Department of Computer and Mathematical Sciences, University of Toronto
MATC58

Syllabus—Winter 2021
January 11, 2021

Instructor: Yun William Yu

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For general course questions that other students might also have, please use Piazza.

For specific questions pertaining only to you, you should email me. When you email me, please write "[MATC58]" in the start of the subject line, to minimize the chance I miss your message. Emails *must* be from your utoronto.ca email account (this is a UofT policy), and should contain all necessary information, including your lecture section and tutorial section.

Homepage: http://www.math.toronto.edu/ywyu/MATC58-2021-Winter/

Quercus: https://q.utoronto.ca/courses/196756

Piazza: https://piazza.com/utoronto.ca/winter2021/matc58h3slec01

Asynchronous lectures: Before every class (except the first), I will be posting a video lecture. These will be linked to on the Homepage and are **required viewing**.

Synchronous class times: Tuesdays, 12-2pm and Thursdays, 3-4pm on Gather.Town. Link will be provided via Quercus. (Note that if there are significant technical difficulties, we may change the medium to something else, like Zoom or Discord.)
During the synchronous class times, I may give a brief review of the topic, but the bulk of the time will be spent working through problems in a *flipped classroom*.

Office hours: Thursdays, 4pm to 5pm at the same Gather.Town link.

Overview

This is an upper level course introducing mathematical biology for 3rd and 4th-year math majors and specialists. The prerequisite for this class is MATB44 (differential equations I), and you are expected to have a solid grounding in calculus, linear algebra, and differential equations. Additionally, there will be basic programming and modelling assignments in Python.

Requirements

Students must have desktop/laptop, working microphone, access to reliable internet, a webcam, and the ability to draw diagrams/write math by hand (either through a scanner, camera, or tablet).

Learning Outcomes

1. **Mathematical analysis**
   You will learn how to solve various types of difference and differential equations. In some cases, we can explicitly write down an analytical solution. In other cases, we cannot write down a solution, but can still rigorously analyze the general behavior of the solutions.

2. **Applying math to biology**
   You will learn how to apply difference and differential equations to analyzing biological problems, including models from population growth, cell biology, molecular evolution, infectious diseases, and more.
3. **Visualization and programming**
   You will learn how to use computer programs to simulate and model biological systems. Sometimes it is much easier to write a simulation than it is to prove an analysis, and after this course, you should be equipped to do both.

Textbooks

- Required: Linda Allen, *An Introduction to Mathematical Biology*.
  This will be the primary textbook for the class, and we will be following its structure.
- Optional: Steven H. Strogatz, *Nonlinear Dynamics and Chaos*.
  This is an optional supplement. It is not biology-specific, but is in my opinion one of the easiest-to-read math textbooks in existence, with a series of beautiful examples. I encourage checking it out if you can get your hands on a copy (of either 1st or 2nd edition), but it is not required.

Flipped classroom: Lectures, Notes, and Recordings

We will be using a flipped classroom model. Before each class, I will post a prerecorded lecture online. These lectures are ***required viewing***. The notes I create during the prerecorded lecture will also be made available on the class Homepage.

During the synchronous portion of class, we will then work through a number of problems. There are several primary modes we will swap between (though this is not an exhaustive list):

- Instructor-led: the most basic mode, in which I lead the discussion and/or lecture.
- Breakout session: the class will be broken up into breakout rooms to work on one or more problems. I will circulate between rooms to make sure that everyone is on track and not stuck.
    - Each breakout session will be equipped with a shared whiteboard, a shared LaTeX document, and sometimes where appropriate a shared Python environment.
    - After each breakout session, every group will turn in a report containing their work, formatted in a readable manner as a LaTeX-generated PDF. The report should include a list of each student's major contributions to the report. Contributions can be anything from "had the insight to the problem" to "drew the figure since everyone else's handwriting was terrible" to "gave incorrect suggestions".
    - Ideally, if you are keeping track of your work on the shared LaTeX document, the report will be straight-forward to generate. However, if a lot of your work was on the whiteboard, you may need to import that into the LaTeX. You may embed images/equations from the whiteboard into the LaTeX document, though obviously using LaTeX typesetting is preferable.
    - Every member of every group should independently upload a copy of their group's report. Note that I expect the reports to be identical. This is mostly for technical/logistical reasons because the groups will not be stable from week to week.

