THE UNIVERSITY OF WINNIPEG
ACS/PHYS-2112-050 Scientific Computing | Fall 2025

Course Information

Instructor:	Michelle Boyce
Email:	m.boyce@uwinnipeg.ca[1]
Lectures:	Wed 6:00-9:00 PM
Classroom:	2L14
Office	2C27
Office Hours:	By Appointment

Important Dates

Sep 3	Our First Class
Sep 30 (T)	True & Reconciliation
Oct 12-18	Thanksgiving/Reading Week
Oct 29	Midterm
Nov 11 (T)	Remembrance Day
Nov 26	Our Last Class
Dec 8-20	Final Exams

Course Description:

This course introduces the basics of Python needed for scientific computing as well as some higher level data structures and features that are uncommon in lower-level languages such as C and C++. Students learn how to write modules and functions to solve a variety of scientific problems. They also learn how to take advantage of the numerical libraries NumPy and Pandas that extend Python with high-performance vectorized calculations and visualizations. Students also explore other packages, such as matplotlib, Vega-Altair and scikit-learn. Note: This course is appropriate for all students with an interest in scientific computing, and experience with elementary computer programming is recommended. Cross-listed: ACS-2112(3). Restrictions: Students may not hold credit for this course and ACS-2112.

Overview

This course provides an introduction to Python, an interpretive software language which is highly utilized in Physics and Engineering. Basic programming structures, such as, conditional statements, loops, functions, and classes, are covered. Advanced features, such as, vector programing, data structures, and data representation, are covered next. Built on top of the aforementioned, are sophisticated libraries for advanced data manipulation and representation, from which some selected topics will be taught. The material covered herein, will provide one with a basic foundation from which to pursue more advanced topics, applicable to specific subject matter domains, such as, astronomy, fluid dynamics, stress analysis, *etc*.

Learning Modules

The following table outlines the learning modules within this course.

Objective	Topics
The Basics	"Hello Word!", data types, operations, control structures, loops, I/O, functions, arrays, strings.
Object Oriented Programing	Classes, data types, inheritance, polymorphism, modules, UML (class notation, class diagrams, object hierarchy diagrams)
Vector Programming and Data Structures	Vectors (NumPy) and tables (pandas).
Data Representation	Matplotlib (line plots, scatter plots, histograms, bubble plots).

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[1] Do not use the Nexus email portal. It is not checked.

Objective	Topics
Application Libraries	Astronomy (Astropy, FITS Files, DS9), Machine Learning (scikit-learn), Data Representation (Vega-Altair), SciPy, *etc.*

NB: The aforementioned table is a general overview of the subject matter to be covered, and the breadth and depth of coverage is on a time-permitted basis – not all topics will necessarily be covered.

Course Material

Reference Texts:

- UML Distilled, Martin Fowler, 3rd ed., Addison-Wesley, 2003. ISBN 0-321-19368-7
- Numerical Recipes, The Art of Scientific Computing (FORTRAN Version), William H. Press, Brian P. Flannery, Saul A. Teukolsky, and William T. Vetterling, 1st ed., Cambridge, 1989. ISBN 0-521-38330-7

Online Resources:

- Basic Programming Structures
  - Python Tutorial: https://www.w3schools.com/python
  - UML Tutorial: https://www.tutorialspoint.com/uml
- Vector Programming and Data Structures
  - NumPy:
    - https://numpy.org/learn
    - https://www.w3schools.com/python/numpy
  - pandas:
    - https://pandas.pydata.org/docs/user_guide
    - https://www.w3schools.com/python/pandas/
- Data Representation
  - Matplotlib:
    - https://matplotlib.org/stable/users
    - https://www.w3schools.com/python
- Application Libraries:
  - Astropy: https://docs.astropy.org/en/stable/index_user_docs.html
  - Vega-Altair: https://altair-viz.github.io/user_guide/data.html
  - scikit-lean: https://scikit-learn.org/stable
  - SciPy: https://www.w3schools.com/python/scipy
- Online Help
  - Add the word "stackoverflow" to your Google searches when stuck on assignment problems and/or have compiler issues. Do not rely on AI.[2]

Evaluation Criterion

The general class format consists of live programming lectures, to which students can follow along, followed by a short break, after which students do hands on programming (tutorial). (Students can use their own personal computer and/or the ones provided in the classroom.)

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[2] See, "How to Succeed in this Course," below.

Typically the live and hands-on programming work becomes part of the assignments. The exams are heavily base on in-class experience and assignments, wherein some questions will be taken directly from this work. So to be successful in this course, attending classes and doing homework is important.

