WFSC/GENE 648
Molecular Evolution
Spring 2018

Course Syllabus

Time and Location: TBA
The time will be set up before the first week of class. I will set up a doodle to find the time that works for most students.

Instructor
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Office Hours: by appointment
Office: HFSB 317

Course Description
Students in this course will examine the theory and tools used in the analysis of molecular evolutionary patterns of DNA, RNA and protein sequences. The course format combines lecture presentations by the instructor, discussion of relevant scientific literature, computer exercises, preparation of an independent research project, oral presentations, and practice in the peer-review process.

Prerequisites
Basic knowledge and courses in genetics, evolution, and statistics are required for enrollment. More advanced courses, such as phylogenetics and population genetics, are suggested as prerequisites to fully achieve the learning outcomes designed for this course.

Learning Outcomes
At the end of the course students should be able to: (1) explain how the forces of evolution act at the molecular level; (2) apply molecular evolution computational methods to analysis of molecular data and interpretation of molecular evolutionary patterns; (3) critically analyze and evaluate current research and the work of peers (including written reviews); (4) prepare research manuscripts for peer-reviewed scientific journals; and (5) deliver concise and coherent oral arguments and research presentations.

This course will provide students with a theoretical background, some practical tools, and some hands-on experience in molecular evolution studies. In addition, students will practice important skills such as critical thinking, manuscript writing, peer-review, and public presentation.

Course credit
3 semester hours, based on two one-hour lectures/discussions per week.

Recommended Books (no textbook required)
- Lynch, M. 2007. The Origins of genome Architecture. Sinauer
- Graur, D. 2016. Molecular and Genome Evolution. Sinauer

Assignments

Student-led discussions. Each student will lead several classroom discussions based on reading assignments (papers). The schedule of the discussions for the whole semester will be set up in the first week of class. Students in charge of the discussion will introduce assigned papers using slides (PowerPoint, PDF, Keynote, etc.), which should be sent to me for review at least 3 days before the discussion. A list of reading assignments (papers) for each topic will be given before the beginning of the semester and further reading assignments might be provided throughout the semester. Students are welcome to suggest papers to read on specific topic as long as they do so at least a week before the scheduled discussion on that topic.

Reading assignment questionnaire. Each student is required to send, *via email only*, a filled in discussion questionnaire provided by me prior to the discussion session.

In-class participation. Each student is required to participate in paper discussions with questions, comments, and insights. Students can use their completed questionnaire to facilitate their participation.

Homework assignments. There will be 4 homework assignments based on exercises shown in the classroom. They will be due within two weeks of their assignment.

Final projects. A major goal of the course is for students to be able to develop a research project in any area of molecular evolution. The requirements for the project are: 1) It must be a novel, unpublished research; 2) It can be a small scale analysis (e.g., a study aimed at finding positive selection amino acids in a single gene family) or a genome-wide analysis (e.g., a study of de novo gene formation in a group of genomes, an analysis of horizontal gene transfers across a range of organisms, etc.); 3) It can be tied to a current research project of one or more students, but it cannot be entirely based on an ongoing or finished dissertation chapter; 4) It must be carried out by teams of up to three students; 5) It must lead to a written assay of 8-12 double-spaced pages of text with additional pages of references and at least one figure. Each team will present their project at the end of the semester. A draft of the project is required by the end of week 8, and a paper describing the final project will be due two weeks before the end of class. Each student will provide a written review (up to a page in length) for the final project papers of all other teams.
In the first week of class I will introduce all major topics of the course, together with an array of examples of projects that can be developed into final projects. Final project teams will be assembled during the first week of the course; teams will identify a project of interest and discuss it with me by the end of week 2. Although I will encourage teams to self assemble, I will also make sure that they have an appropriate balance between graduate students with different expertise and experience.

Note on using TAMU computer clusters
Each student is required to set up an account at the TAMU HPRC (High Performance Research Computing): https://hprc.tamu.edu/user_services/#accounts. The Ada cluster (https://hprc.tamu.edu/wiki/Ada) will be used for some homework assignment and might be used for the final projects.

Grading
[91–100% = A; 81–90% = B; 71–80%= C; 61–70 = D; ≤ 60 = F]

Grades will be based on:
- Leading paper discussion (10%)
- In-class participation (10%)
-Questionnaires on reading assignments (10%)
-Homework assignments (20%)
-Final project in-class presentation (10%)
-Final project paper (30%)
-Review of other project papers (10%)

Late submissions will result in grade penalties.

Attendance
Students are responsible for providing satisfactory evidence to substantiate the reason for an absence. Among the reasons absences are considered excused by the university are the following (see Student Rule 7 for details http://student-rules.tamu.edu/rule07).

Americans with Disabilities Act (ADA)
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit http://disability.tamu.edu

Academic Integrity Statement and Policy
Aggie Honor Code: "An Aggie does not lie, cheat, or steal or tolerate those who do."
Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning and to follow the philosophy and rules of the Honor System. Ignorance of the rules does not exclude any member of the Texas A&M University community from the requirements or the processes of the Honor System. For additional information please visit http://aggiehonor.tamu.edu/ . On course work, assignments, and examinations at Texas A&M University, you may be asked to sign the following Honor Pledge:
"On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work."

Course Schedule (Subject to Change)

Week 1	Introduction to molecular evolution The neutral theory of molecular evolution at 50!
Week 2	Evolution of the gene architecture
Week 3	Mutations and substitutions,
Week 4	Signatures of natural selection and adaptation in molecular sequences *Exercise 1*: Making DNA and protein alignments, detecting positive selection using comparative genomics
Week 5	Molecular clock, molecular phylogenetics and phylogenomics
Week 6	Gene family evolution through gene duplication and gene loss Homework 1 due *Exercise 2*: Intro to the TAMU Ada cluster applications in bioinformatics. Reconstructing gene family evolution using maximum-likelihood
Week 7	Horizontal gene transfer, *de novo* gene formation
Week 8	Transposable elements, genome evolution and innovation *Exercise 3*: Using the UCSC Genome Browsers and Galaxy in comparative and population genomic analyses ***First submission of final project paper***
Week 9	Genome variation: studying SNPs and CNVs using next-gen techniques *Exercise 4*: Detecting CNVs in population genomics datasets Homework 2 due
Week 10	Whole-genome duplications, gene dosage and evolution Homework 3 due
Week 11	Evolution of gene expression variation Homework 4 due
Week 12	Molecular convergent evolution ***Project papers due***
Week 13	Molecular evolution and disease
Week 14	Final projects presentations