- o To the last point, note that I will periodically shuffle up the breakout groups. It is important to learn to work and communicate with a variety of people, not just your friends.
- Student-led: this will generally be after a breakout session. I may sometimes call on one or more of the breakout rooms to present their work. Sometimes this will be a solution to a problem; other times it will be a failed attempt. Indeed, sometimes failed attempts are more educational than a sleek solution.

The synchronous classes may be partially recorded, but recordings will NOT be made available. This is partly a technical limitation, as I can only record the breakout sessions while I am in a particular section. In exceptional instances (such as if you miss a class for a good reason), you may email me to request a particular recording of my view of the breakout session.

Evaluation and Grades

- *30%: Two hour final exam during final exam period*
  Date: To be determined.
  The final exam will be cumulative, but will focus on the material covered in the second half of the class (after the midterm). It will be conducted live and invigilated by the instructor via webcam on Zoom. You may choose to either (1) write your answers on a sheet of paper and scan/upload them or (2) write your answers on a tablet and upload a PDF. You may not use any outside resources and may not search on the internet. There will be 15 minutes after the exam for scanning/uploading. If you have technical difficulties, you must inform me *before* the deadline.
- *30%: One hour and 35 minute in-class midterm + 15 minutes for scanning/uploading*
  Date: Tuesday, March 2, in class
  The midterm will cover the first half of the class. It will be conducted in the same manner as the final exam, with of course the major difference in that the midterm will be shorter.
- *20%: Weekly quizzes.*
  There will be 10 weekly in-class quizzes on Tuesdays (not counting the first day of class and not counting the week of the midterm). These quizzes will be 25 minutes long at the end of each Tuesday class, and you will have 5 minutes for scanning and/or uploading. They will be similar in content to the questions that were worked on during the previous week's synchronous sessions, so if you understood the previous week's synchronous session, the quiz should be familiar.
  You may drop your lowest **two** quiz marks. There will be no make-up quizzes.
- *10%: Participation and breakout session reports.*
  The flipped classroom forms an essential part of this course and I expect everyone to participate. In order to get full participation marks, you must come to class regularly, be an active member of your breakout group (I will be circulating among the breakout sessions), occasionally present to the entire class, and ensure that your breakout groups produce reasonable reports. The reports do not necessarily need to be correct, as I will be marking only for effort/presentation on the breakout session reports, not correctness.
  Participation on the Piazza is not required to get full marks, but if you are lacking in one of the other participation categories but are active on Piazza, I may take that into

account when assigning marks. My fervent hope is that I will be able to give full participation marks to everyone in the class.

- *10%*: *Project and presentation*

    This is a partnered activity. The project may be one of the following: (1) choosing a biological phenomenon to model or analyze using the techniques we cover in the class or (2) a deep dive into the research literature on an advanced topic in mathematical biology. You will have to write a term paper of at least 2,000 words and give a 5-7 minute oral presentation on your project. Your presentation may also be prerecorded as a video instead if you prefer that, but you will still have to field questions from your colleagues. The presentations will be near the end of term, and the term paper will be due on Friday, April 9.

Late policy / extension penalty

I will not accept late exams or quizzes, unless you inform me of technical problems as soon as they occur *before* the deadline. If you have technical problems, I will remain on the Zoom/Gather.Town to help you troubleshoot, and I will accept your work immediately after resolution of the problem.

Your breakout session report is due by midnight after each class with a breakout session. However, I will not penalize you so long as the report is uploaded by the start of the next class. Remember however that I am marking primarily for effort/presentation, so you do not need to spend the time writing out a full solution to the problems.

There will be no extensions given for the math communication project components. This is largely a practical matter, as the due date for the project is the last day of classes, and the University of Toronto prohibits setting assignments due past the end of term. In exceptional cases, you may petition UTSC for longer extensions (see section VII.1. in the UTSC Handbook).

Piazza

If you have a question, chances are someone else in your class does too! As such, for general questions, we prefer that you communicate through the class forums online. Sometimes, other students will be able to answer your question. The teaching staff will also regularly check the online forums, and this will ensure that your classmates can also read the answer.

