ENS 210: Computational Biology - Fall 2013

(November 26, 2013)

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Lectures: Tue 11:40-13:30 FENS L030
Thr 11:40-12:30 FASS 2031

Recitation: Thr 9:00-10:30 FENS 2072

Course Description: The aim of this course is to introduce some of the major contributions of computers to molecular biology. The presentation is organized around four main themes: visualization and manipulation of molecular structures, the flow of information from DNA sequences to proteins, quantitative comparison of protein sequences, and evolutionary implications of sequence analysis. (A detailed list of the course content is given below.) While following this thread of topics, students will learn about the information that is stored in the genomes of organisms, will get familiar with databases making this genetic information available, and will develop programming and analytical skills to manipulate this information. Because the course is geared towards undergraduate students in their second year, previous exposure to biology is assumed to be on the level of NS 102. Familiarity with programming on the level of CS 201 is expected to be helpful.

Evaluation:

Homeworks & quizzes	25 %
Exam 1	25 %
Exam 2	25 %
Final exam	25 %

Textbooks:

Perl	Tisdall, *Beginning Perl for Bioinformatics*, O'Reilly, 2001.
Databases	Agostino, *Practical Bioinformatics*, Garland Science, 2013.
Algorithms	Setubal & Meidanis, *Introduction to Computational Molecular Biology*, PWS, 1997.
Evolution	Higgs & Attwood, *Bioinformatics and Molecular Evolution*, Wiley-Blackwell, 2005.

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Detailed Course Content:

	lecture topic	*recitation activity*
Sep 24	General information about the course	
Sep 26	Introduction to the molecules of life	*No recitation*
Oct 1	From hydrogen bonds to protein and DNA structures	
Oct 3	Chargaff's first and second rules	*Testing Chargaff's second rule (Perl)*
Oct 8	B-DNA, replication, EC #, GenBank, PDB, A-RNA	
Oct 10	Gamow's diamonds and triangles	*Morphing double helices (Perl, VMD)*
Oct 15 Oct 17	Semester Break	
Oct 22	Poisson distribution, language, and protein sequences	
Oct 24	Nonoverlapping, comma-free codes	*Randomizing DNA sequences (Perl)*
Oct 29	National Holiday	
Oct 31	The genetic code	*Pair probabilities as %hash (Perl)*
Nov 5	Transcription, translation and open reading frames	
Nov 7	Control of gene expression: the *lac* operon	*Make-up recitation*
Nov 12	Random genome from Markov chain	
Nov 14	Edit distance and comparison of two sequences	*Exploring the RNY codon rule*
Nov 19	**First Exam**	
Nov 21	Introduction to sequence alignment	*Solving the exam problems*
Nov 26	Dynamic programming	
Nov 28	Jukes-Cantor model of DNA evolution	*Finding promoters in E. coli*
Dec 3	Amino acid substitution matrices PAM, BLOSUM	
Dec 5	BLAST and FASTA	*Aligning protein sequences*
Dec 10	BLASTN, BLASTP, BLASTX, and TBLASTN	
Dec 12	Introduction to phylogenetic trees	*BLAST and databases*
Dec 17	Building phylogenetic trees	
Dec 19	The tree of life	*Your first phylogenetic tree code*
Dec 24	**Second Exam**	
Dec 26		*Solving the exam problems*
Dec 31	Codon usage bias and origin of the genetic code	
Jan 2	Further topics in Bioinformatics	*No recitation*