

# ICPSR 2009 Workshop on Agent-Based Modeling

**with your hosts:**

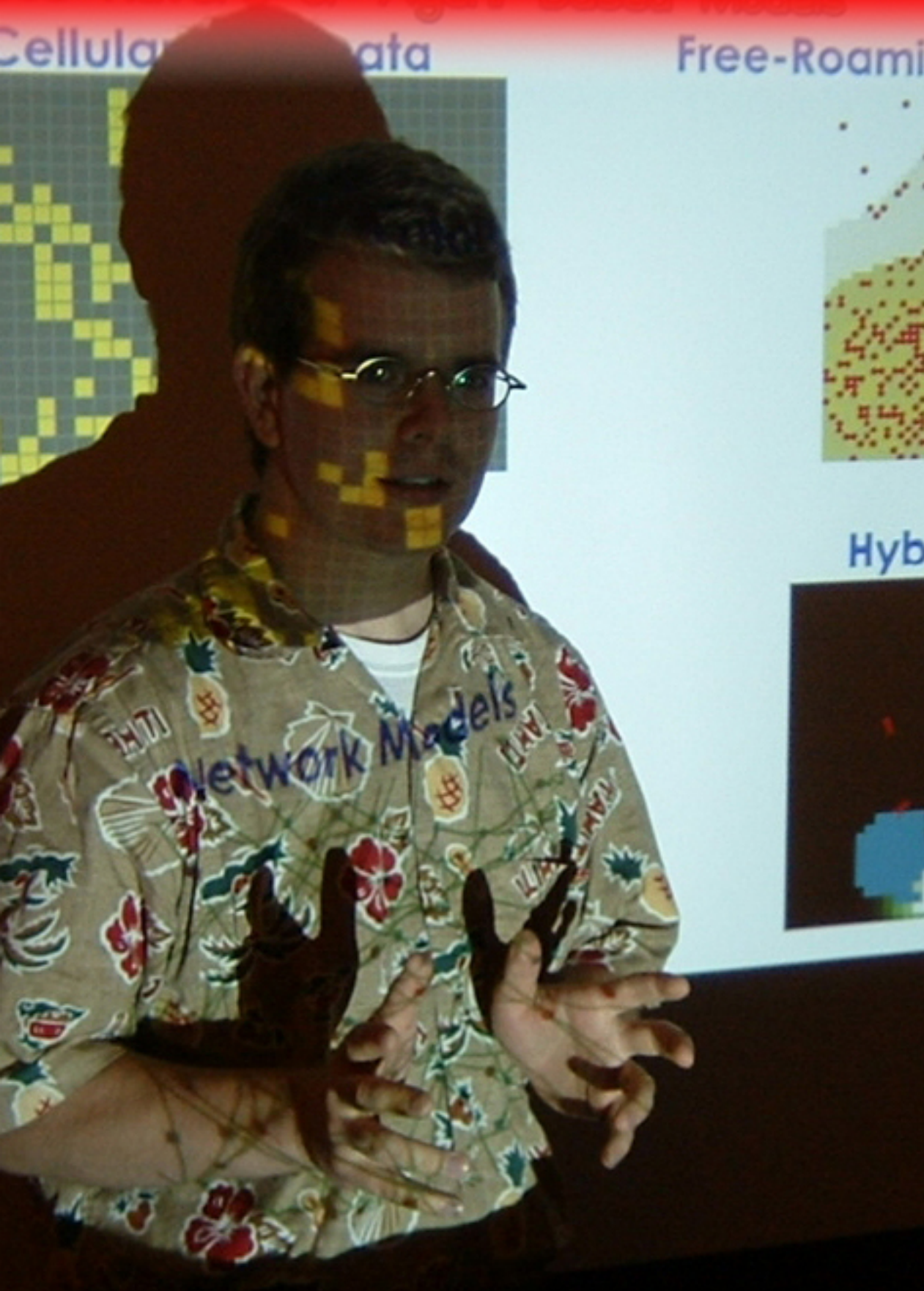
Aaron L Bramson

& Jon Zelner





# INTRODUCTION TO AGENT-BASED MODELING



## Aaron Bramson

### *Perpetual Student*

- Undergrad at University of Florida
  - B.A. Philosophy
  - B.S. Economics: Business School
- 2 Years in Econ PhD at Boston Univ
- M.S. in Mathematics from Northeastern
- Joint PhD at University of Michigan
  - Complex Systems Certificate
  - Political Science
  - Philosophy

### *Gainfully Employed*

- Research Scientist at Lockheed Martin
- Importer of Traditional Japanese Shoes
- Worked as consultant in AI
- Occasional Musician and Photographer



WHO IS THIS GUY?



