

CS 6210: Scientific and Data Computing Course
Syllabus Fall 2023
Instructor: Prof. Martin Berzins

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Course Number and Title: CS 6210

Semester and Year: Fall 2023

Instructor: Martin Berzins

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Office: WEB 4837

Phone: 801 585 1545 (office)

Accessibility & Support: Please use email to contact me. I will hold office hours after class

COURSE DESCRIPTION

This is a three credit entry level graduate class

COURSE DETAILS

- **Course Type:** In person with occasional zoom classes, perhaps one or two only.
- **Location & Meeting Times:** Monday/Wednesday 3pm – 4.20 Gardner Commons 4680
- **In-Person Attendance:** Please do not come to class if you are experiencing COVID-19 symptoms. Remember to maintain social distancing at all times. However you attend you will be expected to participate and answer questions whether you attend in person or not.
- **COVID-19 Considerations:** Students must self-report if they test positive for COVID-19 via .
 - Please do not come to class if you are experiencing COVID-19 symptoms
- **Course Materials:**
 - **Textbook:** *Introduction to Scientific Computing and Data Analysis* by Mark H. Holmes

Published by Springer. This is an essential text and it is recommended that you buy it.

- **Additional course materials:** *You will be required to use Matlab. This may be obtained from the Office of Software Licensing at the University of Utah*
- *Course slides and all required materials will be made available via Canvas*
- **Technical requirements:**
 - *Students are expected to be computer literate and to have programmed in a high level language. You will be expected to learn Matlab independently.*
- **Syllabus subject to change:** *This syllabus is meant to serve as an outline and guide for our course. Please note that I may modify it with reasonable notice to you. I may also modify the Course Schedule to accommodate the needs of our class. Any changes will be announced in class and posted on Canvas.*

CONTENT OVERVIEW

This course is a graduate breadth course to give students exposure to the algorithms and implementations often used in Scientific Computing, data Science and Artificial Intelligence.

It is assumed that students have had some previous experience in some linear algebras and in numerical methods (such as in an introductory numerical analysis or scientific computing course) or in a numerical ODEs course; however, for the diligent student, very little previous knowledge is required (other than basic calculus, linear algebra and ODEs). This course will be followed by an advanced graduate course that focuses on the numerical solution of partial differential equations (CS 6220: Scientific and Data Computing II). This course is designed to expose students to simulation and data science. In this semester, we will use several application areas to help motivate the various topics we will engage. With each topic scientific computing and data science problems and example topics being explored to help us build up our understanding of these areas. Specifically, in this course, we will touch broadly on the following topics:

- Polynomial interpolation and approximation including real data approximation regression and machine learning approaches including fundamental machine learning approximation results.
- Computational linear algebra (direct and iterative methods) including methods for very large scale problems randomized and other methods for data science and AI approaches
- Eigenvalues and singular values including QR and singular value decomposition and its randomized form and applications to data science
- Nonlinear systems and optimization with applications to machine learning including different types of gradient descent methods used in machine learning. Nonlinear equations in one or more variables
- Numerical integration using adaptive methods that automatically control the error.
- Ordinary Differential equations with applications to data fitting and neural ordinary differential equations

COURSE EXPECTED LEARNING OUTCOMES

Knowledge: *You will have obtained knowledge concerning the main topics listed in the course contents by attending the lectures reading the course text and by asking questions in class.*

Comprehension: *You will understand the methods in sufficient depth to be able to describe and code these them in the class assignments and practicums.*

Application: *You will be able to apply these methods to problems of types you have seen and to other related problems such as those arising in research as for example in the class assignments and practicums.*

Analysis: *You will have a sufficient theoretical understanding of the methods as to be able to compare their performance in both a theoretical way from the lectures and a practical way through the assignments and practicums.*

Communication : Your understanding of the main properties will be sufficiently deep that you can communicate this information to anyone who asks, as measured by the mid-term exam.

COURSE DESIGN

This class is based upon lectures with a strong interactive component.

CLASS SCHEDULE & IMPORTANT DATES

Exam Dates: A project will be used instead of a formal mid-term and final exam

Official Drop/Withdraw Dates: The last day to drop classes is Friday September 1 ; the last day to withdraw from this class is Friday October 20th. Please check the academic calendar for more information pertaining to dropping and withdrawing from a course. Withdrawing from a course and other matters of registration are the student's responsibility.

