ECE586IC: Interplay between Control and Machine Learning
Fall 2026

Instructor: Bin Hu (binhu7@illinois.edu)

Course Information:
Lectures: T/Th 12:00PM–1:20PM, Room 3015 ECEB
Office Hours: By appointment, CSL 145
Prerequisites: ECE 515, ECE 534, and ECE 490 are recommended, but not required.

Course Description:

This advanced graduate course focuses on the interplay between control and machine learning. One half of the course focuses on tailoring control tools to study algorithms and network models in large-scale machine learning. In the other half of the course, students will study how to combine machine learning and model-based control methods for control design problems.
The following topics will be covered: empirical risk minimization; first-order methods for large-scale machine learning; stochastic optimization; dissipation inequality; jump system theory; Lur'e-Postnikov type Lyapunov functions; integral quadratic constraints; KYP Lemma; control-theoretic methods for designing certifiably robust neural networks; modern neural verifiers; reinforcement learning for control; control-oriented analysis tools for temporal difference learning and Q-learning; zeroth-order optimization and evolutionary strategies; policy gradient methods for robust control; Goldstein's subgradient method for H-infinity control; adversarial reinforcement learning; imitation learning for control; control barrier functions; diffusion models and generative AI for control; large language models (LLMs) for control.

Grading:

40% regular homework sets (4 homework sets in total, 10% each); 20% in-class presentation; 40% written research report.

Required Materials:

There is no required textbook for the class. All course material will be presented in class and/or provided online. Relevant lecture notes, papers, tutorials, and other resources will be posted on the course website.

Homework:
There are 4 homework sets. Homework will be submitted in class. Discussion on homework problems is permitted; however, each student must write and submit independent solutions. Extensions will be granted with instructor approval in advance. Otherwise, late homework without such prior approval will not be accepted.

In-Class Presentation and Written Research Report:
Each student will give an in-class presentation and submit a written research report. The presentation accounts for 20% of the final grade, and the written research report accounts for 40% of the final grade. Detailed guidelines for the presentation and final project will be posted in the Resources section of the course website.

Policy on Re-grades:
Re-grades will be considered if you believe there is an error in the grading of your homework, presentation, or written report. You should explain the issue to the instructor within one week after the graded work is returned. A re-grade involves reconsideration of the relevant work and could result in a higher or lower grade than before.

Accommodations for Students with Disabilities:
If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way the course is usually taught may be modified to facilitate your participation and progress.

Academic Integrity:
All students are subject to the University's academic integrity policies.