Introduction to Scientific Computing

PSCB57
Fall 2018

Professor Hanno Rein

Lecture	Mondays, 9 am - 11 am, MW 160 - The lectures start prompt at ten past the hour. - Please be on time.
Tutorial	Tuesdays, 3:00 pm - 6:00 pm, SW 505 B - Space is limited, please come to the tutorial in which you are enrolled in.
E-mail	hanno.rein@utoronto.ca - My e-mails only get delivered three times a week (Mondays, Wednesdays, Fridays, at 9am). - Please use your university e-mail account when inquiring about the course.
Website	https://rein.utsc.utoronto.ca/
Office hours	Mondays 11:30 - 12:00 (SW504C) Tuesdays 13:00 - 14:00 (SW504C)
Reading/ Bibliography	- Last year's lecture notes, http://rein.utsc.utoronto.ca/ - Computational Physics at UofT http://compwiki.physics.utoronto.ca/ - Computational Physics, Mark Newman - 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	In this course, we will work with version 3.5 of the programming language python. The differences between the python versions are small, however, all your submitted work must work with python 3.5. For the assignments, you need to have access to a computer with python. If you own a personal computer, please install python, numpy scipy, matplotlib, and jupyter-notebook. You are strongly encouraged to get all the software installed before the beginning of the course. You can do this in many different ways. For beginners, the anaconda distribution is recommended. For instructions on how to install anaconda see http://continuum.io or http://compwiki.physics.utoronto.ca/. Having all the software on your personal computer will make it significantly easier for you to work on the course assignments. However, you can also use computers at UTSC if you do not have a personal computer. The computers in the physics

labs (5th oor of the Science Wing) have python installed. You are welcome to use these rooms at any time if there is no other lab is scheduled in the room.

Lectures

I will use the blackboard to derive the mathematical parts of the material. I will only occasionally use slides. The practical part of the lectures will be done using a live demonstration on a computer. Due to the use of di erent media, you are encouraged to take notes. Reading only the lecture notes will not adequately prepare you for the assignments and exams.

Lecture notes from previous years are available online. However, not that the course content changes a lot from year to year.

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 and the more questions you ask the better.

As a courtesy towards me and your fellow classmates, please refrain from eating any food during the lecture. Please t00(y)2y9ecturI277(le) m28(e)1(e)-g2c0333c tow wwanyear.

Grading Scheme

There are three necessary conditions for passing this course:

1. A nal grade of at least 50%.
2. A combined grade in all assignments and tests of at least 40%.
3. You have to write the nal exam and get at least a 40%.

The nal grade will be calculated from all assignments, tests, the midterm, the nal exam, and optionally the project. The ratio is as follows:

Assignments and tests	$1=4$
Midterm	$1=4$
Final exam	$1=2$

If you choose to work on the optional project, your grade might increase by up

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 nal exam. Valid and *o cial supporting documentation* must be submitted within ve 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 O ce 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 con dential. The UTSC AccessAbility Services sta (located in SW302) are available by appointment to assess speci c needs, provide referrals and arrange appropriate accommodations (416) 287-7560 orability@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.art7rl0(all)-490(w)281rCr376(re409(on/418(wit)28(t185.09(on5b2sl(y)-467g:ll)-490(w)281

