THE UNIVERSITY OF WINNIPEG

ACS/PHYS-2102-052 Scientific Computing | Fall 2023

Course Information

Instructor:	Michelle Boyce
Email:	m.boyce@uwinnipeg.ca
Lectures:	Mon 6:00-9:00 PM
Classroom:	2L14
Office	2C26
Office Hours:	By Appointment

Important Dates

Sep 11	First Class
Sep 30	True & Reconciliation
Oct 8-14	Thanksgiving/Reading Week
Oct 30	Midterm
Dec 4	Last Class
Dec 7-23	Final Exams

Course Description:

Many problems arising in science are too difficult to solve analytically, and thus require analysis of some form by a computer. Using the language of C/C++, this course introduces the most common programming constructs used in scientific computing. The critical importance of data structures to represent information is emphasized, which naturally leads to an object-oriented approach to problem solving. The use of external libraries, such as those for numerical analysis, to solve more advanced problems are explored, with attention paid to checks that can be made on the reliability of the results.

Overview

This course provides an introduction to the C++ programming language, bootstrapped via the C programming language. Some of the underlying core principles of non-object-oriented programming are learned through C, and are carried forth to object-oriented programming through C++. Students will become familiar with the foundations of object-oriented programming, along with some software design concepts through the Unified Modeling Language (UML). Some basic applications used in scientific computing will also be covered. In many ways, C++ is the most fundamental object-oriented programming language, as other languages, such as, Java, JavaScript, Python, Visual Basic, etc., are hobbled in their abilities. Thus, learning C/C++, with a dash of UML, will provide a solid foundation in object-oriented application design and implementation for years to come!

Learning Modules

The following table outlines the learning modules within this course. The UML, Plotting, and Applications modules will be taught in concert with C/C++.

Objective	Topics	Resources
C	"Hello Word!", data types, operations, control structures, loops, I/O, functions, pointers, arrays, strings, structures, memory allocation.	W3Schools C Tutorial
C++	Basic class structure, data types, inheritance, polymorphism, I/O, constructors/destructors.	W3Schools C++ Tutorial
UML	Basic class notation, class diagrams, object hierarchy diagrams.	TutorialsPoint
Plotting	Scatter plots, line plots.	GNUPlot
Applications	Area, slopes, statistics, root finding …	Numerical Recipes

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

Course Material

Reference Texts:

- The ANSI C Programming Language, Brian W. Kernighan and Dennis M. Ritchie, 2nd ed., Prentice Hall, 1988. ISBN 0-13-110362-8
- C++ for C Programmers, Ira Pohl, 2nd ed., Benjamin/Cummings, 1994. ISBN 0-8053-3159-X
- 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:

- W3Schools
  - C Tutorial: https://www.w3schools.com/c/
  - C++ Tutorial: https://www.w3schools.com/cpp/
- TutorialsPoint
  - UML Tutorial: https://www.tutorialspoint.com/uml/index.htm
- GNUPlot
  - http://www.gnuplot.info
- Online Help
  - Add the word "stackoverflow" to your Google searches when stuck on assignment problems and/or have compiler issues.

Evaluation Criterion

Grading Scheme:

- Participation 5%:
  - Attendance taken
  - Must attend full class
  - Two exemptions allowed
- Assignments 25%:
  - Roughly one per week
  - Posted/Submitted *via* Nexus[1]
  - Zero if late
- Midterm 30%:
  - In class
  - No cheat sheets
  - University Approved Calculator
  - Photo ID Required
- Final 40%:
  - Same criterion as Midterm.

NB: If the Midterm is missed for valid reasons, the final shall count as 60%.[2]

The percentage to letter grade conversion guidelines are as follows.

Letter	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

Note: The above are guidelines and that final grades shall be approved by the Department Review Committee and may be subject to change.

[1] Should technical difficulties arise with Nexus, email shall be used.
[2] The midterm date is Oct 30th, which does not conflict with Observed Religious Holidays.

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.
- 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 tests and exams.
- 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., email, 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.

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 2023
  - Lectures begin on September 5.
  - Reading week is October 8 to 14.
  - Lectures end on December 4.
  - Evaluation period is December 7 to 22.
- 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 UWinnipeg 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.
- Voluntary withdrawal
  - The voluntary withdrawal date, without academic penalty, is Monday, November 13, 2023.
  - 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 2023
  - The dates the University is closed for holidays, irrespective of campus closure related to covid-19 are:
    - ★ September 4, 2023 (Labour Day)
    - ★ September 30, 2023 (Truth and Reconciliation Day)
    - ★ October 9, 2023 (Thanksgiving Day)
    - ★ November 11, 2023 (Remembrance Day)
    - ★ December 23, 2023, through January 4, 2024 (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.[2]

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 University Academic Calendar. Particular attention should be given to subsections: 8 (Student Discipline), 9 (Senate Appeals), and 10 (Grade Appeals).
  - Please note the importance of maintaining Academic Integrity, and 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" is a form of academic misconduct.
  - Similarity, 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.
  - The policies and procedures are available at the following links:
    - ★ Academic Misconduct Policy
    - ★ Academic Misconduct Procedure
- 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
- 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://copyright.uwinnipeg.ca/basics/copyright-policy.html

- 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
  - 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

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