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Study Abroad
INTERNATIONAL PROGRAMMES
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Faculty: Sciences, Technology and Engineering

Course: **Data Science and AI with Python**

Programme: Study Abroad in Engineering

Semester: 1 - Fall

ECTS credits: 6

Duration: 45 hours

Language of instruction: English

Instructors: Jordi Villà-Freixa

Course Description

The purpose of this course is to provide you with knowledge of key aspects of modern AI without any intimidating mathematics and in a practical, easy, and fun way. The course provides students with practical hands-on experience using real-world datasets.

Prerequisites

Basic knowledge of programming and basic mathematical skills.

Attendance policy

Attendance is mandatory for all classes, including field studies. Any presentation or activity missed due to student absences can only be rescheduled in cases of certified medical or family emergencies. If a student misses more than three classes in any course half a letter grade will be deducted from the final grade for each additional absence. Seven absences in any course will result in a Fail grade.

Learning outcomes

By the end of the course, students should be able to:
- Write programs for different Data Structures and Algorithms in Python.
- Understand the details of Machine Learning, Deep Learning, Natural Language Processing, Artificial Neural Network, Convolutional Neural Network and Recurrent Neural Network.
- Learn how to analyze AI algorithms.

Method of presentation

Lectures and discussions: Lectures with appropriate visual support provide the theoretical content of the sessions. Class discussions facilitate the students' ability to connect reading and lectures, analysing or applying concepts.

Required work and assessment methods

Throughout the course there will be two evaluation methods, the programming exercises to be delivered and a final team project. The percentage of each of these evaluation methods is detailed below:

1. Programming exercises to be delivered (60%).
2. Team project (40%).

Contents

Unit One: Python for Data Science

Unit Two: Statistical learning

- Supervised Vs Unsupervised Techniques
- Modelling data: linear, multivariate Gaussian, Bayesian models

Unit Three: Monte Carlo techniques

- Simulation
- Estimation
- Optimization

Unit Four: Unsupervised learning

- Risk and Loss
- Expectation-maximization
- Clustering
- Recommenders
- PCA

Unit Five: Regression

- Linear models
- Nonlinear models

Unit Six: Kernel models and regularization

Unit Seven: Classification

- Bayes' rule
- KNN
- SVM
- Multiclass classification

Unit Eight: Decision Trees and Ensemble Methods

- Encoding/decoding of categorical variables
- Random forests

Unit Nine: Deep learning

- Neural networks
- Training NN
- Convolutional NN

Requirements to pass the course. Exam retake

To pass the course, students should obtain at least an overall average grade of 5 out 10 for programming exercises. If delivery is delayed for a particular task (either programming exercises or final project), the grade for such task will be penalized with a maximum score of 60%.

If the minimal grade for programming exercises is not attained, a retake exam will take place. In the case of the final project, there is no possibility of retake.

All deliveries will be done through the Moodle site of the subject in the form of working Jupyter notebooks including detailed explanations of the code in Markdown. If additional files are needed (data, for example), The submission will be done in the form of a ZIP file or a compressed tarball.

Recommended reading

1. "Data Science and Machine Learning. Mathematical and Statistical Methods" by Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre and Radislav Vaisman. CRC Press
2. "Python for Data Science: Comprehensive Guide to Data Science with Python" by Alex Campbell.
3. "Data Science Projects with Python: A case study approach to gaining valuable insights from real data with machine learning", by Stephen Klosterman