Exploring Complexity

In Science and Technology

Nov. 15, 2010

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Logistics

- Due
  - HW6 and Lab5 due today
- Handout HW7 and Lab6
- Final Paper Questions?
- Questions?

Artificial Intelligence

- Changing Definitions
  - FORTRAN
  - ELIZA
    - http://www-ai.ijs.si/eliza/eliza.html
    - http://www.manifestation.com/neurotoys/eliza.php3
- Turing Test

Computer vs. Human Thinking

- Will Computers ever recognize speech?
- No, it takes an oil spill to wreck a nice beach.
- Common Sense = Sensitivity to Context

Analogy Making as Thinking

- "Analogy-making is the ability to perceive abstract similarity between two things in the face of superficial differences."
  - Melanie Mitchell
- "This ability pervades almost every aspect of what we call intelligence."
  - Melanie Mitchell
  - p. 187-8 examples
- "All perception of thuth is the detection of an analogy."
  - Henry David Thoreau

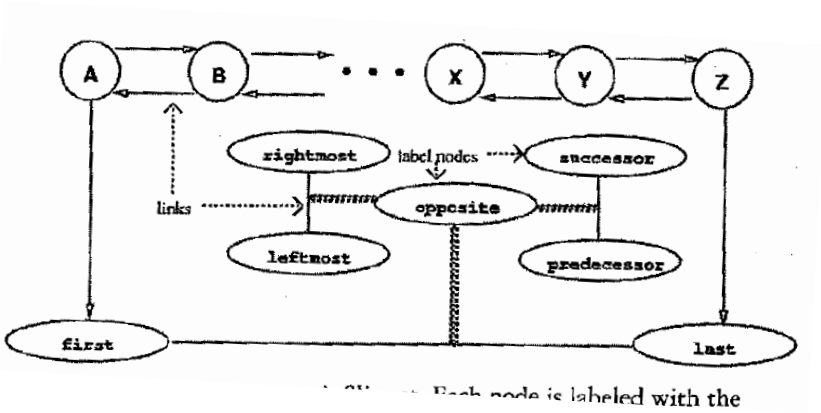
Simplifying Analogy

- Strings of letters:
  - abc ➔ abd; kji ➔ ?
  - groups
- "Conceptual Slipping"
- Balance between exploration and exploitation
  - Combine randomness with highly directed response based on feedback
  - How do ants do this? The immune system?

Copycat

- 3 inputs, e.g. abc ➔ abd; kji ➔ ?
- Slipnet
  - Network of concepts, each with potential associations and slippages
- Workspace
  - Where strings are stored
- Codelets
  - Agents that compete and cooperate to construct perceptual stuctures about actual strings, e.g. b is successor of a
- Temperature
  - Amount of perceived organization
  - Influences degree of randomness

Copycat Slipnet



Each node is labeled with the

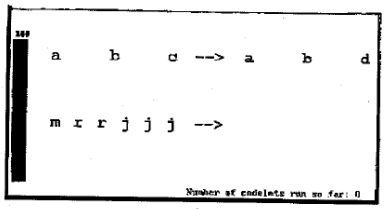


FIGURE 13.2.

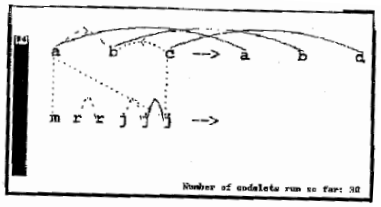


FIGURE 13.3.

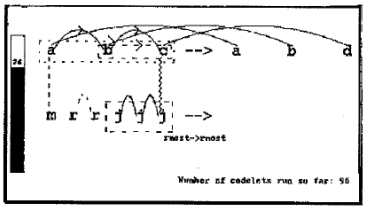


FIGURE 13.4.

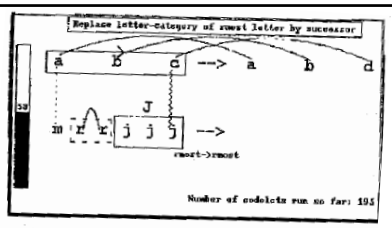


FIGURE 13.5.

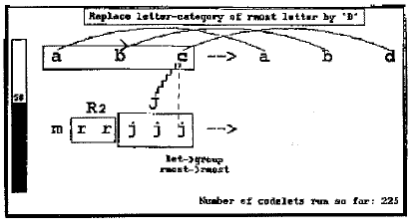


FIGURE 13.6.

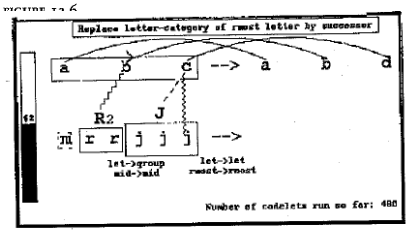


FIGURE 13.7.

