Dr. Marcin Pietroń

Department of Computer Science and Electronics

AGH – University of Science and Technology in Cracow, Poland

website: https://marcinpietron.info

e-mail: pietron@agh.edu.pl

1. Introduction

In this document, you will find instructions to follow the course: "Machine Learning for Optimization". Please read it carefully and check it whenever you have a doubt.

Our classes will take place at the Technople of Reggio Emilia (building 15C) from 13 to 27 November. They consist of theory and practice. The practice consists of coding in the Python language, Pytorch framework and optimization libraries (OR-Tools, Gurobi).

We will start coding from the first lecture onwards. For that, it is necessary to have:

- Basic knowledge of Python 3.5+. Data types, data structures (lists, dictionaries, strings, sets), control structures (if, while, etc.), functions, modules and some popular libraries e.g. numpy, scipy.
- Practice with basic algorithms (linear search, binary search, sorting). Basic knowledge of classes and algorithmic and memory complexity is a plus.
- Basic knowledge of statistics.
- Basic knowledge of machine learning and data mining algorithms.
- Fundamentals of Linear Programming. Modeling with Linear Programs.
- Basic usage of a mathematical programming solvers (OR-Tools, Gurobi, CPLEX).

There will be a final exam. I will also provide some slides and python programs in a Google Drive folder. All material will be shared in this folder, so be sure you have access to it.

2. Schedule

The course (given in English) considers topics in machine/deep learning, evolutionary algorithms and their usage in optimization problems. The practical part of the course will require some basic experience in Python language and some basic knowledge about its libraries. The course has 6 lectures and labs of 3 hours (1hr lecture and 2hr lab) plus a final exam, according to the table below.

day	start	end	Room	hours	Lesson
13-Nov	14:00	17:00	M0.2 Tecnopolo Capannone 15C	3	Introduction to dynamic integer linear optimization and python libraries
15-Nov	14:00	17:00	M0.1 Tecnopolo Capannone 15C	3	Introduction to machine learning and python libraries (e.g. scikit-learn, pandas, seaborn)

18-Nov	14:00	17:00	M0.2 Tecnopolo Capannone 15C	3	Deep learning and python libraries/frameworks (pytorch, transformers)
20-Nov	14:00	17:00	M0.2 Tecnopolo Capannone 15C	3	Machine and deep learning in optimization
25-Nov	14:00	17:00	M0.2 Tecnopolo Capannone 15C	3	Evolutionary algorithms in optimization
27-Nov	14:00	17:00	M0.2 Tecnopolo Capannone 15C	3	Final project and exam

3. Evaluation and grading

The course will be evaluated by a lab project consisting in solving a practical problem with real-world/random data using the optimization algorithms (e.g. incorporated with machine learning model) or deep learning discussed during the course. It will consist of a project to be solved in groups of at most 2 students using the Python language (with Python-based libraries) to solve the given problem. The grading will be established according to the standard method and scale used by UNIMORE.

4. Final considerations

If at any moment you have doubts about the course and lectures, feel free to contact me by email: pietron@agh.edu.pl or ask me during the lectures. I will reserve a time at the end of each lecture to answer questions.

5. Bibliography

1. Peter Harrington, Machine learning in action. 2012
2. Aaron Courville, Ian Goodfellow, and Yoshua Bengio, Deep Learning. 2015
3. Pytorch - https://pytorch.org/
4. Linear Programming, Robert J. Vanderbei. 1996
5. OR-Tools - https://developers.google.com/optimization