Santa Fe Institute – Complexity and Modeling Program
Modeling Complexity in Evolution

Jeremy Van Cleve

Day 1 – morning

1. What is biological complexity?

2. Darwin and the evolution of evolution

3. Some introductory population genetics

4. Complexity as a neutral process: a discussion of the Zero-Force Evolutionary Law

Readings:

1. McShea, Daniel W and Brandon, Robert N. 2010. Biology's first law: the tendency for diversity and complexity to increase in evolutionary systems. University of Chicago Press, Chicago.

2. Zimmer, Carl. 2013. The Surprising Origins of Life's Complexity. Sci Am 309:84–89. doi:10.1038/scientificamerican0813-84

3. Doolittle, W. Ford. 2012. Evolutionary biology: A ratchet for protein complexity. Nature 481:270–271. doi:10.1038/nature10816

Day 1 – afternoon

Genetic drift and mutation simulation

Natural selection simulation (time permitting)

Day 2 – morning

1. Lecture on theory cooperation in biology and economics

2. An experimental economic game

3. Discussion of evolutionary transitions and multilevel selection

Readings:

1. Szathmáry, Eörs and Maynard Smith, John. 1995. The major evolutionary transitions. Nature 374:227–232. `doi:10.1038/374227a0`

2. Godfrey-Smith, Peter. 2006. Local Interaction, Multilevel Selection, and Evolutionary Transitions. Biol Theory 1:372–380. `doi:10.1162/biot.2006.1.4.372`

3. Okasha, Samir. 2010. Levels of selection. Curr Biol 20:R306-7. `doi:10.1016/j.cub.2010.01.025`

Day 2 – afternoon

Cooperation simulation

1. Implement and experiment with a model focusing on spatial structure.

2. If for some reason, we get done with part #1, we can implement and experiment with a model focusing on ability of agents to behavior conditionally.