PHY407F: Fall 2019

Computational Physics Lab

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TAs:

- Haruki Hirawasa (marker)
- Alex Cabaj (demo)
- Mikhail Schee (demo)

THE MOST IMPORTANT POINT ABOUT SUCCESS IN THIS COURSE: To save yourself work, do all your labs with a partner. You can only pair up, you can't form larger groups. You can switch who you pair up with from lab to lab. Both you and your partner can hand in the same lab, just make sure to sign up for the same "Lab Group" on Quercus when you submit. If you don't have a lab partner, you will be basically doing twice as much work as you really need to. See the Assignment Policy sheet.

Lectures: Mondays noon-1 in MP137

Tutorials and labs: Wednesdays 9-12, MP257 (and MP238). Labs start at 9am, and students are invited to divide themselves up between MP257 and PHY238. Please note that the lab room MP257 will be reserved for PHY407 from 9 a.m. to 1 p.m. on Wednesday.

MP257 is a computer lab room that was renovated and expanded in 2015. We have also booked MP238 for overflow during the lab period since the course has become quite popular, and we may be able to find a third room if there are too many of you.

Office Hours: Office hours take place in the computational lab room, MP257. The room will be reserved for PHY407 from 12 p.m. to 3 p.m. on Thursdays. One of us will typically be in the room between 1 p.m. and 3 p.m.

Topics: This is an introduction to scientific computing in physics. Students will be introduced to computational techniques used in a range of physics research areas. By considering select physics topics, students will learn computational methods for function analysis, ODEs, PDEs, eigenvalue problems, non-linear equations and Monte Carlo techniques. "Survival skills" in scientific computing, such as command line programming, debugging, solution visualization,

computational efficiency and accuracy will be developed. The course is based on python and will involve working on a set of computational labs throughout the semester as well as a final project.

You will find a tentative outline of what we will cover below.

Week	Week of …	Text ch	Lab topic
01	9-13 Sep	2-3, 4.3	Intro to python and programming, pseudocode
02	16-20 Sep	4, 5.1-5.3	Numerical errors, integration techniques: trapezoid rule, Simpsons rule, errors on integrals, choosing #steps
03	23-27 Sep	5.5-5.11	Gaussian quadrature, infinite ranges, multiple integrals, derivatives, interpolation
04	30 Sep-4 Oct	6	Solving linear & nonlinear systems: Gaussian elimination, pivoting, LU decomp, eigensystems, QR, relaxation, binary search, Newton's method, secant method, golden ratio search
05	7-11 Oct	7	Fourier Transforms: DFT, 2D DFT, FFT
06	14-18 Oct	8	ODEs 1
07	21-25 Oct	8	ODEs 2
08	28 Oct – 1 Nov	9	PDEs 1
09	4-8 Nov		*Reading week*
10	11-15 Nov	9	PDEs 2
11	18-22 Nov	10	Random Processes
12	25-29 Nov	10	Monte Carlo techniques
13	2-6 Dec		Term Project

The course website is on Quercus. Materials including organizational info, lecture notes, pre-lecture problems, labs, announcements, etc. Please check it frequently, it is a valuable aid for this course.

Prerequisites and background: PHY224H/254H is a prerequisite. Preparation of other physics courses is strongly recommended. CSC courses are helpful but not required.

Make sure you are familiar with content of the tutorials on the computational physics webpage to get started:

https://computation.physics.utoronto.ca/

Note that we had to close the old python wiki, and created the website above as a replacement. If you were used to it and notice missing or incorrectly-migrated elements, let us know as soon as possible.

Course Text: Computational Physics by Mark Newman (2nd edition, 2013). Available at the bookstore or Amazon.

The first few chapters are available free online at the following location so if you aren't sure that you are going to take the course, you can hold off a couple of weeks before buying the text. There are also excellent resources on this webpage such as python programs you will use:

http://www-personal.umich.edu/~mejn/cp/

Lecture Notes: I will also provide my lecture notes on Quercus before the lectures. You are responsible for the material covered in the lectures, even if it is not in the text or the posted lecture notes.

Grading Scheme:	Pre-lectures:	10% (10 quizzes, 1% each)
	Labs:	66% (11 reports, 6% each)
	Final Project:	24%

Pre-lectures: These involve readings from the text and a short online quiz that must be completed before the lecture.

Labs: These are more involved computational exercises that you can work on during the lab time, as well as on your own before or after the lab. They will involve a variety of physics concepts and introduce you to the major scientific computing tools.

Typical weekly schedule

- Monday: pre-lecture questions due before lecture (after week 1), lecture 12-1 pm
- Wednesday: Lab 9-12 in MP257/238. MP257 reserved until 1 p.m.
- Thursday: Office hours R1-3, in MP257 (room booked for PHY407 R12-3)
- Friday: Lab due, next lab assigned, next pre-lecture questions assigned.

