Syllabus for SIADS 602:Math Methods II

Course Overview and Prerequisites

The prerequisite for SIADS 602 is SIADS 502: Math Methods for Data Science.

This course will provide a deeper dive into some of the topics covered in SIADS 502 with specific attention on Linear Algebra and Optimization. Each week there will be one quiz and one programming assignment.

Week 1 starts the unit on Linear Algebra. The topics covered are orthogonal vectors and matrices, orthogonal projections, and the Gram-Schmidt Algorithm.

Week 2 continues the unit on Linear Algebra. The topics covered are trace, determinant, eigenvalues, eigenvectors, positive definite matrices, and singular value decomposition.

Week 3 is the unit on Probability and Distributions. The topics covered are permutations, combinations, famous distributions, entropy, KL divergence, and some limit theorems.

Week 4 is the unit on Optimization. The topics covered are vector calculus, necessary and sufficient conditions for optimality, gradient descent, and maximum likelihood.

Instructional Staff

- Instructor: Alex McLeod (mcleodal@umich.edu)
- Assisting Instructor: Lea Wei (zhuoqunw@umich.edu)
- Graduate Student Instructor: Alexis Castellanos (acastel@umich.edu)

Communication Expectations

- Most questions about the lectures and the assignments should be posted on the Slack channel for the course, so that other students can see the questions, offer their answers and ideas, and see the final answers. Please do not post code related to specific assignment questions (see below).
- If your question is about your specific code for an assignment question, **please send a Slack direct message to all of the teaching staff**. **Make sure to include (a) the assignment number and the question number that your question is about, (b) a**

clean, minimal version of your attempted code, (c) the output of your code, (d) the error message if any, and (e) a very short explanation of what your approach to the problem has been.

- Typically instructors will respond to a Slack post or direct message within 24 hours. If you have not received a response in 36 hours, please resend.

Help Desk: How to get Help

For technical or platform problems (Coursera, Slack, etc.), please email umsimadshelp@umich.edu.

Textbooks for Optional Readings

- "*Mathematics for Machine Learning* " by Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong. Cambridge University Press, 2020.
- "*Pattern Recognition and Machine Learning* " by Christopher M. Bishop. Springer-Verlag New York, 2006.
- "*Introduction to Probability* " by Dimitri P. Bertsekas and John N. Tsitsiklis. Athena Scientific, Belmont, Massachusetts, 2008

To access the recommended textbooks, simply click on the links above.

Learning Outcomes

- Be aware of algorithm complexity
- Be able to translate formulas/demos into code
- Understand orthogonal projections and orthonormal basis
- Know entropy and KL divergence as useful quantities associated with distributions
- Understand limit theorems of probability
- Understand how gradient descent works
- Be able to write clean, easy-to-read code with as little redundant code as possible
- Be knowledgeable about SVD
- Be able to describe common probability distributions covered in class and give example scenarios where they are applicable
- Understand what MLE is and what kind of problems it can help solve
- Be able to compute vector norms, and identify orthogonal vectors and matrices
- Know the eigen-decomposition of a matrix and positive definite matrices

Course Schedule

This course begins on **Wednesday, February 1, 2023** and ends on **Tuesday, February 28, 2023**. Weekly assignments will be due on **Tuesdays at 11:59 pm EST.**

Schedule of Weekly Office Hours via Zoom.

- **Alex McLeod–** Tuesday at 9:00am EST
- **Lea Wei–** Mondays at 10:00pm EST
- **Alexis Castellanos–** Friday at 8:00pm EST

Access via Live Events from the course menu. All OH meeting has passcode **602**

Quizzes, Assignments, and Late Penalties

This course has four quizzes. For each quiz, there is also a practice quiz. The practice quiz will be exactly the same as the real quiz except for two things: (a) your score on the practice quiz does not count towards your final grade, but your score on the real quiz does, and (b) the feedback you receive after you submit a practice quiz is "limited" (i.e. you will learn which questions you answered correctly and which ones you answered incorrectly), but the feedback you receive after you submit a real quiz is "full" (i.e. in addition to the limited feedback, you will receive an explanation about why the correct answer is the correct answer). **For each real quiz, you only get one attempt**. If your submission for a real quiz is made between 0-24h after the deadline will receive a 15% late penalty. If your submission for a real quiz is made between 24-48h after the deadline will receive a 30% late penalty. If your submission for a real quiz is made between 48-72h after the deadline will receive a 45% late penalty. If your submission for a real quiz is made 72h or more after the deadline will receive a 100% late penalty.

This course has four assignments. You have unlimited attempts for each assignment. Any attempt made between 0-24h after the deadline will receive a 15% late penalty. Any attempt made between 24-48h after the deadline will receive a 30% late penalty. Any attempt made between 48-72h after the deadline will receive a 45% late penalty. Any attempt made 72h or more after the deadline will receive a 100% late penalty. Your grade on the assignment will be your highest grade from all your attempts taking any late penalties into account.

Course Item	Percent of Final Grade	Due Date
Quiz 1	8%	Tuesday, Feb 7, 11:59pm EST

Assignment 1	17%	Tuesday, Feb 7, 11:59pm EST
Quiz 2	8%	Tuesday, Feb 14, 11:59pm EST
Assignment 2	17%	Tuesday, Feb 14, 11:59pm EST
Quiz 3	8%	Tuesday, Feb 21, 11:59pm EST
Assignment 3	17%	Tuesday, Feb 21, 11:59pm EST
Quiz 4	8%	Tuesday, Feb 28, 11:59pm EST
Assignment 4	17%	Tuesday, Feb 28, 11:59pm EST
Total	**100%**	

Note: All assignments are required to earn credit for this course.

Letter Grades

Letter Grade	Number Grade Bounds
A	93 – 100%
A-	90 -- 93%

B+	87 -- 90%
B	83 -- 87%
B-	80 -- 83%
C+	77 -- 80%
C	73 -- 77%
C-	70 -- 73%
D+	67 -- 70%
D	63 -- 67%
D-	60 -- 63%
E	0 -- 60%

Refer to the MADS Assignment Submission and Grading Policies section of the UMSI Student Handbook (access to Student Orientation course required).

Academic Integrity

Refer to the Academic and Professional Integrity section of the UMSI Student Handbook. Access to Student Orientation course required.

Accommodations

Refer to the Accommodations for Students with Disabilities section of the UMSI Student Handbook. Access to the Student Orientation course required.

Use the Student Application Form in Accommodate to begin the process of working with the University's Office of Services for Students with Disabilities.

Accessibility

Refer to the Screen reader configuration for Jupyter Notebook Content document to learn accessibility tips for Jupyter Notebooks.

Library Access

Refer to the U-M Library's information sheet on accessing library resources from off-campus. For more information regarding library support services, please refer to the U-M Library Resources section of the UMSI Student Handbook (access to the Student Orientation course required).

Student Mental Health

Refer to the University's Resources for Stress and Mental Health website for a listing of resources for students.

Student Services

Refer to the Introduction to UMSI Student Life section of the UMSI Student Handbook. Access to the Student Orientation course required.