BIMM 140 – Quantitative Principles in Biology
Fall 2018, 4 units

Professor: Gurol Suel, Pacific Hall 2225A, email: gsuel@ucsd.edu
Office hours (Sep 28 – Oct 29): Tuesday, 1PM - 2PM, Pacific Hall 2225

Nan Hao, Bonner Hall 2150C, email: nhao@ucsd.edu
Office hours (Nov 2 – Dec 7): Tuesday, 2PM – 3PM, Bonner Hall 2150C

Instructional Assistants:

Kaito Kikuchi, email: kaito@ucsd.edu
Discussion Section (A01):
Monday 12 PM – 12:50 PM YORK 3020
Discussion Section (A02):
Monday 1 PM – 1:50 PM YORK 3020
Office Hours:
Tuesday 12 PM – 2 PM Pacific Hall 2224A

Hanbin Lu, email: hal213@ucsd.edu
Discussion Section (A03):
Monday 2 PM – 2:50 PM YORK 3020
Discussion Section (A02):
Monday 3 PM – 3:50 PM YORK 3020
Office Hours:
Wednesday 11 AM – 1 PM Natural Science Building 5116

Discussion Sections and Office Hours start from the week of Oct 1!

Class website: On Ted: http://ted.ucsd.edu

Class hours: MWF, 11:00 AM – 11:50 AM, CSB 001.

Important dates (http://blink.ucsd.edu/instructors/courses/enrollment/calendars/2018.html**):**
Oct 31: MIDTERM (in class)
Oct 26: Deadline to drop the class without "W" on transcript.
Nov 9: Deadline to drop without penalty of "F" grade.
Dec 11: FINAL EXAM (11:30AM-2:30PM)
- For other important dates, see the Class Schedule.

Course Prerequisites: BILD1 (The Cell).

Purpose of the course: The course considers problems in biology that were solved using quantitative biology approaches. Problems will range from the molecular to the population level. Students will learn about the scientific method and process, and how to apply it.

COURSE STRUCTURE:

The course includes two sections:

Section 1: This section serves to introduce novel concepts and a way of thinking about biology that is typically not covered sufficiently in standard biology text books. This section will thus provide the conceptual framework for section 2 of the overall course. In this section 1, students will be introduced to the concept of randomness in biology and also the importance of dynamics (processes changing over time). The goal is to provide a more realistic and deeper understanding of biological processes. Specifically, we will discuss select research papers that revealed randomness in biological processes, ranging from the single molecule to the population level. At the conclusion of this section, we will have discussed fundamental questions such as: What is randomness in biology? How does randomness arise in a biological system? What is the functional role of randomness in biology? What can we learn by measuring processes as a function of time? And why and when is it absolutely necessary to be quantitative in order to understand biological processes?

Section 2: In this section, we will build on the quantitative biology concepts and examples from Section 1 and develop simple computational models of biological systems. The goal is to equip students with some very basic and practical skills on ODE-based computational modeling in the context of biological systems. **Students will need to bring laptops with MATLAB installed to the lectures. MATLAB can be downloaded freely at https://matlab.ucsd.edu/student.html.** For students with limited coding experience, don't be scared! As evident from the course prerequisites, the requirement for coding or mathematical skills in this section will be minimal and the instructor will try to be as slow as possible. For students who want to develop more advanced understanding about nonlinear dynamics or modeling, please take BENG125.

Podcast: there will be no podcast of the lectures so attendance would be essential!

Homework (optional):
Section 1: Reading assignments: 1-2 research papers will be assigned for each week; Tutorials and exercises for MATLAB coding will be assigned every week.

Section 2: Homework in Section 2 will be simple modeling tasks, aiming to practice what is covered in the lectures. Students can work in study groups.

Discussion Sections: Discussion sections will be led by IAs once a week, most weeks of the quarter (see Discussion section schedule). All the discussion sections will be held in a computer lab. A major fraction of the time will be used to provide students an opportunity to practice MATLAB coding with the hands-on help from IAs. Students are encouraged to bring their own laptops to facilitate study. The computers in the lab can also be used. Discussion Sections are optional, but highly recommended. IAs will have their personal office hours. The time and location of Discussion Sections and office hours are listed above and will also be posted on the class website.

For Section 1, during the discussion sections, a part of the time will be devoted to review the concepts from previous lectures. The rest of the time will be used to go through the tutorials and exercises in the MATLAB coding homework posted in the previous week. To get the most out of Discussion Sections, it is therefore critical to have first worked through the homework and then to participate in the Discussion Sections.

Similarly, for Section 2, the IAs will primarily focus on the modeling homework posted in the previous week and, again, it is critical to have first completed the homework in study groups and then to participate in the discussion during the Discussion Sections.

EXAMS & GRADING:

Your grade in BIMM 140 is based entirely on your final score. Your final score will be calculated the following way:

Attendance (20% of final score): the attendance will be monitored and recorded using sign-up sheets.

Midterm (40% of final score)

Final Exam (40% of final score): The final exam is given in finals week (see schedule).

- Pens and ID card (student ID or driver's license) are the only personal items you may have with you during the exam; any other items you bring (backpacks, phones turned OFF, etc) must be placed entirely under your seat and are subject to being moved at the IAs' and professor's discretion.

