

ENVR 4000 T06 / GEOG 4670 T04 / GEOG 7010 T16
Programming for Environmental Science Data Analysis
Course Syllabus
Winter 2023

Instructor:	Dr. Juliana M. Marson (Juliana.MariniMarson@umanitoba.ca)
Preferred form of address:	Dr. Marson, Professor Marson
Class schedule:	TR 1:00-2:15 pm in Wallace 321 (please arrive at least 5min earlier)
Office hours:	TR 2:15-3:30 pm (or by appointment)

Course objectives

This course's main goal is for students to start developing a life-long skill that can be applied to any field: programming. It does not matter if you want to produce nice figures with your data for a paper, if you want to build a new videogame or a website, or if you need to perform tedious and repetitive file processing – you need to know how to program. Students will learn about problem-solving with computers, will become familiar with programming languages (the current choice is MATLAB), and will experiment with manipulating different types of environmental data.

Disclaimer: parts of this syllabus and this course were adapted from David J. Malan's course (CS50) with permission (Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) license).

Suggested readings

- Menke, William., and Joshua E. Menke (2012). *Environmental Data Analysis with MatLab*. 1st ed., Elsevier.
https://search.lib.umanitoba.ca/permalink/01UMB_INST/1p55dqn/alma99149107720001651
- Spraul, V. A. (2012). *Think like a programmer: An introduction to creative problem solving*. No starch press.
- Johnson, R. (2010). *The Elements of MATLAB Style*. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511842290
(https://search.lib.umanitoba.ca/permalink/01UMB_INST/1p55dqn/alma99149503281001651)
- Harvard's CS50x course, by David Malan (<https://cs50.harvard.edu/x/2022/>)
- Harvard's CS50P course, by David Malan (<https://cs50.harvard.edu/python/2022/>)

Content

1. Introduction to programming
 - 1.1. What is programming?
 - 1.2. Representing numbers
 - 1.3. Representing text, images, videos, and sounds
 - 1.4. Algorithms
 - 1.5. Pseudocode
 - 1.6. Scratch basics
 - 1.7. Abstraction
 - 1.8. Conditionals and more
2. Essentials of programming (applied to MATLAB)
 - 2.1. Functions and variables
 - 2.2. Conditionals
 - 2.3. Loops
 - 2.4. Exceptions
 - 2.5. File I/O
 - 2.6. Regular expressions
3. Data analysis in MATLAB
 - 3.1. Libraries
 - 3.2. Basic statistical functions
 - 3.3. Other useful functions to perform analyses
4. Visualizing data
 - 4.1. Line plots
 - 4.2. Scatter plots
 - 4.3. Histograms
 - 4.4. Bar and whiskers
 - 4.5. 2-D and 3-D fields
 - 4.6. The m_map package (maps)
5. Manipulating field data
6. Manipulating satellite images
7. Manipulating model outputs

Assessment

Problem sets	50%
Daily checks	10%
Final project	21%
Exam	19%

Assessment information

Problem sets

Problem sets are programming assignments focused on building your basic skills as a programmer. There are seven problem sets (one per week from week 01 to week 07; see [key dates](#)) and you will be able to work on them during Thursday classes so I can help you if you get stuck. Therefore, I encourage you to start working on those problem sets as soon as you leave class on Tuesday. This way, you'll have started all problems by Thursday and know where you need help the most. Problem sets and the final project are evaluated along axes of correctness and style, with correctness ordinarily counting for 75% of your score and style counting for 25%.

It is very likely that this course draws quite the spectrum of students, including “those less comfortable” with programming, “those more comfortable,” and those somewhere in between. However, what ultimately matters in this course is not so much where you end up relative to your classmates but **where you end up relative to yourself when you began.**

Each student's final grade is individually determined at term's end. Remarkable effort and upward trending are considered. The course is not graded on a curve. Those less comfortable and somewhere in between are not at a disadvantage vis-à-vis those more comfortable.

