John Winnicki
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Stanford University

CME 192: MATLAB for Scientific Computing and Engineering
Syllabus and Course Information

This short course runs for eight weeks/eight lectures and is offered in the Winter quarter during the academic year. It is intended for both students with prior programming experience who are expected to use MATLAB in math, science, or engineering courses, and for ambitious students with no prior programming experience. It consists of interactive lectures and application-based assignments. The goal of the course is to make students fluent in MATLAB and to provide familiarity with its wide array of features, in real-world settings. We will have a special emphasis on learning how to actually apply MATLAB outside of a classroom setting. The course introduces essential MATLAB programming concepts and data structures, and builds toward applied scientific computing workflows involving visualization, numerical linear algebra, simulation, machine learning, and toolbox-driven analysis in realistic problem settings.

MATLAB Topics covered in this class include

1. Advanced plotting and 2D/3D visualizations, Interactive Plotting
2. Numerical Linear Algebra, ODEs/PDEs, and Symbolic Math
3. Big data and databases
4. Python/C++ interfaces and workflows
5. Statistics and Machine Learning
6. Optimization and Simulation/Modeling
7. Image Processing and Signal Processing
8. Parallel Processing

The instructor is John Winnicki, winnicki@stanford.edu. John Winnicki is a senior Ph.D. student in the Institute for Computational and Mathematical Engineering with extensive experience in applied mathematics and computational engineering.

Course Website. The course website will be the primary site for course material. Class information, web resources, slides, live scripts, and the schedule will be posted on the course website. We will also post the slides and livescripts on both canvas and the course github.

Survey. There is an online survey you can fill out to tell me about your background, why you are taking the class, and your interests. We will be adjusting the course content based on your responses! You will find the link on the course website.

Support. How to get support? Email the instructor at winnicki@stanford.edu for all questions and concerns relating to the course. Feel free to drop by my office at Building 520, Room 133 to discuss anything in-person!

In addition, we have set up an anonymous form to report issues and concerns. You will find the URL on the course website and on Canvas.

Office hours. Our office hours will be by appointment in person. You can meet with your instructors and teaching assistants during office hours to discuss the material being covered in class, questions or concerns you might have, and other related issues. Feel free to attend an office hour even if you don't have any questions. You can listen in on the conversation (which might spark a question for you), or we can use the time to get to know each other!

Course Prerequisites. Students are expected to have taken an introductory programming course (e.g. CS 101, CS 106A, CS 193) and an introductory linear algebra course (e.g. Math 51). In place of an introductory programming course, students are expected to complete the online MATLAB Onramp course (2 hours) and part of the "Build MATLAB Proficiency" Onramp course (~4 hours). Nice-to-haves include familiarity with Machine Learning, Statistics, ODEs/PDEs, and Signal Processing.

What you will learn. This course emphasizes **real-world applications** of applied and computational mathematics using **MATLAB**. Instead of rote programming exercises, each lecture is organized around a real-world dataset and set of tools used on a daily basis by industry professionals. Students will learn how to analyze, model, and interpret real phenomena using MATLAB's ecosystem. You'll see how mathematical ideas become practical tools for modeling, simulation, data analysis, and optimization. By the end of the course, you'll be able to build complete computational workflows in MATLAB, from loading and cleaning data to visualizing results, performing advanced analyses, and creating interactive, dynamic applications.

Getting started with MATLAB. This course focuses on the MATLAB programming language: we will learn techniques and tools that millions of engineers and industry professionals use on a day-to-day basis. We don't expect students to have familiarity with MATLAB, but do expect students to spend the first week becoming familiar with the language. The first lecture will be focused on bringing students up to speed on basic syntax and capabilities. To get started with MATLAB, we recommend checking out this page created by Mathworks for ICME students. Next, you can browse the following online resources:

- https://www.mathworks.com/support/learn-with-matlab-tutorials.html
- https://www.coursera.org/specializations/matlab-programming-engineers-scientists
- https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf
- https://www.tutorialspoint.com/matlab/index.htm

MATLAB is quite similar to Python, and there are many resources online specifically bridging the two languages. Here is one such example:

- https://blogs.mathworks.com/student-lounge/2021/02/19/introduction-to-matlab-for-python-users/

MATLAB License and Installation. MATLAB is available to all Stanford students through the university's academic license. You may choose to work in MATLAB Online or install the full desktop version. To install MATLAB, simply log-in to your Stanford account at this link! Please reach out to the course instructor if you have any questions.

