Professors:
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GSI:
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Meeting Times:

Lectures are Mon, Wed, and Fri, 11:00–12:00pm in 3083 VLSB
Lab is Wed., 2:00-5:00 pm in 3083 VLSB

Office hours for all professors and the GSI are by appointment. E-mail is often the easiest way to contact us or just track us down before or after class to schedule an appointment.

Our class webpage is **http://ib.berkeley.edu/courses/ib200/** -- please check this often as it will have class announcements

Textbook (required): *Tree Thinking: An Introduction to Phylogenetic Biology*, by David Baum & Stacey Smith (1st Ed.), published by Roberts and Company. We will assign chapters that should be read ahead of the corresponding lecture; the material in that chapter will not be repeated in lecture but rather it will be used as a starting point for the lecture.

Readings & Lecture:

Each lecture you will be provided with a handout outlining the key concepts to be covered that day. Prior to each lecture there will be assigned reading from the textbook and/or one or two articles from the literature, which will give some background on the topic and facilitate discussion of these concepts during the lecture. The required reading will be posted on the class webpage and should be read before class. The class webpage also lists several additional important readings for each topic so that you may delve deeper into those topics which interest you most or which may be related to your final project.

Labs:

Lab exercises will be done on personal computers – you must have access to one that you can bring to class, a laptop is obviously preferable. Handouts will be given for each lab highlighting the program and specific assignments for the day. Prior to labs you will be asked to download programs and files onto your computer. It is to your advantage to download all software prior to your arrival in lab in order to maximize the time spent exploring the program capabilities and minimize troubleshooting.

Grading:

(1/3) **Participation.** Do the reading, come to each class and lab, and participate in discussions. A few homework assignments will also be given.
(1/3) **Quizzes.** Two equally-weighted, one-hour quizzes will be given that emphasize problem solving and conceptual understanding.
(1/3) **Final Project.** An oral presentation during the minisymposium and a written report in a professional journal format. [See below]

Final Project:

This will be a substantive, tree-building and comparative analysis using data from a group of the student's choice (with approval of the instructors; we encourage the study of thesis-related or other study groups). Based on phylogenetic trees that you generate, the project should apply all appropriate comparative methods to evaluate several types of comparative questions. There should also be a rigorous critique of previous comparative literature on the organismal group of choice. A written report will be turned in during finals week, in the form of a professional journal publication, that is, with an introduction (containing the literature review and critique), materials and methods section, results (using summary figures – no raw data), and a discussion (being sure to compare results from the different methodologies applied, and to reach some biological conclusions). We will have a minisymposium at the end of the term (**tentatively scheduled for May 6th**) where students will give a short presentation of their results.

Tentative Schedule:

Week 1:
Jan. 20. Introduction - contemporary issues in phylogenetic systematics - what is at stake? (KWW)
LAB: discussion: student interests; get acquainted roundtable; Tour of systematics collections, labs, and resources in VLSB
Jan. 22. Introduction - contemporary issues in comparative methods (DDA)

Week 2:
Jan. 25. History & philosophy of phylogenetics; the Hennig Principle: homology; synapomorphy (BDM)
Jan. 27. Morphological data I: Character analysis; What is a data matrix? Homoplasy; Ontogeny & structure of plants & animals; The role of morphology (BDM)
LAB: Discussion about homology; Introduction to Nexus and Newick files; Introduction to FigTree and Mesquite
Jan. 29. Morphological data II: Character coding [primary homology, polarity, additivity, etc.]; (KWW)

Week 3:
Feb. 1. Molecular data I: General introduction; types of molecular data (DNA hybridization; allozymes; restriction sites, DNA sequences, ESTs; comparative genomics) (BDM)
Feb. 3. Molecular data II: Sequence alignment (KWW)
LAB: **PROJECT TOPIC DUE -- discuss in class**; introduction to GENBANK and FASTA files; BLAST; sequence analysis and alignment (Clustal, Muscle, AliView)
Feb. 5. Phylogenetic trees I: reconstruction; models, algorithms & assumptions (BDM)

Week 4:
Feb. 8. Phylogenetic trees II: Phenetics; distance-based algorithms (KWW)
Feb. 10. Phylogenetic trees III: Parsimony; Measures of support and robustness (KWW)
LAB: Distance and parsimony inference using PAUP*; UPGMA, neighbor-joining, bootstrap and jackknife
Feb. 12. Phylogenetic trees IV: Maximum likelihood; molecular evolution and phylogenetics (KWW)

