Unique Number: 14670

Instructor: Ann Chen
jingyi.ann.chen@utexas.edu
Office hours: Friday noon-1 pm (virtual or in-person at JGB 2.312)

Time: MW 11 am –11:50 am, and Friday 11am-1pm

Location: JGB 2.312 or join remotely (zoom meeting links will be announced through canvas).

Teaching Assistant: TBD

Web Page: Information about the course, such as the syllabus, homework assignments, handouts, and homework solutions, will be posted regularly on Canvas (http://canvas.utexas.edu). You will also be able to monitor your progress in the course by reviewing your assignment/exam grades.

Catalog Description: Sampling and aliasing. Review of sinusoids and wave terminology, complex numbers and complex sinusoids, vectors and matrices, the discrete Fourier transform, convolution, the convolution theorem, linear digital filters and transfer functions, random variable concepts and statistics, and least squares estimation.

Course Objectives: The course covers the basics of vectors and matrices, solving linear equations, regression and classification, similarity measures, the Discrete Fourier Transform (DFT), linear filters, and power spectrum estimates. We'll discuss the mathematics, but the focus will be on applying matrix methods to practical applications such as tomography, image processing, data fitting, time series prediction, optimal control, finance, and machine learning. Homework sets will require students to use MATLAB or Python to do computations with vectors and matrices and run numerical experiments with real-world data sets.

Prerequisite(s) or Co-requisites(s): COE 301 or an equivalent programming course such as GEO 325J or GEO325G.

Knowledge, Skills, and Abilities Students Should Have Before Entering This Course: Experience with a scientific programming language (e.g. MATLAB) and completion of mathematics courses required of your degree plan (normally 1 year of calculus plus Math 427J or K and 427L or equivalent).

Knowledge, Skills, and Abilities Students Gain from this Course (Learning Outcomes): By the end of the course, you should be able to analyze real data sets from a wide variety of engineering and geoscience disciplines.
Impact on Subsequent Courses in Curriculum:
This is a technical elective course for ASE/COE undergraduate students.

Relationship of Course to Program Outcomes:
This course contributes to the ABET Criterion 3 student outcomes listed below. For more information, see Criteria for Accrediting Engineering Programs, 2021-2022 at https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2021-2022/.

<table>
<thead>
<tr>
<th>STUDENT OUTCOME</th>
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<tbody>
<tr>
<td>1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics</td>
<td>✓</td>
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<tr>
<td>2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors</td>
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<td>3. an ability to communicate effectively with a range of audiences</td>
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<td>4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts</td>
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<td>5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives</td>
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<td>6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions</td>
<td>✓</td>
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<td>7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies</td>
<td>✓</td>
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Topics:
The course covers essential topics in data processing, many related to time series analysis or image processing. Lectures and homework follow and expand on the course notes. A general summary of topics includes (1) Data processing concepts; analog and digital signals, frequency content, analog to digital conversion (2) Mathematical tools: dynamic range and precision, statistics, review of complex numbers and sinusoids, the decibel scale. (3)The Discrete Fourier Transform (DFT). (4) Convolution theorems (5) Linear filter applications. (6) Power spectrum estimates (8) Least squares and maximum likelihood principles, least squares in matrix notation, weighted least squares, applications. (9) SVD (10) correlation and coherence. We will review MATLAB in the 2nd week of class.

Computer:
Homework will include programming assignments to be completed on a computer. You will have access to the JGB2.312 computer lab or you may use your laptop to complete all homework sets.

Textbook(s):
There is no required textbook. Lecture slides will be made available before the lecture.

Class Format:
Three lecture hours a week for one semester. You may attend the lecture in person or through zoom. The live lectures will be recorded. On Friday, an optional lab session (Ann Chen’s office hour) is scheduled after the lecture.
Class Schedule:
We will spend ~ 7 weeks on Digital Signal Processing and ~ 7 weeks on Applied Linear Algebra.

