Introduction to Scientific Computing

PSCB57
Fall 2016

Professor Hanno Rein

Lecture Mondays, 9 am - 11 am, MW160
- The lectures start prompt at ten past the hour.
- Please be on time.

Tutorial Tuesdays, 3:00 pm - 6:00 pm, room to be confirmed

E-mail `hanno.rein@utoronto.ca`

Twitter `@hannorein`

Website `http://rein.utsc.utoronto.ca/`

Office hours Mondays, 1:00 pm - 2:00 pm, SW504C
Wednesdays, 1:00 pm - 2:00 pm, SW504C

Reading/ Bibliography
- Computational physics, Mark Newman
- Last year's lecture notes, `http://rein.utsc.utoronto.ca/`
- Numerical Recipes, The Art of Scientific Computing, 2007, William H. Press
- Learning Python, 5th Edition, Mark Lutz, O'Reilly Media - Charles Dyer's lecture notes, `http://pathfinder.utsc.utoronto.ca/~pscb57/`
- What every programmer should know about floating point numbers, `https://blogs.oracle.com/darcy/resource/OSCON/OSCON_2015-floating-point.pdf`
- The internet! You can find many resources on the topics that we will cover online.

Software The course will use linux throughout the course as the preferred operating system. Linux is the industry standard for scientific computing. We will also work with the unix shell `bash`, the text editor `vi`, the version control system `git` and the programming language `python`, version 3.

If you own a personal computer or a laptop, you want to use that to work on the assignments. You are not required to use linux on your personal computer. However, you have to get familiar with linux. You can get access to a Linux machine that you can work on remotely. To log in to this machine from a windows computer, you need to use an ssh client. One such program is MobaXterm, a rich ssh client with file transfer, file editing and X forwarding capabilities. For personal use, the software is free and can be downloaded at `http://mobaxterm.mobatek.net`.

Lectures The lectures might be different from what you have encountered before. We will use the blackboard to derive the mathematical parts of the material. The practical part of the lectures will be done using a live demonstration. You are strongly encouraged to take notes.

Each lecture is two hours long. Please be on time. We start promptly at ten past the hour. We will have a 10 minute break after 50 minutes.

If something is unclear during a lecture or you would like to hear something again, please raise your hand and ask. Ask as many questions as you like. There are no stupid questions.

As a courtesy towards the lecturer and your fellow classmates, please refrain from eating any food during the lecture. Please turn off the sound of all your electronic devices. If your phone rings during the lecture, you will be asked to leave.

Tutorials and assignments

The tutorial have three purposes:

1. You can ask your professor and the TAs questions about the course material.
2. You can get help with the current assignment.
3. You will take quizzes about your assigment. The mark from these quizzes will contribute to your final mark.

Tutorial attendance is mandatory whenever a quiz is scheduled. If you do not show up, your mark for the assignment and quiz will be 0%.

There will be 6 assignments. The difficulty of each assignment and the contribution towards the final grade will vary. The deadline for submissions will typically be on a Friday. This is a hard deadline. You are required to submit the assignment electronically.

The fraction of submitted and correctly solved problems will constitute towards your grade. Most importantly, *if you submit a solution to an assignment, you have to understand it.* After submitting each assignment, you will have to pass a quiz. The content of the quizzes will vary. You might have to find bugs that have been introduced in your program. You will only be able to find these bugs if you wrote your assignment yourself and understand what your program does. You might also have to answer general questions related to the assignment. A low performance in the quiz will nullify your points from that assignment. By the end of the course, your grade in the assignments has to be 40% or higher, otherwise you will not pass the course.

Grading Scheme

There are three necessary conditions for passing this course:

1. A final grade of at least 50%.
2. A combined grade in all assignments of at least 40%.
3. You have to write the final exam.

The final grade will be calculated from all assignments, the midterm and the final exam. The ratio is as follows:

Assignments	35
Midterm	25
Final exam	40
Total	100

If you miss the midterm for a valid reason (see below), your final exam will be worth more and cover the midterm contribution towards your final grade (65 out of 100). However, if you miss the midterm for a non-valid reason, it will be counted as zero points.

The final exam will take place during the exam period. The exam may include, but is not restricted to, material from all lectures and all tutorials. Neither a calculator

nor an equation sheet will be allowed. Don't worry, you won't need them. The exam will focus on your understanding of the subject, rather then long mathematical calculations.

Absences

In the case of a problem that supports an absence to a tutorial session or an inability to hand in an assignment before the deadline, your grade will be calculated on the basis of all other tutorial work. In the case of a problem that supports the absence to the midterm, your grade will be calculated by increasing the weight of the final exam. Valid and *official supporting documentation* must be submitted within five business days of the missed tutorial or test. It is your responsibility to hand in documentation on time. Failure to do so will impact your grade.

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 as soon as possible. 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 (located in SW302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or `ability@utsc.utoronto.ca`.

Academic Integrity

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`.

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

Specificlly to this course, please be reminded that you need to understand every assignment that you submit. If you work together on an assignment, you still have to be able to pass the quizzes in the tutorials.

There are other offences covered under the Code, but these are by far the most common. 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.

Tentative Class Schedule

Lecture	Date	
1	Sept. 1st (Thursday!)	Introduction, Python, Assignments
—	Sept. 5th	Labour Day - no lecture
2	Sept. 12th	Floating point representation of numbers
3	Sept. 19th	LU Decomposition
4	Sept. 26th	Interpolation and extrapolation
5	Oct. 3rd	Numerical integration
—	Oct. 10th	Reading week – no lecture
6	Oct. 17th	Differential Equations I
7	Oct. 24th	Differential Equations II
8	Oct. 31nd	N-body integrations, geometric integration methods
9	Nov. 7th	Grid-based methods
10	Nov. 14th	Monte Carlo methods
11	Nov. 21rd	tbd
12	Nov. 28th	tbd

September 2016

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1 Lecture 1	2	3
4	5 Labour Day	6 Tutorial	7	8	9 Assignment 1 due	10
11	12 Lecture 2	13 Assignment 1 Quiz	14	15	16	17
18	19 Lecture 3	20 Tutorial	21	22	23 Assignment 2 due	24
25	26 Lecture 4	27 Assignment 2 Quiz	28	29	30	

October 2016

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3 Lecture 5	4 Tutorial	5	6	7 Assignment 3 due	8
9	10 Reading week	11 Reading week	12 Reading week	13 Reading week	14 Reading week	15
16	17 Lecture 6	18 Assignment 3 Quiz	19	20	21	22
23	24 Midterm (1h) Lecture 7 (1h)	25 Tutorial	26	27	28 Assignment 4 due	29
30	31 Lecture 8					

November 2016

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1 Assignment 4 Quiz	2	3	4	5
6	7 Lecture 9	8 Tutorial	9	10	11 Assignment 5 due	12
13	14 Lecture 10	15 Assignment 5 Quiz	16	17	18	19
20	21 Lecture 11	22 Tutorial	23	24	25	26
27	28 Lecture 12	29 Tutorial	30 Assignment 6 due			