Week 5:
Feb. 17. Phylogenetic trees V: Bayesian methods and Markov chain Monte Carlo (WF)
LAB: Maximum likelihood inference; models of DNA sequence evolution; jModelTest and PAUP*; RAxML and CIPRES supercomputer web interface
Feb. 19. Phylogenetic trees VI: Dating in the 21st century: clocks, & calibrations; proper use of fossils (KWW)

Week 6:
Feb. 22. Phylogenetic trees VII: Tree-to-tree comparisons; consensus methods; supertrees (KWW)
Feb. 24. Introduction to statistical thinking in phylogenetics (DDA)
LAB: Bayesian inference using MrBayes and BEAST; Tracer; molecular clocks and fossil calibrations
Feb. 26. Qualitative character evolution within a cladogram I: discrete states; ancestral state reconstructions (DDA)

Week 7:
Feb. 29. Qualitative character evolution within a cladogram II: comparing two or more characters (DDA)
Mar. 2. Quantitative character evolution within a cladogram I: intro; ancestral trait reconstruction; phylogenetic conservatism (DDA)
LAB: Intro to R; Basic Phylogenetic Functions in R
Mar. 4. Quantitative character evolution within a cladogram II: independent contrasts and trait correlations (DDA)

Week 8:
Mar. 7. Phylogenetics and adaptation (DDA)
Mar. 9. Classification I -- introduction to phylogenetic classifications; monophyly, information content (KWW)
LAB: Intro to R continued; continuous characters; ancestral state reconstruction; independent contrasts
Mar. 11. Classification II -- phylogenetic taxonomy including incorporation of fossils; Phylocode (BDM)

Week 9:
Mar. 14. Classification III -- species concepts; speciation (BDM)
Mar. 16. Classification IV -- DNA barcoding and DNA taxonomy (KWW)
LAB: **discuss progress on projects;** Online systematic databases: nomenclature, geography, phylogeny, specimens
Mar. 18. Classification V -- nomenclature; Zoological & Botanical Codes; practical systematics, monography (KWW); **QUIZ 1** handed out (due that evening)

Mar. 21-25. SPRING BREAK

Week 10:
Mar. 28. Evolution and development - heterochrony (BDM)
Mar. 30. Molecular evolution (BDM)
LAB: Introduction to RevBayes: phylogenetic analysis using graphical models and Markov chain Monte Carlo
Apr. 1. Gene family evolution; comparative genomics; evo-devo (BDM)

Week 11:
Apr. 4. Phylogenetic trees VIII: Below the "species level;" phylogeography; dealing with reticulation (BDM)
Apr. 6. Tempo and mode in macroevolution; patterns of diversification and extinction (BDM)
LAB: Coalescence theory: gene tree-species tree reconstruction using RevBayes and the multispecies coalescent
Apr. 8. Phylogenetics and conservation biology (BDM)

Week 12:
Apr. 11. Comparing sister clades within a cladogram: the shape of evolution (DDA)
Apr. 13. Adaptive radiations (DDA)
LAB: **discuss progress on projects in class; present initial analysis of project dataset**; Birth-death models; joint character evolution and diversification analyses using BiSSE; detecting diversification rate shifts using BAMM
Apr. 15. Phylogenies and Community Ecology I (DDA)

Week 13:
Apr. 18. Phylogenies and Community Ecology II (DDA)
Apr. 20. Biogeography I: basic principles; ecological vs. historical approaches (KWW)
LAB: Community and spatial phylogenetics: picante, Phylocom; introduction to BIODIVERSE, phylogenetic beta-diversity, mapping
Apr. 22. Biogeography II: vicariance biogeography; detecting dispersal (KWW)

Week 14:
Apr. 25. Biogeography III: phylogenetics and range modeling; biome recognition and other spatial issues (BDM)
Apr. 27. Comparing cladograms; cospeciation methods (DDA)
LAB: **discuss progress on projects in class**; Probabilistic biogeographic models using BioGeoBEARS and RevBayes
Apr. 29. Coevolution; symbiosis (DDA); **QUIZ 2** handed out (due that evening)

Weeks 15 & 16:
May 6. S**tudent minisymposium**
May 11. **Final papers due**