**Principles of Systematics**

**BSC 420/695**

**4.00 credit hours**

**Spring 2021**

**Lecture + Laboratory:** MW 1:00 pm to 4:00 pm (via Zoom)

**Instructor:** Dr. Kevin Kocot
 307 Mary Harmon Bryant Hall

**Phone:** 205-348-4052

**Email:** kmkocot@ua.edu

**Office hours:** TBD

**Course web page:** <http://ualearn.blackboard.com>

**Prerequisites:** Undergraduate level BSC 360 Minimum Grade of C- or Undergraduate level BSC 373 Minimum Grade of C- or Undergraduate level BSC 376 Minimum Grade of C- or Undergraduate level BSC 483 Minimum Grade of C- or permission of the instructor.

**Course description:** Introduction to the principles, methods, and applications of systematics to analysis of morphological and molecular data. Includes introduction to biological classification and nomenclature.

**Required Texts:** Wiley, E.O. and Lieberman, B.S. 2011. *Phylogenetics*. 2nd edition.

**Other course materials:** Papers for discussions, PowerPoint slides, and other course materials will be made available via Blackboard Learn, UA Box, and/or e-mail. Students are expected to check their UA e-mail address at least once daily.

**Course objectives:** The overarching objective of this course is to familiarize students with the core topics of phylogenetic systematics. Upon completion of this course, students should be able to demonstrate a command of the essential principles in phylogenetic systematics.

**Student learning outcomes:**

* Knowledge of key terms and elements in taxonomy, systematics, and phylogenetics
* Understanding of the significance of phylogenetic systematics in the natural sciences
* Ability to lead and participate in intellectual discussions on a variety of topics in systematics
* Appreciation and understanding for natural history collections curation and digitization
* Competence with computer programs and analytical techniques essential in systematics

**Performance criteria:** Students’ mastery of the principles of systematics will be assessed by a lecture examination, student-led paper discussions, and laboratory assignments. Graduate students will additionally be required to write a grant proposal for a project related to systematics and ‘pitch’ it to the class and a panel of guest judges.

**Exams and assignments:** There are 500 possible points in the course for undergraduate students and 625 possible points for undergraduate students. Grades are calculated based on proportion of possible points earned.

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| 150 points | Final exam (take-home) |
| 50 points | Paper presentation and discussion leadership |
| 300 points | Laboratory assignments (10 X 30 points each) |
| 100 points | Grant proposal (GRADUATE STUDENTS ONLY) |
| 25 points | Grant proposal pitch (GRADUATE STUDENTS ONLY) |

*Exams:* There will be one take-home final exam. The final exam will be comprehensive over the whole course. The specific format is to be determined and may consist of a variety of question types such as multiple choice, true/false, matching, fill in the blank, short answer, diagrams, and/or essay. The exam will test student knowledge of the course material and ability to apply and communicate this knowledge scientifically and synthetically. Students will be given at least one week to complete the exam and may refer to their textbook, other readings from the course, internet sources, etc., but MUST WORK ALONE.

*Paper discussions*: Throughout the course of the semester, each student will give a brief presentation about a peer-reviewed publication and lead a discussion on that paper and topic in general. Readings must be approved by the instructor and made available to the class well in advance. Students leading the discussion are expected to give a brief but thorough presentation on the topic that stimulates discussion. A rubric outlining the expectations for paper discussion assignments will be provided.

*Laboratory assignments*: This is a combined lecture and lab course. Some days we will have a distinct lecture and/or discussion period followed by a separate lab, and other days lecture and lab will be integrated. In most lab sessions, we will perform a computer-based exercise to supplement the lecture topic and/or learn and practice a computer-based skill. We will discuss computer requirements in class and make accommodations for any students who do not own the necessary hardware. In short, any machine running Mac OS, Windows 10, or any Linux distribution with a VPN connection to campus will work fine. Lab meetings with “Lab assignment #” listed will have a graded component that must be turned in on time. Other labs will be a hands-on activity or a demonstration with no graded component, but attendance for these is still mandatory as the material covered may be tested over and/or will be built upon in subsequent lab sessions. Each student’s best ten lab assignment grades (out of ~12) will be used to calculate their final lab grade.

