Fall 2019 - EE 381J Probability and Stochastic Processes I

- Meets TuTh 9:30-11am in EER 1.516
- Unique No: 16635

Instructor

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Description

This course serves as an intermediate level course on probability and stochastic processes for engineers. We will review concepts in probability and stochastic processes introducing some of the measure theoretic foundations and other techniques and concepts that may be of use to you in subsequent courses and research. In addition we will discuss the most common probabilistic models and random processes and introduce basic techniques in estimation and detection,with a view on important applications in communications, control and signal processing, machine learning, as well as other fields in engineering and computer sciences.

Lecture Plan

- **Review of basic probability:** probability spaces, random variables, distribution and density functions, expectation, characteristic functions, conditional probability, conditional expectation
- **Sequences of random variables:** convergence concepts, laws of large numbers, central limit theorem, large deviations
- **Random vectors:** random vectors, covariance characterization, jointly Gaussian random variables.
- **Estimation and detection:** Estimation, MAP, ML, orthogonality principle, minimum mean and squared and linear least square error estimation. Detection, MAP, ML and Bayesian criteria.
- **Basic concepts of random processes:** definition and classification, stationarity and ergodicity, correlation functions, continuity, differentiation, and integration of random processes
- **Representations of random processes:** sampling theorem, Karhunen-Loeve expansion, envelope representation and simulation of narrowband processes.
- **Special processes:** Markov Chains, Martingales, Wiener process, Poisson processes, shot noise, thermal noise, random walk.

Prerequisites

This course is intended for first year engineering graduate students, you must have had an **undergraduate course** in probability as well as background signals and systems. In addition it will be very helpful if you have taken an course where you have learned formal proof techniques, e.g., real analysis, discrete math, or algorithms.

"Required" Text: Highly Encouraged

Probability and Random Processes, G.R. Grimmett and D.R. Strizaker, Oxford, 3rd Edition. (overall graduate level intro to probability)

Other Recommended Texts

Probability in Electrical Engineering and Computer Science: An Appication- Driven Course, J. Walrand, Feb 2014. (This text develops some nice applications motivating the need to learn this material.) *An Exploration of Random Processes for Engineers,* B. Hajek, December 2011. (You can download this book from the **web**)
Stochastic Processes:Theory for Applications, R.G. Gallager 2012. (You can download a draft of this book at **web**)
Introduction to Probability, Dimitri Bertsekas and John Tsitsiklis. (I teach out of this for my undergraduate class)
Stochastic Processes, Sheldon Ross, Wiley.

Course web pages

- Class materials and homeworks will be posted on **Canvas** (Use your UT eid to sign in)
- Homeworks will be submitted on **Gradescope** (You will need to enroll using the entry code provided on intro slides in first class day.)
- We will use **Piazza** for shared online question & answer and discussions. (You will need to enroll **here**)

Homeworks

Homeworks will be assigned on the course web pages. The homeworks will be submitted via Gradescope. You are expected to make an honest, independent attempt to solve and turn in your answers to each homework question.

Late howeworks will be awarded a grade of zero unless permission is sought in advance to turn in late and is based on a valid reason such as a medical emergency. Nevertheless all homeworks must be turned in to pass the course. It is your responsibility to check the course homepage for homework assignements each week.

Midterm and Final Exams

There will be two midterms and a final in this class. Some **estimated** dates and the locations of the exams are below:

- Midterm 1, planned for October 3 in class
- Midterm 2, planned for November 7 in class
- Final will be Saturday December 14th, 7-10pm location TBD

No make-up midterm exams will be given. An excused absence for a midterm must be obtained in advance. If you obtain an excused absence for a midterm your final exam grade will be substituted for the missed midterm exam. In the case of an excused absence from the final exam, the course grade will be based on the homework and midterm exams. Unexcused absences from a midterm or final will result in a grade of zero for that exam. Note that excused absences from exams will be made only in extreme circumstances (serious illness, death in the immediate family, etc.). Requests for excused absences should be made in writing and must be supported by appropriate documentation.

Grading policy

The final grade will be a weighted average of your homework, midterm, and final scores. The weightings are:

Class Participation: 5%
Homeworks: 20%
Midterm 1: 20%
Midterm 2: 25%
Final: 30%

Where does this course fit in?

This course is intended as a broad introduction to provide a basis for graduate study in the CommNetS Area. A sequel to this course, **Probability and Random Processes II**, will delve into the area in more depth.. Additional courses that you might consider taking after this one include: **Communication Networks: Analysis and Design** ,**Performance Evaluation**; **Digital Signal Processing**; **Digital Communications ;Wireless Communications**; **Advanced Signal Processing**; **Information Theory.** **Randomized Algorithms.** Machine Learning.

Academic dishonesty and policies on cheating

Faculty in the ECE Department are committed to detecting and punishing all instances of academic dishonesty and will pursue cases of academic dishonesty in accordance with university policy. Academic dishonesty, in all its forms, is blight on our entire academic community. All parties in our community - professors, staff, and students - are responsible for creating an environment that educates outstanding engineers, and this goal entails excellence in technical skills, self-giving citizenry, and ethical integrity. Industry wants engineers who are competent and fully trustworthy, and both qualities must be developed day by day throughout an entire lifetime.

Details about what constitutes academic dishonesty can be found at the following URL: UT Dean of Students Office (http://www.utexas.edu/depts/dos/sjs/academicintegrity.html).

All cheating will be reported directly to the college/university. Unless explicitly indicated in an assignment,

you must do your homeworks, projects and exams individually. You are welcome and encouraged to discuss material with your colleagues, when and where it is appropriate, but copying, stealing papers, etc. are considered dishonest and will be prosecuted.

Notes: Allegations of Scholastic Dishonesty will be dealt with according to the procedures outlined in Appendix C, Chapter 11, of the General Information Bulletin, http://www.utexas.edu/student/registrar/catalogs/. 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, 471-4241 TDD or the College of Engineering Director of Students with Disabilities at 471-4321.