

COURSE TITLE: ECOL 346
BIOINFORMATICS
Spring 2012
Monday & Wednesday 8:30 – 9:50 AM
Location: Biology Learning Center, Koffler 209

Instructor

Dr. Michael Barker
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Course Objectives

Advances in genomic and other high-throughput biological technologies are rapidly changing how biologists study the diversity of life. This course will introduce students to these new data and computational tools. As a field, bioinformatics is built around a core of fundamental evolutionary biology concepts and these will serve as an organizing theme for the course. Lectures provide 1) the conceptual and methodological basis of how large-scale biological data – especially genomic and transcriptomic data – are analyzed, 2) the basic biological principles that underly bioinformatic analyses, in particular homology, duplication and loss of genes and genomic regions, types and rates of mutation in genomes, and the basic evolutionary forces that shape genomes 3) descriptions of contemporary problems in bioinformatics and computational and wet-laboratory approaches to addressing these issues, and 4) experience with current genomic and other large-scale data sets and databases as well as the computational methods for their analysis.

Expected Learning Outcomes

Students will develop skills in efficiently manipulating complex next-generation biological data sets, proficiency with the unix command line and perl scripting, and will learn to synthesize data from multiple sources to evaluate hypotheses. Students will improve their basic problem solving skills as they are challenged to break complex problems into logical units and manageable tasks. By integrating these computational skills over a foundation of basic biology, students will emerge with a greater understanding of how bioinformatics may be applied to address questions in a broad range of biological disciplines.

Homework

Regular homework will be assigned to the class and the results will be discussed in groups during the following lecture. Assignments will be graded as acceptable or unacceptable. Acceptable coding assignments will generally be successful at solving the assigned problem or at least provide an explanation or outline of the approach with the attempted code attached. Students will have an opportunity to revise an unacceptable assignment. There will be a 10% penalty each day an assignment is late or awaiting revision.

Midterm Exams

There will be two midterm exams.

Final Exam - Group Project

For the final exam, students will be organized into groups during the semester and collaborate to apply

bioinformatic approaches to a contemporary question in biology. Students will consult with each other and the professor to outline a reasonable question that may be addressed with knowledge gained in the course. During the last lecture periods of the semester, students will present their efforts to the class and turn in a scientific manuscript-style paper reporting on their results including their code. The final project will be graded based on the classroom presentation (30%), success answering the question or at least evidence of reasonable effort on the task (20%), and the composition of the manuscript (50%).

Grading

Your final grade will be determined by the total number of points accumulated from exams and homework assignments.

		Grade Scale
Midterm 1	100	A: 90-100%
Midterm 2	100	B: 80-89%
Final Exam	100	C: 70-79%
<u>Homework</u>	<u>100</u>	D: 60-69%
Total	400	E (fail): 0-59%

Tentative Schedule

<i>Date</i>	<i>Topic</i>
1/11	Introduction to the Course
1/18	Working on the Unix Command Line
1/23	Introduction to Perl
1/25	Basics of Perl Scripting
1/30	Perl Scripting Continued
2/1	Introduction to Biological Databases
2/6	Search Algorithms and Clustering Sequences
2/8	Assembling Next-Generation Genomic Data
2/13	Circumscribing Gene Families
2/15	Identifying Orthologs and Paralogs
2/20	Measuring Genomic Divergence Among Species: SNPs and LSDs
2/22	Gene Trees vs Species Trees
2/27	Midterm 1
2/29	Gene Ontology and Annotation
3/5	Comparative Genomics and Synteny Evolution
3/7	Ancestral Genome Reconstruction
3/19	Natural Variation in Genomic Data I: SNPs & CNVs
3/21	Natural Variation in Genomic Data II: Selection and Demographic History
3/26	Genome Wide Association Studies
3/28	Variation in Gene Expression I: Quantifying gene expression
4/2	Variation in Gene Expression II: Cis vs trans divergence
4/4	Networks of Genes
4/9	Gene Connectivity, Dosage Balance, and Paralog Evolution
4/11	Midterm 2
4/16	Taxonomic and Phenotypic Databases
4/18	Biogeographic Data and Niche Modeling
4/23	Integrating Multiple Data Sources to Address Biological Questions
4/25	Group Presentations
4/30	Group Presentations
5/2	Group Presentations

Textbook and Course Materials

R. L. Schwartz, b. d. foy, and T. Phoenix, 2011, *Learning Perl, Sixth Edition*, is a required text for the course. This book will provide a useful introduction to perl scripting and will serve as a ready resource for solving coding problems. Other recommended texts will be posted on the course website (TBA). Lecture notes will be posted online, but students are responsible not just for online notes but any material covered during the lectures. *In other words, the posted notes are study aids only and you should be present and take your own class notes.*

Honors Students

Honors students will be expected to contribute a gene family annotation to a public genome project, such as the Plant Genome Database (<http://www.plantgdb.org/tutorial/annotatemodule/>).

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. Except for those provided explicitly for classroom activities, 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://deanofstudents.arizona.edu/policiesandcodes>

Policy Against Threatening Behavior

<http://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://deanofstudents.arizona.edu/policiesandcodes/codeofacademicintegrity>

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, AZ 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, AZ 85721-0064, (520) 621-3268, FAX (520) 621-9423, <http://drc.arizona.edu>. The appropriate office must document the need for accommodations.