ISyE 4600 Methods and Applications of Machine Learning

Syllabus

Course Information

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

Credit: 3-0-3

Prepared by: Prof. Yao Xie, Fall 2025

Prerequisites: 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

The topical outline is shown in Table 1. The first column lists the topics to be covered. The second column lists the number of weeks these topics will be covered.

Table 1. Topical outline

Topics	Number of weeks
Introduction and review of basics	1
Clustering: k-means	1
Dimensionality reduction, PCA	1
Recommender systems	1
Variable/feature selection	1

Topics	Number of weeks
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 introduction to deep learning	1
Anomaly detection	1
Boosting algorithms	1
Trees and Random Forests	1
Final review	1
Total	**15**

Software

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

Course Learning Outcomes

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

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

Mapping from Course Outcomes to ABET Student Learning Outcomes

Table 2 shows the relationship between course outcomes and ABET student learning outcomes. The first column lists the course learning outcomes. The next seven columns list the abbreviated ABET student learning outcomes. The entry of H in a row with a specific course learning outcome and column with a specific ABET student learning outcome indicates that the importance of attaining this outcome is high and will be assessed.

Table 2. Mapping from course outcomes to ABET student learning outcomes

Course outcome / Program outcomes	1. Identify, formulate, and solve engineering problems by applying engineering, science, and mathematics	2. Produce solutions that consider public health, safety, welfare, global, cultural, social, environmental, and economic factors	3. Communicate with a range of audiences	4. Recognize ethical and professional responsibilities and make informed judgments	5. Function effectively on a team, provide leadership, create a collaborative and inclusive environment, plan tasks, and meet objectives	6. Develop and conduct experiments, analyze and interpret data, and use engineering judgment to draw conclusions	7. Acquire and apply new knowledge using appropriate learning strategies
1. Formulate/select ML algorithms	H					H	M
2. Implement/evaluate with software	H						
3. Analyze and interpret results						H	
4. Communicate conclusions			H				

Evaluation of Important Outcomes

H will be assessed in the final project.