

Essay 2

Math 309

Fall 2016

Deadline: 12N Friday 11 November

Late deadline: 18 November

## Writing

- Select **one** of the following items and write a 600-700 word essay in response.
  - Using *concise and clear sentences*, incorporate symbols and illustrations into your text. Have an audience in mind. Focus on *developing* an explanation or argument. Using specific examples to illustrate a general idea or claim is often a helpful tactic. What are you trying to establish and how are you're trying to establish it?
  - For writing assistance, consult the style and content guide at the class website.
  - Submit **double-spaced** in hard copy.
- 1) Develop an example—real or imagined—that illustrates how a complex system produces diversity (of some kind that you should carefully articulate). Contrast this example with one that involves the production of a state that lacks diversity (a “university?”).
  - 2) The “object” on which evolution acts is a population as a heritable variation possessed by individuals is selected due to some adaptive advantage that it confers. Can evolution select for a variation that’s emergent—a change in a property that arises only collectively? Be careful to take account of how the emergent variation is heritable.
  - 3) Each member of a class selects a number of extra credit points (5 or 10) to be added to the final exam score. If 10% or more select 10, everyone receives 0. Otherwise, each person receives the selected amount. How do you choose? Is there a rational choice? Can you set up the process as a game—say, there are two members of the class? Three? Compare this dilemma to the use of the commons—say, energy resources, CO<sub>2</sub> emissions. (See G. Hardin, *The tragedy of the commons*, Science, 1968, 1243-1248.)
  - 4) Evaluate the claim that a nation should manage its finances in the same way that a family or individual does. For instance, when times are tough, debt should be reduced or avoided. How does the number of agents influence the nature of the interactions among them? Are there properties or structures that emerge only in the large population?
  - 5) Devise an evolutionary algorithm that attempts to solve an optimization problem—such as the polygon problem: given  $N$  line segments, what polygonal arrangement of the segments maximizes the enclosed area? You need to specify the protocols, the reproduction cycle, and the selection process (fitness??). It might help to work on the simplest case of a quadrilateral first and then extend the procedure. Discuss how well you think the algorithm would work.