Course Description

An Information Age: Math and Technology of Data

We live in an era of information. If you are interested in a topic, you can type it into a search box and page after page of information will appear. How does Amazon know which products to recommend that you buy? How does Netflix know which titles you may like? We will investigate the answers to these questions and more by diving into the field of mathematics and computer science known as machine learning.

Syllabus

Course Objectives:

- Acquire new mathematical skills applicable to machine learning.
- Analyze various machine learning algorithms both conceptually and using computational tools.
- Explore applications of machine learning including online shopping, streaming, and social media.

Assignments and Evaluations:

- Problem Solving - Solve problems involving machine learning algorithms.
- Discussions - Class discussions about various machine learning algorithms and their applications.
- Project - Find or create a data set and analyze it using several machine learning algorithms.

Course Outline

- Welcome and Introductions
    - Third Person Introductions
    - Icebreaker: Human Machine
    - Rules and Expectations
    - Warm Up: Sorting Activity
- Machine Learning Applications
    - Amazon
    - Facebook
    - Netflix
- Similarity and Features
    - Preference Space
    - Feature Space
    - Apple and Orange Example
- Overview of Machine Learning
    - Problem Solving
    - Supervised vs. Unsupervised
    - Classifications, Regression, and Clustering
    - Examples
    - Popular Algorithms
- Descriptive Statistics
    - Measures of Center
    - Percentiles
    - Five Number Summary
    - Measures of Spread
    - Visualizing Data
    - Introduction to Orange
- Measuring Model Performance
    - Accuracy vs. Precision

    - Terminology
    - True and False Positives and Negatives
    - Error, Accuracy, Precision, and Recall
- Matrices and Vectors
    - Definitions
    - Addition and Subtraction
    - Representing Data
- Norms and Distance
    - Euclidean
    - Taxicab
    - Infinity
    - Distance
- *K*-Nearest Neighbor
    - Definition
    - Football vs. Basketball
    - Algorithm
    - Caveats
    - Orange
- Classification Trees
    - Definitions
    - Examples
    - Algorithm
    - Coin Sorting
    - Orange
- *K*-Means
    - Clustering Example
    - Definitions
    - Algorithm
    - Handout
    - Orange
- Regression
    - Correlation
    - Line of Best Fit
    - *MSE*, *RMSE*, *AME*, and R^2
    - Multiple Linear Regression
- Other Machine Learning Algorithms
    - Logistic Regression
    - Gaussian Naive Bayes
    - Support Vector Machines
- Machine Learning Project
- Evaluations and Certificates