

GEO 325G Spring 2022 Computational Applications in the Geosciences

An introduction to programming in MATLAB and applications to simulation of physical processes and data analysis in the geosciences

Lectures will be online between Jan 18, 2022 and Jan 31, 2022 and in-person for the rest of the semester. Online classes will be broadcasted and recorded via ZOOM, and all lectures will be recorded via ZOOM.

Tuesday 3:30-5:30pm: JGB 3.120 and at <https://utexas.zoom.us/j/92774207885> (see below for more info)

Monday 12 - 2 pm: JGB 2.312 and at <https://utexas.zoom.us/j/99178746759> (see below for more info)

Instructor: Nicola Tisato, nicola.tisato@jsg.utexas.edu

Zoom office: <https://utexas.zoom.us/j/8363310129> (See below for more info)

Office Hours: Thursday 11 AM – 12 PM + appointment

Teaching Assistant: Carolyn Bland, cdbland@utexas.edu

Zoom office: TBD

Office Hours: TBD

This course requires that you install on your computer MATLAB 2018b or later, supporting the Live Script (.mlx) format, used for Lecture summaries and homework. MATLAB can be installed on any student owned computer under the terms of our UT-wide license. See <http://www.utexas.edu/its/products/matlab/license.php>.

You also need to install on your computer Zoom and that you connect to the internet during lectures and labs. We will also use Zoom for live online meetings and lectures. Please click on this link to download, install, and login to get “zoom-ready”. While it is possible to log in to Zoom through a personal account, please use your UT institutional account tied to your UT EID. See instructions below, or here: <https://zoom.its.utexas.edu/>

Course on Canvas is here: <https://utexas.instructure.com/courses/1326612>

Text and Web Site: We will be using Canvas to coordinate all activities, assignments and meetings. Canvas will be used to post homework, schedules and other files. Use the FILES tab to find folders containing Lecture livestcripts, data, homework, practice exams, and various MATLAB resources. MATLAB also has help files as part of the MATLAB installation.

Other references: Mathworks.com has many useful discussions of some topics covered in the course.

University of Texas Policies: The core values of The University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the university is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community. You are responsible for understanding UT's Academic Honesty and the University Honor Code which can be found at the following web address:

<https://deanofstudents.utexas.edu/conduct/standardsconduct.php>

Services for Students with Disabilities: This class respects and welcomes students of all backgrounds, identities, and abilities. If there are circumstances that make our learning environment and activities difficult, if you have medical information that you need to share with me, or if you need specific arrangements in case the building needs to be evacuated, please let me know. I am committed to creating an effective learning environment for all students, but I can only do so if you discuss your needs with me as early as possible. I promise to maintain the confidentiality of these discussions. Any student with a documented disability who requires academic accommodations should contact Services for Students with Disabilities at 471-6259 (voice) or 512-410-6644 (Video Phone) as soon as possible to request an official letter outlining authorized accommodations. For more information, visit <http://ddce.utexas.edu/disability/about/>.

Sharing of Course Materials is Prohibited: No materials used in this class, including, but not limited to, lecture hand-outs, videos, assessments (quizzes, exams, papers, projects, homework assignments), in-class materials, review sheets, and additional problem sets, may be shared online or with anyone outside of the class unless you have my explicit, written permission. Unauthorized sharing of materials promotes cheating. It is a violation of the University's Student Honor Code and an act of academic dishonesty. I am well aware of the sites used for sharing materials, and any materials found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in sanctions, including failure in the course.

Q Drop Policy: If you want to drop a class after the 12th class day, you'll need to execute a Q drop before the Q-drop deadline, which typically occurs near the middle of the semester. Under Texas law, you are only allowed six Q drops while you are in college at any public Texas institution. For more information, see: <http://www.utexas.edu/ugs/csacc/academic/adddrop/qdrop>

Title IX Reporting: Title IX is a federal law that protects against sex and gender-based discrimination, sexual harassment, sexual assault, sexual misconduct, dating/domestic violence and stalking at federally funded educational institutions. UT Austin is committed to fostering a learning and working environment free from discrimination in all its forms. When sexual misconduct occurs in our community, the university can:

1. Intervene to prevent harmful behavior from continuing or escalating.
2. Provide support and remedies to students and employees who have experienced harm or have become involved in a Title IX investigation.
3. Investigate and discipline violations of the university's relevant policies (<https://titleix.utexas.edu/relevant-polices/>).