## CONTENTS

### *What Are Agent-Based Models*

- Brief History of Complex Systems and ABM
- Various Flavors of Agent-Based Models

### *What are ABMs made of?*

- Various Flavors of Agent-Based Models (review)
- Components of all Agent-Based Models
- Model specific ABM components
- How to compare the value of different components
- Benefits and Limitations of Agent-Based Models

### *Survey of ABM packages*

- Do it Yourself from Scratch (C++, Java, etc.)
- Comparison of Swarm, AnyLogic, Ascape, NetLogo, and RePast
- Comparing NetLogo and RePast
- Analyze the Rabbit, Grass, Weeds Model
- Identify Lever Points in the Cooperation Model



## CONTENTS

### *Before you Begin Building a Model...*

- Can it be done in NetLogo?
- Find Code to Steal
- Locate Sources of Help (Internet and Human)

### *Practical Guide to Building NetLogo Models*

- Simplicity or Speed
- Planning Algorithms before Writing Them
- Reuse as much code as possible (but not more)
- Tons of Examples and Explanations

### *Exercises and Applications*

- Students will build models to develop skill and comfort
- Guided construction of a chosen model



## CONTENTS

### *Advanced Techniques and Extensions in Netlogo*

- NetLogo 3D
- Shapes Editor, Dynamical Systems, Behavior Space
- Networks, Functions, and Famous Kludges
- Java Extensions and Import & Exporting

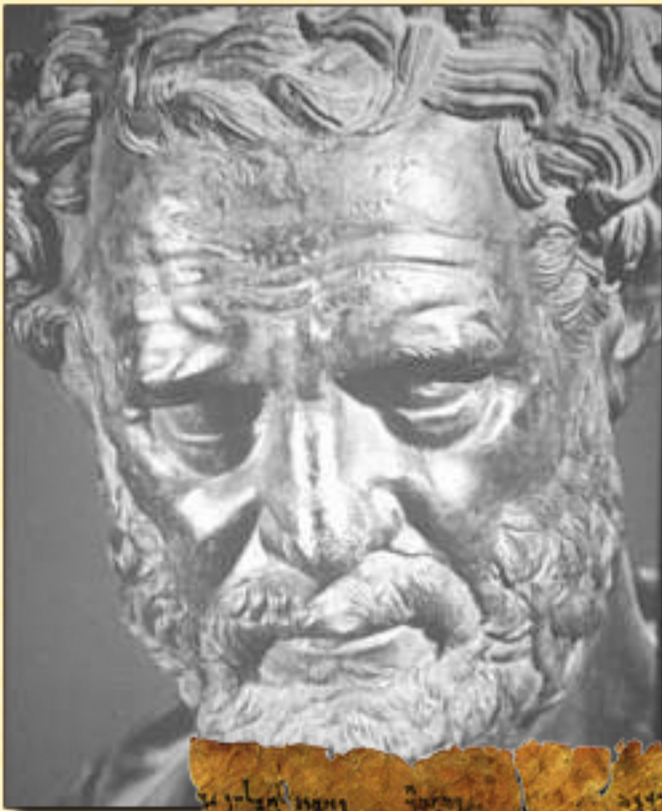
### *Dealing with Data*

- Batch Runs and Post Processing
- Metrics, Measures, and Modeling Magic
- The Folly of Statistics
- Are Your Results Viciously Built into the Model?

### *Developing and Working on Projects*

- Finding a Good Base Model
- Planning the Development Stages
- Work, Work, Work. Get 'er done!





