**ECE 5555 (Fall 2014)** **Syllabus**

# Stochastic Systems: Estimation and Control

## 1 Course Description

The problem of sequential decision making in the face of uncertainty is ubiquitous. Examples include: dynamic portfolio trading, operation of power grids with variable renewable generation, air traffic control, livestock and fishery management, supply chain optimization, internet ad display, data center scheduling, and many more.

In this course, we will explore the problem of optimal sequential decision making under constraints and uncertainty over multiple stages – *stochastic optimal control*. We will discuss different approaches to modeling, estimation, and control of discrete time stochastic dynamical systems (with both finite and infinite state spaces). Solution techniques based on dynamic programming will play a central role in our analysis. Topics include: Fully and Partially Observed Markov Decision Processes, Linear Quadratic Gaussian control, Robust Minimax Control, Bayesian Filtering, and various techniques in Approximate Dynamic Programming. Applications to various domains will be discussed throughout the semester.

## 2 Instructor Information


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| Instructor: | Eilyan Bitar |
| Office: | 326 Rhodes Hall |
| Office Hours: | Tuesday, 1:00 - 2:30 PM |
| Email: | eyb5@cornell.edu |
| Phone: | (607) 255-7156 |


Course website: http://bitar.engineering.cornell.edu/ece5555.pdf

## 3 Lectures

Lectures will be held Tuesday/Thursday (11:40 - 12:55 PM) in 203 Phillips Hall.

## 4 Textbooks

There are two recommended textbooks for this course:

1. D. Bertsekas. *Dynamic Programming and Optimal Control.* Vol. I and II. 3rd ed. Nashua, NH: Athena Scientific, 2007. ISBN: 9781886529083.

2. P. R. Kumar and P. Varaiya. *Stochastic Systems: Estimation, Identification and Adaptive Control.* Prentice-Hall, Englewood Cliffs, NJ, 1986.

The second book is out of print. A PDF version can be downloaded from:
http://bitar.engineering.cornell.edu/varaiyabook.pdf

## 5 Prerequisites

Calculus, Probability, Linear Algebra, Convex Analysis, comfort with mathematical proofs, and basic Matlab (or Python) programming.

## 6 Grading

Your final grade will be based on **homework** (30%, assignments equally weighted), **midterm** (30%), and **final** (40%). The final will either be exam or project based – to be determined 4 weeks into the semester.

## 7 Collaboration and Code of Conduct

Every student attending this course is expected to abide by the Cornell University Code of Academic Integrity, which can be found at cuinfo.cornell.edu/Academic/AIC.html. Any piece of work you turn in for credit must be your own work. Discussion with other students about specific homework problems is permitted to the extent that discussion is limited to problem approach and does not include note taking. In writing up your homework solution, you must acknowledge anyone with whom you collaborated. If you use papers or books or other sources (e.g. material from the web) to help obtain your solution, you must cite those sources. You may not discuss exam problems with other students. Please ask if you are unclear as to what constitutes excessive collaboration.

## 8 Misc

The midterm and final will take place in the evening to provide students with ample test time. To compensate students for the additional time commitment outside of normal class hours, two to three regular lectures will be canceled.