Syllabus – GMS 6234

Course Title: Introduction to phylodynamics of pathogens

Instructor: Marco Salemi, Ph.D.
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Gainesville, FL 32610-3633, U.S.A.
Tel +1 352 273 9567, Email: salemi@pathology.ufl.edu

Office Hours: Every Tuesday and Thursday 4:00pm – 5:00pm, please contact Karen Cox (kcox@ufl.edu) to make an appointment

Course registration: Please contact Linda Harlan: lburch@pathology.ufl.edu

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 V. cholerae data sets) to infer maximum likelihood (IQ-TREE) and Bayesian trees (BEAST), 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 (BEAST). Class meeting times: course starts June 5th 2018 and ends August 2nd 2018 (8 weeks); class meets every Tuesday and Thursday 1:00 pm – 4:00 pm (Periods 6-8). Final exam, August 7th 2018.

Amount of credit: 3

Course Outline

Week 1a – 06/5/2018 – Principles of molecular evolution

- An overview of the evolutionary theory at the molecular level

Week 1b – 06/07/2018 – Phylodynamics and its applications to the study of microbial pathogens

- Phylogenetic trees: basic definitions and topology
- Basic concepts in phylodynamics

Week 2a – 06/12/2018 – Phylodynamics and its applications to the study of microbial pathogens

- Examples of phylodynamic analysis applied to the study of microbial pathogens (HIV, HCV, influenza and V. cholerae)

Week 2b – 06/14/2018 – Evolutionary distance and Phylogenetic Inference using distance methods

- An introduction to Markov models
- Distance methods in phylogenetic-tree reconstruction
Week 3a – 06/19/2018 – Phylogenetic Inference using maximum parsimony methods

- Occam’s razor and phylogenetic inference
- Maximum Parsimonious Reconstructions of genealogical histories

Week 3b – 06/21/2018 – Phylogenetic Inference using Maximum Likelihood methods and hypothesis testing

- Likelihood function and phylogeny inference
- Testing phylogenetic hypotheses: bootstrapping and likelihood ratio based test

Weeks 4a – 07/03/2018 – Phylogenetic Inference using Bayesian methods

- Bayes Theorem
- Markov Chain Monte Carlo (MCMC) methods and their applications to molecular phylogenetics

Weeks 4b – 07/05/2018 – **Practical Computer Session**: Phylogeny inference with distance and likelihood based methods

- Introduction to Mega7, IQTREE and FigTree
- Inferring and interpreting phylogenies of viral data sets

Week 5a – 07/10/2018 – **Practical Computer Session**: Bayesian phylogeny inference with MrBayes

- Introduction to MrBayes
- Phylogenetic analysis with MrBayes

Weeks 5b – 07/12/2018 – Molecular clocks and Basic coalescence

- Strict and relaxed molecular clocks
- Kingman’s coalescence

Weeks 6a – 07/17/2018 – Advanced coalescence

- Parametric and non-parametric demographic models
- BEAST implementations

Week 6b – 07/19/2018 – **Practical Computer Session**: Bayesian phylogeny inference with BEAST

- Clock testing with BEAST
- Population demography reconstruction with BEAST

Week 7a – 07/24/2018 – Introduction to Phylogeography

- Inferring gene flow from microbial phylogenies
- Bayesian phylogeography

Week 7b – 07/27/2018 – **Practical Computer Session**: Bayesian phylogeography with BEAST
Phylogeography inference with BEAST
Phylogeography mapping with SPREAD

Week 8a – 07/31/2018 – Phylogenetic signal and recombination

- Phylogenetic signal and phylogenetic noise
- Brief overview of recombination detection methods

Week 8b – 08/02/2018 – Phylodynamics and Phylogeography Journal Club

- Discussing phylodynamic/phylogeography papers (journal club)

Students’ evaluation
Evaluation will include the following: participation in discussions during classes, 10% (10 points); journal club presentation, 30% (30 points); final written exam, 60% (60 points). Point cut-offs for letter grades:

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Information on current UF grading policies for assigning grade points can be found at the following website: [http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html](http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html).

Course material and Recommended textbooks
University of Florida SAKAI e-learning suite: syllabus, lesson plans, lecture slides, assigned papers, and homework for Introduction to Phylodynamics will all be accessible online. The exact address will be provided to the students by email prior to class starting.

Required textbook:

Suggested (but not mandatory) readings:

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.