Daily checks

Daily checks are used to review content, to facilitate collaboration and conversation, and to scaffold problem sets. They will consist of a few printed questions which you'll need to answer with pencil/pen instead of using your computer. The activity will last 9 min. You'll have 3 min to think/answer the questions on your own, and 3 min to discuss it with a neighbour. In the last 3 min, all of us are going to discuss it together. You will keep the paper so you can use it to study for the exam. Points are awarded automatically as long as you participate in this activity; therefore, you need to attend class to get those points. If you are sick, notify me beforehand so I can make arrangements for you.

Final project

The climax of this course is its final project. The final project is your opportunity to take your newfound savvy with programming out for a spin and develop your very own piece of software. So long as your project draws upon this course's lessons, the nature of your project is entirely up to you, albeit subject to my approval. If you are a grad student, this is your chance to build something that will help you with data analysis for your thesis, but also that might be useful for other people working in your area of research. If not, just write something that can solve an actual problem, that can impact campus, or – who knows – that can change the world! In any case, strive to create something that outlives this course.

Inasmuch as software development is rarely a one-person effort, you are allowed an opportunity to collaborate with one or two classmates for this final project. Needless to say, it is expected that every student in any such group contribute equally to the design and implementation of that group's project. Moreover, it is expected that the scope of a two- or three-person group's project be, respectively, twice or thrice that of a typical one-person project. A one-person project, mind you, should entail more time and effort than is required by each of the course's problem sets. Although no more than three students may design and implement a given project, you are welcome to solicit advice from others, so long as you respect the course's policy on academic honesty.

Here is the breakdown of how the project will be evaluated: 12% for code correctness, 5% for style, and 4% on originality. Your code must include at least two functions developed by you. In the second-to-last class, you will present your project to the class. Bear in mind that, if working in a group, I will request a peer evaluation and members with poor performance might have their grade adjusted accordingly.

Exam

Details about the exam will be provided in class.

Lateness

Late submissions (of problem sets and the final project's milestones) will be penalized at a rate of 0.1% per minute.

- If you submit 10 minutes late, your score will be penalized 1%. Your score will thus be 99% of what it would have been if submitted on time.
- If you submit 60 minutes late, your score will be penalized 6%. Your score will thus be 94% of what it would have been if submitted on time.
- If you submit 1,000 minutes (just over 16 hours) late, your score will be penalized 100%. Your score will thus be effectively zeroed.

Academic honesty

The course's philosophy on academic honesty is best stated as "be reasonable." The course recognizes that interactions with classmates and others can facilitate mastery of the course's material. However, there remains a line between enlisting the help of another and submitting the work of another. This policy characterizes both sides of that line.

The essence of all work that you submit to this course must be your own. **Collaboration on problem sets is not permitted except to the extent that you may ask classmates and others for help so long as that help does not reduce to another doing your work for you.** Generally speaking, **when asking for help, you may show your code to others, but you may not view theirs,** so long as you and they respect this policy's other constraints. Collaboration on the course's quizzes and test is not permitted at all. Collaboration on the course's final project is permitted to the extent prescribed by its specification.

Regret clause. If you commit some act that is not reasonable but bring it to the attention of the course's heads within 72 hours, the course may impose local sanctions that may include an unsatisfactory or failing grade for work submitted, but the course will not refer the matter for further disciplinary action except in cases of repeated acts.

Below are rules of thumb that (inexhaustively) characterize acts that the course considers reasonable and not reasonable. If in doubt as to whether some act is reasonable, do not commit it until you solicit and receive approval in writing from the course's heads. Acts considered not reasonable by the course are handled harshly. If the course refers some matter for disciplinary action and the outcome is punitive, the course reserves the right to impose local sanctions on top of that outcome that may include an unsatisfactory or failing grade for work submitted or for the course itself. The course ordinarily recommends exclusion (i.e., required withdrawal) from the course itself.

Reasonable

- Communicating with classmates about problem sets' problems in English (or some other spoken language), and properly citing those discussions.
- Discussing the course's material with others in order to understand it better.
- Helping a classmate identify a bug in their code at office hours, elsewhere, or even online, as by viewing or running their code after you have submitted that portion of the PSET yourself. Add a citation to your own code of the help you provided and resubmit.
- Incorporating a few lines of code that you find online or elsewhere into your own code, **provided that those lines are not themselves solutions to assigned problems and that you cite the lines' origins.**
- Sending or showing code that you've written to someone, possibly a classmate, so that they might help you identify and fix a bug.