Computer Software: for more info, see the document called "Requirements, guidelines and suggestions regarding software", distributed as an appendix to this syllabus.

- The programming language for this course is python 3. **Not python 2!**
- Optional pieces of software or services, which you are not required to use, but which may make your life easier: GitHub (https://github.com/), Jupyter(lab), syzygy (https://utoronto.syzygy.ca).

- In previous years, markers have found it very difficult to test code, written with versions of python that were not compatible with theirs. The following rules are in place to help:
- **Do not use python 2.**
- **If you use python scripts (.py), make sure they run on the machines of the department before submitting your lab reports.**
- **If you use jupyter notebooks (.ipynb), make sure they run on syzygy, and export the file as a pdf so that Turnitin can process it.**
- **For your lab project, follow the rules above, plus the fact that you can only use the following packages:**
    - **Numpy,**
    - **Pylab,**
    - **Scipy, and**
    - **Matplotlib.**

  If you want to use another package (Pandas, TensorFlow…), ask us first! We need to make sure that the code you submit will work on our machines.

Academic Integrity: Academic integrity is fundamental to learning and scholarship at the University of Toronto. Participating honestly, respectfully, responsibly, and fairly in this academic community ensures that the U of T degree that you earn will be valued as a true indication of your individual academic achievement, and will continue to receive the respect and recognition it deserves. Familiarize yourself with the University of Toronto's Code of Behaviour on Academic Matters (http://www.governingcouncil.utoronto.ca/policies/behaveac.htm). It is the rule book for academic behaviour at the U of T, and you are expected to know the rules.

The University of Toronto treats cases of academic misconduct very seriously. All suspected cases of academic dishonesty will be investigated following the procedures outlined in the Code. The consequences for academic misconduct can be severe, including a failure in the course and a notation on your transcript. If you have any questions about what is or is not permitted in this course, please do not hesitate to contact me.

If you are experiencing personal challenges that are having an impact on your academic work, please speak to me or seek the advice of your college registrar.

This year, we will test the Turnitin feature. Normally, students will be required to submit their course essays to Turnitin.com for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com

web site. Note though that we never tested this feature with Quercus, nor, in this course, and may need to abandon this experiment early on. Also note that Turnitin does not make any decision, it just sends us a report. For some of what we will ask you to do, there will not be many ways to explain or code something. Turnitin might give us warnings, but we will exert judgment on those instances.

You can choose to opt out of Turnitin , under our conditions of use. If you do so, let us know before Wednesday, Sep. 11th at noon, so that we can find alternative arrangements.

Accommodations: If you have a learning need requiring an accommodation the University of Toronto recommends that students immediately register at Accessibility Services at http://www.studentlife.utoronto.ca/as.

Location: 4th floor of 455 Spadina Avenue, Suite 400
Voice: 416-978-8060
Fax: 416-978-5729
Email: accessibility.services@utoronto.ca

The University of Toronto supports accommodations of students with special learning needs, which may be associated with learning disabilities, mobility impairments, functional/fine motor disabilities, acquired brain injuries, blindness and low vision, chronic health conditions, addictions, deafness and hearing loss, psychiatric disabilities, communication disorders and/or temporary disabilities, such as fractures and severe sprains, recovery from an operation, serious infections or pregnancy complications.

As the instructor of this course, you are also invited to communicate with me at any time about your learning needs. Confidentiality of learning needs is respectfully and strictly maintained.

Equity, Diversity and Excellence (from http://www.hrandequity.utoronto.ca/about-hr-equity/diversity.htm): At the University of Toronto, we strive to be an equitable and inclusive community, rich with diversity, protecting the human rights of all persons, and based upon understanding and mutual respect for the dignity and worth of every person. We seek to ensure to the greatest extent possible that all students enjoy the opportunity to participate as they see fit in the full range of activities that the University offers, and to achieve their full potential as members of the University community.

Our support for equity is grounded in an institution-wide commitment to achieving a working, teaching, and learning environment that is free of discrimination and harassment as defined in the Ontario Human Rights Code. In striving to become an equitable community, we will also work to eliminate, reduce or mitigate the

adverse effects of any barriers to full participation in University life that we find, including physical, environmental, attitudinal, communication or technological.

Our teaching, scholarship and other activities take place in the context of a highly diverse society. Reflecting this diversity in our own community is uniquely valuable to the University as it contributes to the diversification of ideas and perspectives and thereby enriches our scholarship, teaching and other activities. We will proactively seek to increase diversity among our community members, and it is our aim to have a student body and teaching and administrative staffs that mirror the diversity of the pool of potential qualified applicants for those positions.

We believe that excellence flourishes in an environment that embraces the broadest range of people, that helps them to achieve their full potential, that facilitates the free expression of their diverse perspectives through respectful discourse, and in which high standards are maintained for students and staff alike. An equitable and inclusive learning environment creates the conditions for our student body to maximize their creativity and their contributions, thereby supporting excellence in all dimensions of the institution.