Tentative Class Schedule

	Date	Topic
Tutorial 1	Sept. 4th	Python/jupyter notebook installation. In the first tutorial, we will help you setup python and jupyter notebooks on your own personal laptop or how to use these tools on one of the physics lab computers. If you have not used python before, it is essential that you come to this tutorial as you will not be able to work on the assignments otherwise.
Lecture 1	Sept. 10th	Introduction to Python. In the first lecture, you will learn the basics about python, the python syntax, and the features of jupyter notebooks. After this lecture you should be able to write and run simple python programs.
Tutorial 2	Sept. 11th	Test 1. In the second tutorial, you will need to demonstrate to the TA that you are able to write and run a short python program. You can either do this on your own personal computer or on one of the computers in the physics labs. The TA might give you a simple task such as *"Write a python program that prints out the result of* 5 98". Once you have completed the task successfully, you may leave the tutorial. The purpose of this test is to ensure everyone is able to work on the assignments which follow. The test is worth 10pts.
Lecture 2	Sept. 17th	Number representations. In this lecture, we will discuss how numbers are represented on a computer. In particular, we will discuss IEEE754 floating point numbers in great detail. You will be able to determine how accurate a calculation might possible be on a computer and when a calculation might fail completely. You should understand how one can convert from decimal numbers to floating point numbers and back. Assignment 1 will be about floating point numbers.
Tutorial 3	Sept. 18th	Drop in help desk. In this tutorial you will have the opportunity yo ask questions and get help with assignment 1. Attendance is voluntary for this tutorial.
Assignment 1	Sept. 24th	Deadline to hand in assignment 1 is 9am! Assignment 1 is worth 10pts.
Lecture 3	Sept. 24th	Arrays, plotting, and chaotic maps. Using the logistic and standard map, we will explore two chaotic iterative maps. While working with these systems, you will learn how to make plots in python with matplotlib and how to use scientific python libraries such as numpy. You will use these tools to complete assignment 2.
Tutorial 4	Sept. 25th	Test 2. In this tutorial you will go over your submission of assignment 1. Make sure you really understand your submission. Although having a working program is good, it is not sufficient to get marks in the test. You might have to explain parts of your program to the TA or professor. In addition to the assignment, the test is worth 10pts.
Assignment 2	Oct. 1st	Deadline to hand in assignment 2 is 9am! Assignment 2 is worth 10pts.
Lecture 4	Oct. 1st	Root finding methods. You will learn how to solve one dimensional non-linear equations using a root solver. We will discuss different root solvers and their properties. You will also learn how to numerically solve non-linear problems in higher dimensions and what problems might arise.
Tutorial 5	Oct. 2nd	Test 3. In this tutorial you will go over your submission of assignment 2. Make sure you really understand your submission. Although having a working program is good, it is not sufficient to get marks in the test. You might have to explain parts of your program to the TA or professor. In addition to the assignment, the test is worth 10pts.

October 8th to Oct. 12th { Reading week { No lectures or tutorials		
Lecture 5	Oct. 15th	Computers and micro-controllers. In this lecture we'll take a step back and discuss what a computer actually is. You will learn the basic components that make up a computer. As an example of a very small computer, we will discuss the ESP8266 micro-controller. You will be able to use this micro-controller for an optional project in this course.
Tutorial 6	Oct. 16th	Project. Attendance for this tutorial is optional. Come if you are interested in doing an optional project using the ESP8266 micro-controller. If you do a succ-seful project, your grade might get a boost (see above). After you present your idea for the project to the TA or professor, you can sign up for the project and can pick up a WEMOS D1 mini device with an ESP8266 micro-controller and any additional components you might need.anlsh co1(e)27(o)2r321[(ah(ab)-w-333(8t

Tutorial 10	Nov. 13th	Project. Attendance for this tutorial required only for those students who have signed up for a project. In the tutorial you will talk to the TA or professor about your progress, show a demo, or get help if you are stuck.
Assignment 5	Nov. 12th	Deadline to hand in assignment 5 is 9am! Assignment 5 is worth 10pts .
Lecture 10	Nov. 19th	Random numbers and Monte Carlo methods. In this lecture, we will discuss what random numbers are and how computers generate them. We will then use random numbers to perform numerical calculations. We will discuss how such methods can be used in statistics when solving integrals that appear in Bayes' Theorem.
Tutorial 11	Nov. 20th	Test 6 . In this tutorial you will go over your submission of assignment 5. Make sure you really understand your submission. Although having a working program is good, it is not su cient to get marks in the test. You might have to explain parts of your program to the TA or professor. In addition to the assignment, the test is worth 10pts .
Lecture 11	Nov. 26th	Projects. In this lecture you will present the micro-controller projects that you've been working on.
Tutorial 12	Nov. 27th	Exam prep. In this tutorial, you will solve several problems from previous exams in small groups, then discuss your answers with the TA or professor. This is for practice only, you will not receive a grade for your answers.
Lecture 12	Dec. 3rd	Make up lecture / revision. We will use the last lecture to wrap-up any loose ends. If time permits, we will revisit some of the more di cult material from the course. We will also talk about how to best prepare for the nal exam.

End

Congratulations! You've read the syllabus all the way to the end. As a reward you will get one extra point counting towards your assignment grade. Just draw a picture of a cat somewhere on the nal exam (any stick gure cat with four legs and a tail will do).