- Turning to the course's instructor for help or receiving help from the course's instructor during the exam.
- Turning to the web or elsewhere for instruction beyond the course's own, for references, and for solutions to technical difficulties, **but not for outright solutions to problem set's problems or your own final project.**
- Whiteboarding solutions to problem sets with others using diagrams or pseudocode **but not actual code.**
- Working with (and even paying) a tutor to help you with the course, provided the tutor does not do your work for you.

Not Reasonable

- Accessing a solution to some problem prior to submitting your own.
- Asking a classmate to see their solution to a problem set's problem before submitting your own.
- Failing to cite (as with comments) the origins of code or techniques that you discover outside of the course's own lessons and integrate into your own work, even while respecting this policy's other constraints.
- Giving or showing to a classmate a solution to a problem set's problem when it is they, and not you, who is struggling to solve it.
- Looking at another individual's work during the exam.
- Paying or offering to pay an individual for work that you may submit as (part of) your own.
- Providing or making available solutions to problem sets to individuals who might take this course in the future.
- Searching for or soliciting outright solutions to problem sets online or elsewhere.
- Splitting a problem set's workload with another individual and combining your work.
- Submitting (after possibly modifying) the work of another individual beyond the few lines allowed herein.
- Submitting the same or similar work to this course that you have submitted or will submit to another.
- Turning to humans (besides the course's instructor) for help or receiving help from humans (besides the course's instructor) during the exam.
- Viewing another's solution to a problem set's problem and basing your own solution on it.

Grading scale

<i>LETTER GRADE</i>	<i>PERCENTAGE RANGE</i>	<i>DESCRIPTION</i>
A+	90-100	Exceptional
A	80-89.9	Excellent
B+	75-79.9	Very Good
B	70-74.9	Good
C+	65-69.9	Satisfactory
C	60-64.9	Adequate
D	50-59.9	Marginal
F	0-49.9	Failure

NOTE: All final grades are subject to departmental review.

Key dates

	TUESDAY	THURSDAY
WEEK 00	Jan 10 L00 – Welcome	Jan 12 L01 – Intro to Programming
WEEK 01	Jan 17 L02 – Algorithms	Jan 19 PSET00
WEEK 02	Jan 24 L03 – Functions and Variables	Jan 26 PSET01
WEEK 03	Jan 31 L04 – Conditionals	Feb 02 PSET02
WEEK 04	Feb 07 L05 – Loops	Feb 09 PSET03
WEEK 05	Feb 14 L06 – Exceptions	Feb 16 PSET04 FP checkpoint: <i>present idea and development plan</i>
WINTER TERM BREAK	Feb 21 NO CLASS	Feb 23 NO CLASS
WEEK 06	Feb 28 L07 – File I/O	Mar 02 PSET05
WEEK 07	Mar 07 L08 – Regular Expressions	Mar 09 PSET06
WEEK 08	Mar 14 L09 – Data Analysis in Matlab I	Mar 16 L10 – Data Analysis in Matlab II
WEEK 09	Mar 21 L11 – Visualizing data I	Mar 23 L12 – Visualizing data II
WEEK 10	Mar 28 L13 – Field data	Mar 30 L14 – Satellite data
WEEK 11	Apr 04 L15 – Model output	Apr 06 Presentations
WEEK 12	Apr 11 Exam	

Assignment extensions

Reasons for granting an extension (assignments): a death in your immediate family, an illness in either yourself or in a dependent (requires email notification BEFORE the due date), and requirement to travel for work. The instructor will not accept an email dated AFTER the due date.

Reasons for not granting an extension: having another assignment or midterm on the same day, being away from the university for a personal reason (i.e. holiday or personal vacation), being too busy with other course work (i.e. having a midterm that same day or week), not attending the lectures due to personal or compassionate reasons (or other reasons), car broke down and could not submit assignment on time, computer is not working properly and you lost the assignment, or any other reason deemed inappropriate by the instructor. This is not an exhaustive list. Please don't ask for an extension if any of these or similar reasons apply. If you know that you will be away, you MUST submit the assignment before the due date.