Grading Scheme:
- Participation 5%:
  - Attendance taken
  - Must attend full class to get full attendance marks
  - Students must focus on work pertaining to the class
  - Two exemptions allowed
- Assignments 25%:
  - Roughly one per week
  - Posted/Submitted *via* Nexus[3]
  - Zero if late
- Midterm 30%:
  - In class
  - No cheat sheets
  - A Simple Calculator (incapable of storing information)
  - No personal electronic devices (*e.g.*, phones, smart watches)[4]
  - Photo ID Required
- Final 40%:
  - Same criterion as Midterm

NB: If the Midterm is missed for valid reasons, the final shall count as 70%.[5]

Grading System:
The percentage to letter grade conversion guidelines are as follows.

Letter	Percentage
A+	90.00 - 100.00
A	84.00 - 89.99
A-	80.00 - 83.99
B+	74.00 - 79.99
B	67.00 - 73.99
C+	61.00 - 66.99
C	55.00 - 60.99
D	50.00 - 54.99
F	0.00 - 49.99

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[3] Should technical difficulties arise with Nexus, email shall be used.
[4] They must be turned off and stowed away.
[5] The midterm date is Oct 29th, which does not conflict with Observed Religious Holidays.

Note: The above are guidelines, wherein the final grades shall be approved by the Department Review Committee (DRC), and so are subject to change.

How to Succeed in this Course

It is important to attend classes and participate in all activities. Learning programming is an experiential process. The process of typing in code (not copy-pasting), compiling, running, and debugging (trouble shooting) is what leads to success.

The use of AI tools is highly discouraged. Instead of struggling to understand a problem, its usage affects memory retention, as it is not an effective experiential learning tool. It is also prone to errors. In addition, it is not good at human interaction, as it provides a false sense of positive reinforcement – it tells you what you want to hear. Given that you will be evaluated based on closed book exams, this is a recipe for disaster.

Copying from fellow classmates is highly discouraged. However, collaborating with a classmate, after struggling with a problem, is an effective method of reinforced learning. Also, with human interaction, you are not always told what you want to hear. This punctuates the learning process by making you re-evaluate your thoughts. This will lead to critical thinking skills, which lends well to programming and problem solving – in general!

Programming requires logical thinking and paying attention to detail. These guidelines are here to help you with that process. When it comes to exams, memorizing syntax becomes less of an effort, as it will be reinforced through experiential learning.

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).
- Uploading the assignment questions on file-sharing websites (such as Chegg.com, quizlet, ChatGPT, or any other 'Help' sites) in order to receive help or solutions.
- Copying from any sources, including, but not limited to: the Internet; any AI tools, 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, including, but not limited to: the in-person exams, take-home exams, or remote exams.
- Talking or communicating with other student(s), during the exams/tests (in-person or on Zoom), in any language, for any reason or purpose.
- Using or having in one's possession any unauthorized sources and devices 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).

AI Text-generating Tools

Students must follow principles of **Academic Integrity** (*e.g.*, honesty, respect, fairness, and responsibility) in their use of material obtained through AI text-generating tools (*e.g.*, ChatGPT, Bing, Notion AI). If an instructor prohibits the use of AI tools in a course, students may face an allegation of academic misconduct if using them to do assignments. If AI tools are permitted, students must cite them. According to the MLA (https://style.mla.org/citing-generative-ai/), "you should

1. cite a generative AI tool whenever you paraphrase, quote, or incorporate into your own work any content (whether text, image, data, or other) that was created by it
2. acknowledge all functional uses of the tool (like editing your prose or translating words) in a note, your text, or another suitable location
3. take care to vet the secondary sources it cites"

If students aren't sure whether or not they can use AI tools, they should ask their professors.

University of Winnipeg Regulations and Policies

- Course Outline changes
  - 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.
- COVID-19
  - Students can find answers to updates and frequently asked questions related to COVID-19 here: https://www.uwinnipeg.ca/covid-19/index.html
- Fall term 2025
  - Lectures begin on September 2.
  - Reading week is October 12 to 18.
  - Voluntary withdrawal is November 12.
  - Lectures end on December 2.
  - Evaluation period is December 8 to 20.
- Class Cancellation
  - When it is necessary to cancel a class due to exceptional circumstances, every effort will be made to inform students *via* UWinnipeg email.

