

Course Outline

PHYS/ACS-2112-001 Scientific Computing with Python

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1 Course Information

- This course has two listings: PHYS-2112-002 and ACS-2112-002
- 2021 Winter Semester
- Instructor: Stuart Williams
- Email: stuw@swilliams.ca
- TA/Lab Assistant/Marker: phys-2112-ta@googlegroups.com
- Class meeting times: Mon/Wed/Fri 8:30 a.m. - 9:20 a.m.
- Course Outline URL: <https://uwcloud.uwinnipeg.ca/s/4FyMYZnaFW2pG8A>
- Course Webpage and Schedule: <https://uwcloud.uwinnipeg.ca/s/dazWxD6i5zsxN5b>
- Office: Not available
- Course Format: Online-synchronous via video-conference
 - Lectures may be recorded and made available.
 - Invitations will be sent to students' UWinnipeg email addresses.
 - High-speed internet connection is required.
 - Students are expected to install Python and Jupyterlab on their personal computer. In theory <https://colab.research.google.com> could be used instead with permission of the instructor.
 - Students are expected to attend the online classes, for lectures, unannounced quizzes, class activities, and/or taking tests and exams. Students cannot be admitted to this course if they can't attend regularly, including if they have another course scheduled simultaneously. There is a high correlation between skipping lectures and doing poorly in the course.
 - Please disable notifications on your phone and computer during lectures.
 - For classes (via video-conferencing), students are expected to be on time, raise hands when they have questions, and abide by the UW Respectful Working and Learning Environment Policy at <http://www.uwinnipeg.ca/respect/>
 - Students are expected to have their video enabled. This helps everyone (you, other students, and the instructor), with being and staying engaged. If you have a concern with this, talk with the instructor.
 - To minimize noise, students should stay muted except when asking or answering questions. You may also use the meeting chat function, but the instructor may not notice new questions for a few minutes when focused on the shared screen. Feel free to attract their attention via the meeting software's raise-hand function, or raise your hand or otherwise get their attention via video, or unmute.
- Office hours:

Due to Remote Delivery of this course, there will be no in-person Office Hours. You can ask your questions via e-mail or other online means and I will do my best to answer them. However, to better answer your questions, a one-on-one conversation via video will be encouraged. Such sessions will be arranged by appointment only.

- Calendar Course Description from <https://www.uwinnipeg.ca/academics/calendar/docs/all-course-descriptions.pdf>

PHYS-2112 (3) Scientific Computing with Python (3 hrs Lecture)

This Python language course shows students how to create basic programming structures in Python including decisions, loops and more advanced topics such as object-oriented programming with classes and exceptions. Unique Python data structures such as tuples and dictionaries are introduced. Students learn how to create Python programs with graphic elements as well as data visualization and publication quality figures. Applications from a variety of scientific fields are discussed when appropriate.

Note: Prior course-work or experience with computers and elementary computer programming is strongly recommended. Historically, students without any programming experience have rarely succeeded except by putting in extra work, especially in the first half of the course.

Cross-listed: ACS-2112

Experimental Course - This course is offered on a trial basis to gauge interest in the topic. Students who successfully complete this course receive credit as indicated.

Restrictions: Students may not hold credit for this course and ACS-2112.

2 Topics and Learning Outcomes

Upon the successful completion of this course, the student will have:

- A basic understanding of some basic computer science concepts:
 - Hardware and software in computing
 - Efficiency of computer algorithms
 - How variables are used in software, and two models of implementing them
- A basic understanding of computer programming:
 - Concept of data types
 - Specific data types: number, string, list, tuple, dictionary, set, file, np.array, pd.Series, pd.DataFrame
 - How computers represent numbers, characters, and pointers
 - How to write functions
 - Boolean expressions and if statements
 - Loops
 - Software testing strategies
 - Object oriented programming basics
- Some ability to code in Python using its basic features:
 - Objects
 - Names, namespaces, scopes and search order
 - Built-in data types and their most important operators and methods
 - Built-in functions
 - String formatting and f-strings
 - Sequence indexing and slicing
 - List comprehensions and generator expressions
 - Generators
 - Simple classes
 - Exceptions
 - Character encoding
 - Function locals, non-locals, globals
- Introduction for awareness to some advanced Python features
 - Class internals
 - Bound methods
 - Metaclasses
 - Decorators
 - Special methods of classes
 - Iterables, iterators, and the iterator protocol
- Basic ability to handle large amounts of data in Python efficiently with NumPy and Pandas
- Basic ability to visualize data with at least one Python visualization library
- Familiarity with techniques to measure and increase the performance of Python code
- Brief introduction to Machine Learning

Note that the details of the topics and learning outcomes above are tentative and some of them may not be achieved.

3 Course Material

The following free online books will be used in the course. Only parts of each book will be used.

- Think Python - How to Think Like a Computer Scientist 2nd Edition, Version 2.4.0 by Allen B. Downey (Green Tea Press). Copyright 2015 Allen Downey.

