BIOL 274 – Introduction to Bioinformatics – Fall 2016

Instructor: Eric S. Ho (hoe@lafayette.edu)
Office: Kunkel 13
Office hours: TTh 2-4 pm

Lecture: MWF 11:00-11:50 am, Venue: Kunkel 117
Lab: M/W 1:10-4:00 pm, Venue: Kunkel 313B

TAs: Amy Boles (bolesa@lafayette.edu), Emily Grady (gradye@lafayette.edu)

Course Description:
"Emerging technologies such as synthetic biology, proteomics, and information technologies, including bioinformatics and computational biology, have the potential to create a vibrant bioeconomy" – National Bioeconomy Blueprint, April 2012, The White House, Washington, p.15.

The integration of genomics and information technology makes many once thought unattainable scientific pursuits possible such as the human genome project. The success of the human genome marked the beginning of bioinformatics - a subject that uses computational methods to study biology. Today, biologists routinely incorporate bioinformatics in their experiments in order to study complex biological processes in larger scale.

This course provides a comprehensive overview of bioinformatics. The emphasis is on the application of computational tools and biological databases, widely used by today's scientists, in studying biology. Major topics include DNA/RNA/protein sequence analysis, biological databases, gene expression analysis, molecular phylogeny, protein structure, and system biology. Basic understanding of statistics is preferable but not mandatory. Students will learn basic R programming but prior knowledge in computer programming is not required.

Lab is an integral component of learning. It reinforces learning by allowing students to apply what they have "heard" in lectures to solve real biological problems. Lab consists of in-silico investigation, for examples, identifying differentially expressed genes in certain disease, building a phylogenetic tree for an essential gene, highlighting the active sites of a protein, etc.

Learning Outcomes:
At the completion of this course, students should be able to:
- Harness tools and databases to unlock biological information encoded in biomolecules
- Identify sources of relevant databases in problem solving
- Conduct sequence analysis
- Visualize and compare genomes from different species
- Analyze high throughput gene expression data
- Utilize modeling tools to understand protein folding
- Construct phylogenetic trees using DNA/protein sequences
- Understand the gene network underlying a biological process

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Prerequisites:
BIOL 101 or 102

Grading Policy:
- 9 labs (total 27%)
- Three in-class exams (total 43%)
- A cumulative final exam (30%)

Students are required to submit the electronic version of their lab report to Moodle, AND hand in a printed copy of the lab report to the instructor. Unless otherwise specified, lab reports must be done individually and they are due in 24 hours after lab. Late submission is acceptable if you have notified the instructor ahead of time.

Three written exams will be scheduled during regular class time. Dates are listed in the timetable near the end of this document. In addition, there is a cumulative final exam. All exams are conducted in closed book/notes format. Test materials are based on lectures, reading assignments, and lab reports. Past exam questions and extra practice problems will be posted in Moodle before the exams.

Your final grade is based on the percentage of total points earned for the course i.e. exams and lab reports. Letter grades are assigned according to the following scale:

A	93-100%	C	73-76
A-	90-92	C-	70-72
B+	87-89	D+	67-69
B	83-86	D	63-66
B-	80-82	D-	60-62
C+	77-79	F	0-59

Course Materials:
Required Textbook
Bioinformatics and Functional Genomics 3rd edition. 2015. Jonathan Pevsner. Wiley Blackwell. Skillman Library owns eBook licenses of the textbook.

Additional Materials
Additional learning materials such as lecture slides, extra reading materials, supplemental notes, and assignments will be disseminated through Moodle. Students are expected to check the course's Moodle site regularly.

Attendance Policy:
Attendance and class participation are critical to learning. Although attendance will not be taken for lectures, statistics tells that attendance highly correlates with the final grade. If there is in-class quiz, absentees will receive a zero for that quiz.

Federal Credit Hour Policy:

The student work in this course is in full compliance with the federal definition of a four [two or one as appropriate for half and quarter unit courses] credit hour course. Please see the Registrar's Office web site (http://registrar.lafayette.edu/additional-resources/cep-course-proposal/) for the full policy and practice statement.

Academic Honesty:
You are expected to abide by the college policy on Intellectual Honesty (see Student Handbook p.7).

