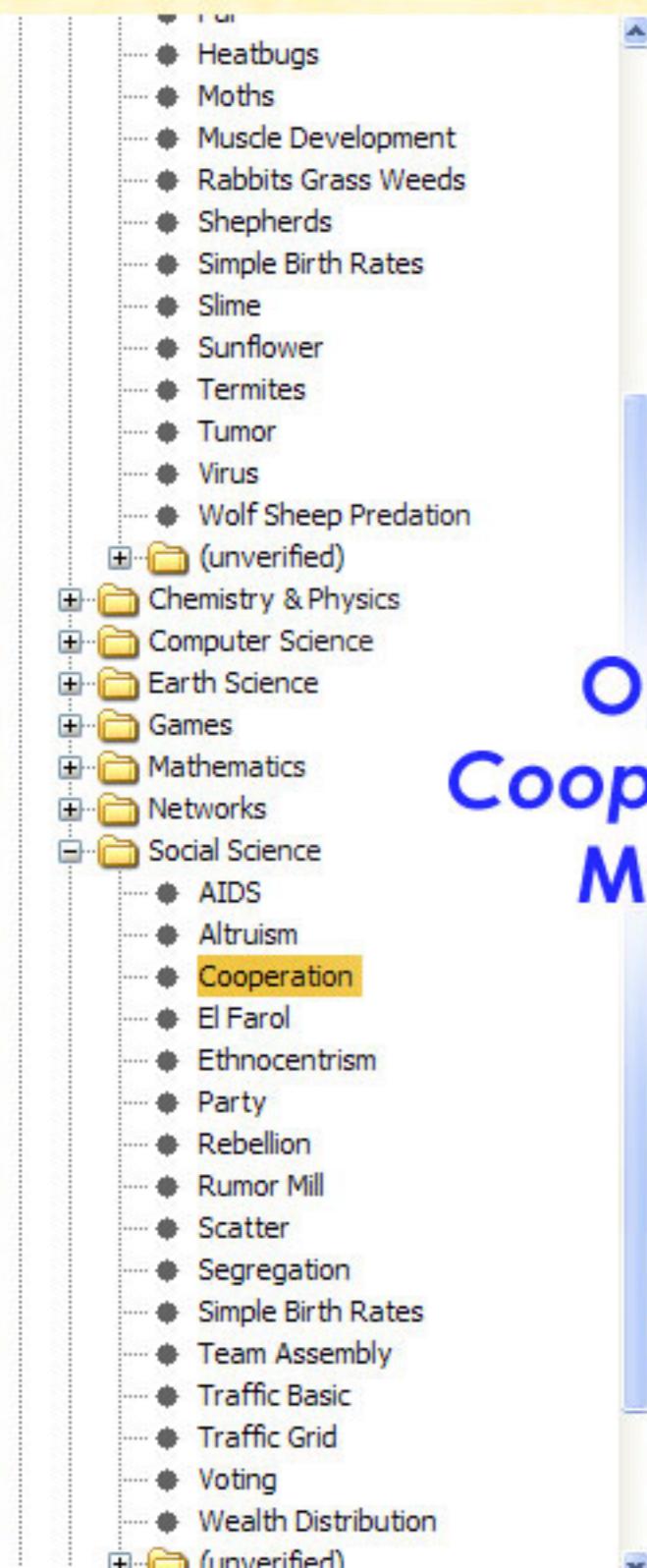
- Select Type of Distribution (Normal, Exp,...)
- Select Distribution Parameters