Grading:
Homework 50%
Midterm 15%
Final 30%
Other credits 5%

Letter grades will be assigned as follows:

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<thead>
<tr>
<th>Grade</th>
<th>Cutoff</th>
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<tbody>
<tr>
<td>A</td>
<td>90</td>
</tr>
<tr>
<td>A-</td>
<td>87</td>
</tr>
<tr>
<td>B+</td>
<td>84</td>
</tr>
<tr>
<td>B</td>
<td>80</td>
</tr>
<tr>
<td>B-</td>
<td>77</td>
</tr>
<tr>
<td>C+</td>
<td>74</td>
</tr>
<tr>
<td>C</td>
<td>70</td>
</tr>
<tr>
<td>C-</td>
<td>67</td>
</tr>
<tr>
<td>D</td>
<td>57</td>
</tr>
<tr>
<td>F</td>
<td>&lt;57</td>
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Homework Policy:
There will be ~9-10 total assignment. The lowest homework score will be dropped in the final grade calculation. Assignments will be due at 11:59 pm on the date marked on the assignment sheet, unless modified by the instructor. Late assignments will be penalized by 20 points per day. No late homework will be accepted 5 days after the due date.

Students are strongly encouraged to discuss course topics with each other, since such discussions are an important part of the learning process. However, each student must carry out assignments independently. All assignments in this course may be processed by TurnItIn, a tool that compares submitted material to an archived database of published work to check for potential plagiarism. Other methods may also be used to determine if the homework is the student's original work. Regardless of the results of any TurnItIn submission, the faculty member will make the final determination as to whether or not a homework set has been plagiarized.

Examinations:
There will be two open-notes exams. The final exam (3 hours) date will follow the university schedule. The mid-term exam (one hour) is tentatively scheduled on Oct. 22 in class. You must take the exam in person. Alternative dates for the exams will be arranged only for students with documented medical/family emergencies.

Attendance:
We expect students to attend the lectures in person or via zoom. Lecture recordings will be available to students.
Important Dates:
Please refer to UT academic calendar 2021-2022:
https://registrar.utexas.edu/calendars/21-22

Academic Integrity:
Each student in the course is expected to abide by the University of Texas Honor Code: “As a student of The University of Texas at Austin, I shall abide by the core values of the University and uphold academic integrity.” Plagiarism is taken very seriously at UT. Therefore, if you use words or ideas that are not your own (or that you have used in previous class), you must cite your sources. Otherwise you will be guilty of plagiarism and subject to academic disciplinary action, including failure of the course. You are responsible for understanding UT’s Academic Honesty and the University Honor Code which can be found at the following web address: http://deanofstudents.utexas.edu/sjs/acint_student.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.

The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TDD or the Cockrell School of Engineering Director of Students with Disabilities at 471-4321.

Evaluation:
Note that the Measurement and Evaluation Center forms for the Cockrell School of Engineering will be used during the last week of class to evaluate the course and the instructor. They will be conducted in an electronic format for Spring 2021. You may also want to note any other methods of evaluation you plan to employ.

COVID-19 Updates: Fall 2021 Semester

Classroom Safety and COVID-19
To help preserve our in person learning environment, the university recommends the following.

- Adhere to university mask guidance (https://tinyurl.com/UTMaskGuidance). Masks are strongly recommended indoors regardless of vaccination status.
- Vaccinations are widely available, free and not billed to health insurance. The vaccine will help protect against the transmission of the virus to others and reduce serious symptoms in those who are vaccinated. Visit https://uthealthaustin.org/patient-resources/covid-19-updates/covid-19-vaccination for more information.
- Proactive Community Testing remains an important part of the university’s efforts to protect our community. Tests are fast and free. Visit https://healthyhorns.utexas.edu/coronavirus_proactive_testing.html for more information.
- Visit protect.utexas.edu for updated information and announcements from the university.

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 websites 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.

**Class Recordings**
Class recordings are reserved only for students in this class for educational purposes and are protected under FERPA. The recordings should not be shared outside the class in any form. Violation of this restriction by a student could lead to Student Misconduct proceedings. Guidance on public access to class recordings can be found [here](#).

**Prepared by:** Ann Chen       **Date:** 08/20/2021