Federico Agostini

Curriculum Vitae

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Personal Details

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Profile

Currently, I am a Ph.D. student in the National Ph.D. in Artificial Intelligence led by the Polytechnic University of Turin and the University of Padua. My field of study is related to the applications of Machine Learning in the bio-physical and medical domains, such as Cardiac Magnetic Resonance Imaging and ECG. In addition, I also work on NLP-related projects related to QA and NER extraction from medical notes. Formerly, I obtained a Bachelor's Degree in *Physics* and a Master's Degree in *Physics of Data* at the University of Padua.
During the internship at *Omnys*, I applied Machine Learning techniques in an industrial context, studying the field of Predictive Maintenance. In particular, I developed a method based on Spectrum Kernel, Multiple Representation Learning, and Boosted Decision Tree to classify short maintenance tickets which achieved better results with respect to state-of-the-art Transformers, demanding also less computational resources. In addition, I also built the corresponding infrastructure for the company using Amazon Web Services.
My interests span all the different fields of Artificial Intelligence, from Computer Vision tasks to Natural Language Processing and Reinforcement Learning.

Education

2021 – now **National PhD in Artificial Intelligence**, *Polytechnic University of Turin and University of Padua*
PhD Subject: *Machine Learning Algorithms for IOT sensors in bio-physical applications*

2019 – 2021 **Master Degree in Physics of Data**, *University of Padua*, *110/110 with Honor*
Thesis: *Industrial application of Machine Learning: Predictive Maintenance for failure detection*

2014 – 2018 **Bachelor's Degree in Physics**, *University of Padua*, *95/110*
Thesis: *B_0 meson decays reconstruction in the channel $J/\psi\, K_s^0$ at the CMS experiment*

Master Thesis

Title *Industrial application of Machine Learning: Predictive Maintenance for failure detection*

Supervisors Stefano Campese and Jacopo Pazzini

Description
- Development of algorithms to perform Predictive Maintenance in order to detect failures from the alarms collected by refrigeration systems. Multiple solutions are investigated both using Boost Decision Trees and Neural Networks.
- Natural Language Processing study to automatically classify failures from short maintenance tickets.
- Two proposed solutions are compared against state-of-the-art Transformers, showing better results with a lower computational cost:
  - *SpectrumBoost* extracts features from text using Spectrum Kernel and performs the classification through a Boost Decision Tree
  - *Deep Multiple Representation Learning* is able to learn a new representation combining base kernels in both a linear and non-linear way. This new representation is then passed through a fully connected layer with regularization and then forwarded to fully connected layers to make the classification.
- The studies of this work have been published in IJCNN [1].

Working Experience

2021 **Machine Learning / Data Scientist**, *University of Padua*, Research Fellowship
Machine Learning Applications in Neurology on subjects with nervous system disorders, such as Ictus and Alzheimer.

2020 – 2021 **Machine Learning / Data Scientist**, *Omnys*, Vicenza, Internship
Applications of Machine Learning for Predictive Maintenance and development of pipelines with AWS.

Teaching

2021 – 2022 **Management and Analysis of Physics Datasets**, *Laurea Magistrale in Physics of Data*, University of Padua, Prof. Pazzini
Docker, SQL, Spark, Dask, Kafka.

2022 – 2023 **Deep Learning Applied to Neuroscience and Rehabilitation**, *Laurea Magistrale in Bioingegneria*, University of Padua, Prof. Atzori
Python, Sklearn, Keras, Tensorflow e Pytorch with examples of Dense, Convolutional and Recurrent Neural Networks.

2022 – 2023 **Laboratory of Computational Physics**, *Laurea Magistrale in Physics of Data*, University of Padua, Prof. Zanetti
Python programming.

Languages

Italian Native Language

English Intermediate-Advanced *B2 level certificate at CLA, University of Padua, Sep 2018*

Skills

Programming
■■■■■ Python, Latex
■■□□□ HTML, CSS, Javascript, R, Fortran
■■■□□ Bash, C/C++, git
■□□□□ Java, SQL

Libraries
- *Machine Learning*: Scikit-learn, XGBoost, Tensorflow, Keras, PyTorch, Lightning, HuggingFace, Sentence-Transformers, Ray Tune
- *Big Data*: Spark, Dask
- *Others*: Numpy, Scipy, Pandas, Matplotlib, OpenCV, boto3
- *Web*: Hugo, Wowchemy, Netlify, Wordpress
- *Container*: Docker

AWS
- Glue, Lambda, Athena, Forecast, Cloudwatch, SageMaker, EC2, ...

Machine Learning
- *Computer Vision*: Good experience on different CV tasks with Machine Learning (classification, segmentation, object detection), also applied in the medical domain.
- *Natural Language Processing*: Knowledge of the state-of-the-art Transformers architectures and the different BERT variants. Experience with Huggingface Transformers. Among the different projects:
  - Master Thesis: comparison between Transformers and new proposed Multiple Representation Learning in maintenance ticket classification.
  - Kaggle *NBME - Score Clinical Patient Notes* challenge: QA and NER tasks using Huggingface Transformers. In this work, I combined the idea of QA to merge question and answer in the same sentence with token classification to extract relevant information from the answer. In addition, I also exploited word and sentence similarity to extract more information from unlabelled data, in order to increase my training set. Different models were tested (BioBERT, RoBERTa, DeBERTa, ...), also using Masked-Language Modeling to optimize them for medical text.
- *Reinforcement Learning*: Base knowledge of the principles and simple experience with OpenAI Gym.
- *Kernel Methods*: Good knowledge of Kernel Methods, applied also in NLP tasks. Expertise with Multiple Kernel Learning algorithms, and the Multiple Representation Learning methods introduced in the Master Thesis.

Extra

- Basketball player, coach and mantainer of the society website.

Publications

[1] S. Campese, F. Agostini, J. Pazzini, and D. Pozza, "Beyond transformers: fault type detection in maintenance tickets with kernel methods, boost decision trees and neural networks," in *2022 International Joint Conference on Neural Networks (IJCNN)*, pp. 1–8, 2022.

[2] F. Agostini, S. Campese, R. Vianello, M. Pizzi, A. Cipriani, and M. Zanetti, "A post processing pipeline to prepare raw data for machine learning algorithms in cardiac magnetic resonance imaging," *European Heart Journal - Cardiovascular Imaging*, vol. 23, 08 2022. jeac141.017.

[3] S. Campese, F. Agostini, T. Sciarretta, M. Pizzi, A. Cipriani, and M. Zanetti, "Myocardial fibrosis detection using kernel methods: preliminary results from a cardiac magnetic resonance study," *European Heart Journal - Cardiovascular Imaging*, vol. 23, 08 2022. jeac141.005.