Data Science for Finance

Course name:	Deep Learning Methods in Finance	Academic year: 2023-2024
Professor:	Prof. Bernardo Dias Raimundo (NOVA IMS)	
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Office Hours:	To schedule with students	
Professor Short Bio:	Bernardo Dias Raimundo is a guest professor at NOVA IMS Information Management School. He holds a masters degree in Statistical and Information Management with a specialization in Risk Analysis and Management from Nova IMS and a bachelor's degree in Economics from ISEG-UTL. During his Nova IMS master's program, he focused his thesis on the application on machine learning model combinations in credit scoring methods. His research efforts culminated in the publication of a scientific paper, showcasing his contributions to advancing methodologies in the field. His scientific interest focus on Data Science for Finance specifically in portfolio optimization, risk management and credit scoring.	
Webpage:	-	

A. COURSE DESCRIPTION

In recent years, the resurgence of interest in Machine Learning has been particularly pronounced, with the most significant breakthroughs occurring in the realm of Deep Learning – a collection of Machine Learning methods inspired by the human brain. Today, Deep Learning is at the heart of many state-of-the-art (predictive) analysis tools providing a competitive edge to organizations, especially in the financial industry. Examples include, credit default prediction, pattern recognition, stock price prediction, sentiment analyses, outlier detection, and natural language processing, to name only a few. This course aims to explore selected topics within Deep Learning, ranging from elucidating the fundamental architecture of a neural network to delving into the workings of Recurrent Neural Networks (RNNs) through practical examples and the utilization of publicly available datasets. The hands-on aspect of the course will involve practical illustrations using the Python programming language, providing participants with valuable skills and insights into the application of Deep Learning in the financial domain.

COURSE OUTLINE

1. Introduction to Deep Learning history and cognitive basis of neural computation
2. Fundamentals of Neural Networks
    2.1 Components of a neuron: inputs, weights, bias, activation function, and output.
    2.2 Architecture overview: input layer, hidden layers, and output layer.

2.3 Demonstration of how input data propagates through the network to produce an output.
2.4 Role of activation functions in introducing non-linearity to neural networks.
2.5 Definition and purpose of loss functions in neural networks.
2.6 Explain backpropagation as the training algorithm for neural networks.
2.7 Gradient Descent and Optimization Techniques
2.8 Overfitting and Regularization Methods

3. Recurrent Neural Networks
   3.1 Components of a neuron in RNN : inputs, weights, bias, activation function, and output.
   3.2 Architecture overview of RNN: input layer, hidden layers, and output layer.
   3.3 Temporal Data Propagation in RNNs
   3.4 Role of activation functions and loss functions in RNNs
   3.5 Role backpropagation through time as the training algorithm for RNNs.
   3.6 Gradient Descent and Optimization Techniques for RNNs
   3.7 Overfitting and Regularization Method in RNNs
   3.8 Addressing the vanishing and exploding gradient problems in RNNs
   3.9 Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU)
4. Practical Applications

B. TEACHING METHODS

- Expositional and Questioning Method Active Methods and Case Studies
- Investigation projects and practical applications with python programming.
- Knowledge development and learning capability.

C. EVALUATION METHODS (Exams and Grading)

The final grade for Exam Seasons 1 is computed as follows:

- Group Project: 100%

The final grade for Exam Seasons 2 & all Special exams is computed as follows:

- Group Project: 100%

D. BIBLIOGRAPHY

1. Goodfellow, I. J., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.
2. Chollet, F. (2017). Deep learning with python. Manning Publications.