*Grant proposal*: Graduate students in the course will additionally be required to write a mock (or better yet – real!) grant proposal that is directly related to a topic covered in the course and ideally is relevant to their thesis/dissertation research. Students will be expected to identify a real funding opportunity (e.g., <https://systass.org/grants-and-awards/srf/>) and draft up a proposal that could be submitted to this agency, organization, society, etc. The proposal must include all relevant supplementary documents (except letters of recommendation) required by the agency. If not required by the funding agency, the student must also provide a realistic budget and budget justification for the proposed project. A rubric outlining the expectations for the assignment will be provided.

*Grant proposal pitch:* Graduate students in the course will additionally be required to give a 5-10 minute ‘sales pitch’ for their grant proposal to a mock funding agency panel consisting of systematics faculty guests invited from the department. The panel will be provided with the criteria used to judge proposals by the funding agency and will evaluate presentations based on these criteria and the strength of the arguments made by the investigator. A rubric outlining the expectations for the assignment will be provided. Creativity is encouraged.

**Attendance Policy:**Attendance to lecture, discussions, and lab are mandatory (but should be fun!) unless otherwise stated. Some review material will be optional.

**Grading policy:** Grades are based on a percentage derived from total points accumulated during the semester:

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| A+ = 98-100 | B+ = 88-89.9 | C+ = 78-79.9 | D+ = 68-69.9 | F < 60 |
| A = 92-97.9 | B = 82-87.9 | C = 72-77.9 | D = 62-67.9 |  |
| A- = 90-91.9 | B- = 80-81.9 | C- = 70-71.9 | D- = 60-61.9 |  |

In order to ensure a fair and accurate representation of the performance of all students in the class, the instructor reserves the right to modify the above point distribution in the students’ favor for all students in the course in the event of unusual circumstances that prevents a large proportion of the class from completing class requirements in the normal fashion (i.e., the instructor may ‘curve’ the grades). Bonus questions may be added to exams or other extra credit opportunities may be provided. Otherwise, please DO NOT ask for extra credit or extra work to improve your grade.

**Policy on missed lecture examinations and coursework:** Students will be permitted to make up exams and coursework with a significant, documented excuse (generally health-related) that should be submitted as soon as possible. Requests for makeup exams made after the exam will only be granted for emergencies. Make-up exams may be different from regular exams.

Excused absences must be verifiable and written by an authorized individual (e.g., physician, judge, etc), and must clearly indicate that the student was unable to attend the laboratory session in question. Please notify the instructor you will be absent from lab ahead of time if you can. The student is responsible for contacting the instructor to arrange a make-up of work missed due to an excused absence. Excused absences include:

1. Illness of self or a dependent provided the instructor is given a valid physician’s note.
2. Official participation in UA-sponsored activities (including student athletes).
3. Absences of students registered with the Office of Disabilities Services for disabilities eligible for "a reasonable number of disability-related absences" provided such students give the instructor notice of a disability-related absence.
4. Severe weather emergencies that prohibit a student from attending a scheduled laboratory session.
5. Death of a family member.
6. Jury or military duty, provided that official documentation is given to the instructor.

**Elasticity Statement:** The instructor will make every effort to follow the guidelines of this syllabus as listed; however, the instructor reserves the right to amend this document as the need arises. In such instances, the instructor will notify students in class and via email and will endeavor to provide reasonable time for students to adjust to any changes.

**Students with disabilities:** If you are registered with the Office of Disability Services, please make an appointment with me as soon as possible to discuss any course accommodations that may be necessary. If you have a disability but have not contacted the Office of Disability Services, please call 348-4285 to register for services. Students should set up all exams (including the final) at ODS during the first two weeks of the semester to ensure that they have a spot for testing.

