

ISYE 4600 METHODS AND APPLICATIONS OF MACHINE LEARNING

Required/Elective: Concentration Depth for Data Sci and Analytics Concentration

Credit: 3-0-3

Prepared Prof. Yao Xie, Fall 2025

Prerequisite(s): ISYE 3030 BASIC STATISTICAL METHODS and ISYE 3133 ENGINEERING OPTIMIZATION

Catalog Description:

This course introduces the available methods in machine learning, which methods are better in what situations, objective functions and errors, and how to tune parameters.

Text:

No formal textbook will be used.

References:

The course material will be based on the lecture slides provided in the course.

Objective

This course develops an understanding of core ML methods and their practical use in ISyE contexts. Upon completion, students will be able to: Gain a thorough understanding of ML algorithms, use machine learning algorithms and choose the correct ones, and gain experience with analyzing real data.

Topical Outline

| Topics | No of Weeks |
|---|-------------|
| Introduction and review of basics | 1 |
| Clustering: k-means | 1 |
| Dimensionality reduction, PCA | 1 |
| Recommender systems | 1 |
| Variable/feature selection | 1 |
| Model assessment, bias-variance tradeoff | 1 |
| Optimization for ML | 1 |
| Classification: General principle, Bayes | 1 |
| Classification: KNN, logistic regression | 1 |
| Classification: Support Vector Machines | 1 |
| Neural networks and intro. to deep learning | 1 |
| Anomaly detection | 1 |
| Boosting algorithms | 1 |
| Trees & Random Forests | 1 |
| Final review | 1 |
| Total | 15 |

Software

Python (NumPy, pandas, scikit-learn) will be used for assignments/projects. Use of Jupyter/Colab is encouraged.

Outcomes and their relationships to ISyE Program Outcomes

At the end of this course, students will be able to:

1. Formulate ML problems and select appropriate algorithms.
2. Implement and evaluate ML models using software tools.
3. Analyze data and interpret model outputs with statistical rigor.
4. Communicate ML-driven conclusions for engineering decision-making.

| Course outcome \ Program Outcomes | | ISyE Program Outcomes | | | | |
|-------------------------------------|---|--|---|--|--|---|
| 1. Formulate/select ML algorithms | H | 1. identify, formulate solve engg prob by engg, sci & Math | 2. produce solutions consider public health, safety, welfare, global, cultural, social, environ & economic. | 3 communicate with a range of audience | 4 recognize ethical & professional responsibilities, make informed judgement consider resolutions in global, economic, environ and societal context. | 5. effective on a team provide leadership, collaborative and inclusive envirn, plan tasks & meet objectives |
| 2. Implement/evaluate with software | H | | | | | H |
| 3. Analyze & interpret results | | | | | | H |
| 4. Communicate conclusions | | H | | | | M |
| | | | | | | 7. acquire and apply new knowledge using appropriate learning strategies |

Evaluation of the important outcomes

- H will be assessed in the final project.