- Communication
  - Students have the responsibility to regularly check their University of Winnipeg email addresses to ensure timely receipt of correspondence from the University and/or their course instructors.
  - Students are also responsible for regularly checking Nexus for announcements, notes/slides updates, assignments (downloads/uploads), *etc*. This will be the primary source for the dissemination of information pertaining to this course. Nexus has email alerts that can be set.
    - Should technical difficulties arise with Nexus, communication shall default to email.
    - Do not use the Nexus email tool, as it is not checked.
- Voluntary Withdrawal
  - The Voluntary Withdrawal (VW) date, without academic penalty, is Wednesday, November 12, 2025.
  - Please note that withdrawing before the voluntary withdrawal date does not necessarily result in a fee refund.
  - A minimum of 20% of the work on which the final grade is based will be evaluated and available to the student prior to the voluntary withdrawal date.
  - Students are encouraged to contact their instructor prior to withdrawing in case they can help in any way.
- University Closures 2025
  - The dates the University is closed for holidays, irrespective of campus closure related to COVID-19 are:
    - ★ September 1, 2025 (Labour Day)
    - ★ September 30, 2025 (Truth and Reconciliation Day)
    - ★ October 13, 2025 (Thanksgiving Day)
    - ★ November 11, 2025 (Remembrance Day)
    - ★ December 23, 2025, through January 1, 2026 (Holiday break)
- Religious Holy Days
  - 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 Undergraduate Academic Calendar.[5]

    https://www.uwinnipeg.ca/academics/calendar/docs/important-notes.pdf
- Regulations, Policies, and Academic Integrity
  - Students are encouraged to familiarize themselves with the Regulations and Policies found in the 2025-26 Academic Calendar. Particular attention should be given to subsections 8 (Student Discipline, including Academic Misconduct Policies and Procedures), 9 (Senate Appeals), and 10 (Grade Appeals).
  - Please be mindful of the importance of maintaining academic integrity and the potential consequences of engaging in plagiarism, cheating, and other forms of academic misconduct. Even unintentional plagiarism 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.
  - An updated and expanded University of Winnipeg library site outlining principles of Academic Integrity can be found at https://library.uwinnipeg.ca/use-the-library/help-with-research/academic-integrity.html.

- 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, communications, or acts that are inconsistent with a number of UW policies, such as,
    - ★ Respectful Working and Learning Environment Policy
    - ★ Acceptable Use of Information Technology Policy

    could be considered "non-academic" misconduct.
  - More detailed information can be found here:
    - ★ Non-Academic Misconduct Policy
    - ★ Non-Academic Misconduct Procedures

- Scent Policy
  - In order to ensure a safe and comfortable learning environment for everyone, we kindly ask that all students refrain from wearing or using scented products while attending class.

- 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 (or computer). 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; such consequences could possibly involve legal sanction under the Copyright policy
    https://www.uwinnipeg.ca/policies/docs/policies/copyright-policy.pdf

- 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 https://www.uwinnipeg.ca/research/ethics/human-ethics.html

- Privacy
  - A guide to the basic requirements for the collection, use, and disclosure of personal information may be found here. The Privacy and Policy Procedures may be found here.
  - Students should be reminded of their rights in relation to the collecting of personal data by the University, especially if Zoom is being used for remote learning and testing/proctoring:
    - ★ Student Privacy Notice
    - ★ Zoom Privacy Notice
    - ★ Zoom Test and Exam Proctoring

Sexual Violence and Human Rights Advisor (SVHRA)

Students who have experienced Sexual Violence can access support from the SVHRA. The SVHRA receives disclosures and can support students with on and off-campus reporting. In collaboration with the Sexual Violence Response Team (SVRT), the SVHRA also provides fast-track referrals to Student Wellness, academic accommodations, security support, and other on and off campus supports. The SVHRA and SVRT operate within a confidential, survivor-centered, and trauma-informed framework.

Disclosures may be made in-person, email, by text, by phone, or Zoom/Teams.

5Ri55, 5th Floor (Rice Centre)

204.230.6660 – *call or text (confidential line)*

svrt@uwinnipeg.ca   **uwinnipeg.ca/respect/sexual-violence**

Accessibility Services

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 at 204-786-9771 or accessibilityservices@uwinnipeg.ca to discuss appropriate options. All information about a student's disability or medical condition remains confidential.

More information about Accessibility Services can be found online at
http://www.uwinnipeg.ca/accessibility/

Land Acknowledgement

We acknowledge that we are gathered on ancestral lands, on Treaty One Territory. These lands are the heartland of the Métis people. We acknowledge that our water is sourced from Shoal Lake 40 First Nation.
https://www.uwinnipeg.ca/indigenous/land-acknowledgement.html