Syllabus for CS395T: Foundations of Machine Learning for Systems Researchers

Course Overview

Rapid advances in machine learning have enabled us to build systems with capabilities that were unimaginable just a few years ago, such as AlphaGo, which plays the board game Go better than any human player, DeepSeekCoder, which can generate programs in more than 300 computer languages, and AlphaEvolve, which can discover advanced algorithms. The goal of this course is to analyze the key breakthroughs that underlie these kinds of systems, and to understand how they can be used to build systems for solving other problems.

Lectures will cover three main machine learning technologies used in these systems: deep neural networks, reinforcement learning, and evolutionary computing. Unlike in machine learning courses, this material will be presented using PL/systems concepts such as dataflow analysis. Lectures will be complemented each week by student presentations of key papers in these areas from recent AI/ML conferences. Some of these papers go into greater depth in the core AI/ML technologies while others are case studies that analyze how they are deployed in systems for board games, multiplayer games, coding assistants, and algorithm discovery.

Prerequisites

- Proficiency in Python
- Familiarity with undergraduate-level algorithms and data structures
- Familiarity with calculus, statistics, and linear algebra, and strong mathematical skills
- Coursework or equivalent experience in AI and ML at the level of CS342 is strongly recommended. Practical experience with training machine learning models will be useful.

Course Outcomes

Build a solid foundation in DNNs, RL, and evolutionary computing—including limitations. Understand how these technologies are deployed in modern systems. Evaluate and leverage advanced AI/ML technologies to build new systems.

Coursework

- One paper presentation (20%)
- One paper review (5%)
- 3 programming assignments (10% each, 30% total)
- A substantial term project (40% total)
  - Project Proposal (5%)
  - Final Project Paper (20%)
  - Project Presentation (15%)
- Participation and project meetings (5%)

Academic Honesty

You may discuss concepts with classmates, but all written work and programming assignments must be your own or your project team's work when teamwork is permitted. You may not search online for existing implementations of algorithms related to the programming assignments, even as a reference. Students caught cheating will automatically fail the course and will be reported to the university. If in doubt about the ethics of any particular action, talk to the instructor or the TA.

Notice about students with disabilities

The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Division of Diversity and Community Engagement — Services for Students with Disabilities at 512-471-6529.

Course Staff

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