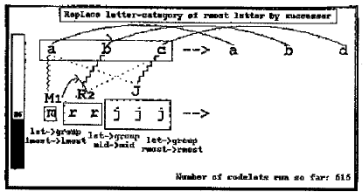


FIGURE 13.8.

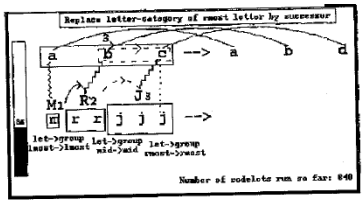


FIGURE 13.9.

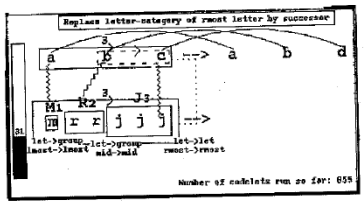


FIGURE 13.10.

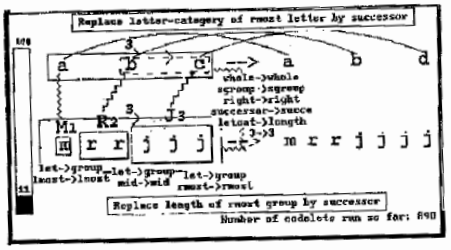


FIGURE 13.11.

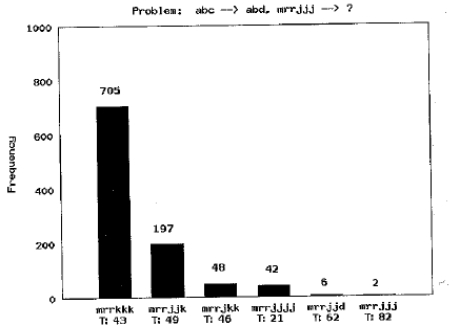


FIGURE 13.12. A bar graph plotting the different answers Copycat gave over 1,000 runs, each starting from a different random number seed.

Models in Science

- Mathematical Models
- Mechanistic Models
- Idea Models Examples
  - Maxwell's demon
  - Logistic model and logistic map
  - von Neumann's self-reproducing automata
  - Genetic algorithms
  - Cellular automata
  - Koch curve
  - Copycat

Idea Models

- Show that a proposed mechanism for a phenomenon is plausible (or implausible)
- Explore the effects of vartiations on a simple model and prime one's intuitions about a complex phenomenon
- Inspire new technologies
- Lead to mathematical theories

Main Theories for the Evolution of Altruism

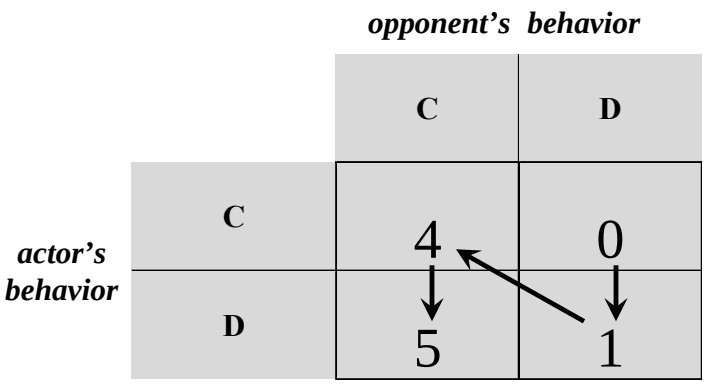
- Multilevel Selection
  - Altruist dominated groups do better; altruists within groups do worse
  - $\Delta Q = \Delta Q_B + \Delta Q_W$
- Inclusive Fitness/Kin Selection
  - Gene self interest, Hamilton's rule ($\Delta Q > 0$ if $rb > c$)
  - $w_{inclusive} = w_{direct} + w_{indirect}$
- Reciprocal Altruism
  - Conditional behaviour, Iterated Prisoner's Dilemma (IPD), emphasis on non-relatives
  - Indirect reciprocity, strong reciprocity, reciprocity on graphs
- Others
  - By-product mutualism, conflict mediators, policing, social markets

Advances in Unification Program

- Unifying Multilevel Selection and Inclusive Fitness Theories
  - (Price 1970, Wade 1980, Breden 1990, Queller 1992, Frank 1998, Sober and Wilson 1998, Lehmann et al. 2007)
- Unifying Reciprocal Altruism and Inclusive Fitness Theories
  - (Queller 1985, Nee 1989, Frank 1994, 1998, Sober and Wilson 1998)
  - Less successful; less formal; less accepted

Prisoner's Dilemma (PD)

Actor's Fitness (Utility)



- Individually rational to defect
- Collectively irrational