Beginning January 1, 2020, Texas Senate Bill 212 requires all employees of Texas universities, including faculty, report any information to the Title IX Office regarding sexual harassment, sexual assault, dating

violence and stalking that is disclosed to them. Texas law requires that all employees who witness or receive any information of this type (including, but not limited to, writing assignments, class discussions, or one-on-one conversations) must be reported. I am a Responsible Employee and must report any Title IX related incidents that are disclosed in writing, discussion, or one-on-one. Before talking with me, or with any faculty or staff member about a Title IX related incident, be sure to ask whether they are a responsible employee. If you would like to speak with someone who can provide support or remedies without making an official report to the university, please email advocate@austin.utexas.edu. For more information about reporting options and resources, visit <http://www.titleix.utexas.edu/>, contact the Title IX Office via email at titleix@austin.utexas.edu, or call 512-471-0419.

Although graduate teaching and research assistants are not subject to Texas Senate Bill 212, they are still mandatory reporters under Federal Title IX laws and are required to report a wide range of behaviors we refer to as sexual misconduct, including the types of sexual misconduct covered under Texas Senate Bill 212.

The Title IX office has developed supportive ways to respond to a survivor and compiled campus resources to support survivors.

Zoom Etiquette:

1. Mute yourself unless you are speaking. This will cut down on background noise and limit distractions.
2. Be mindful of your surroundings when on camera. Be sure to avoid as much distraction as possible.
3. Turn your camera off if you are leaving the meeting temporarily.
4. If the video or audio is choppy, try turning off your video.
5. Please always use reliable private or enterprise WIFI.

Diversity Statement: As The University of Texas at Austin strives to meet its mission of unlocking potential and preparing future leaders of the state, it embraces diversity in many forms. The university is dedicated to attracting highly-qualified students, faculty and staff with a wide range of backgrounds, ideas and viewpoints. This includes those from all races and ethnicities; first-generation college students; women; and others who have been historically underrepresented on campus. As a university with a past history of denying equitable access to qualified students, UT recognizes the profound benefits of creating an inclusive environment in which students can learn from one another. All students are better prepared to succeed in an increasingly diverse state and interconnected society when they receive the educational benefits of learning on a diverse campus.

Course Work and Grades: *Grades (plus-minus grades are assigned): Lab Discussion Participation 5%, 3 in-class exams, (no final) 50%; Homework Exercises 45%.*

Prerequisites: Completion of the first two semesters of mathematics courses required of your degree plan (at least 2 semesters of calculus), an introductory course in physical geology (GEO 401 or 303), and 1 semester of physics (PHY 301 or 303K, Mechanics). No prior computer programming experience is expected.

Course Topics: This course is required of Geological Sciences BS students, and designed for the second semester of the sophomore year. An approximate schedule will be posted on the Canvas site and updated as needed. The course goal is to teach computer programming (using the MATLAB language) in the context of solving geoscience problems. We will approach various geoscience problems that should be familiar from an introductory physical geology course, identify computational elements need to solve them, and write related scripts and functions. Some problems will involve data sets obtained from websites and other sources. In the process, students will become accomplished users of MATLAB, and develop a good understanding of typical computational and data processing issues encountered in the geosciences, including: statistics and errors in data, estimation using least squares, vectors, matrices, linear

algebra, numerical solutions of differential equations, and others. A related goal is to learn good computing practices, such as orderly coding and documentation.

Lectures

Theme 1: Basic MATLAB and Computer sciences

T Jan 18	Lecture 01 Introduction to the course, MATLAB and the computer
M Jan 24	Lecture 02 Introduction to the course, MATLAB and the computer
T Jan 25	Lecture 03 Variables, Basic operations, Scripts, and Coding Hygiene
M Jan 31	Lecture 04 Variables, Basic operations, Scripts, and Coding Hygiene
T Feb 1	Lecture 06 Custom function and Logic
M Feb 7	Lecture 07 Loops and Logic
T Feb 8	Lecture 07 Loops and Logic
M Feb 14	{No class Freeze storm}
T Feb 15	{No class Freeze storm}
M Feb 21	{Optional lab}
T Feb 22	{Optional lab}

Theme 2: Mathematics and Statistics

M Feb 28	Lecture 08 Basic 1D array (vector) and 2D array (matrix)
T Mar 1	Lecture 09 Prepare for test
M Mar 7	Test nr. 1
T Mar 8	Lecture 10 Calculating the Density of Earth (MATLAB Live Script)

Mar 14-20 – Spring Break!

