BME 780
METHODS IN QUANTITATIVE BIOLOGY

Class time: Wednesdays 4-4:50 PM Location: ME 2106 1 credit
Fall 2018

Instructor:
Prof. Megan McClean
3156 ECB
mmcclean@wisc.edu
Office Hours: by appointment

Guest lecturers are an important feature of this course. Guest lecturers will typically lead one lecture discussing a key method in quantitative biology that they use in their own research. They will also select and help to guide the discussion of a key paper illustrating this method in practice.

Textbook: None

Grading:

Presentations	40%
Assignment	20%
Participation	20%
Quizzes	20%

The course participation grade will be based on participation in each session and scored according to the following rubric:
Strong Contributor: Contributions in class reflect thorough preparation. In addition to reading the assigned article(s), a strong contributor might further prepare by reading appropriate background material and references. Ideas offered are substantive and provide insight. Challenges are well substantiated and persuasive. Strong contributors sometimes offer new directions for class discussion. (Score 3/3)
Adequate Contributor: Contributions in class reflect satisfactory preparation, including reading the assigned article(s). An adequate contributor will answer straight forward questions about methods, results, and figures in the assigned articles(s). Ideas offered in class are sometimes substantive and provide generally useful insights but seldom offer a new direction for the discussion. Challenges are presented, fairly well substantiated and sometimes persuasive. (Score 2/3)
Weak Contributor: Contributions in class reflect inadequate preparation, including a cursory reading of the assigned article(s). Weak contributors are unable to volunteer straight forward information about methods, results, and figures in the assigned article(s). Comments that integrate information from the article or effectively challenge are absent. (Score 1/3)
Non-Participant: A non-participant says little or nothing in class, providing no basis for evaluation. Score (0/3)

NOTE: You may also participate in the course through *online* discussion on Canvas. For each paper, a discussion group will be opened. The scoring for contributing to the online discussion follows the rubric above. All students are encouraged to participate *in class* however the online discussion group offers another forum to participate.

Final grades will be calculated on a straight scale, 93-100 (A); 88-92 (AB); 83-87 (B); 78-82 (BC); 70-77 (C); 60-69 (D); below 60 (F). Depending upon the final grades, a curve may be applied; however, this will only result in an improved letter grade relative to the straight scale.

Website: canvas.wisc.edu

Course Description
This course focuses on understanding the key methods and principles of quantitative biology through a close reading of the primary literature. Class periods will alternate between a lecture outlining the basics of a particular quantitative biology technique and a student-led presentation of a key paper illustrating the use of that technique. Topics covered will include deterministic and stochastic methods for modeling cellular systems, techniques in systems and synthetic biology, image processing tools and image analysis for biology, data-driven network models, genomic approaches, single-molecule approaches, and key computational biology tools. This course is intended for graduate students from a variety of backgrounds who are interested in pursuing quantitative biology during their graduate studies. Students who have a background in differential equations and linear algebra and cell biology will find themselves well prepared for this course.

Prerequisites

Graduate or professional standing

Learning Objectives:
At the end of this course, students should be able to:

- understand the benefits and limitations of key methods used in the field of quantitative biology
- critically evaluate experimental and theoretical papers in quantitative biology

This course is designed to bring together students from different undergraduate backgrounds interested in graduate studies in quantitative biology. Students with a primarily quantitative/theoretical background should enhance their ability to fluently converse in the language of the biological sciences. Students with a biological background should improve their quantitative skills and ability to identify and utilize modeling appropriately in biology. The learning objectives will be achieved through the 5 main components of this course: lecture, readings, presentations, assignments, and participation in class discussion.

Lectures:
Lectures will present the important aspects of a theoretical or experimental method that is key to studies in quantitative biology. Lectures are intended to allow students to more effectively read and evaluate a key paper from the quantitative biology literature which utilizes said method. Topics to be covered include molecular biology tools for synthetic biology, data-driven network models, imaging and image processing, statistical modeling techniques, and differential equation models.

Readings:
Readings will be made available via the course website. Readings will consist of key papers from the quantitative biology literature which illustrate the use of important quantitative biology methods.

Paper Presentations
Students will be expected to present one of the key quantitative biology papers in-depth in a journal club style discussion. Students will be graded on the clarity of their presentation, their critical analysis of the paper's strengths and weaknesses, as well as their ability to answer questions. Student presenters are expected to design a quiz that their classmates will take prior to participating in the class discussion.

Assignment:
There will be one assignment in this course. The assignment will be designed to allow the student to delve further into a technique or topic of interest. Each student will be asked to choose an unfamiliar topic (e.g. differential equation modeling, gene editing, image processing) that they would like to learn more about. Students will be asked to write an introductory tutorial for this topic, geared towards a first-year graduate student. This tutorial must include references appropriate for an introductory student as well as a worked exercise illustrating the topic or technique, complete with solution. More details on this assignment will be given as the course progresses. Various parts of the assignment will be due throughout the course. Assignments are due at the beginning of class on the assigned due date. Late assignments will **NOT** be accepted for full credit without prior arrangement with the professors. Electronic copies of assignments are **NOT** accepted without prior approval. Students are allowed (and encouraged) to consult with each other on their assignments, but each student must turn in an individual assignment on a unique topic.

Participation
A key aspect of this course is in-depth discussion of key papers illustrating methods in quantitative biology. Participation in these discussions is the most important part of the course. Come to class having read the assigned reading and be prepared to discuss the selected paper in detail.

Quizzes
Students will be asked to complete a quiz on the assigned reading prior to the in-class discussion.

Website:
The course website will be maintained on Canvas.

- *Content:* Go here to find lecture notes, assigned readings, assignments, etc.
- *Grades:* All grades for assignments will be posted here.

Absences:
Please notify the professor in advance if you will be missing a class period.

Classroom climate:

The UW-Madison is committed to creating a dynamic, diverse, and welcoming learning environment for all students and has a non-discrimination policy that reflects this philosophy. Disrespectful behavior or comments addressed toward any group or individual, regardless of race/ethnicity, sexuality, gender, religion, ability, or any other difference is deemed unacceptable in this class, and will be addressed by Dr. McClean.

Course Schedule:
See Canvas