BIOL 274 – Introduction to Bioinformatics – Fall 2013

Instructor: Dr. Eric S. Ho (hoe@lafayette.edu)
Office: Kunkel 13
Office hours: Tuesday, Thursday 2-4 pm (or by appointment)

Time: MWF 11:00-11:50am
Venue: Kunkel 117

Course Description:
"The End of Theory: The Data Deluge Makes the Scientific Method Obsolete" – Chris Anderson, Wired Magazine 06.23.08.

"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.

Information and genomic technologies advance at accelerating pace which result in voluminous amount of experimental data awaiting for interpretation. Bioinformatics and computational biology empower today's scientists to leverage on data for making major discovery.

This course provides a comprehensive overview of bioinformatics – the use of information science to study biology. It emphasizes using computational tools and databases to solve biological problems. Major topics include DNA/RNA/Protein sequence analysis, genome annotation, protein visualization, molecular phylogeny, and system biology. Basic understanding of statistics is preferable but not mandatory. No prior computer programming knowledge is required and no computer programming will be taught in this course.

Learning Outcomes:
At the completion of this course, students should be able to:
- Use tools and databases to unlock biological information encoded in DNA/RNA/protein sequences
- Interpret sequence analysis reports
- Visualize genome organization of various species
- Choose special purpose databases to study their biological problems
- Utilize visualization tool to understand protein structures
- Construct phylogenetic trees using DNA/protein sequences
- Obtain a quantitative picture of how genes interact in a network
- Formulate bioinformatics methods to study biological problems
- Incorporate bioinformatics elements in research projects
- Learn other bioinformatics tools and databases by themselves

Prerequisites:
BIOL 101 or 102

BIOL 274 – Introduction to Bioinformatics – Fall 2013

Grading Policy:

- Participation (5%)
- Assignments x7 (5 points each, total 35%)
- Exams x3 (20 points each, total 60%)

Quizzes are short answer questions based on required readings or lecture materials. Quizzes are administrated in Moodle.

Assignments contain longer questions that could involve accessing certain websites, extracting information, interpreting results, etc. Unless otherwise specified, assignments must be done individually. Usually, they are due in a week.

Late assignment:

- If submission is late but within 24 hours of due time (Moodle time), it will still be graded but 50% of the actual earned points will be deducted, e.g. the assignment has earned 4 points out of 5, only 2 points will be given.
- If submission is late by more than 24 hours of due time, it will not be graded and receive zero point.

Required Textbook:

Introduction to Bioinformatics 3rd edition, Arthur M. Lesk, Oxford University Press

Students are required to read the assigned readings either from the textbook or supplement articles. Examinations are based on materials from lectures AND the textbook.

Academic Honesty:

You are expected to abide by the college policy on Intellectual Honesty (see student handbook and attached document).

Useful Links:

1. Lecture notes, additional reading materials, quizzes, assignments, and announcements are disseminated through Moodle http://moodle.lafayette.edu
2. NCBI outreach and education: http://www.ncbi.nlm.nih.gov/About/outreach/courses.html
3. A science primer http://www.ncbi.nlm.nih.gov/About/primer/index.html
4. Biomedical literatures database, PubMed: http://www.ncbi.nlm.nih.gov/pubmed/
5. Web of Science: http://0-webofknowledge.com.libcat.lafayette.edu/WOS
6. Understanding evolution: http://evolution.berkeley.edu/evolibrary/article/evo_01

BIOL 274 – Introduction to Bioinformatics – Fall 2013

Week	Date	Major Topics	Assigned Reading
1	Aug 26	Introduction and overview of the course	
	Aug 28	The Central Dogma	Ch1 6-9
	Aug 30	Pairwise DNA sequence alignment	Ch5 242-254
2	Sep 2	Global and local sequence alignment	Ch5 261-267
	Sep 4	Score matrices	Ch5 254-258
Add/Drop	Sep 6*	Pairwise protein sequence alignment	Ch5 242-254
3	Sep 9	NCBI Entrez	Ch1 9-16, Ch4 219-234
	Sep 11	Other biological databases	Ch1 9-16, Ch3 137-161, 174-180
	Sep 13	Sequence based database query	Ch5 258-261
4	Sep 16	The BLAST Suite	Ch5 258-261
	Sep 18	Fasta, GenBank, and BLAST report	Ch5 258-261
	Sep 20	Advanced BLAST searching	
5	Sep 23	Mini-review	
	Sep 25	Useful tools for the lab	
	Sep 27	Exam 1 (Aug 26 - Sep 20)	
6	Sep 30	Useful tools for the lab	
	Oct 2	Genome organization – Eukaryotes	Ch2
	Oct 4	Genome organization – Prokaryotes and Viruses	Ch2
7	Oct 7	Genome Browser	
	Oct 9	Gene Expression analysis	
	Oct 11	DNA Microarray	
8	Oct 14	- Fall break -	
	Oct 16	DNA Microarray	
	Oct 18	Next Generation Sequencing	
9	Oct 21	MicroRNAs	
	Oct 23	MicroRNAs	
	Oct 25	Mini-review	
10	Oct 28	Exam 2 (Sep 25 – Oct 18)	
	Oct 30	Protein building blocks	Ch6
	Nov 1	Protein structure	Ch6
11	Nov 4	Protein Data Bank	Ch6
	Nov 6	Protein visualization	Ch6
	Nov 8	Multiple sequence alignment	Ch5 271-276
12 WD	Nov 11*	Multiple sequence alignment	Ch5 271-276
	Nov 13	Molecular evolution	Ch1 4-6
	Nov 15	Phylogenetics trees	Ch5 281-297
13	Nov 18	Phylogenetics trees	Ch5 281-297
	Nov 20	Phylogenetics trees	Ch5 281-297
	Nov 22	Pathway database KEGG	Ch4 213-218
14	Nov 25	System biology	Ch7
	Nov 27	- Thanksgiving -	
	Nov 29	- Thanksgiving -	
15	Dec 2	System biology	Ch7
	Dec 4	Translational Bioinformatics	
	Dec 6	Review	
		Final Exam (to be scheduled)	