Available free in PDF format at <https://greenteapress.com/wp/think-python-2e/>, HTML format at <http://greenteapress.com/thinkpython2/html/index.html>, and Jupyter notebooks adapted from it at several locations.

Other editions will be similar, but some assignment problems won't match, so check the version of your copy on the first page of the book.

This book teaches programming using Python.

- The Python Data Science Handbook by Jake VanderPlas (O'Reilly). Copyright 2016 Jake VanderPlas, 978-1-491-91205-8.

Available free in PDF or Jupyter Notebooks at <https://jakevdp.github.io/PythonDataScienceHandbook/>

This book teaches NumPy and Pandas.

Most "pages" in this book have lots of small code samples so the number of words per page will be about half of a typical textbook.

This book will be used both as a textbook and a reference. In its role as a textbook it presents concepts you should understand and on which you will be tested. In its role as a reference it may help you complete assignments.

- A Whirlwind Tour of Python by Jake VanderPlas (O'Reilly). Copyright 2016 O'Reilly Media Inc, 978-1-491-96465-1.

Available free in PDF or Jupyter Notebooks at <https://github.com/jakevdp/WhirlwindTourOfPython>

This book teaches programming with Python and can be used as an alternative or supplement to the Think Python book.

4 Important Dates

- January 6 - April 7th, 2021 - course lectures
- February 14 - 20 - Reading Week (no classes)
- March 16 - Final date to withdraw without academic penalty
- April 2 - Good Friday - no classes and university closed
- April 7 - Last class - makes up for April 2
- TBD - Final Exam
- April 23 - the last assignment will be due on or before this date

For all other important dates, see <https://www.uwinnipeg.ca/academics/calendar/docs/dates.pdf>

5 Grade Distribution

- 5% In-class quizzes, unannounced
- 40% Assignments (about 12, one per week, varying weights)
- 15% Test 1
- 15% Test 2
- 25% Final exam

6 Important Notes

- Assignments:
 - Assignments will usually be finalized and communicated on Friday or Saturday and will be due the following Friday at 11 p.m.
 - Assignments will be posted as updates to the course schedule on uwcloud.uwinnipeg.ca
 - Assignments must be submitted online via uwcloud.uwinnipeg.ca as either Python code files and/or Jupyter notebook files, depending on the assignment.
 - Assignment submissions are not accepted via e-mail.
 - Late assignments will not be accepted without prior consent of the instructor.
 - You should try first to complete your assignments without any assistance. If you succeed, you'll learn the most. However, if you are stuck, you are allowed to receive help with assignments, but you are not allowed to copy code from a helper, the internet, or anywhere, to complete an assignment. A good rule of thumb is you can talk with others about how you might approach a solution, but you can't take any notes; then you have to do a different activity for at least an hour, for example studying for a different class, and then after that you should try to complete your assignment.
- Assistance: Students are encouraged to consult with the TA/lab assistant or instructor when experiencing difficulties in the course. We will do our best to help and/or provide advice.
- Tests/Exams:

- o Tests and Exams are administered and/or submitted online. The format and specific instructions will be communicated prior to the test/exam date.
 - o Authorized course materials and devices will be communicated prior to each test/exam. In short, they are closed book.
 - o Please note that student's activities will be monitored during online quizzes/tests/exams, including via video.
- Communication: Your University of Winnipeg email address will be used for course related correspondence.
 - Grading System: Below are the guidelines for conversion from numerical (percentage) grades to letter grades. The final grades are approved by the Physics Department Review Committee.

Letter Grade - Percentage:

| | |
|----|--------|
| A+ | 95-100 |
| A | 87-94 |
| A- | 80-86 |
| B+ | 74-79 |
| B | 67-73 |
| C+ | 61-66 |
| C | 53-60 |
| D | 50-52 |
| F | 0-49 |

7 Academic Integrity

You are expected to take academic integrity very seriously and be mindful of your own activities and the requests/offers you may receive from others.

In addition to the guidelines in the Academic Calendar (Regulations and Policies, Subsection 8a), for all assessment items in this course, the following are considered cheating, plagiarism, or academic misconduct:

- Copying from another student's work and submitting it as your own (group or collaborative work approved by the instructor is not considered cheating).
- Consulting or copying from any unauthorized sources, including, but not limited to: the Internet; online calculators and graphing tools; assignments or tests/exams from previous years or from other courses; solutions provided by a third party (purchased or otherwise).
- Asking questions from another student or any unauthorized person during the exams and tests.
- Using any unauthorized sources during the tests and exams.
- Soliciting and obtaining solutions to the assignments, tests, and exams via any means of communication (e.g., e-mail, text, phone call, social media chats, etc.).
- Providing test or exam questions and/or solutions to another student, uploading them to a filesharing website, or otherwise sharing them outside the course.

