

Spring 2021

AMATH 301: Beginning Scientific Computing

Location: Online

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

TAs: Hongda Li, Rohan Rele, Zidan Luo, Ziqing Lu, Frank Mei, Binnan Yu.

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, this quarter (different from past quarters), I will allow 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 (TBA around the halfway point of the quarter), 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.

Tentative Curve: (Accumulated points + 4)/10. This will be capped at 4.0 of course.

For example: if a student gets above threshold on 9 coding projects, and above threshold on 9 quizzes, they would receive 36 points, then $(36 + 4)/10 = 4.0$.

If a student gets above threshold on 7 coding projects, and above threshold on 5 quizzes, they would receive 26 points, then $(26 + 4)/10 = 3.0$.

Note that this effectively drops your lowest quiz or project score, so we won't have a formal lowest score drop as this process adds more flexibility. To demonstrate why this method is better: say a student did all projects with 100% accuracy, but missed more quizzes. With a formal score drop, the student would only have one quiz score dropped, however with this method, the student can have up to 4 below threshold quizzes and still get a 4.0.

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 and/or Python will be used as the primary environment(s) for numerical computation. You can choose one or both languages. 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 and/or Python to implement numerical algorithms.
- Interpret, format, and present results, including visualization of data.

Course Structure: The lectures will be completely asynchronous. Office/Lab hours will be live and conducted by the instructor and TAs. During instructor office hours, I will briefly recap some material, and to the best of my ability (and resources available) interact with students through Zoom and *polleverywhere*. 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. We also understand that students are joining the class from a variety of time zones, and to the best of our ability will try to accommodate all time zones (for example, with flexible start times for quizzes).

This year, 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 me or the TAs if you believe that there exist any additional accommodations that would improve your learning experience this quarter. 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.

Communication: 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.

Please note that there are **600 students** (expected) in this course, and therefore emails would not be the most efficient form of communication.

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

Quizzes: One quiz per week through Canvas on Mondays (can begin quiz at any time on that day).

Gradescope: Please create your (free) [gradescope.com](https://www.gradescope.com) account using your UW email address and add this course (Amath 301 Spring 2021) using the password (entry code): YVBPN5.

Tentative Schedule:

Week	Topics	Project (Due Thursday)	Available Quizzes (Monday)
03/29 – 04/02	Intro, Arrays and Vectors, Matrices, Plotting	Practice Submission (no grade)	Quiz n Attempt m = Qn_m
04/05 – 09	Loops, Conditionals, MATLAB/Python Functions	Coding Project 1 (CP1)	Q1_1
04/12 – 16	Linear systems, Computational Complexity, LU Factorization	Coding Project 2 (CP2)	Q1_2, Q2_1
04/19 – 23	Iterative Methods, Eigenvalues	Coding Project 3 (CP3)	Q1_3, Q2_2, Q3_1
04/26 – 30	Finding Extrema	Coding Project 4 (CP4)	Q2_3, Q3_2, Q4_1
05/03 – 07	Statistical Fit, Interpolation	Coding Project 5 (CP5) Additional attempt for CP1 to CP4	Q1_4 – Q2_4, Q3_3, Q4_2, Q5_1

	Open Assignment Week (Monday through Friday)	Up to Friday for CP5	
05/10 – 14	Differentiation and Integration	Coding Project 6 (CP6)	Q4_3, Q5_2, Q6_1
05/17 – 21	First Order Ordinary Differential Equations (ODEs)	Coding Project 7 (CP7)	Q5_3, Q6_2, Q7_1
05/24 – 28	Higher Order ODEs	Coding Project 8 (CP8)	Q6_3, Q7_2, Q8_1
05/31 – 06/04	Boundary Value Problems (BVPs), Singular Value Decomposition (SVD), Facial Recognition	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/>