Winter 2022

AMATH 582/482: Computational Methods for Data Analysis

Instructor: Dr. Amin Rahman; Email: arahman2@uw.edu

TAs: Katherine Johnston and Michael Kupperman.

Office hours: Please see Canvas for the latest office hour schedule

Website: http://faculty.washington.edu/arahman2
Prerequisites: AMATH 301 and (AMATH 352, MATH 136, or MATH 208).
Optional Textbook (completely optional – electronic copy will be provided): Data-Driven Modeling and Scientific Computation: Methods for Complex Systems & Big Data by J. Nathan Kutz (UW Amath Professor)

Syllabus:

Course Grade: < 4 pts.: grade = 0.7. >= 4 pts: grade = 1.5 + pts./7.2

Points breakdown: For CP 1 to 4, 582: 2 pts. for code + 2 pts. for report. 482: 3 pts. for code + 1 pt. for report. Since we only have one week for CP5, 582: 1 pts. for code + 1 pts. for report. 482: 2 pts. for code + no report required. To get the points you have to have over a certain threshold of the code correct and meet a certain standard for the report (I will provide templates for both so you meet those standards).

Course Description: Exploratory and objective data analysis methods applied to the physical, engineering, and biological sciences. Brief review of statistical methods and their computational implementation for studying time series analysis, spectral analysis, filtering methods, principal component analysis, orthogonal mode decomposition, and image processing and compression.

MATLAB will be used as the primary environment for numerical computation and will be the only language formally taught and supported in office hours, but if you choose to you may submit solutions in Python.

Course Structure: The lectures will be in-person (unless otherwise noted by official communication from the university) and will be recorded for any student that cannot attend class (especially important if you are not feeling well) and for the EDGE section. We will have a combination of Zoom and in-person Office hours conducted by the instructor and TAs in order to best accommodate student needs. We will also have a discord channel for more informal and pseudonymous course discussions.

Over the past three years, we have faced unprecedented circumstances and challenges. Please remember that your health, safety, and well-being are more important than your performance in this class. I encourage you to reach out to DRS, me, or the TAs if you believe that there exist any additional accommodations that would improve your learning experience this quarter. In cases where the TAs and I are unauthorized to provide assistance, we will help you reach out to

DRS. In addition, if you wish to anonymously discuss safety and well-being concerns for yourself or others, you can call SafeCampus at 206-685-7233 anytime, no matter where you work or study. SafeCampus's team of caring professionals will provide individualized support, while discussing short- and long-term solutions and connecting you with additional resources when requested.

Online communication: In addition to in-person lectures, we will mainly use Canvas for official communications. In the past, Piazza was used, however they switched to a pay platform, so we will use the Canvas discussion board instead. I will go through the boards frequently, but TAs and other students are also encouraged to reply to questions. This is also where I will keep track of what concepts to go over during office hours. We will also have a course discord channel where students can help each other and for more informal discussions.

Please note that there are **200 students** (expected) in this course (all sections combined), and therefore emails would not be the most efficient form of communication.

Coding Projects: 5 projects throughout the quarter. 4 points each for CP 1 to 4, and 2 points for CP5. 18 pts. total. For CP 1 to 4, 582: 2 pts. for code + 2 pts. for report. 482: 3 pts. for code + 1 pt. for report. Since we only have one week for CP5, 582: 1 pts. for code + 1 pts. for report. 482: 2 pts. for code + no report required. To get the points you have to have over a certain threshold of the code correct and meet a certain standard for the report (I will provide templates for both so you meet those standards). You will also be given two opportunities during the quarter to make up points.

Quizzes: None

Gradescope: You will receive information about your gradescope.com account through your UW emails.

Tentative Schedule:

Week	Topics	Project
1/2 – 1/6	Fourier Series, Fourier Transform, Radar Detection and Filtering	
1/9 – 1/13	Radar Detection and Averaging, Time-Frequency Analysis, Wavelets	Coding Project 1: Detecting Vibrational Signals. Due Jan. 30th.
1/16 – 1/20	Multi-resolution Analysis, Spectograms, Gabor Transform, Image Analysis	
1/23 – 1/27	Linear Filtering for Image Denoising, Diffusion and	Coding Project 2: Parsing Frequencies in Music. Due Feb. 10th.

	Image Processing, The Singular Value Decomposition (SVD)	
1/30 – 2/3	Principal Component Analysis (PCA), Proper Orthogonal Decomposition (POD)	
2/6 – 2/10	Independent Component Analysis, Image Separation	Mid-quarter Open Assignment Week: You may go back to any projects that you did not complete or that you missed in order to make up the points. Coding Project 3: Principal Component Analysis. Due Feb. 24th.
2/13 – 2/17	Image Classification, Linear Discriminant Analysis	
2/20 – 2/24	The L1 Norm, Signal Reconstruction, Image Reconstruction	Coding Project 4: TBD. Due March 10th.
2/27 – 3/3	Modal Expansion for PDEs, PDEs in the Right Basis	
3/6 – 3/10	Dynamic Mode Decomposition	Coding Project 5: TBD. Due March 17th.
Finals Week		Final Open Assignment Week: You may go back to any projects that you did not complete or that you missed in order to make up the points.

University policies

1. **UW Student conduct policy: https://www.washington.edu/studentconduct/**
2. **Academic integrity:** https://www.washington.edu/cssc/facultystaff/academic-misconduct/
3. **Observance of religious holy day:** Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Faculty Syllabus Guidelines and Resources. Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form available at: https://registrar.washington.edu/students/religious-accommodations-request/
4. **Disability resources: https://depts.washington.edu/uwdrs/**
5. **Safety: https://www.washington.edu/safecampus/**