IE 5571/8571: Reinforcement Learning and Dynamic Programming

University of Minnesota, Fall 2023

Instructor:

Dr. Kevin Leder
Office: Lind Hall 240F
Email: `kevin.leder@isye.umn.edu`

Meeting Time/Location:

Monday, Wednesday 9:05 AM–11:00 AM
Keller Hall 3-111

Office Hours:

Monday 12:00PM-1:30 PM

Required Text:

Richard Sutton and Andrew Barto. Reinforcement Learning, Second Edition.
MIT Press 2020.
http://www.incompleteideas.net/book/RLbook2020.pdf

Supplementary Text:

Dimitri Bertsekas. Reinforcement Learning and Optimal Control, First Edition.
Athena Scientific, 2019.

Prerequisite and Content: This courses assumes knowledge of probability, optimization and linear algebra at the undergraduate level. We will cover Chapters 2-12 of the Sutton and Barto book. In addition, we will do further examples on neural networks.

Grading: Grades will be based upon homework assignments, and a final project.

There will be bi-weekly homework assignments, homework maybe uploaded to the canvas site. You can consult with other students on how to do the homework problems, but all homework must be completed individually.

Course grades will be broken down as follows:

Project	30%
Homework	70%

Outline of Topics

- Finite Horizon Dynamic Programming

- Multi-armed bandits

- Markov Decision Processes

- Infinite Horizon Dynamic Programming

  - Bellman Equation

  - Policy and Value Iteration

- Tabular Reinforcement Learning

  - Monte Carlo Methods

    * On-policy methods

    * Off-policy methods and Importance Sampling

  - Temporal-Difference Learning

    * Q-learning

    * Sarsa

- Reinforcement Learning with Approximations

  - Approximation architectures

    * Linear approximation architectures

    * Neural networks, introduction and training

  - Least Squares Temporal Differences

  - On-policy Control with Approximation

  - Eligibility Traces

    * TD(λ)

  - Policy Gradient Methods

    * Actor-Critic Methods

  - Deep Q-learning Applications