COURSE TITLE:

ECOL596H Complex systems: networks and self-organization in biology

Spring 2008

Instructor:
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Course description

We will discuss current and classic literature on complex systems research at multiple levels, including gene regulatory networks, neural net(work)s, ecological networks, and social networks. We will try to identify the commonalities of these systems and what is so exciting about 'systems biology'. We will also discuss what types of models are used to describe and study self-organization and networks in general.

Objectives

The goal of this class is to help students think of their study system from a different angle, and to inspire them to use methods and theory developed in other fields. In addition, my goal is to see if we can come up with a useful list of commonalities of various 'complex systems', which may lead to a review on the subject. We will mostly stick to current literature on the different topics, to see how much researchers have integrated results on self-organization and networks theory in their work.

Expected learning outcomes

Students will become familiar with the terminology and methods used in networks, self-organization, and complex systems research. Students will practice reading and discussing current research in fields that are not directly related to their own. They will also be trained in presenting on their own field/interests to a non-specialist audience.

Outline

1. Introduction to complex systems: what is it and why is it interesting
2. Social networks: Six degrees
3. Self-organization: Ants as search algorithm
4. Systems biology: gene regulatory networks, molecular physiology
5. Discussions and student presentations
    a. Neural networks: what is complexity?
    b. The complete yeast gene network (?)
    c. The regulome and the interactome (too many omes or real systems?)
    d. Ecological networks, robustness, and extinctions
    e. Social insects as adaptive complex systems
    f. Social networks in epidemiology
    g. Climate as a complex system?
    h. Nonlinear dynamics
    i. Multi-agent models vs. ODE and other models
    j. What is chaos?
    k. Artificial complex systems: stock market, traffic, etc.
    l. Artificial life
6. What are commonalities, do we learn from one system how to study another?

Student Presentations
Each student will give a presentation in class and lead a discussion on the same topic afterwards. If class size permits, each student will give two presentations. Presentation topics should be current research on the respective topic, or a historical review of the respective field. Students are encouraged to make links with own research. Each presentation should be accompanied by a one-page handout (for other students in class).
Graduate students' presentations should be 30 minutes; undergrads' should be 15 minutes.

Written assignments
Each student is required to write a one-page handout to accompany her/his presentation in class (this handout will be distributed to all students). The handout should contain some references, ideally with a description what each contains. Students are also required to write a new Wikipedia entry, or improve an old one, on a topic related to their presentation.

Grading
Final grade will be determined from the presentation(s) (40%), attendance and participation in class discussions (40%), and the written handout and Wikipedia entry (20%).

A: 90-100 %
B: 80-89 %
C: 70-79 %
D: 60-69 %
E (fail): 0-59 %

Readings
TBD

Course website
You will be able to obtain readings and check the current class schedule at the course website: http://eebweb.arizona.edu/Faculty/Dornhaus/courses/ecol596h.html

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Policy on Expected Classroom Behavior
Enrollment in the course signifies that a student will participate to the best of his or her abilities in each class session. No electronic communication devices should be used during the class session. Each student is expected to attend every class session; however, all holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion, and absences pre-approved by the UA Dean of Students (or Dean's designee) will be honored.

Policy Against Plagiarism
http://dos.web.arizona.edu/uapolicies

Policy Against Threatening Behavior
http://policy.web.arizona.edu/~policy/threaten.shtml.

Academic Integrity
Integrity is expected of every student in all academic work. The guiding principle of academic integrity is that a student's submitted work must be the student's own. This principle is furthered by the *Student Code of Conduct* and disciplinary procedures established by ABOR Policies 5-308 - 5-403, all provisions of which apply to all University of Arizona students.

For further information, please see: http://w3.arizona.edu/~studpubs/policies/cacaint.htm.

Special Needs and Accommodations Statement
Students who need special accommodation or services should contact the SALT (Strategic Alternatives Learning Techniques), the Center for Learning Disabilities (SALT Center, Old Main, PO Box 210021, Tucson, Arizona 85721-0021, (520) 621-1242, FAX (520) 621-9448, TTY (520) 626-6072), http://www.salt.arizona.edu/, and/or the Disability Resources Center, 1540 E. 2nd Street, PO Box 210064, Tucson, Arizona 85721-0064, (520) 621-3268, FAX (520)621-9423, http://drc.arizona.edu/. The appropriate office must document the need for accommodations.