Course Syllabus

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Instructor

Dr. Hanno Rein
My preferred pronouns are he/him/his. Hanno is my first name. Rein is my last name. If you are an undergraduate student, you should not address me by first name. When sending me an e-mail, please use an appropriate opening line such as "Dear Professor Rein". I like cats.

Office hours

There will be regular online office hours during which I will be available to meet with you individually or as a group.

E-mail

hanno.rein@utoronto.ca (mailto:hanno.rein@utoronto.ca)
I try to respond quickly to e-mails Monday to Friday, 9am to 5pm, but I am unlikely to respond outside of these hours. Please send your e-mail from your university account and include your student number.

TA

Fergus Horrobin
horrobin@astro.utoronto.ca (mailto:horrobin@astro.utoronto.ca)

Learning outcomes

By the end of this course you will be comfortable writing short python programs and the jupyter notebook environment. You will have an understanding of number representations and algorithmic complexity. You will be able to read and write data files in different formats. You will be able to visualize scientific data sets and generate high quality plots suitable for scientific publications. You will be able to write simple algorithms to calculate derivatives, integrals, find solutions to linear and non-linear equations, and solve ordinary differential equations. You will

be able to apply these methods to physical problems.

Lectures

Mondays 9:10am - 11:00am.
Active participation in the lectures is expected. There might be quizzes during the lectures. The material covered in the lecture will be important for the tutorial in the same week.

Tutorials

IN PERSON AN ONLINE SYNCHRONOUS. Tuesdays, 3:10Pm - 5:00Pm
Attendance is mandatory for all tutorials. During the tutorials, you will apply the knowledge from the previous lecture. This might involve you working on an assignments. Myself and the TA will guide and assist you through the tasks. Note that you might either need to hand in your assignment by the end of the tutorial, or by the end of the week. These assignments will make up a major component of your grade.
Note that the first tutorial will be on September 7th, the first day of classes and before our first lecture. In the first tutorial, we will assist you with getting python and jupyter notebooks up and running.

Zoom Link (for lectures and tutorials)

https://utoronto.zoom.us/j/83069729913 (https://utoronto.zoom.us/j/83069729913)
Meeting ID: 830 6972 9913
Passcode: 996527

Technical requirements

If the current COVID19 situation allows for it, the lectures and tutorials will be in-person. To successfully complete the course, you will need a computer with fast internet access. In addition:

- You will need to run code using python, jupyter notebooks, numpy, scipy, and matplotlib. We will use python 3 in this course (python 2 is not acceptable). You can either install all software on your own computer, or use a cloud based service such as **https://utoronto.syzygy.ca (https://utoronto.syzygy.ca)** . Both of these options have their advantages and disadvantages. Both are free for you to use.

- The tutorials will be interactive. You have the option to join via a live video link, and work on a jupyter notebook at the same time. Make sure your are able to share your computer screen so that a TA and myself can help you with your assignment.
- Some assignments, all quizzes, and all exams will have a time limit. There will be some accommodations if you experience technical problems, but it is ultimately your responsibility to make sure that you can take part in all activities of this online course.
- If you join remotely, you will need a need a microphone and webcam for the tutorials and the oral exam.
- If you own a cat, it is mandatory to turn on your webcam for as long as your cat is in the frame.

Grading Scheme

Assignments/Quizzes/Journal 40%
Mid-term exam (written) 10%
Final exam (written) 10%
Final exam (oral) 40%

The mid-term exam will be a timed online exam where you have to answer a selection of questions from a question bank. The final exam will be an oral exam. The TA and myself will examine each student individually. During that time, we will go over some of your assignments and your written exams. The purpose of the oral exam is to test your understanding and to prevent plagiarism, but not memorization. I will post an example oral exam online to give you an idea of the format.

Academic Integrity in PHYB57

In addition to general rules about academic integrity listed below, there are several ones that apply specifically to PHYB57.

- Most importantly, you are explicitly given permission to use to internet to help you with assignments, quizzes, and even exams. However, keep in mind that the questions have been designed with the internet in mind. A simple google search is unlikely to provide you with the correct answer. You will have to think for yourself. Also note that for many questions, it will be much faster to recall basic knowledge from memory rather than googling it. Time will be limited and you will most likely be under pressure to answers

googling it. Time will be limited and you will most likely be under pressure to answers as many questions as possible. Use your time wisely.

- Whereas you are encouraged to interact with other students in the course, you cannot use their work and hand it in as yours. If you work together with another student, each of you will need to indicate this when you submit your assignments. Failure to do so will count as an academic offence. Note that even if you work together, each of you needs to work on their own document. Do not submit the same document. Here is a simple question you should ask yourself when submitting an assignment: Do I fully understand what I am about to submit? If the answer is no, then you might be about to commit an academic offence.
- Do not ask friends or relatives to do the assignments for you. Do not hiring someone to do the assignment for you. This would be a serious academic offence.
- As a general rule, you can use the internet to access information, but you cannot post any lecture material online. This includes lecture materials, assignments, quizzes, and exams. You cannot post such material on public spaces (such as forums, stackoverflow, etc). You also cannot share them in private spaces (chats, instant messages, etc). Documents might be watermarked with your student ID and might be traced back to you.

