

FRONTIERS OF AGENT-BASED MODELLING

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benefits and LIMITATIONS of including an ABM in your research project

- A) how to extract the most benefit from a model
 - 2) when are they most/least insightful, and
 - III) what one can't do without an ABM.
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- 4) limitations of measurement & performance
 - e) data overload and the limits of statistics
 - vi) scepticism and the inadequacy of sufficiency

BUT FIRST,

some ABMs in unexpected places

- **Game Theory** is a kind of agent-based modelling
- Policy space, issues space, spatial voting,
and other **Hotelling models** are AMBs
- ABMs in **AI**: swarm systems, GAs, CAs, multi-agent, etc.
- Much of **Network Theory** can be seen as ABMing

current benefits

- Implicit Non-Linear Dynamics
- Feedback, Multiplier Effects, Dynamic Interactions
- Spatially Explicit Modelling (GIS, Mars Rover, Cafe Seating)
- “Medium” Number of Agents
- Evolvable/Adaptive Agents and System Characteristics
- Plagiarism is Encouraged and Rewarded
- Visualizations Can Pump Intuitions
- Fun, Sexy, New Kind of Cutting-Edge Science

future benefits

- Computers are Getting Faster and Cheaper
- More Off-the-Shelf Packages Becoming Available
- Growing Research Support Community
- Recognized in Industry and Government (aka \$\$\$)
- Specialized Journals with Less Competition
- Improvements in Information Extraction (Measurements)
- Improvements in Interfaces and Visualizations
- Complexity Scientists will be the Academic Elite

current LIMITATIONS

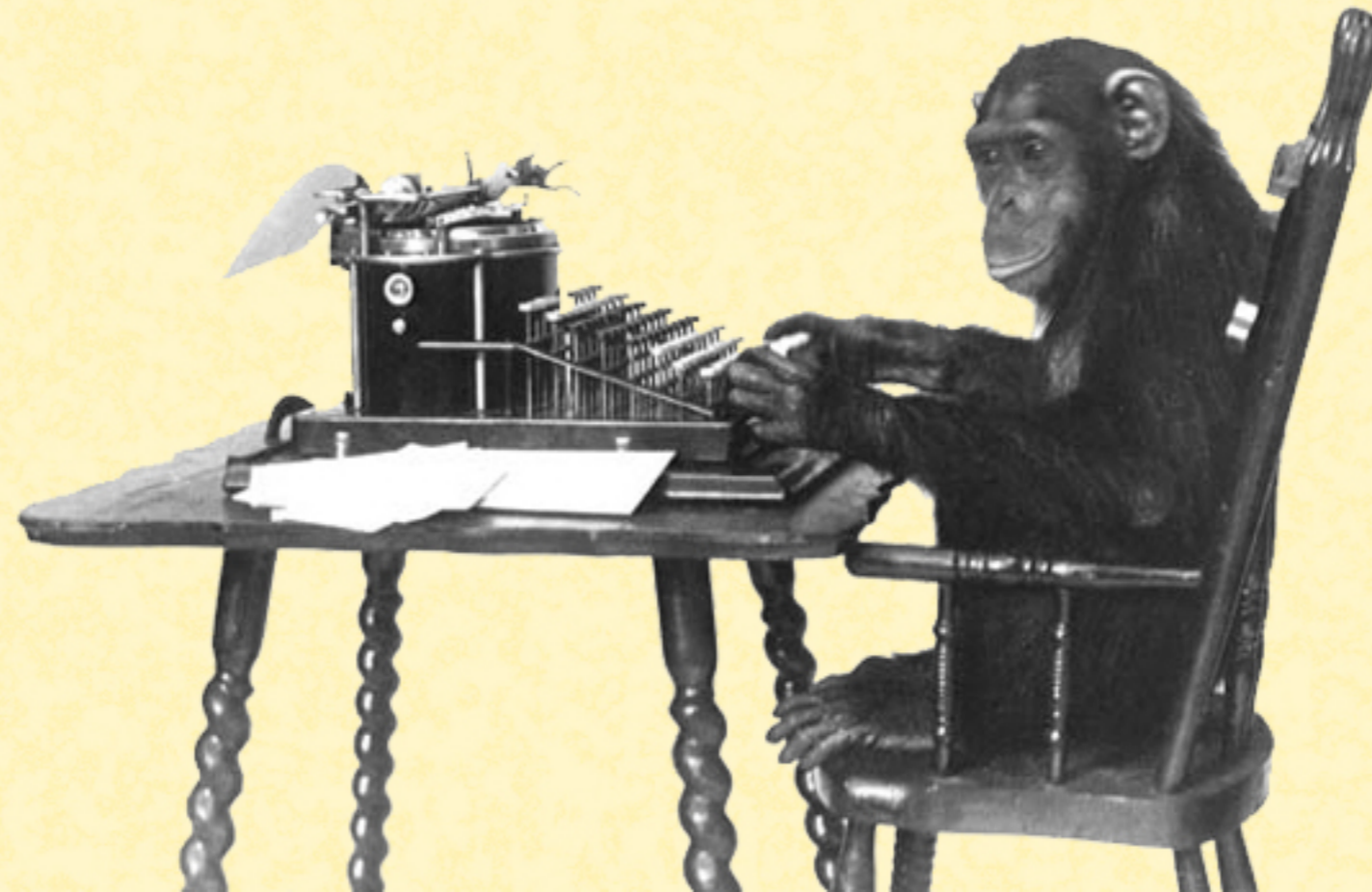
- Computer Programming is Tedious and Annoying
- ABM packages are Limited and Constraining
- Complex Systems is a Conceptual Mess
- Statistical Methods are Inappropriate for ABMs
- Few Good Measures of System Characteristics
- Research Groups are Isolated and Marginalized
- Paper Journals are not Formatted Appropriately
- Recalcitrant Has-Beens Skeptical of New Ideas