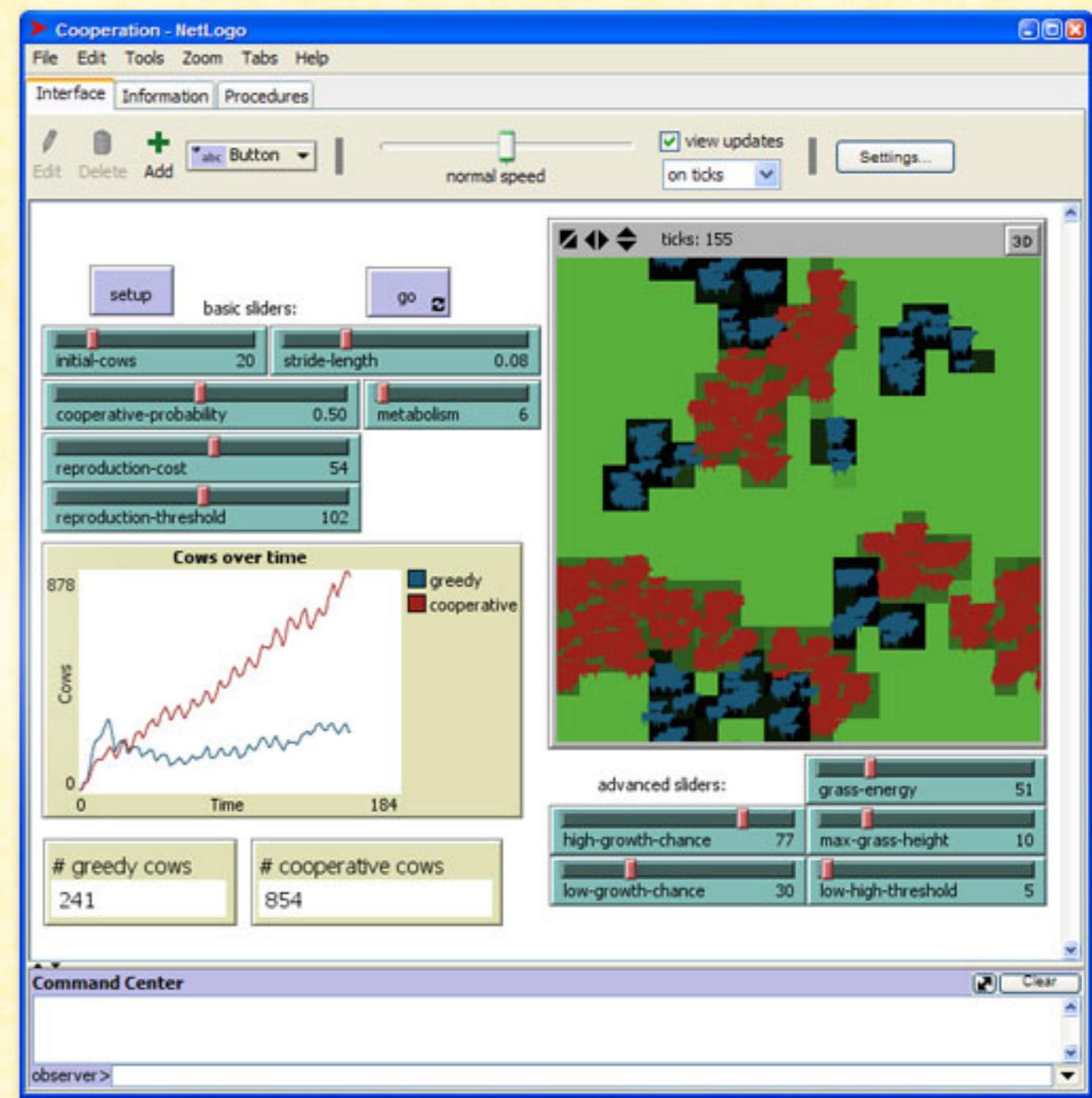
Everything Must Be Decided **BY YOU!**

INTRODUCTION TO AGENT-BASED MODELING

Hands-On Modeling Examples



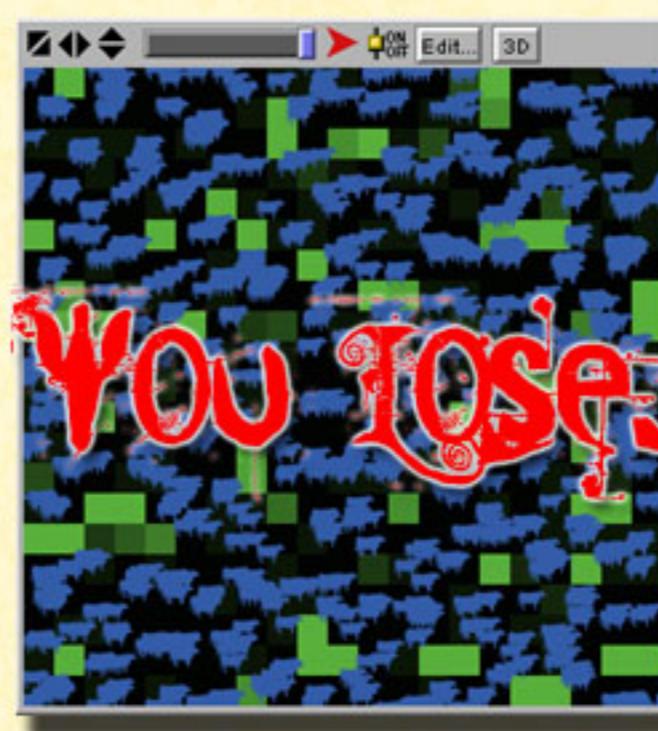
Open Cooperation Model



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?



