

Course Outline

PHYS/ACS-2112-001 Scientific Computing with Python

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1 Course Information

This course has two listings: PHYS-2112-001 and ACS-2112-001

2020 Winter Semester

Instructor: Stuart Williams

Email: stuw@swilliams.ca

Office: 2C25

Office hours (subject to change): Mondays 1:30 - 2:15 p.m., 3:45 - 4:30, or by appointment

Class meeting times: Monday, Wednesday 02:30 p.m. - 03:45 p.m.

Classroom: 3D04 (Duckworth Centre)

Course Outline URL: <http://bit.ly/PHYS-2112>

Course Webpage: On Nexus <https://nexus.uwinnipeg.ca>

Calendar Course Description:

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

ACS-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: Experience with elementary computer programming is recommended.

Cross-listed: PHYS-2112(3).

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 PHYS-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 at <https://greenteapress.com/wp/think-python-2e/> (and Jupyter notebooks adapted from it at several locations).
This book teaches programming with Python.
- 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.
- 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 books 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.

4 Course Schedule

- Week 01 Jan 6, 8
- Week 02 Jan 13, 15
- Week 03 Jan 20, 22
- Week 04 Jan 27, 29
- Week 05 Feb 3, 5
 - Test 1
- Week 06 Feb 10, 12
- Feb 17 - Reading Week
- Week 07 Feb 24, 26
- Week 08 Mar 2, 4
- Week 09 Mar 9, 11
 - Test 2
- Week 10 Mar 16, 18
- Week 11 Mar 23, 25
- Week 12 Mar 30, Apr 1
- Final Exam - April 11, 2020 1:30 - 4:30 p.m.

5 Grade Distribution

- 30% Assignments (most weeks, approximately 10)
- 20% Test 1

- 20% Test 2
- 30% Final Exam

Important Notes

- Assignments:
 - Assignments will be usually given at the beginning of the class and will be due the following week before class, or other dates as specified by the instructor. Assignments must be submitted online (details will be announced later) as Python code that can be run.
 - Late assignments will not be accepted without prior consent of the instructor.
 - Assignment and solutions will be posted on the course webpage.
- Classroom:
 - Attendance of the lectures is expected. Students cannot be admitted to this course if they can't attend regularly due to having another course scheduled simultaneously.
 - Please silence phones during class.
- Assistance: Students are encouraged to consult with me when experiencing difficulties in the course. I will do my best to help and/or provide advice.
- Tests/Exams:
 - No identification will be asked at the tests/exams.
 - Calculators are not permitted in tests/examinations.
 - Smart phones/cell phones must be switched off for the duration of the tests/exams.
 - Class notes, books, and course materials are not allowed in the test/exams, unless specified by the instructor prior to exam date.
- Communication: Only your University of Winnipeg email address will be used for course related correspondence.
- The voluntary withdrawal date, without academic penalty: March 13, 2010 is final date to withdraw without academic penalty. Please contact me if you are considering dropping the course.

Grading System: Below are the guidelines for conversion from numerical (percentage) grades to letter grades. The final grades are approved by the 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

6 Notes from the Dean

1. When it is necessary to cancel a class due to exceptional circumstances, I will make every effort to inform students via uwinnipeg email (and/or using the preferred form of communication, as designated in this outline), as well as the Departmental Assistant and Chair/Dean so that class cancellation forms can be posted outside classrooms.
2. Students are reminded that they have a responsibility to regularly check their uwinnipeg e-mail addresses to ensure timely receipt of correspondence from the University and/or their course

instructors.

3. Please note that withdrawing before the VW date does not necessarily result in a fee refund.
4. The first day of this class is January 6th, 2020. Last class will be held on April 1st, 2020. No make-up classes will be scheduled. See <https://www.uwinnipeg.ca/academics/calendar/docs/dates.pdf> for all dates.
 - Feb 16 - 22 Winter Term Reading Week. No classes.
 - Feb 17 Louis Riel Day: University closed.
 - Apr 10 Good Friday: University closed.
5. Avoiding Academic and Non-academic Misconduct. Students are encouraged to familiarize themselves with the Academic 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 note, in particular, the subsection of Student Discipline pertaining to plagiarism and other forms of cheating.

Detailed information can be found at the following:

- 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>
 - 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>
6. Misuse of Filesharing Sites. 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) involves "aiding and abetting" plagiarism. Students who do this can be charged with Academic Misconduct.
 7. Avoiding Copyright Violation. Course materials are owned by the instructor who developed them. Examples of such materials are course outlines, assignment descriptions, lecture notes, test questions, and presentation slides. 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 photographing or recording slides, presentations, lectures, and notes on the board.
 8. 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>.
 9. The Dean recommends you watch the University of Winnipeg library video tutorial "Avoiding Plagiarism" <https://www.youtube.com/watch?v=UvFdxRU9a8g>

7 University of Winnipeg Senate Regulations

1. Students may choose not to attend classes or write examinations on holy days of their religion, but they must notify their instructors at least two weeks in advance. Instructors will then provide opportunity for students to make up work examinations without penalty. A list of religious holidays can be found in the 2019-20 Undergraduate Academic Calendar.

2. Students with documented disabilities, temporary or chronic medical conditions, requiring academic accommodations for tests/exams (e.g., private space) or during lectures/laboratories (e.g., note-takers) are encouraged to contact Accessibility Services (AS) at 204-786-9771 or accessibilityservices@uwinnipeg.ca to discuss appropriate options. All information about a student's disability or medical condition remains confidential <http://www.uwinnipeg.ca/accessibility>.
3. Reference to the appropriate items in the Regulations & Policies section of the Course Calendar, including Senate appeals and academic misconduct (e.g. plagiarism, cheating) <http://uwinnipeg.ca/academics/calendar/docs/regulationsandpolicies.pdf> Instructors should become familiar with the procedures for dealing with alleged academic misconduct at <https://www.uwinnipeg.ca/institutional-analysis/docs/policies/academic-misconduct-procedures.pdf>
4. All students, faculty and staff have the right to participate, learn, and work in an environment that is free of harassment and discrimination. The UW Respectful Working and Learning Environment Policy may be found online at <http://www.uwinnipeg.ca/respect/>