It is your responsibility to know the policies and guidelines, and to be aware of the academic misconduct procedures. Anybody involved in the process could be charged with academic misconduct. For more information, please see the Academic Calendar, Regulations and Policies, Subsection 8a. <https://uwinnipeg.ca/academics/calendar/docs/regulationsandpolicies.pdf>

8 Important Information from the Department and the Dean of Science

1. A permitted or necessary change in mode of delivery may require adjustments to important aspects of course outlines, like class schedule and the number, nature, and weighting of assignments and/or exams.
2. Students can find answers to frequently ask questions related to remote learning here: <https://www.uwinnipeg.ca/covid-19/remote-learning-faq.html>.
3. [Intentionally left blank.]
4. The method of delivery and submission of graded work should be specified, as well as the type of equipment/resources authorized for use in tests/exams.
5. When it is necessary to cancel a class due to exceptional circumstances, every effort will be made to inform students via UWinnipeg email (and/or using the preferred form of communication, as designated in this outline).
6. Students have the responsibility to regularly check their UWinnipeg e-mail addresses to ensure timely receipt of correspondence from the University and/or their course instructors.
7. Please note that withdrawing before the VW date does not necessarily result in a fee refund. Please contact the instructor before withdrawing in case they can help in any way.
8. The first day of class is January 6. Last class will be held on April 7. Evaluation period is April 7 to 23. See <https://www.uwinnipeg.ca/academics/calendar/docs/dates.pdf> for all dates.
9. Regulations, Policies, and Academic Integrity. Students are encouraged to familiarize themselves with the "Regulations and Policies" found in the University Academic Calendar at: <https://uwinnipeg.ca/academics/calendar/docs/regulationsandpolicies.pdf>. Particular attention should be given to subsections 8 ("Student Discipline"), 9 ("Senate Appeals"), and 10 ("Grade Appeals"). Please emphasize the

importance of maintaining academic integrity, and to the potential consequences of engaging in plagiarism, cheating, and other forms of academic misconduct. Even "unintentional" plagiarism, as described in the UW Library video tutorial "Avoiding Plagiarism" (<https://www.youtube.com/watch?v=UvFdxRU9a8g>) is a form of academic misconduct. Similarly, uploading essays and other assignments to essay vendor or trader sites (filesharing sites that are known providers of essays for use by others who submit them to instructors as their own work) is a form of misconduct, as it involves "aiding and abetting" plagiarism. More detailed information can be found here: Academic Misconduct Policy and Procedures: <https://www.uwinnipeg.ca/institutional-analysis/docs/policies/academic-misconduct-policy.pdf> and <https://www.uwinnipeg.ca/institutional-analysis/docs/policies/academic-misconduct-procedures.pdf>.

10. Respectful Learning Environment. Students are expected to conduct themselves in a respectful manner on campus and in the learning environment irrespective of platform being used. Behaviour, communication, or acts that are inconsistent with a number of UW policies (e.g. Respectful Working and Learning Environment Policy <https://www.uwinnipeg.ca/respect/respect-policy.html>, Acceptable Use of Information Technology Policy <https://www.uwinnipeg.ca/institutional-analysis/docs/policies/acceptable-use-of-information-technology-policy.pdf>) could be considered "non-academic" misconduct. More detailed information can be found here: Non-Academic Misconduct Policy and Procedures: <https://www.uwinnipeg.ca/institutional-analysis/docs/student-non-academic-misconduct-policy.pdf> and <https://www.uwinnipeg.ca/institutional-analysis/docs/student-non-academic-misconduct-procedures.pdf>.
11. Copyright and Intellectual Property. Course materials are the property of the instructor who developed them. Examples of such materials are course outlines, assignment descriptions, lecture notes, test questions, and presentation slides--irrespective of format. Students who upload these materials to filesharing sites, or in any other way share these materials with others outside the class without prior permission of the instructor/presenter, are in violation of copyright law and University policy. Students must also seek prior permission of the instructor/presenter before, for example, photographing, recording, or taking screenshots of slides, presentations, lectures, and notes on the board. Students found to be in violation of an instructor's intellectual property rights could face serious consequences pursuant to the Academic Misconduct or Non-Academic Misconduct Policy.
12. Research Ethics. Students conducting research interviews, focus groups, surveys, or any other method of collecting data from any person, including a family member, must obtain research ethics approval before commencing data collection. Exceptions are research activities done in class as a learning exercise. For submission requirements and deadlines, see <http://www.uwinnipeg.ca/research/human-ethics.html>
13. Privacy. Students are reminded of their rights in relation to the collecting of personal data by the University (<https://www.uwinnipeg.ca/privacy/admissions-privacy-notice.html>), especially if Zoom is being used for remote teaching (<https://www.uwinnipeg.ca/privacy/zoom-privacy-notice.html>) and testing/proctoring (<https://www.uwinnipeg.ca/privacy/zoom-test-and-exam-proctoring.html>).