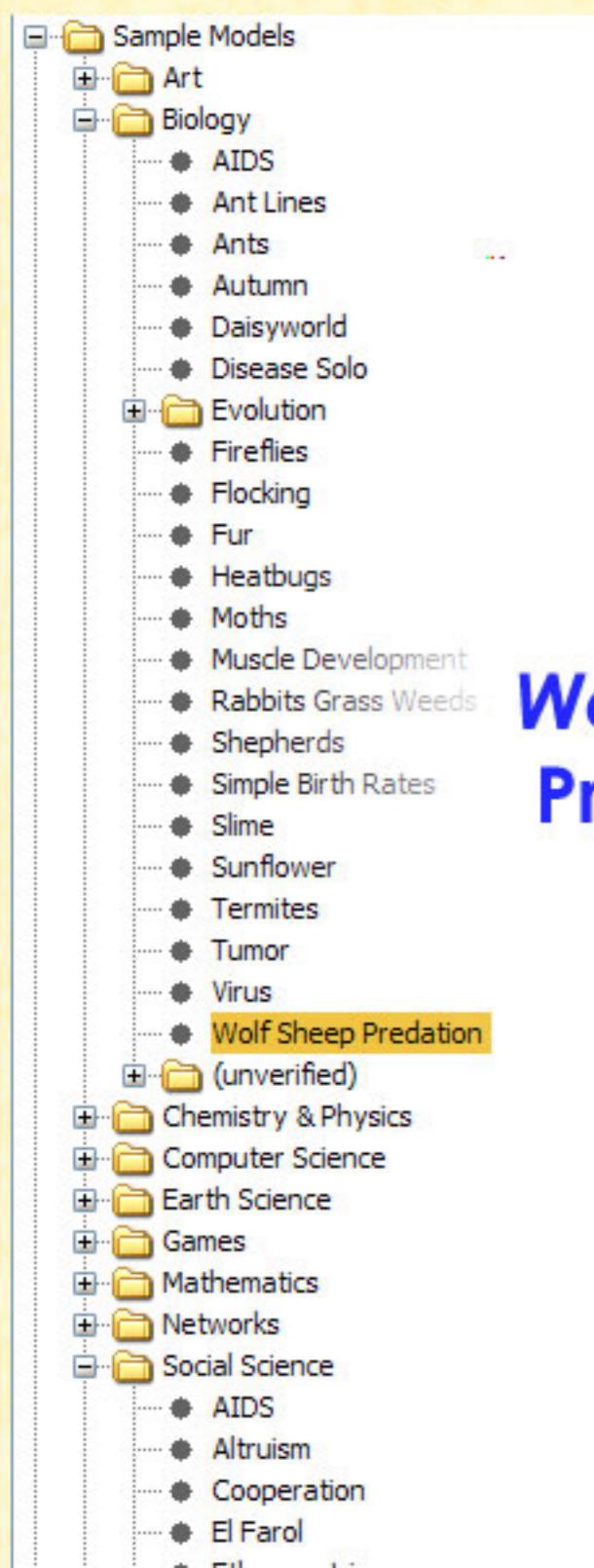
Hands-On Modeling Examples

Optional Homework: Identify Characteristics of Cooperation

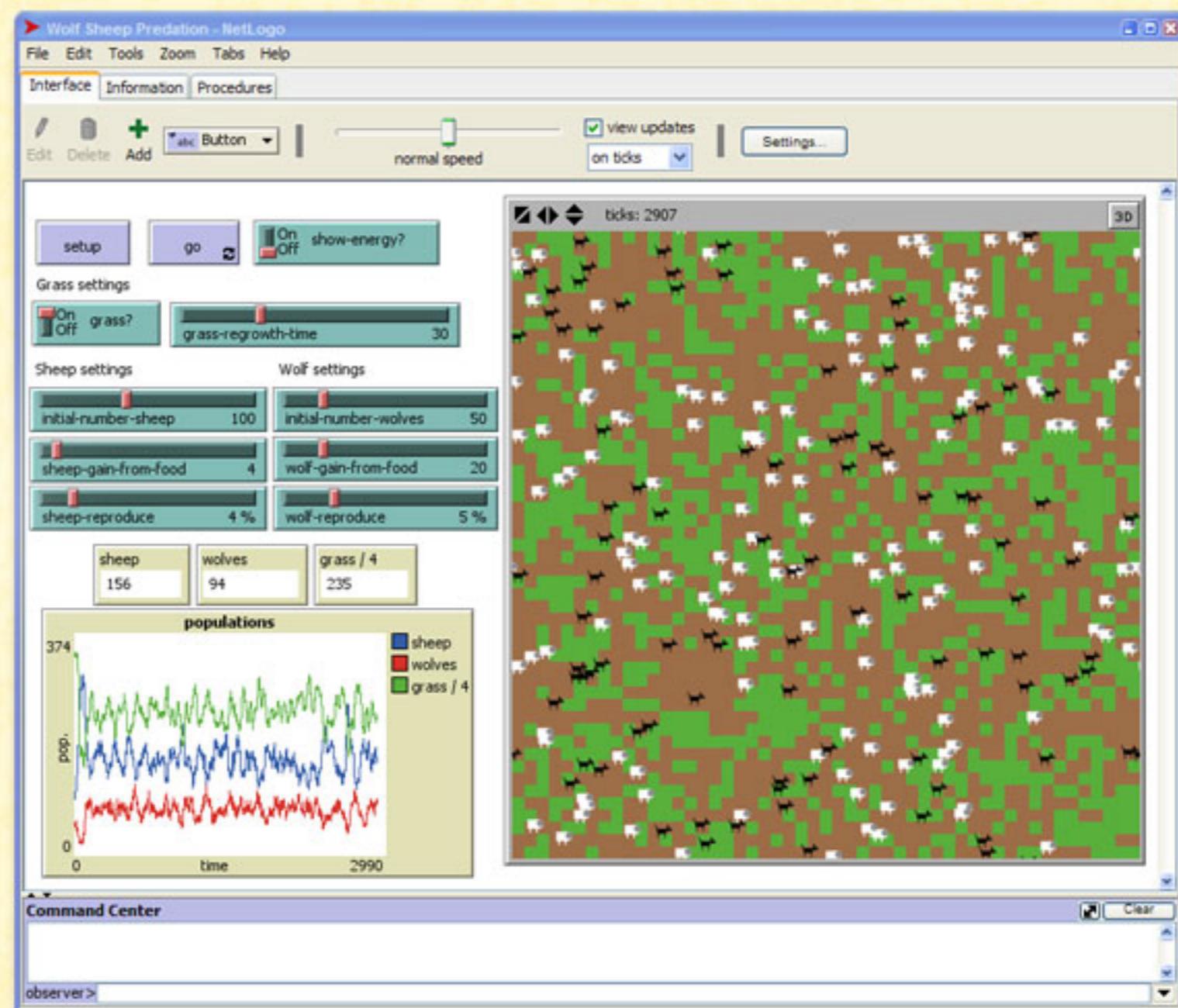
- What Type(s) of Models? CA, Free Agents, Network, Hybrid
- What Kinds of Agents Are there?
- Any Agent-Agent Interaction? Describe.
- Any Agent-World Interaction? Describe.
- Bounded or Toroidal World? Does the World Hold Values?
- What Are the Parameters? Any Hidden Parameters?
- What Does the Model 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)?

INTRODUCTION TO AGENT-BASED MODELING

Homework Assignment #1



Open
Wolf Sheep
Predation
Model



INTRODUCTION TO AGENT-BASED MODELING

Homework Assignment #1

Go to
tinyurl.com/mscz9w
and download
ICPSR09_HW1_YourLastName.doc
just follow the instructions

