Advanced Machine Learning

Course Outline

In previous courses, we have studied how to build a predictive model for different scenarios.

1. **Can we combine the decisions from multiple models to make better predictions?**
2. **For data where one of the target classes has a higher ratio compared to the other(s), how do we ensure that the model performs well?**
3. **How to optimize a model's performance to ensure that it aligns with the business objective we want to achieve?**

Improving a model's performance is key to achieving business outcomes, and we can do so by leveraging model ensembles and model tuning techniques.

Overview

Ensemble models use a collection of machine learning models and leverage techniques like bagging, boosting, and stacking to make predictions, and can be used across a wide variety of classification and regression problems.

In order to maximize a model's performance, we need to first get a clear picture of how a given model is performing, and using cross-validation helps us better use our data to get that picture. Once this clarity is obtained, we can use one of the most common methods, called hyperparameter tuning, to maximize a model's performance and get optimal predictions.

When dealing with any classification problem, there will be situations where one has to deal with datasets having an unequal distribution of the target class, and the value of finding the minority class is much higher than that of finding the majority. Such datasets are called imbalanced datasets and one can use specialized techniques to deal with the imbalance and build a robust predictive model.

Overall, the **Advanced Machine Learning** course encompasses key topics like ensemble methods, cross-validation, hyperparameter tuning, and imbalance handling, enabling us to enhance our predictive modeling expertise and achieve better outcomes.

Course Objectives

After completing this course, you will be able to:

- Use ensemble techniques to improve predictability and enhance the stability and robustness of ML models
- Focus on problem recognition and build predictive models in the context of business decision-making
- Use cross-validation to get a better understanding of model performance across different metrics
- Improve the performance of a model by finding the optimal set of model parameters using search algorithms
- Handle class imbalance in the output classes to balance the business costs associated with them and reduce the bias and error in model predictions

Topics Covered

Week	Module	Name of the topic
1	**Bagging and Random Forest**	• Introduction to Ensemble Techniques • Introduction to Bagging • Sampling with Replacement • Introduction to Random Forest

2	**Boosting**	• Introduction to Boosting
		• Boosting Algorithms
		  ○ Adaboost
		  ○ Gradient Boosting
		  ○ XGBoost
		• Stacking

3	**Model Tuning**	• Cross-validation • Oversampling and Undersampling • Model Tuning and Performance • Hyperparameter Tuning • Grid Search • Random Search

Learning Materials

Week	Module	No. of Videos	Total Duration	No. of Test Your Understanding Quizzes	No. of Graded Quizzes	No. of Practice Assignments
1	Bagging and Random Forest	5	~1.5 hours	5	1	1
2	Boosting	7	~1.5 hours	7	1	1
3	Model Tuning	9	~2 hours	9	1	1

Project

A graded project is to be submitted by the learners at the end of the course.

A hands-on project to be submitted at the end of the course would need you to apply the learned techniques to standardize the process and improve the model's performance by balancing the target class and tuning the model's hyperparameters to help a bank predict which customers are going to renounce their credit card services.

Power Ahead!