Communication

Effective September 1, 2013, the University requires all students to activate an official University email account. The U of M will only use your university email account for official communications, including messages from your instructors, department or faculty, academic advisors, and other administrative offices (http://umanitoba.ca/registrar/email_policy/).

Please use your UManitoba email address for all email communications with me (Juliana.MariniMarson@umanitoba.ca). You are welcome to send course-related questions about the course structure (**provided you check the syllabus first**) or content to my email address, or to request a meeting outside of office hours. I expect all emails to be professional and courteous, and will respond within 48 hours during the work week.

Office hours

I will hold regular office hours on the dates/times indicated on page 1. If you can't make it to office hours, please feel free to send me an email so that we can set up another meeting.

Voluntary withdrawal date

The voluntary withdrawal date is the last date for withdrawing from this course without academic penalty. The voluntary withdrawal date for this course is **March 22, 2023**. Evaluative feedback will be provided prior to this date.

Expectations

I expect you to:

- Read and regularly consult the course syllabus. Ask for clarification on any part of the course syllabus that is unclear
- Take notes during lectures
- Arrive on time and listen actively during lectures
- Regularly check your UM email to read course announcements
- Complete all quizzes and exams without consulting any other person
- Follow university policies on plagiarism, cheating, and exam impersonation
- Let me know as soon as possible if you encounter obstacles that will prevent you from completing any aspect of the course on-time
- Be courteous and respectful to students and the instructor, and follow university policies on Respectful Work and Learning Environment and Inappropriate and Disruptive Student Behavior
- Ask questions
- Communicate with me as much as possible about any extra difficulties you encounter during the semester

You can expect me to:

- Do my best to create a welcoming, inclusive, and positive learning environment
- Treat you fairly and respectfully
- Listen to and consider all feedback you give about the course, and implement changes where possible
- Respond to questions and concerns you have sent to my University of Manitoba email account within 48 hours during the work week
- Hold regular office hours
- Make appointments outside of office hours as needed

Missing course work for medical reasons

Students who are unable to meet a course requirement due to medical circumstances are currently not required to submit medical notes. However, students are required to contact their instructor or academic advisor by email to inform of the missed work and to make arrangements for extensions, deferrals, or make-up assignments. Please follow these guidelines if you are unable to meet an academic requirement for your courses.

- Contact your instructor for term work such as a class, quiz, midterm/test, assignment, lab;
- Contact an advisor in your faculty/college/school of registration for a missed final exam (scheduled in the final examination period);
- Inform your instructor/advisor as soon as possible do not delay. Note for final exams, students must contact within 48 hours of the date of the final exam; and
- Email your instructor/advisor from a U of M email address, and include your full name, student number, course number, and academic work that was missed.

Student accessibility

The University of Manitoba is committed to providing an accessible academic community. Students Accessibility Services (SAS) offers academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g., mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation.

Student Accessibility Services
520 University Centre
Phone: (204) 474-7423
Email: Student_accessibility@umanitoba.ca

Copyright

All course material is copyrighted by Juliana Marson, 2021. No audio or video recording of this material, lectures, or presentations is allowed in any format, openly or surreptitiously, in whole or in part without written permission from Juliana Marson. Course materials (both paper and digital) are for the participant's private study and research, and must not be shared. Violation of these and other Academic Integrity principles, will lead to serious disciplinary action.

Policy on Respectful Work and Learning Environment (RWLE)

- Each individual has the right to participate, learn, and work in an environment that promotes equal opportunities and prohibits discriminatory practices.
- RWLE [2016], Section 2.2 The University wishes to promote and support a community which embraces diversity and inclusion, provides for equality of opportunity, and recognizes the dignity of all people.
- RWLE [2016], Section 2.3 Members of the University Community, including every student and employee, are entitled to a respectful work and learning environment that is:
 - (a) Free from Discrimination and provides for Reasonable Accommodation;
 - (b) Free from Harassment; and
 - (c) Collegial and conducive to early resolution of conflict between members of the University Community.
- Respectful Work and Learning Environment Policy: <http://bit.ly/2b63HQO>
- Student Discipline Bylaw: <http://bit.ly/2b3RL3p>