**Academic misconduct:** All acts of dishonesty in any work constitute academic misconduct. This includes but is not limited to, cheating, plagiarism, and fabrication of information, misrepresentations and abetting of any of the above. The Academic Misconduct Policy will be followed in the event that academic misconduct occurs. Students should refer to the Student Affairs Handbook, which can be obtained in the Office of Student Life and Services in the Ferguson Center. The University of Alabama expects all students to conduct their studies in an honorable manner. Any form of academic misconduct will result in appropriate penalties, which may include dismissal from the university. As an academic community, our educational mission is enhanced by the robust exchange of ideas that occurs between a diverse student body, faculty, and staff within a respectful and inclusive learning environment. All members of the UA community are expected to contribute positively to the environment and to refrain from behaviors that threaten the freedom or respect that every member of our community deserves. UA is committed to providing an inclusive environment that is free from harassment or discrimination based on race, genetic information, color, religion, ethnicity, national origin, socioeconomic status, political beliefs, sex, sexual orientation, gender expression, gender identity, age, ability, size, or veteran status. UA prohibits any verbal or physical conduct that threatens or endangers the health or safety of any individual or group, including physical abuse, verbal abuse, threats, stalking, intimidation, harassment, sexual misconduct, coercion, and/or other communication or conduct that creates a hostile living or learning environment. Harassment or other illegal discrimination against individuals or groups not only is a violation of University Policy and subject to disciplinary action, but also is inconsistent with the values and ideals of the University.

**Severe Weather Protocol:** Please see the latest Severe Weather Guidelines in the Online Catalog.

**Pregnant Student Accommodations:** Title IX protects against discrimination related to pregnancy or parental status. If you are pregnant and will need accommodations for this class, please review the University’s FAQs on the UAct website.

**Religious Observances:** Under the Guidelines for Religious Holiday Observances, students should notify the instructor in writing during the first two weeks of the semester of their intention to be absent from class for religious observance. The instructor will work to provide reasonable opportunity to complete academic responsibilities as long as that does not interfere with the academic integrity of the course. See full guidelines at Religious Holiday Observances Guidelines.

**UAct Statement:** The University of Alabama is committed to an ethical, inclusive community defined by respect and civility. The UAct website (www.ua.edu/uact) provides extensive information on how to report or obtain assistance with a variety of issues, including issues related to dating violence, domestic violence, stalking, sexual assault, sexual violence or other Title IX violations, illegal discrimination, harassment, hate or bias incidents, child abuse or neglect, hazing, threat assessment, retaliation, and ethical violations or fraud.

**Statement on COVID-19:** All University faculty, staff, and students are expected to maintain a commitment to the health and safety of our campus community. Due to the current COVID-19 pandemic, specific health and safety standards are in place to minimize exposure and community spread on campus. In the interest of your health and safety and that of all UA students, faculty and staff, the University reserves the right to change the mode of instruction or schedule of instruction at any time, based upon prevailing public health and other guidance. While the method of delivery may change, educational instruction and opportunities will continue. As such, the University will not provide a refund of tuition, in whole or in-part, based on any such changes. Detailed information on changes in format or schedule can be found at studentaccounts.ua.edu and financialaid.ua.edu.

All students must be familiar with and abide by the requirements outlined in the UA Return Plan | UA System Comprehensive Health and Safety Plan. Students must (1) wear a mask or face covering at all times while participating in face-to-face class; (2) adhere to social distancing standards; and (3) comply with all other health and safety restrictions. If a student refuses to comply with the requirements, the student will be asked to leave the class and reported for a conduct violation. Unless a student has an exemption from the requirement to wear a face covering, (more information can be found at ods.ua.edu/covid-19-disability/), the student will be reported to Student Life for further disciplinary action. More information on these requirements and UA Healthcheck system and screening can be found at healthinfo.ua.edu/return plan. You are expected to visit the site and comply with all noted requirements related to in-person class attendance.