Holidays: *There will be no class on Wednesday November 22nd due to the November 23rd (Thanksgiving break).*

COMMUNICATION

Clarify which forms of communication and responsibilities you expect from your students. For instance:

- *All course materials, such as lecture slides, assignments, solutions, grades, etc. will be posted on the Course Canvas site . Class announcements will be done via email through the Canvas server. You will be responsible for any information contained in them as well as the information announced in class.*
- *It is your responsibility to also regularly check your Umail (make sure you set up forwarding if you do not check it regularly), your Umail is the only way for me to communicate privately with you, there will be occasions during the semester that we may need to reach out to you individually (e.g. regarding a grade or assignment) and it is in your best interest to respond promptly.*
- *Feel free to contact me by email for questions at mb@sci.utah.edu I will do our my best to answer emails promptly.*
- *I will always do my best to ensure the communication relevant to the course is clear and transparent, it is your responsibility as well to keep yourself updated by regularly checking: the announcements on Canvas, your Umail, the posts on the Discussions Board, and pay attention to the announcements given in class and Discussion Section.*
- *Course Canvas Page: Include expectations for Canvas monitoring (e.g. Students are expected to log in and check canvas **everyday** for posted announcements and assignments. Students are also strongly advised to set up notifications for canvas so they do not miss any important notifications.)*

NETIQUETTE - EXPECTATIONS FOR ONLINE LEARNING ENVIRONMENT

- *Classroom equivalency: Respectful participation in all aspects of the course will make our time together productive and engaging. Zoom lectures, discussion threads, emails and canvas are all considered equivalent to classrooms and student behavior within those environments shall conform to the student code.*

- *Electronic or equipment failure: It is your responsibility to maintain your computer and related equipment in order to participate in the online portion of the course. Equipment failures will not be an acceptable excuse for late or absent assignments.*
- *Online submissions: You are responsible for submitting the assignment with the required naming convention, correct file extension, and using the software type and version required for the assignment.*

ASSIGNMENTS, ASSESSMENT & GRADING

Course Grading

This course will be assessed by three general areas: attendance and participation, assignments, and the final project.

Regular homework assignments will be issued. Some may contain a listing of problems from the text and/or additional problems that relate to issues we are discussing in class.

Students are expected to attend class and to actively participate in the problem discussion.

Successful participation in the class accounts for 6% of your grade.

Each assignment will have a collection of problems to be done individually by a student. Assignment and submission details are below

Attendance and Participation: 6%

Assignment 1: 12%

Assignment 2: 12%

Assignment 3: 12%

Assignment 4: 12%

Assignment 5: 12%

Assignment 6: 12%

Mid Term Project Plan 7%

Final Project 15%

Assignment Policies:

All assignments will be take home and are to be done individually. Discussing topics is allowed; however, copying of each others work is considered cheating and will result in a failing grade. If a student is suspected of cheating, they may be asked to answer randomly selected homework questions in a public session to verify that they have actually mastered the material as claimed.

Assignments are due by 11.55pm MT on the day in which they are to be submitted. Submissions will be done via Canvas. Ten points per 24-hour period as of the day and time for which the call went out (counting Saturday and Sunday) will be deducted for late assignments.

Assignments will be submitted in electronic format and must be typeset. We recommend you use L^AT_EX to typeset your assignments. While there is a bit of a learning curve, it is worth learning. . If neither of those work, feel free

to use Word to type up your assignments and to generate pdfs. The deadline will be indicated on the class webpage. You will also submit any code you generate to solve the homework.

The principle language of our textbook is Matlab. We will use Matlab for in-class demonstrations also. Please also make sure to comment your code well so that we know what you are doing.

It is the student's responsibility to ensure the accuracy of all recorded homework, quizzes, online assignments, and exam grades. Also you should keep as record all your graded assignments. If you see any error in your grades on Canvas, reach out to the instructor as soon as possible, or at the latest within two weeks from when the assignment was returned.

Incompletes: According to university policy, to be considered for an incomplete, a student must have 20% or less of the course work remaining and be passing the course with a C or better. You must request an incomplete grade and I will consider giving that grade only under exceptional circumstances.

Content Accommodations: Consistent with principles of academic freedom, the faculty, individually and collectively, has the responsibility for determining the content of the curriculum. Students are expected to take courses that will challenge them intellectually and personally. Students must understand and be able to articulate the ideas and theories that are important to the discourse within and among academic disciplines. Personal disagreement with these ideas and theories or their implications is not sufficient grounds for requesting an accommodation (see).

Plagiarism: Plagiarism will not be tolerated.