M Mar 21	Lecture 12 Basic Linear Algebra (matrix operation)
T Mar 22	Lecture 13 Line plotting and Matrix operation (matrix operation)
M Mar 28	Lecture 14 Basic Linear Algebra (matrix operation)
T Mar 29	Lecture 15 Least square (ENSO data)
M Apr 4	Lecture 16 Preparing for test 2
T Apr 5	Lecture 15 Least square (ENSO data)
M Apr 11	Test nr. 2

Theme 3: Application of MATLAB in Geosciences

T Apr 12 Lecture 20 Seismic Waves and Instrument control with MATLAB (Sonar)
M Apr 18 Lab Seismic Waves and Instrument control with MATLAB (Sonar)
T Apr 19 Lecture 21 3D plotting (surface plot, contour plot) and Gridding
M Apr 25 Lecture 22 Smoothing and Interpolation, Images and Movies
T Apr 26 Lecture 23 Prepare for test
M May 2 Lecture 24 Forward modeling of gravitational anomaly
T May 3 Test nr. 3

Additional Optional Topics

Finite Difference

Numerical Derivatives

Refraction Seismology

Numerical Integration

Heat Flow, Movies

Symbolic Algebra

Seismic waves and Reflection coefficient

Mapping

Nicola Tisato Zoom office

<https://utexas.zoom.us/j/8363310129> Meeting ID: 836 331 0129

One tap mobile

+13462487799,,8363310129# US (Houston)

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209.9.211.110 (Hong Kong SAR)

64.211.144.160 (Brazil)

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Monday 12-2pm Lab Lecture Zoom invitation

Topic: Sp22 - COMP APPLS IN GEO (27420)

Time: Jan 24, 2022 12:00 PM Central Time (US and Canada)

Every week on Mon, until May 2, 2022, 15 occurrence(s)

Please download and import the following iCalendar (.ics) files to your calendar system.

Weekly: [https://utexas.zoom.us/meeting/tJ0scOGvqj0tH918G5b-bwV_FQ-](https://utexas.zoom.us/meeting/tJ0scOGvqj0tH918G5b-bwV_FQ-2vzh2ap_5/ics?icsToken=98tyKuChrzwiHdCTtxyORox5BY_CWe3wiCFagvoMxDiwAW1RdTXJENMPYKRIGlrR)

[2vzh2ap_5/ics?icsToken=98tyKuChrzwiHdCTtxyORox5BY_CWe3wiCFagvoMxDiwAW1RdTXJENMPYKRIGlrR](https://utexas.zoom.us/meeting/tJ0scOGvqj0tH918G5b-bwV_FQ-2vzh2ap_5/ics?icsToken=98tyKuChrzwiHdCTtxyORox5BY_CWe3wiCFagvoMxDiwAW1RdTXJENMPYKRIGlrR)

Join Zoom Meeting: <https://utexas.zoom.us/j/99178746759>

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Meeting ID: 991 7874 6759

Tuesday 9-11 Lecture Zoom invitation

Topic: Sp22 - COMP APPLS IN GEO (27420)

Time: Jan 18, 2022 03:30 PM Central Time (US and Canada)

Every week on Tue, until May 3, 2022, 16 occurrence(s)

Please download and import the following iCalendar (.ics) files to your calendar system.

Weekly: [https://utexas.zoom.us/meeting/tJYqcO2qrjwiEtGhuS4Y0FCrf-](https://utexas.zoom.us/meeting/tJYqcO2qrjwiEtGhuS4Y0FCrf-ZIXOqt8JT5/ics?icsToken=98tyKuCqqTwuGNSSuBGCRoWQB4_CLOrziGZHj7d6IArWV)

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