Inappropriate and disruptive student behaviour

- Inappropriate and disruptive behavior that interferes with the learning of other students, or the instructors' ability to teach will not be tolerated. Such behaviours would include but would not be limited to the following:
 - (a) threats to the physical safety of the individuals or others;
 - (b) verbal threats to or abuse of students or University personnel;
 - (c) recurring and willful damage of University property;
 - (d) inappropriate or disruptive behaviour as a result of misuse of drugs or alcohol on University property; and
 - (e) actions which habitually interfere with the learning environment or requires the inordinate time and attention of faculty and staff.
- Inappropriate or Disruptive Student Behaviour Policy: <http://bit.ly/2a15au5>
- Student Discipline Bylaw: <http://bit.ly/2b3RL3p>

Academic integrity

Students are responsible for ensuring they understand the University of Manitoba's policy on Academic Integrity (plagiarism, cheating, and examination impersonation). These policies are available in the University Catalog 2016-2017, General Academic Regulations <http://bit.ly/2asrIZN>

The penalties for plagiarism and cheating are severe and range from receiving a grade of zero on an assignment, to academic suspension. For more information on Cheating, Plagiarism, and Fraud: <http://bit.ly/2b63fBP> & <http://bit.ly/2b63ywR>

All work is to be completed independently unless otherwise specified.

Schedule "A"

Schedule "A" is the new requirement passed by the University of Manitoba Senate in 2016 that requires that a mandated list of supports for services plus contact information is provided to students. While this information is important and useful, should you require advice and support, the instructor is happy to meet with you and discuss issues and concerns

Student Resources

Writing and Study Skills Support

The Academic Learning Centre (ALC) offers services that may be helpful to you as you fulfill the requirements for this course. Through the ALC, you may meet with a study skills specialist to discuss concerns such as time management, reading and note-taking strategies, and test-taking strategies. You may also meet one-on-one with a writing tutor who can give you feedback at any stage of the writing process, whether you are just beginning to work on a written assignment or already have a draft. Writing tutors can also give you feedback if you submit a draft of your paper online. (Please note that the online tutors require 48 hours, from Mondays to Fridays, to return your paper with comments.)

All Academic Learning Centre services are free for U of M students. For more information, please visit the Academic Learning Centre website at: umanitoba.ca/student/academiclearning/

You can also talk to a member of the Academic Learning staff by calling 480-1481 or by dropping in at 201 Tier Building.

University of Manitoba Libraries (UML)

As the primary contact for all research needs, your liaison librarian can play a vital role when completing academic papers and assignments. Liaisons can answer questions about managing citations, or locating appropriate resources, and will address any other concerns you may have, regarding the research process. Liaisons can be contacted by email or phone, and are also available to meet with you in-person. A complete list of liaison librarians can be found by subject: <http://bit.ly/WcEbA1> or name: <http://bit.ly/1tJ0bB4>. In addition, general library assistance is provided in person at 19 University Libraries, located on both the Fort Garry and Bannatyne campuses, as well as in many Winnipeg hospitals. For a listing of all libraries, please consult the following: <http://bit.ly/1sXe6RA>. When working remotely, students

can also receive help online, via the Ask-a- Librarian chat found on the Libraries' homepage:
www.umanitoba.ca/libraries.

The English Language Centre

The English Language Centre has workshop and programs in advanced academic and health-sciences English (located at 520, University Centre).

Homepage: <http://umanitoba.ca/student/staffdir/elc.html>

Student Accessibility Services

Student Accessibility Services (SAS) provides support and advocacy for students with disabilities of all kinds: hearing, learning, injury-related, mental health, medical, physical or visual. Students with temporary disabilities such as sprains and breaks are also eligible to use our services. SAS acts as a liaison between students and the faculty and staff of the University of Manitoba as well as support agencies within the province of Manitoba. Please phone: 474-6213 (voice) or 474-9690 (TTY) for service. For more information, please visit the Student Accessibility website at: <http://umanitoba.ca/student/saa/accessibility/>

Mental Health

For 24/7 mental health support, contact the Mobile Crisis Service at 204-940-1781.