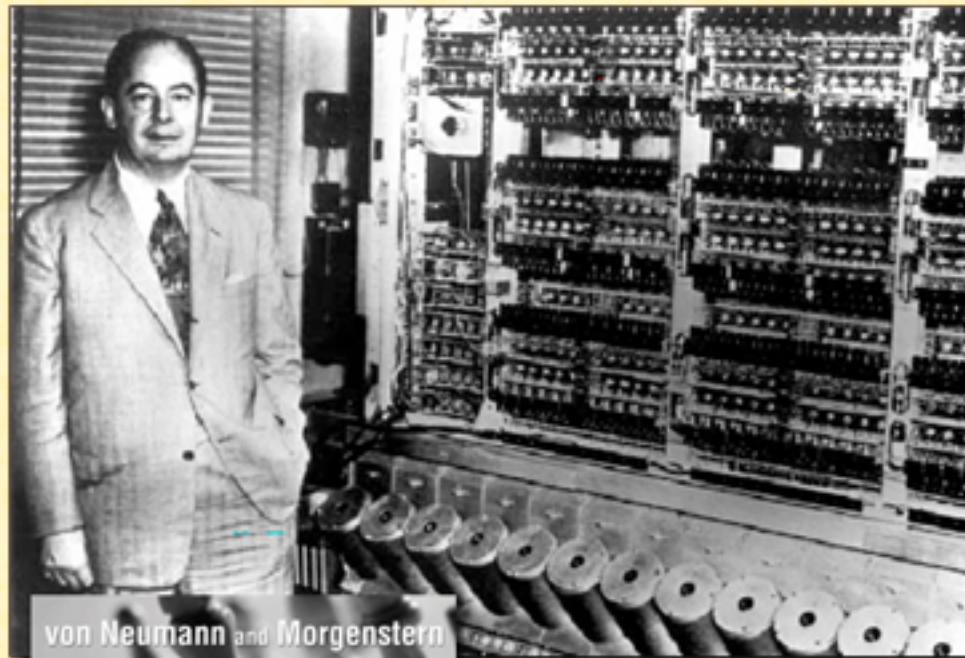
## Democritus

- Grandfather of Complex Systems
- Natural Philosopher 460-370 B.C.E.
- Co-Founder of Atomist Theory
- Very little first-hand work is known; most information is from second-hand accounts and may be bunk



