MTHE/MATH 472/872 **Winter 2018**

Control of Stochastic Systems

Classes held in Jef 225 at Mon 10:30-11:20, Wed 9:30-10:20, Fri 8:30-9:20.

Brief Course Information

This course is concerned with control and optimization of dynamical systems under probabilistic uncertainty. Such systems are of increasing importance in many application areas such as information systems, control systems, and networks as well as in economics, biology, optimization etc., and applied mathematics at large.

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Marker:	Sina Sanjari
Office Hours:	Monday 11:30-12:30
Recommended Text:	*Discrete-Time Markov Control Processes, by O. Hernandez-Lerma and J. B. Lasserre*,
	Supplemental Notes will be posted on the course web site
References:	*Dynamic Programming and Optimal Control*, by D. P. Bertsekas
	Markov Chains and Stochastic Stability, by S. P. Meyn, R. L. Tweedie
Announcements:	Visit http://www.mast.queensu.ca/˜ math472 for announcements, homeworks etc.
Grading:	Homework Assignments 15%, Project and Presentations 20%,
	maximum of(Midterm 30% + Final 35%, Midterm 20% + Final 45%)

Topics

- Introduction to Markov Chains
- Martingales and Stochastic Stability
- Control Problems over Finite and Infinite Time and Dynamic Programming
- Partially Observed Models
- Linear Quadratic Gaussian Problem and Kalman Filtering
- The Average Cost: ACOE and the Linear Programming Approach to Markov Decision Processes
- Numerical Methods and Algorithms (Value/Policy Iteration, Linear Programming, Q-Learning) and Approximations
- Decentralized Stochastic Control
- Continuous-Time Models and Elements of Stochastic Differential Equations

Intended Learning Outcomes

(1) A knowledge base for engineering

  (a) Computational proficiency

    (a) Computing optimal policies and costs for stochastic control problems

  (b) Mathematical reasoning

    (a) Reasoning on team decision problems
    (b) Establishing structural results on optimal control policies through dynamic programming and properties of conditional expectation
    (c) Establishing the existence of optimal policies for finite horizon, discounted infinite horizon and average cost infinite horizon problems

  (c) Understanding of mathematical structures

    (a) Understanding stochastic stability notions for Markov chains, including recurrence, positive Harris recurrence, and transience
    (b) Establishing the controlled and uncontrolled Markov chain properties

  (d) Mathematical rigour

    (a) Rigorously using tools from stochastic control theory

(2) Problem analysis

  (a) Deriving mathematical models of optimization problems and analyzing them using tools from stochastic control theory

(3) Design

  (a) Designing controllers leading to various forms of stability for a controlled stochastic system