**Tentative Schedule**

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| **Date** | **Lecture/Discussion Topic** | **Laboratory Topic** | **Reading** |
| January 13 (W) | Welcome to the course | Computer hardware, software, and accounts needed for this course (UAHPC account, terminal, Cisco VPN, WinSCP/Cyberduck/etc., TextPad/TextWrangler/etc., Mesquite, MEGA) |  |
| January 18 (M) | **No class** | **No lab** |  |
| January 20 (W) | Introduction to systematics | Crash course on the command line (optional) | Chapter 1 |
| January 25 (M) | Species, species concepts, and speciation | Lab assignment #1: Annotated bibliography of species concepts | Chapter 2 |
| January 27 (W) | Introduction to High-Performance Computing (HPC) and the Slurm job scheduler | Navigating UAHPC, submitting jobs, file formats used in systematics, and handy one-liners |  |
| February 1 (M) | Taxa, classification, and basic premises in phylogenetic Inference | Lab assignment #2: Tree thinking quiz | Chapters 3 & 8 |
| February 3 (W) | Phylogenetic trees, character evolution, and homology | Lab assignment #3: The caminacules – characters, character states, and classification | Chapters 4 & 5 |
| February 8 (M) | Principles of phylogenetic systematics, optimality criteria, ordering, and rooting | Lab assignment #4: Refining the caminacules data set |  |
| February 10 (W) | Discussion – Phenetics (Kevin) | Lab assignment #5: Phenetic analyses of the caminacules | Paper for discussion |
| February 15 (M) | **No class** | **No lab** |  |
| February 17 (W) | Discussion – Haplotype Networks (Emily) | Creating haplotype networks in PopArt (Emily) | Paper for discussion |
| February 22 (M) | Maximum parsimony | Lab assignment #6: Maximum parsimony analyses of the caminalcules | Chapter 6 (part) |
| February 24 (W) | Discussion – Systematic artifacts (Will) | No lab | Paper for discussion |
| March 1 (M) | Search strategies, bootstrapping, jackknifing, and a brief intro to models of sequence evolution | Lab assignment #7: Manipulating tree files and making tree figures | Chapter 6 |
| March 3 (W) | Discussion – Long branch attraction and the CAT model (Richard) | Combating long-branch attraction | Paper for discussion |
| March 8 (M) | Specimens, curation, and museum collection digitization | Lab assignment #8: iDigBio group projects | Chapter 10 |
| March 10 (W) | Discussion – Why should we care about natural history collections? (Meghan) | Presentation of iDigBio group projects | Paper for discussion |
| March 15 (M) | **No class** | **No lab** |  |
| March 17 (W) | Discussion – Heteroplasmy and plant phylogenomics (Bryan) | Guest Speaker: Nathan Whelan | Paper for discussion |
| March 22 (M) | Nomenclature | Lab assignment #9: Naming species | Chapter 11 |
| March 24 (W) | Discussion – Multiple sequence alignment (Damien) | Lab assignment #10: Align-o-rama | Paper for discussion |
| March 29 (M) | Maximum likelihood | Lab assignment #11: Maximum likelihood analyses in RAxML and IQ-TREE | Chapter 7 (pages 203-219) |
| March 31 (W) | Discussion – Essential laboratory techniques for the 21st century molecular systematist (Mary Beth) | High-molecular-weight DNA & RNA extraction (Spiraliabase virtual lab meeting recording) | Paper for discussion |
| April 5 (M) | Bayesian inference | Lab assignment #12: Bayesian inference in PhyloBayes | Chapter 7 (pages 219-227) |
| April 7 (W) | Discussion – Molecular clocks (Chelsey) | Molecular clocks | Paper for discussion |
| April 12 (M) | Hypothesis testing and comparing trees | Hypothesis testing and comparing trees |  |
| April 14 (W) | Discussion – Coalescent and supertree approaches (Nick) | Coalescent and supertree approaches (Nick) | Paper for discussion |
| April 19 (M) | Biogeography and phylogeography; **GRANT PROPOSALS DUE** | No lab | Chapter 9 |
| April 21 (W) | Proposal panel | No lab |  |
| April 30 (F) | **FINAL EXAM DUE** |  |  |