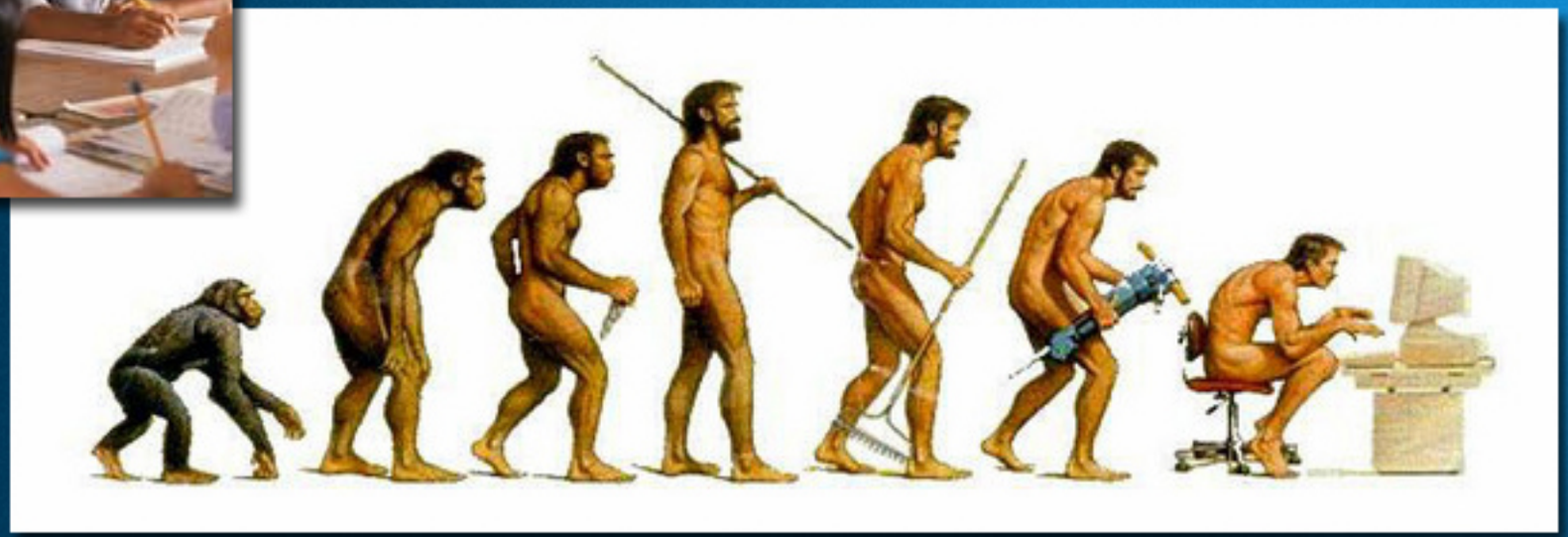
Introduction to Agent-Based Modeling

Day 11

Adaptation, Learning, & Evolution



Adaptation, Learning, and Evolution

Distinctions vs Definitions

Terminology

- Words Are Frequently Used Interchangably
- No Concise Definitions or Principled Usage
- Distinctions are Real and Clear, Just not the Terms

Some Included and Related Terms

- Reaction
- Adaptation
- Learning
- Development
- Updating
- Evolution

Adaptation, Learning, and Evolution

Reaction

UniLevel Stimulus Response

- Behave According to Update Rule
- Update Rules Cannot Change Through Time
- Memoryless: Agents Do Not Track Changes

Some Included and Models and Behavior

- Game of Life
- 99% of Game Theory
- Wolfram-style Cellular Automata
- Laughing at a Joke
- Moving Your Hand out of a Fire
- Thermostats and Traffic Lights

Adaptation, Learning, and Evolution

Adaptation (Agents and Systems)

MultiLevel Action Rule

- Behave According to Update Rule
- Update Rules May Change Through Time
- Agents May Track Changes
- Must Include a Feedback Mechanisms
- Robust Behavior with Stickiness

Some Examples

- Clothing Choice by Season
- Purchasing Choices by Wealth and Price
- Thermostats and Traffic Lights

Adaptation, Learning, and Evolution

Learning (Kind of Agent Adaptation)

Hebbian Learning

- Reinforcement of Positive Feedback
- Analogous to Preferential Attachment
- How the Brain Works (Neural Nets)

Bayes Learning

- Updating Conditional Probabilities
- Statistical Decision Rule
- Not Learning in any Intersting Way

Genetic Algorithms

- Use Things that Work, Change Things that Don't
- Keeps an Implicit History of Behavior
- Allows Agents to Be Part of an Evolving System

Adaptation, Learning, and Evolution

Evolution (System Property)

Population Dynamics

- Agents Enter and Leave the System
- Entry is Based on Fitness Measure
- Fitness is Engogenously Determined

Ellusive Structure and Dynamics

- Fitness is Defined for Models
- Artificial Death and Replication
- Time Frame and Complication are Beyond Human Ability

Examples

- Existence of Life on Earth
- Fashions, Technology, and Culture
- Future Autonomous Robotic Systems