**EMGT 457: Markov Decision Processes**

**Fall, 2013**

**Class Meetings:** M: 4-6.30 PM

**Office Hours:** M: 10-12

**Instructor**: Dr. Abhijit Gosavi **Office**: EMAN 219

Phone number: (573) 341-4624 Email: gosavia@mst.edu

Course website: <http://www.mst.edu/~gosavia/mdpcourse.html>

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**Course** **Objectives:** This course is meant to introduce you to the topic of Markov decision processes (MDPs). MDPs are being widely used to solve problems of control optimization in a variety of fields such as computer science, management science, and electrical engineering. We will begin the course with details of some of the fundamental ideas underlying MDPs, i.e., Markov chains and control, and then gradually make the transition to sophisticated algorithms for MDPs based on the Bellman equation. The first part of the course will be devoted to the theory and algorithms, in particular dynamic programming techniques. The second half will be devoted to applications and some recent advances, e.g., reinforcement learning.

It is expected that the student has already taken a basic course in Prob./Stat. and a course in computer programming (C and its variants or MATLAB). *The course will require a significant amount of computer programming, and students who are afraid of or dislike computer programming should not register for this course*. Some of the main contents of this course are:

* Markov chains
* Exhaustive enumeration
* Dynamic programming: value and policy iteration using Bellman and Poisson equations
* Semi-Markov control
* Applications including *machine maintenance*, *airline revenue management*, and *robotic grid-world problems*
* Reinforcement Learning

By the end of the semester, you should expect familiarity and a high level of comfort with (a) the main algorithms of dynamic programming and reinforcement learning, (b) writing computer codes for the above, and (c) some of the main applications of MDPs.

There is no textbook for this course. We will use notes that will be put up on blackboard. Some textbooks for reference are:

1. *Dynamic programming* by D.P. Bertsekas, Vol II, Athena, 1995.
2. *Neuro-Dynamic Programming* by D.P. Bertsekas and J. Tsitsiklis, Athena, 1996.
3. *Simulation-based Optimization: Parametric Optimization Techniques and Reinforcement Learning* by A. Gosavi, Springer, 2003.

**Grading:**

1. 4 homework assignments (25% each)
2. Grading: 90-100: A; 80-89: B; 70-79: C

**Schedule:**

Assignment 1: due on September 9, 2013

Assignment 2: due on Nov 4, 2013

Assignment 3: due on November 18, 2013

Assignment 4: due on Dec 6, 2013

Sept 3: Class cancelled (Labor Day)

October 7: Conference Travel (Class cancelled)

Nov 25-29: Thanksgiving break

Dec 6: Last day of classes

Organization of Course Material:

1. Chapter on Dynamic Programming (all sections except Section 10)
2. Chapter on Reinforcement Learning (all sections)
3. Chapter on Case Studies (all sections)

**Class Policies:**

1. Late assignments will not be accepted under normal circumstances.

1. The rules regarding academic dishonesty are at: <http://registrar.mst.edu/academicregs>
2. *If you have a documented disability and anticipate needing accommodations in this course, you are strongly encouraged to meet with me early in the semester. You will need to request that the Disability Services staff* (<http://dss.mst.edu>) *send a letter to me verifying your disability and specifying the accommodation you will need before I can arrange your accommodation.*
3. While attendance is not mandatory, it is strongly encouraged.
4. The purpose of the Academic Alert System [http://academicalert.mst.edu](https://minermail.mst.edu/exchweb/bin/redir.asp?URL=http://academicalert.mst.edu/) is to improve the overall academic success of students by improving communication among students, instructors and advisors; reducing the time required for students to be informed of their academic status; and informing students of actions necessary by them in order to meet the academic requirements in their courses. I will use the academic alert system in case of problems.

***If you have any problem regarding the course, feel absolutely free to stop by my office during office hours or other times if you see me in the office. Otherwise send me an email to make an appointment. Good luck and have a wonderful semester!***