Autumn 2023

AMATH 301: Beginning Scientific Computing

Time and Location

Sec. A (KNE 110): MTWF 8:30 – 9:20, Sec. B (KNE 220): MTWF 3:30 – 4:20,

Sec. C [Mech E only] (DEM 012): MTWF 9:30 – 10:20

Instructor: Dr. Amin Rahman; Office: Lewis 116; Email: arahman2@uw.edu

TAs: Alanna Sholokhova, Damien Beecroft, etc

Online Office hours: To Be Announced + by appointment

Website: http://faculty.washington.edu/arahman2
Prerequisites: MATH 125, MATH 135, or Q SCI 292.
Optional Textbook (completely optional): Data-Driven Modeling and Scientific Computation: Methods for Complex Systems & Big Data by J. Nathan Kutz (UW Amath Professor)

Syllabus:

Course Grade: Mastery-based. Instead of allowing only a small number of submissions and grading based on percentage, students will be allowed multiple submissions and grade based on the number of coding projects (and quizzes) you complete with near 100% accuracy (the exact threshold will be defined per assignment). We hope that this will encourage you to seek out help from TAs if your code is not working, and allow you to choose to skip an assignment on a particularly busy week (for example if you have an exam or paper due in another class). This will also keep everything completely transparent as you will be able to see exactly how many points you have accumulated throughout the quarter.

Points breakdown: Quizzes = 1pt. and Coding Projects = 3pts. Total of 40 pts. From 10 quizzes and 10 projects.

Multiple attempts: Coding Projects can be submitted an unlimited number of times until the hard deadline; no more submissions after the deadline, so submit early and submit often. Quizzes can be taken a total of three times once per week (if your score was below threshold on the first attempt, you will get a second attempt the following week. If you choose not to take a quiz, that particular attempt will be given a score of 0. For example: if you have a particularly busy week, you may choose to take a 0 for that attempt, but will be able to retake it the following week if you did not use up all three attempts).

Open project/quiz weeks: You will have two chances to make up any below threshold work (with one additional attempt). One will be the midterm open week (10/30 – 11/3), and the other will be during the week of finals. You will be able to retake any quiz or coding project that was below threshold to makeup those points, however you will only have one additional attempt for quizzes; for coding projects you can submit until 11:59 on Friday.

Tentative Curve: **(Accumulated points)/10.**

Since makeup assignments are built into the grading system, we won't have a formal lowest score drop as this process adds more flexibility.

Course Description: This course will provide an introduction to the use of computers in solving problems arising in the physical, biological, and engineering sciences. Various computational approaches commonly used to solve mathematical problems will be presented, including systems of linear equations, optimization, curve fitting, integration, and differential equations. Both the theory and applications of each numerical method will be demonstrated.

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. No previous coding experience is required (although it would help); an overview of the appropriate syntax, code structure and algorithms will be given. Although the subject matter of scientific computing has many aspects that can be made rather difficult, the material in this course is meant to be an introduction and will therefore be presented in as simple a way as possible. In particular, theoretical aspects will be mentioned through the course, but more complicated issues such as rigorous proofs will not be presented. Instead, applications will be emphasized.

Learning Objectives: In this course you will implement numerical methods and tools used in scientific applications. You will learn to:

- Identify common mathematical problems (e.g., linear systems, optimization, curve fitting, differential equations, and principal component analysis) and choose appropriate mathematical methods (e.g., iterative solvers, time-stepping methods, etc.) to solve them.
- Understand the strengths and weaknesses of different numerical algorithms in terms of accuracy, complexity, and speed. Further, you will use the knowledge gained to choose the appropriate technique for the application of interest.
- Write code in MATLAB to implement numerical algorithms.
- Interpret, format, and present results, including visualization of data.

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). All Office/Lab hours will be either in-person in Lewis Hall or over Zoom at TAs discretion. We do understand that each student's educational preferences are different, and therefore the level of interaction is completely up to the student – I will never pressure you to participate in discussions if you do not wish to.

Over the past two 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 to communicate. 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 instructor 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 over **400 students** in this course (all sections combined), and therefore direct emails would not be the most efficient form of communication.

Coding Projects: One coding project per week to be due through gradescope.com on Thursdays end of day (11:59 pm) through Gradescope.

Quizzes: One quiz per week through Canvas on Mondays. Quizzes will open at midnight and close at 11:59 pm.

Gradescope: You will receive an email with login instructions on the first day of class. If you registered for the course after the first day of class you may have to contact me or the TAs to get the login.

Tentative Schedule:

Week	Topics	Project (Due Thursday)	Available Quizzes (Monday)
09/27 – 29	Intro, Arrays and Vectors, Matrices, Plotting	Practice Submission (no grade)	Quiz n Attempt m = Qn_m
10/02 – 06	Loops, Conditionals, MATLAB Functions	Coding Project 1 (CP1)	Q1_1
10/09 – 13	Linear systems, Computational Complexity, LU Factorization	Coding Project 2 (CP2)	Q1_2, Q2_1
10/16 – 20	Iterative Methods, Eigenvalues	Coding Project 3 (CP3)	Q1_3, Q2_2, Q3_1
10/23 – 27	Finding Extrema	Coding Project 4 (CP4)	Q2_3, Q3_2, Q4_1
10/30 – 11/3	Statistical Fit, Interpolation Open Assignment Week (Monday through Friday)	Coding Project 5 (CP5) Additional attempt for CP1 to CP4 Up to Friday for CP5	Q1_4 – Q2_4, Q3_3, Q4_2, Q5_1
11/6 – 8 Veteran's Day	Differentiation and Integration	Coding Project 6 (CP6)	Q4_3, Q5_2, Q6_1

11/13 – 17	Integration, First Order Ordinary Differential Equations (ODEs)	Coding Project 7 (CP7)	Q5_3, Q6_2, Q7_1
11/20 – 22 Thanksgiving	Higher Order ODEs, Boundary Value Problems (BVPs)		Q6_3, Q7_2, Q8_1
11/27 – 12/1	BVPs, Nonlinear dynamics and Chaos, Singular Value Decomposition (SVD)	Coding Project 8 (CP8)	
12/1 - 8	SVD, Partial Differential Equations (PDEs), Machine Learning (if time permits)	Coding Project 9 (CP9)	Q7_3, Q8_2, Q9_1
Finals Week	Open Assignment Week (Monday through Friday)	Coding Project 10 (CP10) Additional attempt for CP1 to CP9 Up to Friday for CP10	Extra attempt on all past quizzes. Two more attempts for Q9 and three total for Q10: Q9_(2 – 3), Q10_(1 – 3)

Note that you are always allowed to skip an assignment. For example, if you already acquired enough points to get the grade you want, you can skip CP10 and/or Q10.

For available quizzes, you only take new ones and/or the additional attempts for ones that you did not pass (i.e., above threshold, which as mentioned earlier will be near 100%). If you already passed the quiz the first time please don't take the second attempt.

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/**