

Evolutionary Systems

Geology 200

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We have covered a tremendous range of ideas and concepts this semester, from the nit-picking details, to the global, and from the abstract, to applications to human behavior and relationships. What out of all this do we need you to know? There is so much! We want to be fair, yet there are specific concepts and applications we want you to leave with.

There are three portions to the test. One, written essay, second descriptions of programs we used, and the third a concluding statement. The written questions are given below. These are the exact questions that will be on the test, although you will answer only a select number of them.

How to Prepare and What is Expected

Below are a series of questions. These are the exact questions for the test. You should be prepared to answer any of them but **will have to answer only a few of them** depending on their length. You will not know which questions will be asked until test time, but there is also be some choice on which questions you answer.

- L Test is open-book/open-note. This means the accuracy of your information is taken for granted. What we are after is how well you can integrate, explore, and explain, while being comprehensive and complete in ways that an educated layperson will easily grasp, understand, and be able to apply.
- L The questions below are minimally stated, but you should be prepared to present a fully developed thesis on the subject, incorporating and defining all special terms, and explaining and relating all necessary concepts.
- L You must include pertinent examples from the programs and experiments you ran, and where possible, examples from the real world, fully explaining how and why they relate to the concept under discussion.
- L Quality and thoroughness of the written answers: Imagine this. You have to give a presentation on the subject to your boss. How well you do determines whether you get a promotion, a big raise, and the corner office with windows, or stay in the basement.

So, . . . you need to be organized, logical, and thorough, but not tedious. This is not an exhaustive, detailed description but a presentation that captures the quintessence¹. It should include the most important elements and explain how they relate and build to a concise understanding of the subject, including definitive examples, but leaving out what is incidental or insignificant.

Do not assume we know what you are talking about. Write for an educated person who knows nothing about the subject, but really wants to learn. Remember, act as if your whole future depends on how professionally you can pull this off.

1. Concept Questions

- A. Write a statement distinguishing a “Top-Down” vs. a “Bottom-Up” strategy in solving a problem, incorporating where appropriate the concept of “local rules, global behavior.” Apply these concepts to the behavior of cellular automata, boids, genetic algorithms, and real world problems.

For the questions below you must give specific examples, both in the computer models and in the real world that illustrate the concept under discussion. It is both the ability to explain clearly what the concept is, and how it applies that is important.

¹ Quintessence: 1. An extract from anything containing in concentrated form its most essential principle. 2. The purest and most essential part of anything.

- B. What is the *problem of problems*, why is it a problem, and what are its possible solutions?
- C. Explore the concept of a *dissipative structure*.
- D. Explore the concept of *bifurcations*.
- E. Explore the concept of *sensitive dependence*.
- F. Explore the concept of *emergence*.
- G. Write a statement explaining to your parents what *SOC* is.
- H. Describe the concept of an *attractor* relating especially what they are, the kinds there are, and the different ways they are generated. Include drawings or other examples illustrating the various kinds.
- I. Explore the concepts of *hysteresis and bistable behavior*.

The next few questions deal with more specific topics we explored.

- J. Is Artificial Life, Life?
- K. Explain the *Prisoner's Dilemma*, including but not restricted to:
 - < Game Theory.
 - < An analysis of typical strategies and their interactions.
 - < An exploration of when to use selected strategies
 - < Important conclusions we draw from the evolutionary tournaments.
 - < A statement on the ethical and moral implications of the "game."
- L. What is *self-organization*, the problems with defining and recognizing it, and how they might be overcome.
- M. Discuss *swarm behavior*, and its applications to human and non-human systems .

2. Program Descriptions/Explanations

Given any one or more computer models (programs) we used during the semester:

- A. Describe what kind of program it is, e.g. mathematical model, cellular automata, chaos, genetic algorithm, fractal, etc.
- B. Explain how it works; i.e. what the program is supposed to do or demonstrate, and/or its algorithm, and/or how it goes about doing it.
- C. Explain the quintessential lessons we learn from the program.

3. Concluding Statement:

Describe something you learned from this class that has a strong impact on you, or that will have lasting value for you.