Syllabus
IE437 Data-Driven Decision Making and Control (2023 Spring)

Instructor

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Office hours: Wed 3:00-4:00 PM (other times are available by appointment by email)

Time/Location

Time: Mon/Wed from 09:00 AM – 10:15 AM
Location: (E2) Industrial Engineering & Management Bldg. #1501

Course TA

Jo Jaeyeon (Head), Yu Jihwan, Yoon Taeyoung

Prerequisites

None

Textbook

None

Overview

Welcome to our graduate-level course on data-driven decision-making! In this course, we will cover a range of topics related to optimization, statistics, and machine learning, with a focus on their application to decision-making problems.

We will begin by reviewing optimization techniques and introducing the fundamentals of Bayesian statistics. From there, we will delve deeper into Bayesian data analysis and explore the basics of machine learning. The bulk of the course will focus on data-driven static decision-making, where we will cover a variety of optimization techniques such as surrogate model-based and generative model-based design optimization. We will also introduce Bayesian optimization and explore its applications.

Moving on to dynamic decision-making, we will explore Markov decision processes and dynamic programming. We will also cover value-based and policy-based reinforcement learning, as well as model-based and meta reinforcement learning. Finally, we will discuss offline reinforcement learning, which involves learning from pre-collected data.

By the end of the course, you will have a solid understanding of how optimization, statistics, and machine learning can be applied to solve a range of decision-making problems. You will also be equipped with the necessary tools to approach new decision-making challenges in your field of study or profession.

Topics (tentative)

0.Introduction

(Fundamentals)

1. Optimization Problem Modeling
2. Fundamentals on Bayesian Statistics
3. Bayesian Networks

(Data-Driven Static Decision Makings)

4. Bayesian Optimization
5. Deep Learning with Inductive Biases
6. Data-Driven Design Optimization (Surrogate Model Based)
7. Data-Driven Design Optimization (Generative Model Based)

(Dynamic Decision Making)

8. Markov Decision Process and Dynamic Programming
9. Value Based RL
10. Linear Dynamic System and Optimal Control
11. Policy Based RL
12. Model-Based RL
13. Meta RL
14. Offline RL

Evaluations

- 3 sets of homework (30%)
- Midterm exam (30%)
- Final Project (30%)
- Attendance and class participation (quiz) (10%)