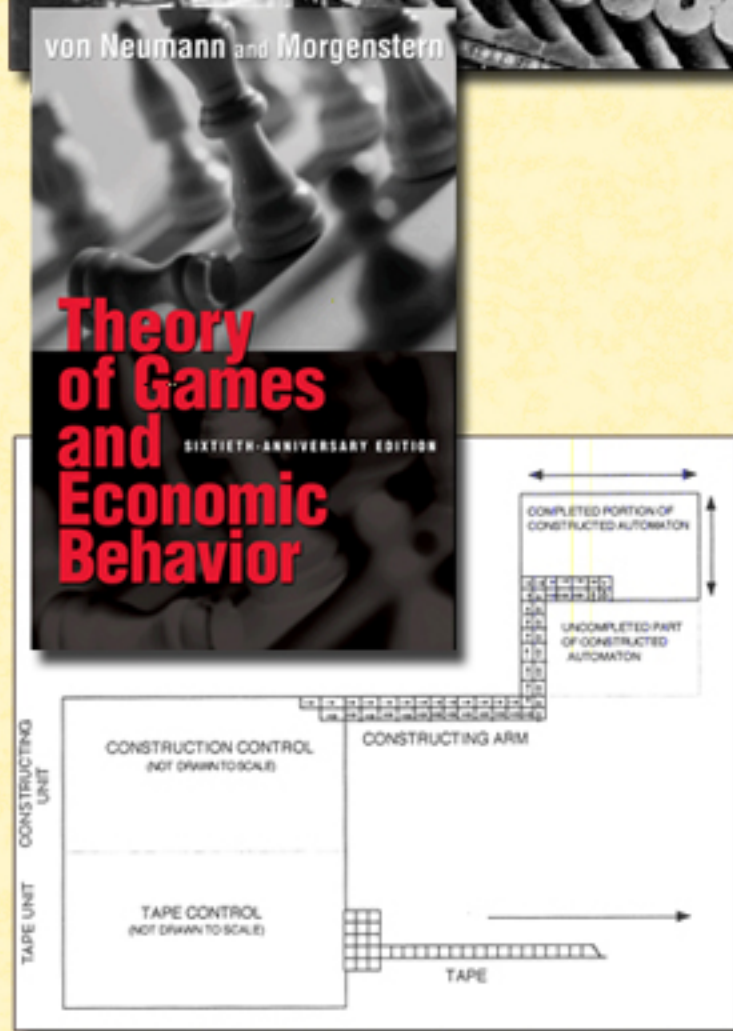


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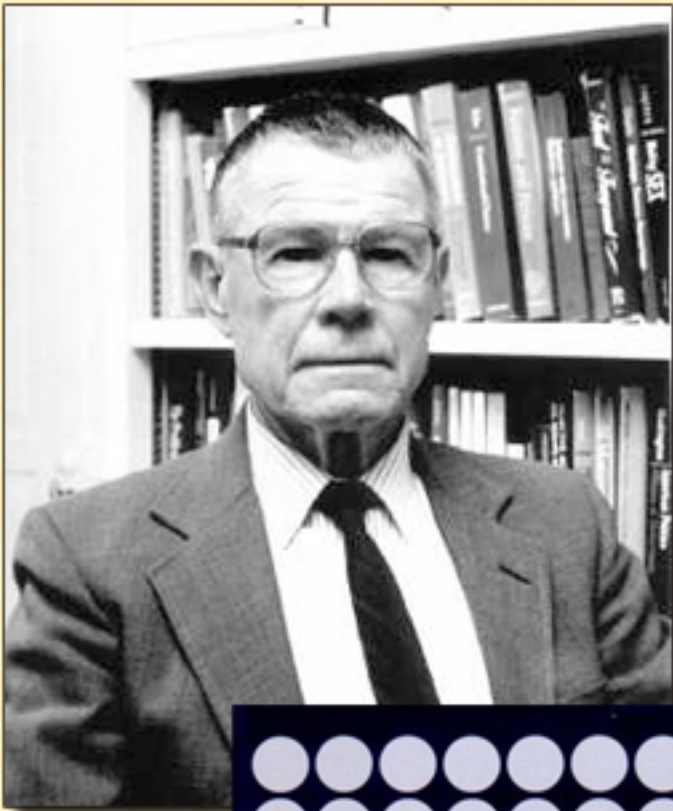


## John von Neumann

- Grandfather of Agent-Based Modeling
- Hungarian born Mathematician, 1903-1957 (died of cancer)
- Invented Game Theory
- Helped Develop Atomic Bomb
- Invented the Computer
- Invented Cellular Automata
- Figured out Godel's Incompleteness Theorem before Godel (but was nice)

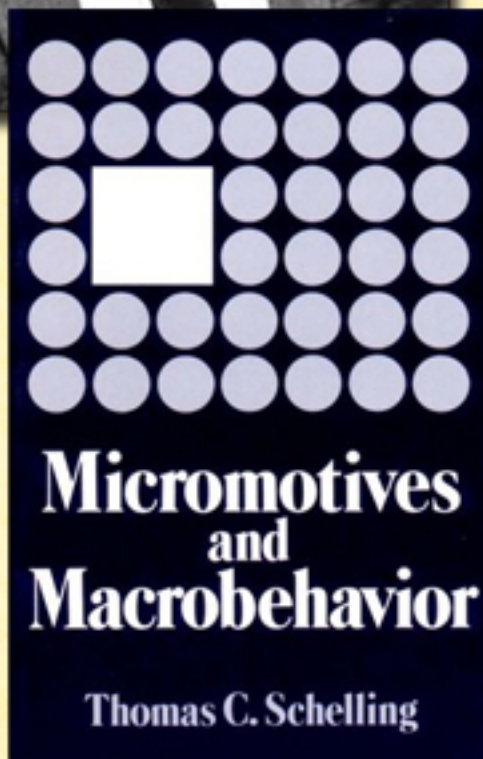






## Thomas C. Schelling

- Father of Agent-Based Modeling
- 2005 Nobel Prize Winner in Economics for work in Game Theory
- Clearly explained and motivated bottoms-ups approach in his 1978 book *Micromotives and Macrobehavior*
- Famous Segregation (aka "Tipping") model is the first modern agent-based model



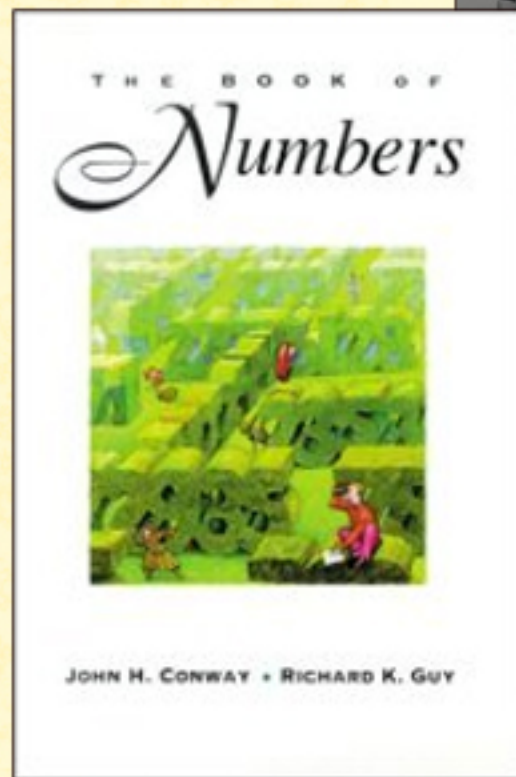
**Show Model**





## John H. Conway

- Mathematician and early adopter
- Created cellular automata model called “The Game of Life”
- Provoked strong reactions and garnered interest in ABMs
- Complex behavior from simple rules



**Show Model**