
BNF 5106 / BIOL 5515 BIOINFORMATICS

Course description

Major concepts and methods of bioinformatics. Topics may include, but are not limited to: genetics, statistics & probability theory, alignments, phylogenetics, genomics, data mining, protein structure, cell simulation and computing.

Textbook

Deonier RC, Tavaré S and Waterman MS. 2005. *Computational genome analysis*. Springer, New York. [ISBN-10: 0387987851; availability: <http://www.springerlink.com/content/g71507/?p=b5409bac8d9f48b9968ac2dc14020fea&pi=0>]

Evaluation

Mini-review papers (two in total)⁽¹⁾: 40% (20% + 20%)

Research seminar⁽²⁾: 60% (30% + 30%)

1. Students will have to write two short reviews (one per half term; up to five pages plus one page of references) on an imposed topic extending the concepts covered in class.
2. Students will present a research seminar individually or by groups of twos. Research topics can be suggested, although students are encouraged to submit their own. A computational component is required.

Times & location

Mondays	01:00-02:30	Desmarais Building (DMS) 8143.
Wednesdays	11:30-01:00	DMS 8143.

Coordinator

Dr Stéphane Aris-Brosou
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Office hours: Fridays 2-5pm and by appointment.

Syllabus

(Not contractual, subject to change without notice.)

Week	Lect.	Date	Topic	Instructor
1	1	Sep 9	- Introduction	Aris-Brosou
2	2	Sep 14	- Basics of Genetics (organisms, central dogma, genetics code, promoters)	Drouin
	3	Sep 16	- Overview of Statistics I (random variables, distributions, likelihood, conditional probability, estimation, testing)	Aris-Brosou
3	4	Sep 21	- Overview of Statistics II (stochastic processes, inference for stochastic processes)	Aris-Brosou
	5	Sep 23	- NGS for genome acquisition	Aris-Brosou
4	6	Sep 28	- Pairwise alignments	Aris-Brosou
	7	Sep 30	- Pairwise alignments and database searches	Aris-Brosou
5	8	Oct 5	- Multiple sequence alignments [MSA]	Aris-Brosou
	9	Oct 7	- Application of MSA I: model-based phylogenies, likelihood	Aris-Brosou
6	10	Oct 12	- Application of MSA II: model-based phylogenies, Bayesian approaches	Aris-Brosou
	11	Oct 14	- Application of MSA III: on the use and uses of codon models	Rodrigue
7	12	Oct 19	- Genome rearrangement algorithms	Sankoff
	13	Oct 21	- RNA structure prediction & motifs	Turcotte
8	14	Oct 26	- <i>Study Week (no class)</i>	—
	15	Oct 28	- <i>Study Week (no class)</i>	—
9	16	Nov 2	- Hidden Markov models	Aris-Brosou
	17	Nov 4	- Machine learning in bioinformatics	Green
10	18	Nov 9	- RNA transcription and microarrays	Aris-Brosou
	19	Nov 11	- Causes of cell-to-cell variability in response to the mutagenic small molecule MMS	Phenix
11	20	Nov 16	- Estimating gene regulatory relationships based on expression	Perkins
	21	Nov 18	- New directions in cancer 'omics	Lee
12	22	Nov 23	- Course evaluation; High performance computing for bioinformatics	Palidwor
	23	Nov 25	- Computational approaches in studying mechanisms of gene regulation	Ioschikhes
13	24	Nov 30	- Lipid structure and prediction in lipidomics	Bennett
	25	Dec 2	- Oral presentations [‡] : TBD	Aris-Brosou
14	26	Dec 7	- Oral presentations [‡] : TBD	Aris-Brosou

[‡]: **10-minute presentations, followed by 2 minutes of discussion**; remember to outline the biological question first, to provide the computational solution to a naive audience (“self contained” presentation) and to give preliminary results where applicable; you will need to discuss and provide evidence of a good understanding of the potential limits of your approach. **Final reports (research projects) due by Dec 14, 5pm. Submit PDF only, by email. Note: final submissions should be formatted as a research manuscript in ≤ 20 pages, inclusive** (see lecture notes for layout specification).