Advanced Topics in Machine Learning

CSCI 8000

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Lecture 1: Course Overview

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General Information

• **Instructor**: Sheng Li ([sheng.li@uga.edu](mailto:sheng.li@uga.edu))

• **Syllabus & Course Website**:
http://www.cs.uga.edu/~shengli/CSCI8000F18.html

• **Time and Location**:
TR: 11:00am-12:15pm; W: 11:15am-12:05pm (Boyd 306)

• **Office Hour and Location**:
Thursday: 10:00am-11:00am (Boyd 549)
What is Machine Learning

Note: This figure is mainly used to described data mining, but still shows some insights about ML
ML Related Courses at UGA

• Machine Learning
  • CSCI 8950 Machine Learning

• Artificial Intelligence
  • CSCI 4550/6550 Artificial Intelligence
  • CSCI 4560/6560 Evolutionary Computation and Its Applications
  • CSCI 4330/6330 Artificial Intelligence and the Web
  • CSCI 8050 Knowledge-Based Systems
  • CSCI 8820 Computer Vision and Pattern Recognition
  • CSCI 8920 Decision Making under Uncertainty
  • CSCI 8940 Computational Intelligence

• Data Science
  • CSCI 3330/4360/6360 Data Science I/II
  • CSCI 4380/6380 Data Mining
  • CSCI 8955 Advanced Data Analytics
  • CSCI 8960 Privacy-Preserving Data Analysis

Incomplete list
Style of Course

• Graduate level course
• Present an overview of several advanced topics in *machine learning* and *deep learning*, with a special focus on *representation learning* techniques
• Paper review and presentation
• Research-oriented learning with a *final project*
• No textbook
Recommended Prerequisites

• CSCI 6380 Data Mining or CSCI 6550 Artificial Intelligence

• Understand the basic concepts of machine learning

• Solid mathematics / statistics / programming background would be a plus

• However, these requirements are NOT strict, as long as you are well motivated and eager to learn machine learning
Tentative Schedule

• Course overview (by instructor)

• An overview of machine learning (by instructor)

• An overview of deep learning (by instructor)

• Paper review and presentations (by students)

• Project proposal and final presentations (by students)

• Guest lectures
Grading Breakdown

• Class participation (15%)
• Paper Review (15%)
• Paper Presentation (25%)
• Final Project (45%)
Covered Topics

• Review of machine learning and deep learning
• Dimension reduction, unsupervised learning, clustering
• Multi-view learning and transfer learning
• Deep learning for CV / NLP / User Modeling
• Graph convolutional networks
• Adversarial training
• Neural architecture search
• Machine learning meets causal inference
• Interpretable machine learning
• …
Paper Review & Presentation

• Paper list and (tentative) schedule is available on the course website

• Please sign up as soon as possible

• Also, the paper list is negotiable. You may explore and suggest another interesting ML paper for review and presentation. But it should be approved by the instructor.
Paper Review

• Students will be required to read 10 papers and write a review for each of them

• **Suggested outline** of review
  - Main idea and contributions
  - Summarize the methodology and major experimental findings
  - Discuss the strengths and weaknesses of the paper
  - You are also *encouraged* to check the state-of-the-art papers that cited the assigned paper, and briefly review the ideas

• Review should be emailed to the instructor by midnight (12:00am) before the scheduled lecture
Paper Presentation

• Each presenter should prepare slides for a 30-40 minutes talk, which should address the following points:
  • Motivation & Related Work
  • Problem Statement & Methodology
  • Experiments
  • Conclusions & Discussions

• The presenter will lead another 10-20 minutes discussion, and need to prepare discussion questions on the paper’s content, pros/cons, and future works.

• Slides should be emailed to the instructor by midnight (12:00am) before the scheduled lecture
Course Project

• Individual or group (no more than three students) research project

• Can be on any topic related to the course

• Tentative timeline
  • Sep. 25 – Sep. 27: Project proposal presentation
  • Nov. 07: Project status update
  • Nov. 27 – Nov. 29: Final project presentation
  • Dec. 6: Final project report due

• Detailed requirements of proposal and final report will be released soon
Course Project Suggestions

• Theoretical Study
  • Study the proof techniques of a particular ML problem; Try to improve it or extend it to new settings

• New Algorithms
  • Extend the state-of-the-art algorithms, derive solutions, and validate it on benchmark datasets

• New Modeling/Applications
  • Identify a new setting or new application of ML model; Encourage to explore *interdisciplinary* research
Course Project Suggestions

• Identify an open problem from your current research projects, and try to design ML models to improve the system performance

• Look into the assigned paper again, check the follow-up works (with source code & data), and try to develop an improved version

• The high-quality course project reports might be converted into paper submissions for future ML venues
Recommended Books

• Not Required

• Christopher Bishop, *Pattern Recognition and Machine Learning*, 2006