BIOL 274 – Introduction to Bioinformatics – Fall 2015

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

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 genomic and information technologies makes many once thought unattainable scientific pursuits possible such as the human genome project. The era of bioinformatics has arrived. Fusing experimental and computational methods in studying complex biological questions becomes a routine process for today's biologists.

This course provides a comprehensive overview of bioinformatics – the application of computational and information sciences in studying biology. The focus is to learn prevalent computational approaches used by biologists. Major topics include DNA/RNA/Protein sequence analysis, biological databases, gene expression analysis, protein structure, molecular phylogeny, and system biology. Basic understanding of statistics is preferable but not mandatory. No prior computer programming knowledge is required.

Additionally, lab classes are coupled with major topics discussed in lectures. The purpose is to provides students hands-on experience in using biological databases and tools to investigate a real biological problem such as identifying exons and introns of a novel sequence, highlighting the active sites of a protein structure, 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
- Conduct sequence analysis
- Visualize and compare genomes from different species
- Identify special purpose databases in supporting their biological research
- Analyze high throughput gene expression data
- Utilize modeling tools to understand protein folding
- Construct phylogenetic trees using DNA/protein sequences
- Obtain a quantitative picture of how genes interact in a network

Prerequisites:
BIOL 101 or 102

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Grading Policy:

- 10 labs (total 40%)
- Two in-class exams (15% each) and a cumulative final exam (30%) (total 60%)

Students are required to submit lab reports to Moodle. Unless otherwise specified, lab reports must be done individually and they are due in 24 hours after lab. Notify your professor ahead of time to avoid late penalty if you anticipate late submission.

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

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. Library has a ebook edition.

Additional Materials

In order to save trees, lecture slides, reading materials, supplement 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 31	Course overview	
	Sep 2	Bioinformatics showcase	
	Sep 4	The structure of DNA and RNA	
2	Sep 7	The structure of DNA and RNA	
	Sep 9	The Central Dogma	
	Sep 11	Biological databases	
3	Sep 14	Biological databases	
	Sep 16	Biological databases	
	Sep 18	Pairwise sequence alignment & dotplot	
4	Sep 21	MSA & BLAST	
	Sep 23	BLAST report	
	Sep 25	BLAST & Score matrices	
5	Sep 28	Score matrices	
	Sep 30	Mini-review	
	Oct 2	Exam 1 (covers from the beginning to Sep 28)	
6	Oct 5	BLAST search	
	Oct 7	Comparative genomics	
	Oct 9	Gene finding	
7	Oct 12	- Fall Break -	
	Oct 14	Hidden Markov Model	
	Oct 16	Hidden Markov Model	
8	Oct 19	Gene expression analysis	
	Oct 21	DNA Microarray	
	Oct 23	DNA Microarray data analysis	
9	Oct 26	T-statistic and t-test	
	Oct 28	Clustering	
	Oct 30	Next Generation Sequencing	
10	Nov 2	Next Generation Sequencing	
	Nov 4	Mini-review	
	Nov 6	Amino acids	
11	Nov 9	Protein structure	
	Nov 11	Protein structure + PDB video	
	Nov 13	Exam2	
12	Nov 16	Phylogenetic trees	
	Nov 18	Phylogenetic trees	
	Nov 20	UPGMA	
13	Nov 23	Neighbor joining tree	
	Nov 25	- Thanksgiving -	
	Nov 27	- Thanksgiving -	
14	Nov 30	NJ tree	
	Dec 2	Maximum likelihood	
	Dec 4	ML Tree	
15	Dec 7	*- No class due to special academic duty -*	
	Dec 9	*- No class due to special academic duty -*	
	Dec 11	*- No class due to special academic duty -*	Final Exam (to be scheduled)

Tentative Lab Schedule:

Week	Major Topics
1	No lab – first week
2	Lab1 – Movie week
3	Lab2 – Biological information in NCBI
4	Lab3 - DNA & protein sequence alignments
5	No lab – Exam 1
6	Lab4 - BLASTn, BLASTp, BLASTx, tBLASTn
7	No lab – Fall break
8	Lab5 – Genome Browser
9	Lab6 - Computational gene prediction
10	Lab7 – Sequencing technologies
11	Lab8 – Protein visualization
12	Lab9 - Phylogenetic trees
13	Lab10 - TBD
14	No lab - Thanksgiving
15	No lab due to special academic duty

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