Piazza: https://piazza.com/utoronto.ca/winter2021/matc58h3slec01

Quercus Info

This course uses the University's learning management system, Quercus, to post information about the course. This includes posting readings and other materials required to complete class activities and course assignments, as well as sharing important announcements and updates. The site is dynamic and new information and resources will be posted regularly as we move through the term, so please make it a habit to log in to the site on a regular, even daily, basis. To access the course website, go to the U of T Quercus log-in page at https://q.utoronto.ca. Once you have logged in to Quercus using your UTORid and password, you should see the link or "card" for MATC58H3. You may need to scroll through other cards to find this. Click on the MATC58H3 link to open our course area, view the latest announcements and access your course resources. There are Quercus help guides for students that you can access by clicking on the "?" icon in the left side column. SPECIAL NOTE ABOUT GRADES POSTED ONLINE: Please also

note that any grades posted are for your information only, so you can view and track your progress through the course. No grades are considered official, including any posted in Quercus at any point in the term, until they have been formally approved and posted on ACORN at the end of the course. Please contact me as soon as possible if you think there is an error in any grade posted on Quercus.

Accessibility Statement

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the Access*Abillity* Services as soon as possible.

Accessibility Services staff (located in Rm SW302, Science Wing) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. You can reach them by phone at 416-287-7560 or email ability@utsc.utoronto.ca. The sooner you let us know your needs, the quicker we can assist you in achieving your learning goals in this course.

Specific Medical Circumstances

If you become ill and it affects your ability to do your academic work, consult the course instructor right away. Normally, you will be asked for medical documentation in support of your specific medical circumstances. The University's Verification of Student Illness or Injury (VOI) form is recommended because it indicates the impact and severity of the illness, while protecting your privacy about the details of the nature of the illness. You can submit a different form (like a letter from the doctor), as long as it is an original document, and it contains the same information as the VOI. For more information, please see
http://www.illnessverification.utoronto.ca/

If you get a concussion, break your hand, or suffer some other acute injury, you should register with Accessibility Services as soon as possible. A student registered with the AS isn't usually asked to provide a VOI because registration with AS already requires students to provide health-related documentation.
(pg.23 http://www.viceprovoststudents.utoronto.ca/Assets/Students+Digital+Assets/Demystifying+Academic+Accommodations.pdf)

Religious Accommodation

The University has a commitment concerning accommodation for religious observances. I will make every reasonable effort to avoid scheduling tests, examinations, or other compulsory activities on religious holy days not captured by statutory holidays. According to University Policy, if you anticipate being absent from class or missing a major course activity (like a test, or in-class assignment) due to a religious observance, please let me know as early in the course as possible, and with sufficient notice (at least two to three weeks), so that we can work together to make alternate arrangements.

Academic Integrity

The University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters
(http://www.governingcouncil.utoronto.ca/policies/behaveac.htm) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences in papers and assignments include using someone else's ideas or words

without appropriate acknowledgement, submitting your own work in more than one course without the permission of the instructor, making up sources or facts, obtaining or providing unauthorized assistance on any assignment. On tests and exams cheating includes using or possessing unauthorized aids, looking at someone else's answers during an exam or test, misrepresenting your identity, or falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes.

Privacy/FIPPA Statement

Personal information is collected pursuant to section 2(14) of the University of Toronto Act, 1971, and at all times it will be protected in accordance with the Freedom of Information and Protection of Privacy Act. Please note that this course requires presentations of one's work to the group. For more information, please refer to www.utoronto.ca/privacy.

Harassment/Discrimination

The University of Toronto is a richly diverse community and as such is committed to providing an environment free of any form of harassment, misconduct, or discrimination. In this course, I seek to foster a civil, respectful, and open-minded climate in which we can all work together to develop a better understanding of key questions and debates through meaningful dialogue. As such, I expect all involved with this course to refrain from actions or behaviours that intimidate, humiliate, or demean persons or groups or that undermine their security or self-esteem based on traits related to race, religion, ancestry, place of origin, colour, ethnic origin, citizenship, creed, sex, sexual orientation, gender identity, gender expression, age, marital status, family status, disability, receipt of public assistance or record of offences.