EE351M Digital Signal Processing

UTC 4.132 [Tue, Thu 12:30-2pm]

Zoom link for lectures: https://utexas.zoom.us/j/93305450694

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Electronic course site: We will use Canvas (http://canvas.utexas.edu) to deliver homework assignments and any extra reading materials. You should be able to log in if you have a valid UT ID and are registered for this class. In addition, basic course information and essential handouts will also be available at http://users.ece.utexas.edu/~hvikalo/ee351m.html.

Piazza discussion board: https://piazza.com/class/ksp4ilg1vntrk (join with code 'ee351m')

Textbook: *Discrete-Time Signal Processing* (Oppenheim, Schafer, and Buck), Prentice-Hall, 3rd edition, 2010, ISBN 0-13-198842-5.

Homeworks and exams: There will be roughly weekly homework assignments; there will be two midterm exams in class, and a final exam. The weighting will be as follows:

- Homeworks: 15%
- Midterm exams: 45%
- Final exam: 40%

Homeworks are to be submitted via Gradescope at the beginning of the class when they are due. You may discuss homework problems with other students but must submit your own independent solution. For each student, the lowest homework score will not count towards the total homework score. Late homework assignments will not be accepted.

Exam dates (tentative):

- Midterm 1: September 30
- Midterm 2: November 9
- Final: TBA

Prerequisite: *EE313 Linear Systems and Signals*, with a grade of at least C.
Pre/Co-requisite: *EE351K Probability and Random Processes*.

Official course description: Sampling, aliasing, truncation effects; discrete and fast Fourier transform methods; convolution and deconvolution; finite and infinite impulse response filter design methods; Wiener, Kalman, noncausal, linear phase, median, and prediction filters; and spectral estimation.

Course Introduction: Signal processing deals with representation, transformation, and manipulation of signals and the information they contain. It is a rich subject with tools that have applications in a broad class of problems including communications, control, image processing, biomedicine, sonar, radar, array processing, and digital video.

This course provides a thorough treatment of DSP including the fundamental theorems and properties of discrete-time linear systems, filtering, sampling, and discrete-time Fourier analysis. Furthermore, it explores connections between DSP techniques and methods for learning from data, and introduces fundamental stochastic signal processing concepts. The emphasis in the class will be on algorithms, their derivations, and their applications.

By the end of the course, you should know how to:

- analyze discrete-time systems by examining their input and output signals;
- compute a system output (in either time or frequency) given the system input and a description of the system;
- represent a continuous-time signal by a discrete-time signal (using the conditions for perfect reconstruction);
- filter continuous-time signals in discrete-time (and vice versa);
- design good digital filters based on well-known analog filter designs;
- learn parameters of a system using data at its input and output;
- use the Fourier transform, Fourier series, discrete Fourier transform, and the z-transform and know when to use them;
- implement fast discrete Fourier transform;
- derive and implement optimal filters for stochastic signals;
- analyze the spectrum of real signals (both deterministic and stochastic).

Outline of the topics:

- Review of Discrete-Time Signals and Systems
- z-Transform
- Sampling and Digital Processing of Continuous-Time Signals
- Analysis of Linear Time-Invariant Systems
- Structures for Discrete-Time Systems
- Adaptive Filtering (LMS algorithm); Single and Multi-Layer Perceptrons
- Filter Design Techniques
- The Discrete Fourier Transform
- The Fast Fourier Transform
- Analysis of Signals Using the DFT
- Discrete-Time Random Signals; Wiener and Kalman Filters

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.

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

- Adhere to university mask guidance.
- 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.
- Proactive Community Testing remains an important part of the university's efforts to protect our community. Tests are fast and free.
- Visit protect.utexas.edu for more information

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. 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.