Syllabus

Course Title: Introduction to phylodynamics: a practical approach to molecular phylogenetics of pathogens

Instructor: Marco Salemi, Ph.D.
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Office Hours: Every Wednesday 10:00am-12:30pm

Course Objectives and class meeting times
Teaching objectives: by the end of the course the students will have a solid understanding of the basic principles of molecular evolution, tree-building algorithms (distance, maximum likelihood and Bayesian based methods), molecular clocks theory, and coalescence theory. They will also be able to analyze real molecular sequence data (using HIV and HCV data sets) with the MEGA5 and BEAST software programs, to infer maximum likelihood and Bayesian trees, calibrate a molecular clock and use coalescence models to investigate the demographic history of microbial epidemics and the relationship between intra-host viral evolution and pathogenesis. Class meeting times: course starts January 15th 2013 and ends March 28th 2013 (10 weeks); class meets every Tuesday and Thursday 10:00 am - 12:30 pm. Final exam, April 11th 2013.

Amount of credit: 3

Course Outline

Week 1: Principles of molecular evolution.

- An overview of the evolutionary theory at the molecular level
- Examples of phylodynamic analysis applied to the study of microbial pathogens (HIV, HCV and MRSA)

Week 2: Evolutionary distance and nucleotide substitution models

- The concept of evolutionary distance
- An introduction to Markov models

Week 3: Phylogenetic Inference using distance methods

- Complex nucleotide substitution models
- Distance methods in phylogenetic-tree reconstruction

Week 4: Phylogenetic Inference using maximum parsimony and maximum likelihood methods
- Occam's razor and phylogenetic inference
- Maximum Likelihood function and calculating the likelihood of a tree

Week 5: Tree searching
- Heuristic tree-search algorithms
- Introduction to Mega4 (practical computer section)

Week 6: Phylogenetic Inference using Bayesian methods
- Bayes Theorem, Markov Chain Monte Carlo (MCMC) methods and their applications to molecular phylogenetics
- Introduction to MrBayes (practical computer section)

Weeks 7: Molecular clocks and Basic coalescence

- Strict and relaxed molecular clocks
- Kingman's coalescence

Weeks 8: Testing evolutionary hypothesis

- Phylodynamic hypothesis testing
- Introduction to BEAST (practical computer section)

Week 9: Special topics: recombination and phylogeography
- The impact of recombination and phylogenetic noise in phylogenetic inference: Trees versus Networks
- A brief introduction to phylogeography

Week 10: Inter- and intra-host Phylodynamics

- Discussing phylodynamic papers (journal club)
- Phylodynamics with BEAST (practical computer section)

Students' evaluation
Evaluation will include the following: participation in discussions during classes, 10% (10 points); journal club presentation, 10% (10 points); final written exam, 80% (80 points). Point cut-offs for letter grades:

A	A–	B+	B	B–	C+	C	C–	D+	D	D–	F
95-100	90-94	87-89	83-86	80-82	77-79	73-76	70-72	67-69	63-66	60-62	<60

Information on current UF grading policies for assigning grade points can be found at the following web site: http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html.

Recommended textbooks
No textbook is required, but chapters from the books listed below and assigned scientific journal articles will be used for readings and discussion material.
- *The phylogenetic handbook: a practical approach to phylogenetic analysis and hypothesis testing,* 2008, Lemey P, Salemi M and Vandamme AM, Cambridge University Press, New York
- *Inferring phylogenies*, 2004, Felsenstein J, Sinauer Associates Inc, Sunderland, MA.

Class attendance and make-up exams policy
Attendance to all lessons is expected. Excused absences follow the criteria of the UF Graduate Catalogue (e.g., illness, serious family emergency, military obligations, religious holidays), and should be communicated to the instructor prior to the missed class day when possible. Regardless of attendance, students are responsible for all material presented in class and meeting the scheduled due dates for class assignments. Personal issues with respect to class attendance or fulfillment of course requirements will be handled on an individual basis.

Accommodations for Students with Disabilities
Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.