ACADEMIC CODE OF CONDUCT

Students are encouraged to review the Student Code for the University of Utah: . In order to ensure that the highest standards of academic conduct are promoted and supported at the University, students must adhere to generally accepted standards of academic honesty, including but not limited to refraining from cheating, plagiarizing, research misconduct, misrepresenting one's work, and/or inappropriately collaborating. A student who engages in academic misconduct as defined in Part I.B. may be subject to academic sanctions including but not limited to a grade reduction, failing grade, probation, suspension or dismissal from the program or the University, or revocation of the student's degree or certificate. Sanctions may also include community service, a written reprimand, and/or a written statement of misconduct that can be put into an appropriate record maintained for purposes of the profession or discipline for which the student is preparing. *Incidents of academic misconduct (e.g. cheating, plagiarizing, misrepresenting one's work, and/or inappropriately collaborating on exams) will be subject to penalty per Section V of Policy 6-400, the . Incidents of academic dishonesty on homework assignments will result in a minimum penalty of a full letter-grade reduction and up to a failing grade (E) for the course. Incidents of academic dishonesty on exams will result in a minimum penalty of a failing grade (E) for the course, and the incident(s) will be referred to the dean of your major-department college for possible further sanction.*

ADDITIONAL POLICIES AND RESOURCES

Inclusivity Statement: It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to

present materials and activities that are respectful of diversity: age, color, disability, gender, gender identity, gender expression, national origin, political affiliation, race, religion, sexual orientation, and veteran status, and other unique identities. gender, sexuality, disability, age, socioeconomic status, ethnicity, race, culture, and other unique identities. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

Discrimination and Harassment: If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or Office of the Dean of Students, 270 Union Building, 801-581-7066. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS). Please see Student Bill of Rights, section E . I will listen and believe you if someone is threatening you.

Names/Pronouns. Canvas allows students to change the name that is displayed AND allows them to add their pronouns to their Canvas name. Class rosters are provided to the instructor with the student's legal name as well as "Preferred first name" (if previously entered by you in the Student Profile section of your CIS account, which managed can be managed at any time). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class or on assignments. Please advise me of any name or pronoun changes so I can help create a learning environment in which you, your name, and your pronoun are respected. If you need any assistance or support, please reach out to the LGBT Resource Center. https://lgbt.utah.edu/campus/faculty_resources.php

English Language Learners. If you are an English language learner, please be aware of several resources on campus that will support you with your language and writing development. These resources include: the Writing Center (<http://writingcenter.utah.edu/>); the Writing Program (<http://writing-program.utah.edu/>); the English Language Institute (<http://continue.utah.edu/eli/>). Please let me know if there is any additional support you would like to discuss for this class.

Undocumented Student Support. Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at 801.213.3697 or visit dream.utah.edu.

Veterans Center. If you are a student veteran, the U of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: <http://veteranscenter.utah.edu/>. Please also let me know if you need any additional support in this class for any reason.

Wellness Statement. Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.

Student Success Advocates: The mission of Student Success Advocates is to support students in making the most of their University of Utah experience (ssa.utah.edu). They can assist with mentoring, resources, etc. Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact a Student Success Advocate for support ().

The Americans with Disabilities Act:

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, 801-581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

Addressing Sexual Misconduct: Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted on the basis of your sex, including sexual orientation or gender identity/expression, you are encouraged to report it to the University's Title IX Coordinator; Director, Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or to the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to police, contact the Department of Public Safety, 801-585-2677(COPS).

Campus Safety: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit

University Counseling Center provides developmental, preventive, and therapeutic services and programs that promote the intellectual, emotional, cultural, and social development of University of Utah students. They advocate a philosophy of acceptance, compassion, and support for those they serve, as well as for each other. They aspire to respect cultural, individual and role differences as they continually work toward creating a safe and affirming climate for individuals of all ages, cultures, ethnicities, genders, gender identities, languages, mental and physical abilities, national origins, races, religions, sexual orientations, sizes and socioeconomic statuses.

Office of the Dean of Students The is dedicated to being a resource to students through support, advocacy, involvement, and accountability. It serves as a support for students facing challenges to their success as students, and assists with the interpretation of University policy and regulations. Please consider reaching out to the Office of Dean of Students for any questions, issues and concerns. 200 South Central Campus Dr., Suite 270. Monday-Friday 8 am-5 pm.

Copyright Policy:

For the Class materials presented in the class meetings or posted in Canvas are copyrighted and the

University of Utah's Copy right policy applies. The students and faculty are expected to abide by this policy 7-103.

Policy 7-013: Copyright Policy: Copying of Copyrighted Works:

<https://regulations.utah.edu/research/7-013.php>

Please also see Copyright Policy for Faculty Work in canvas.

<https://utah.instructure.com/courses/172949/pages/u-of-u-copyright-ownership-policy>