Student Counselling Centre (SCC)

Contact SCC if you are concerned about any aspect of your mental health, including anxiety, stress, or depression, or for help with relationships or other life concerns. SCC offers crisis services as well as individual, couple, and group counselling. Student Counselling Centre:

<http://umanitoba.ca/student/counselling/index.html>

474 University Centre or S207 Medical Services (204) 474-8592

Student Support Case Management (SSCM)

Contact the Student Support Case Management team if you are concerned about yourself or another student and don't know where to turn. SSCM helps connect students with on and off campus resources, provides safety planning, and offers other supports, including consultation, educational workshops, and referral to the STATIS threat assessment team. Student Support Intake Assistant

<http://umanitoba.ca/student/case-manager/index.html>

520 University Centre (204) 474-7423

University Health Service

Contact UHS for any medical concerns, including mental health problems. UHS offers a full range of medical services to students, including psychiatric consultation. University Health Service

<http://umanitoba.ca/student/health/>

104 University Centre, Fort Garry Campus (204) 474-8411 (Business hours or after hours/urgent calls)

Health and Wellness

Contact our Health and Wellness Educator if you are interested in information on a broad range of health topics, including physical and mental health concerns, alcohol and substance use harms, and sexual assault.

Health and Wellness Educator <http://umanitoba.ca/student/health-wellness/welcome.html>
Katie.Kutryk@umanitoba.ca

469 University Centre (204) 295-9032

Live Well @ UofM

For comprehensive information about the full range of health and wellness resources available on campus, visit the Live Well @ UofM site: <http://umanitoba.ca/student/livewell/index.html>

Copyright

All students are required to respect copyright as per Canada's Copyright Act. Staff and students play a key role in the University's copyright compliance as we balance user rights for educational purposes with the rights of content creators from around the world. The Copyright Office provides copyright resources and support for all members of the University of Manitoba

Visit <http://umanitoba.ca/copyright> for more information.

University and Unit Policies, Procedures, and Supplemental Information

Your rights and responsibilities

As a student of the University of Manitoba you have rights and responsibilities. It is important for you to know what you can expect from the University as a student and to understand what the University expects from you. Become familiar with the policies and procedures of the University and the regulations that are specific to your faculty, college or school.

The Academic Calendar

<http://umanitoba.ca/student/records/academiccalendar.html> is one important source of information. View the sections University Policies and Procedures and General Academic Regulations. While all of the information contained in these two sections is important, the following information is highlighted.

If you have questions about your grades, talk to your instructor. There is a process for term work and final grade appeals. Note that you have the right to access your final examination scripts. See the Registrar's Office website for more information including appeal deadline dates and the appeal form <http://umanitoba.ca/registrar/>

You are expected to view the General Academic Regulation section within the Academic Calendar and specifically read the Academic Integrity regulation. Consult the course syllabus or ask your instructor for additional information about demonstrating academic integrity in your academic work. Visit the Academic

Integrity Site for tools and support <http://umanitoba.ca/academicintegrity/> View the Student Academic Misconduct procedure for more information.

Sexual Assault

- If you experience Sexual Assault or know a member of the University community who has, it is important to know there is a policy that provides information about the supports available to those who disclose and outlines a process for reporting.
- The Sexual Assault policy may be found at:
http://umanitoba.ca/admin/governance/governing_documents/community/230.html
- More information and resources can be found by reviewing the Sexual Assault site
<http://umanitoba.ca/student/sexual-assault/>
- For information about rights and responsibilities regarding Intellectual Property view the policy
http://umanitoba.ca/admin/governance/media/Intellectual_Property_Policy_-_2013_10_01.pdf

Academic Programs and Regulations

- For information on regulations that are specific to your academic program, read the section in the Academic Calendar and on the respective faculty/college/school web site
<http://umanitoba.ca/faculties/>
- Contact an Academic Advisor within our faculty/college or school for questions about your academic program and regulations <http://umanitoba.ca/academic-advisors/>

Student Advocacy

Contact Student Advocacy if you want to know more about your rights and responsibilities as a student, have questions about policies and procedures, and/or want support in dealing with academic or discipline concerns.

<http://umanitoba.ca/student/advocacy/>

520 University Centre 204 474 7423 student_advocacy@umanitoba.ca