let's address these one at a time

overcoming LIMITATIONS

Computer Programming is
Tedious and Annoying

- Co-Author Your Paper with a Computer Nerd
- Pay a Grad-Student to Program for You
- Write a Program to Automate Parts of Programming



overcoming LIMITATIONS

ABM packages are
Limited and Constraining

I pity the fool
who use NetLogo!



- Programming from Scratch is Unnecessary Repetition
- NetLogo Sucks for All but the Basics
- RePast is Ugly, Bulky, and Poorly Documented
- Ascape is Obscure and Poorly Documented
- Use JAVA to Customize and Expand Package Abilities
- NetLogo is Useful for Testing Ideas, and it has 3D!!!
- RePast is Open for Improvements and Recommendations
- Ascape is my Favorite, but It Needs Publicity

overcoming LIMITATIONS

C=mp̄l̄ẽΣ S̄yshtēmsh
ish ả C=ncẽptuả Mesh

- No Solid Definition of Complexity or Emergence or ...
- People Disagree about Root Concepts (e.g. SOC vs HOT)
- “We Have a Model, but What Does it Mean?”
- Causality, Law Following, or Just Correlation?
- Wrangle Philosophers into Complex Systems
- Locate Oneself in the Logical Geography
- Recognize Link between Methods and Concepts
- Read More Philosophy!!! (Especially Metaphysics)

overcoming LIMITATIONS

Statistical Methods are
Inappropriate for ABMs

- ABMs Generate **TONS** of Data
- Reliance on Current Statistics Reduces Insight
- Apply over States, not Processes
- No More Sophisticated than Observational Approaches
- Wrangle Statisticians into Complex Systems
- Research Obscure Statistical Techniques
- Recognize Limitations of Current Statics and Statistics
- Develop New Internal Statistical Techniques

overcoming LIMITATIONS

FEW GOOD MEASURES OF SYSTEM CHARACTERISTICS

- We Don't Know What to Measure
 - Dynamic Measures are Difficult to Conceptualize
 - Previous Research Programs Didn't Them
 - Few Benchmarks for a Good Measures (BEST GUIDE is INTUITION)
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- Wrangle Mathematicians into Complex Systems
 - Research Obscure Mathematical Techniques
 - Identify Desiderata for Complexity Measures
 - Discover/Invent a New Branch of Mathematics

overcoming LIMITATIONS

RESEARCH GROUPS ARE
ISOLATED AND MARGINALIZED

- Few Departments of Complex Systems Exist
- Few Journals Accept Non-Mainstream Ideas
- Too Small a Community for National Conferences
- Education Systems Change Slower than Climate
- Develop Unified Curriculum for Complex Systems
- Demonstrate Relevance and Similarity to Extant Research
- Create Sessions with Sexy Titles at Popular Conferences
- Write Letters, Send E-mails, Tell Carl, “We Want Degrees!!”

overcoming LIMITATIONS

Paper Journals are
Not Formatted Appropriately

- Journal Articles Are Typically too Short to Describe Model
- Predominantly Black and White Printing
- No Interaction, Audience Can't See It Working
- Utilize/Start Online Journals and Article Repositories
- Wait until Everyone Buys a Tablet PC to Read from

overcoming LIMITATIONS

RECALCITRANT HAS-BEENS
SKEPTICAL OF NEW IDEAS

- Advisor Doesn't Like/Trust Complex Systems/AMBs
- Need to Spend Time Mastering Old Techniques
- Can't Get a Job in a Typical _____ Department
- Friends and Family Have No Idea What You're Studying
- Use Terminology that People Are Used To
- Take Extra Time to Earn Your Degree ʘ
- Get A Job in Industry/Government (More \$\$\$ too)
- Complex Systems Sounds Impressive
- Memorize Some Good Slogans and Few Simple Examples

In Summary,

AMBs are Awesome!!!

Tell Everyone.