- There will be no scheduled make-up exams for the Midterm or Final. Failure to take the exam at the assigned time and place will result in a grade of zero for that exam. Extraordinary circumstances preventing you from taking an exam at the scheduled time must be submitted in writing and include official documentation of the cause as far in advance as possible to the instructors.

- Requests to reconsider any grading must be submitted in writing along with your original exam to the instructors during class or office hours.

- Any student who is observed to look at and/or copy off another student's paper during a midterm and/or final will be reported to the Academic Integrity Office according to university policy for an investigation into academic dishonesty (see section on Academic Integrity below).

CLASS POLICIES:

Attendance: Attendance in class and during Discussion sections is optional, but very strongly encouraged. You simply will not do well in the class if you do not put in significant effort.

Academic integrity: All suspicions of academic misconduct will be reported to the Academic Integrity Office according to university policy.

Those students found to have committed academic misconduct will face administrative sanctions imposed by their college Dean of Student Affairs and academic sanctions imposed by me. The standard administrative sanctions include: the creation of a disciplinary record (which will be checked by graduate and professional schools); disciplinary probation; and attendance at an Academic Integrity Seminar (at a cost of $75). Students can also face suspension and dismissal from the University; those sanctions are not at my discretion. Academic sanctions can range from a score of zero on an exam to an F in the class. The appropriate sanctions are determined by the egregiousness of the Policy violation. Students who assist in or are complicit

with cheating could also be in violation of the Policy. Thus, students who become aware of their peers either facilitating academic misconduct or committing it should report their suspicions to me for investigation.

Please review UCSD's Policy on Academic Integrity, which can be found on this website: http://students.ucsd.edu/academics/academic-integrity/defining.html

It should be needless to say that it is much easier to pass this course, and any future courses that use this course as a prerequisite, by putting the energy into understanding the material of the course rather than into an attempt to pass the course by cheating.

Disabilities: If you qualify for accommodations because of a disability, please submit to me an AFA letter from the Office for Students with Disabilities (OSD) as soon as possible, and no later than the second week of class, so that your needs may be addressed. The OSD determines accommodations based on documented disabilities. Please see guidelines at: http://disabilities.ucsd.edu/

GOOD LUCK!

BIMM 140 – Quantitative Principles in Biology, Fall 2018, Gurol Suel and Nan Hao

Date(*)	Lecture#	Planned Topic
Section 1 (Prof. Gurol Suel)		
Sep 28	1	Introduction to course and concepts of noise – dynamics
		Homework 1 – MATLAB Basics 1
Oct 1	2	The source of randomness: Single molecule events - enzymes
Oct 3	3	The source of randomness: Single molecule events - enzymes
Oct 5	4	Single-cell dynamics: randomness as a function of time
		Homework 2 – MATLAB Basics 2
Oct 8	5	The source of randomness: Single molecule events – ion channels
Oct 10	6	The source of randomness: Single molecule events – ion channels
Oct 12	7	Randomness at the single cell level
		Homework 3 – MATLAB Basics 3
Oct 15	8	Can cells control/suppress noise?
Oct 17	9	Microorganisms utilize noise: Randomness in microbial differentiation
Oct 19	10	Microorganisms utilize noise: Randomness in microbial differentiation
		Homework 4 – MATLAB Basics 4
Oct 22	11	Case studies: Role of randomness in chemotaxis
Oct 24	12	Case studies: Role of randomness in microbial populations
Oct 26	13	Case studies: emergence of order out of microbial populations
		No Homework – prepare for the midterm
Oct 29	14	Midterm exam discussion
Oct 31		**Midterm** (in class; covers lectures 1-14)
Section 2 (Prof. Nan Hao)		
Nov 2	15	Section overview

		Homework 5 – MATLAB Basics 5
Nov 5	16	Ordinary differential equations; Modeling simple gene regulation
Nov 7	17	Modeling simple gene regulation 2
Nov 9	18	Steady state and response time
		Homework 6 – MATLAB Basics 6; Modeling Task 1
Nov 12		**Veterans Day Holiday – no class**
Nov 14	19	Simple stochastic simulation of gene expression
Nov 16	20	Modeling signal-dependent gene regulation
		Homework 7 – Modeling Task 2
Nov 19	21	MATLAB coding: How to develop computational models
Nov 21	22	Dose response; Cooperativity; Hill function
Nov 23		**Thanksgiving Holiday – no class**
		Homework 8 – Modeling Task 3
Nov 26	23	Numerical estimation of parameter values
Nov 28	24	Modeling gene expression to transient versus sustained inputs
Nov 30	25	Model simplification; Time-scale separation
		Homework 9 – Modeling Task 4
Dec 3	26	Bistability; Switch-like response; modeling positive feedback loop
Dec 5	27	Review of main concepts and equations
Dec 7	28	Review of MATLAB coding

Dec 11, Tuesday, 11:30 am – 2:30 pm **FINAL** (coding exam; cover lectures 15 - 28)

(*): Classes are on MWF from 11:00 AM to 11:50 AM in CSB 001.