There are other offences covered under the Code of Behaviour on Academic Matters as described below. Please respect these rules and the values which they protect. Offences against academic integrity will be dealt with according to the procedures outlined in the Code of Behaviour on Academic Matters.

Academic integrity (general)

Academic integrity is one of the cornerstones of the University of Toronto. It is critically important both to maintain our community which honours the values of honesty, trust, respect, fairness and responsibility and to protect you, the students within this community, and the value of the degree towards which you are all working so diligently. Detailed information about how to act with academic integrity, the Code of Behaviour on Academic Matters, and the processes by which allegations of academic misconduct are resolved can be found online: **http://www.artsci.utoronto.ca/osai/students** (http://www.artsci.utoronto.ca/osai/students) .

According to Section B of the University of Toronto's Code of Behaviour on Academic Matters

According to Section 2 of the University of Toronto's Code of Behaviour on Academic Matters (**http://www.governingcouncil.utoronto.ca/policies/behaveac.htm (http://www.governingcouncil.utoronto.ca/policies/behaveac.htm)**) which all students are expected to know and respect, it is an offence for students to:

- To use someone else's ideas or words in their own work without acknowledging that those ideas/words are not their own with a citation and quotation marks, i.e. to commit plagiarism.
- To include false, misleading or concocted citations in their work.
- To obtain unauthorized assistance on any assignment.
- To provide unauthorized assistance to another student. This includes showing another student completed work.
- To submit their own work for credit in more than one course without the permission of the instructor.
- To falsify or alter any documentation required by the University. This includes, but is not limited to doctor's notes.
- To use or possess an unauthorized aid in any test or exam.

Missed tutorials and exams

If you miss a tutorial, a deadline for an assignment, a quiz, or the mid-term exam for a valid reason, your final exam will be worth more. However, if you miss a tutorial, a quiz, or the mid-term for a non-valid reason, these components of your grade will be counted as zero points. Deadlines in this course are hard deadlines. You cannot hand in a late assignment. It is also not possible to write the mid-term at a later date. You have to participate in the final oral exam in order to pass this course.

What counts as a valid reason to and what not is hard to define precisely in these unusual times. Try to submit official supporting documentation to support your case whenever possible. Note that a late enrolment in the course does not count as a valid reason for missing the first assignments and quizzes.

Accessibility

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 AccessAbility Services Office. The earlier you do that, the better I will

be able to accommodate you. I will work with you and AccessAbility Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC AccessAbility Services staff are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. They can be reached via telephone and e-mail: 416-287-7560, **ability@utsc.utoronto.ca (mailto:ability@utsc.utoronto.ca)** .

Tentative Schedule:

Note that this is only a tentative schedule of the material that we will cover in each lecture. It might change. The tutorials will in general have the same topic as the lecture the day before.

==DATES TO BE UPDATED==

Note the first tutorial will be on September 7th, before the first lecture!

Lecture 1, September 13th
Welcome to the course
Open source software
Python basics
Jupyter notebook basics
Writing a first python program
Conditional statements

Lecture 2, September 20st
Writing algorithms with loops, functions, recursion
Arrays, numpy package
Different approaches to solving the same problem
Measuring runtime

Lecture 3, September 27th
Number representations
Integers
Floating point numbers
String manipulations

Lecture 4, October 4th

Lecture 4, October 4th
Reading and writing different file formats
Text files
Binary files
Creating graphs with matplotlib
Plotting one and two dimensional datasets
Perceptually uniform colormaps

Reading week

Lecture 5, October 18th
Interpolation
Least square fits
Overfitting
Measuring uncertainty

Lecture 6, October 25th
Numerical differentiation with finite differences
Computational complexity
Big O notation
Convergence

Lecture 7, November 1nd
Numerical integration with Riemann sums
Midpoint method
Simpson's rule

Lecture 8, November 8th
Random numbers
Markov Chain Monte Carlo methods

Lecture 9, November 15th
Numerical solutions to differential equations

Euler method

Leap-frog method for dynamical systems

Lecture 10, November 22rd

N-body integrators

Parallel algorithms

Super computers

Using GPUs in scientific calculations

Lecture 11, November 29th

To be determined (Fluid dynamics?)

Lecture 12, December 6th

To be determined

Final written exam: Saturday, December 11, 2021, 12:00-13:00.
The final oral exams will take place during the exam period, December 8th to December 21st.
They will be scheduled on an individual basis.

Course Summary:

Date	Details	Due