CS 678 • Machine Learning • Winter 2020

Contact Information

- Instructor: Dr. Erin Carrier (erin.carrier@gvsu.edu)
- Office: 618A Eberhard Center
- Hours: Tuesdays 5:00–6:00pm; and by appointment
- Course Pages:
  - https://github.com/cis678-w20/class-material - Includes all course policies, assignments and class documents
  - https://piazza.com/class/k54czgfsw4l45q - For class communication

Course Description and Objectives

This course provides a broad introduction to machine learning – computer programs that improve their performance with experience. Topics covered include decision trees, neural networks, statistical methods, genetic algorithms, Bayesian learning methods, explanation-based goal regression, reinforcement learning, deep learning, and clustering. The course includes an applied component that provides exposure to established algorithms and machine learning programs.

Upon completion of this course, the student will:

- understand a variety of machine learning algorithms and their use in data-driven knowledge discovery.
- be able to modify existing machine learning algorithms and design new algorithms.
- be able to compare and contrast various machine learning algorithms and relate them to human learning processes.
- be familiar with the state of the art in machine learning and current research topics.

Prerequisites

- CS 500 Fundamentals of Computer Science
  - Solid programming skills

Textbooks

Required:

- *Introduction to Machine Learning, 3rd Ed.*; Ethem Alpaydin; MIT Press, 2014.

Grading

- Homework / Exercises 15%
- Programming Projects 70%
- Final Project 15%

Grading Scale

A / A-	90%
B+ / B / B-	80%
C+ / C / C-	70%
D+ / D	60%
F	< 60%

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Course Policies

- The deadline to drop with a "W" is Friday, March 6th, at 5:00 p.m.
- Course policy summary: you agree to be a responsible and communicative student, I in turn promise to be a fair and reasonable instructor.
- Course policy details:
  - Announcements: All announcements will be made on Piazza or in class – you are responsible for monitoring Piazza and coming to class.
  - Piazza: Please do not post solution code publicly on Piazza.
  - Assignments/Projects: Unless previous arrangements have been made, all homework assignments, project/project reports are due at the beginning of class on the due date.
  - Programs: All programs should have acknowledgments/citations for any work that is not your own. Code should be well formatted with comments.
  - Special Needs: Please see me if you have any special accommodations to be considered.

Course Outline

Course Outline/Topics

1. Learning Concepts
2. Supervised Learning
    - Regression
3. Decision Trees
    - Classification
    - Pruning
4. Neural Networks
    - Multi-layer nets
    - Backpropagation
    - Training
5. Deep Learning
    - Convolutional Networks
6. Bayesian Learning
    - Bayes Theorem
    - Belief networks
7. Parametric Methods
    - Maximum Likelihood Estimation (MLE)
8. Unsupervised Learning
    - *k*-Means Clustering
9. Dimensionality
    - Principle Component Analysis (PCA)
10. Genetic Algorithms
    - Evolutionary computing
11. Hidden Markov Models
12. Support Vector Machines
13. Learning Agents
    - Reinforcement learning
    - Agent architectures

Final Project: Tuesday, 4/21 6:00–7:50 pm

Lab Projects/Programs

Projects, presentations, and programming assignments are designed as experiments and exercises in support of classroom concepts; as a means to provide hands-on experience with concepts/algorithms; and as opportunities for interdisciplinary and collaborative work.