Reading. There is no required textbook for this course. Several optional references may be helpful, depending on your background and interests. *Numerical Computing with MATLAB* by Cleve Moler provides a concise and authoritative reference to MATLAB's core numerical capabilities. For

students seeking a more applied and accessible introduction, *An Introduction to MATLAB Programming and Numerical Methods for Engineers* by Timmy Siauw and Alexandre Bayen combines MATLAB fundamentals with essential numerical methods. Additional references focusing on engineering and scientific applications will be suggested throughout the course as appropriate.

Grading. Grading is based primarily on two assignments that apply concepts and tools covered in class to real-world datasets. These projects are designed to reinforce what is seen in class and course materials, and the required components will be very manageable in scope.

Students are expected to attend at least four class sessions. Attendance will be recorded using a sign-in sheet distributed at the beginning of each lecture. If you anticipate missing more than four classes, there will be a Google Form on the course website which can be used to explain your absences for those additional days.

The final percentage will be determined using:

Assignment 1/OnRamp Certification*	33%
Assignment 2	33%
Attendance	34%

Late policy. You may submit your assignment up to 72 hours after the deadline for a 10% penalty without any special justification.

For excused late submissions, students should request late days at least **24 hours before** the due date of an assignment. This is done using an online form that can be found on the course website. Students must provide a reason when requesting late days. There is no penalty for instructor-approved late submissions.

After receiving your grade on gradescope, you are welcome to request a regrade using the gradescope interface. No one is perfect. We strive to grade accurately and fairly and provide helpful feedback, but mistakes do happen. We will be happy to address any concerns you have. However, to help with the logistics, we prefer that you submit your regrade request **at most 1 week after** the grade has been released.

What you can expect from me. I am here to guide your learning and will challenge you to actively engage in the learning process through class activities, assignments, and more. I will strive for an inclusive and collaborative classroom and welcome suggestions for improvement. I will do my best to give you the tools, feedback, and support to succeed, so let me know if I can do anything more. Learning is a never-ending process, so I hope to motivate students to seek more information on topics we don't have time to cover. I want to support you all in this learning experience! The best way to reach me is by email or Slack. You should expect a response within three business days (but often much sooner!).

Respect for diversity. I intend that students from all diverse backgrounds, perspectives, and situations 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. I intend to present materials and activities that are respectful of diversity, including but not limited to: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, religion, political affiliation, culture, and so on. I acknowledge that there is likely to be a diversity of access to resources among students, and I plan to support all of you as best as possible. 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 we can make arrangements for you.

All people have the right to be addressed and referred to in accordance with their personal identity. In this class, we will have the chance to indicate the name that we prefer to be called (see the survey on Canvas) and, if we choose, to identify the pronouns with which we would like to be addressed. I will do my best to address and refer to all students accordingly and support classmates in doing so.

Support services. The current geo-political situation is a stressful time for us all. In addition, you may experience a range of other challenges that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating, or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce your ability to participate in daily life. Stanford is committed to advancing all its students' mental health and well-being. Services are available if you or someone you know is feeling overwhelmed, depressed, or in need of support.

Learn more about the broad range of confidential mental health services available on campus: https://vaden.stanford.edu/caps-and-wellness/counseling-and-psychological-services-caps

Access and accommodations. Stanford is committed to providing equal educational opportunities for disabled students. Disabled students are a valued and essential part of the Stanford community. We welcome you to our class.

If you experience a disability, please register with the Office of Accessible Education (OAE). Professional staff will evaluate your needs, support appropriate and reasonable accommodations, and prepare an Academic Accommodation Letter for faculty. To get started or to re-initiate services, please visit oae. stanford.edu.

If you already have an Academic Accommodation Letter, we invite you to share your letter with us. Academic Accommodation Letters should be shared at the earliest possible opportunity so we may partner with you and OAE to identify any barriers to access and inclusion that might be encountered in your experience of this course.

The OAE is located at 563 Salvatierra Walk; phone: 723-1066; http://oae.stanford.edu

Honor Code and Office of Community Standards. We take the honor code very seriously. Here is an excerpt from the Stanford honor code:

> The Honor Code is an undertaking of the students, individually and collectively, that they will not give or receive aid in examinations; that they will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading.

Note that the student who lets others copy their work is as guilty as those who copy. Violations include at least the following circumstances: copying material from another student, copying previous years' solution sets, copying solutions found using Google, copying solutions found on the internet. You will be automatically reported without a warning if a violation is suspected. The Office of Community Standards is in charge of determining whether a violation occurred. OCS does not always contact you during the quarter and may delay until the quarter is over.

Please do not post any material from this class online. This will encourage honor code violations and penalize other students. This is also a violation of copyright.

If found guilty of a violation, your grade will be lowered by at least one letter grade.

Homework is designed to help you learn the material. You will lose all the benefits if someone hands you the solution.

We hope you enjoy learning about MATLAB this quarter!