Disability Statement:
In compliance with Lafayette College policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Requests for academic accommodations need to be made during the first two weeks of the semester, except for unusual circumstances, so arrangements can be made. Students must register with the Office of the Dean of the College for disability verification and for determination of reasonable academic accommodations.

Privacy Policy:
Moodle contains student information that is protected by the Family Educational Right to Privacy Act (FERPA). Disclosure to unauthorized parties violates federal privacy laws. Courses using Moodle will make student information visible to other students in this class. Please remember that this information is protected by these federal privacy laws and must not be shared with anyone outside the class. Questions can be referred to the Registrar's Office.

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Tentative Schedule for Lectures & Reading Assignment:

Week	Date	Major Topics	Assigned Reading
1	Aug 29	Course overview	Moodle:
	Aug 31	Bioinformatics showcases	"Nucleic acids,
	Sep 2	The structure of DNA and RNA	the Central Dogma"
2	Sep 5	The structure of DNA and RNA	
	Sep 7	The Central Dogma	
	Sep 9	The Central Dogma	
3	Sep 12	The Central Dogma	A Sickle cell article
	Sep 14	Globin gene cluster	Ch2 Pevsner
	Sep 16	Biological databases	
4	Sep 19	Biological databases	Ch2 Pevsner
	Sep 21	Biological databases	
	Sep 23	**Exam I (covers weeks 1-3)**	
5	Sep 26	Gene Expression	Ch11 Pevsner
	Sep 28	Gene Expression	
	Sep 30	**Exam I retake**	
6	Oct 3	Microarray	
	Oct 5	Microarray	
	Oct 7	T-statistic	
7	Oct 10	*- Fall Break -*	
	Oct 12	Correlation	Ch9 Pevsner
	Oct 14	Scatterplot	
8	Oct 17	DNA sequencing	Ch3 Pevsner
	Oct 19	Next Generation Sequencing	
	Oct 21	Next Generation Sequencing	
9	Oct 24	Pairwise sequence alignment	
	Oct 26	Similarity versus Homology	
	Oct 28	**Exam II (covers weeks 5-8)**	
10	Oct 31	Dotplot	Ch6 Pevsner
	Nov 2	Dotplot	
	Nov 4	Global & Local Alignment	
11	Nov 7	Global & Local Alignment	
	Nov 9	Multiple Sequence Alignment	Ch7 Pevsner
	Nov 11	BLAST	Ch4 Pevsner
12	Nov 14	BLAST Demo	
	Nov 16	BLAST Theory	
	Nov 18	BLAST Theory	
13	Nov 21	Phylogenetic Trees	
	Nov 23	*- Thanksgiving -*	
	Nov 25	*- Thanksgiving -*	
14	Nov 28	Phylogenetic Trees	
	Nov 30	UPGMA	
	Dec 2	**Exam III (covers weeks 10-13)**	
15	Dec 5	Maximum likelihood tree	
	Dec 7	Protein structure	Moodle: "Protein
	Dec 9	Protein structure	Folding & Chimera"

Tentative Lab Schedule:

Week	Major Topics
1	Lab 1 - Movie week
2	No lab
3	Lab 2 – Biological information in NCBI
4	No lab
5	No lab
6	Lab 3 - Microarray data analysis
7	No lab – Fall break
8	Lab 4 – RNA-Seq
9	Lab 5 - RNA-Seq
10	No lab
11	Lab 6 – Sequence alignment 1
12	Lab 7 – BLAST
13	No lab
14	Lab 8 - Phylogenetic trees
15	Lab 9 - Protein visualization

Useful Links:

1. Lecture notes, additional reading materials, quizzes, and announcements are disseminated through Moodle http://moodle.lafayette.edu
2. NCBI educational resources: http://www.ncbi.nlm.nih.gov/education/
3. Biomedical literatures database, PubMed: http://www.ncbi.nlm.nih.gov/pubmed/
4. Web of Science: http://0-webofknowledge.com.libcat.lafayette.edu/WOS
5. Understanding evolution: http://evolution.berkeley.edu/evolibrary/article/evo_01
6. Chimera tutorials: http://www.cgl.ucsf.edu/chimera/tutorials.html