ML with Finance Applications using Python

Course Description:

This course is planned to give an introduction to machine learning methods such as supervised, unsupervised learning, feature engineering as well as model evaluation. It has a practical perspective and showcases of **Finance applications with financial data** using important machine learning libraries in Python.

We will extensively use Python and the related libraries. **The course will be balanced between theory and practice to understand practical applications in financial domain**.

Learning Objectives:

- Implement basic machine learning algorithms
- Select the right algorithm for the right job
- Understand how to improve a machine learning algorithm's performance
- Model evaluation
- Data visualization techniques
- Learning Python and related libraries to train and test Machine learning models

Requirements:

- Basic understanding of computer algorithms and programming
- Knowledge of linear algebra and statistics
- Programming knowledge in Python. (The course includes an introduction to programming with Python)

Software:

- We will use Python on Jupyter Notebook with Numpy, Pandas, SciPy and Scikit-Learn libraries.

Assignments and Grading: There will be homework assignments and a group project that together determine the grade for this course. Homework/projects will involve implementation in Python. The project will involve groups of 4-6 students based on the class size. During the project participants will train a machine learning model on a certain problem and present their results at the final weeks of the semester. Grades are individually assigned, based on performance on assignments (40%), the group project write-up and presentation (40%), and class participation (20%).

References:

- Hand-on Machine Learning with Scikit-Learn and Tensorflow by Aurelien Geron, O'Reilly, 1st Edition, 2017.
- Introduction to Machine Learning with Python by Andreas C. Mueller and Sarah Guido, 2016.
- Introduction to Machine Learning, MIT Press 3rd Edition, Ethem Alpaydin, 2014.
- Python for Finance, O'Reilly Media, Yves Hilpisch, 2015.
- Doing Math with Python Use Programming to Explore Algebra, Statistics, Calculus, and More, Amit Saha, 2015.
- COMP0050 Machine Learning with Applications in Finance http://www.cs.ucl.ac.uk/1819/A7P/T2/COMP0050_Machine_Learning_with_Applications_in_Fin ance/
- COMPG014 - Machine Learning with Applications in Finance http://www.cs.ucl.ac.uk/current_students/syllabus/compg0/compg014_machine_learning_with_applications_in_finance/

Detailed Course Outline:

- Introduction to programming with Python
- Python mathematical libraries like Numpy, Pandas, SciPy
- Data visualization techniques using Python Matplotlib library
- Introduction to Machine Learning
- End-to-end machine learning project: Working with data, performance measure, training/test set split, data visualization
- End-to-end machine learning project – Classification: Data preparation, selecting/training a model, model evaluation, fine-tuning model, performance measures, cross-validation
- Classification: performance measures, cross-validation, confusion matrix, precision/recall, F1-score, ROC curve, AUC, Binary Classifier, multiclass classification
- Training models: Linear regression, Gradient Descent, Polynomial Regression, Learning curves
- Training models: Regularization, Logistic Regression
- Support Vector Machines
- Decision Trees
- Ensemble Learning and Random Forest
- Dimensionality Reduction, Clustering
- Introduction to Artificial Neural Networks/Deep Learning