Matteo De Francesco

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About Me

I am a first-year PhD student in the computer science department of the University of Geneva. My research focuses on algorithms for graph problems and motion planning problems, with a focus on computational complexity and probabilistic approaches. I am also interested in quantum computing and the generation of intermediately-hard instances that may help demonstrating quantum advantage.

Education

PhD student in Computer Science Sep. 2023 - ongoing
University of Geneva, Switzerland

Master's Degree (MSc) in Computer Science Sep. 2020 - Feb. 2023
University of Pisa, Italy 110/110 with honors

Bachelor's Degree (BSc) in Computer Science Sep. 2017 - Jul. 2020
University of Pisa, Italy 104/110

Research/Work Experience

PhD Student Sep. 2023 - ongoing
University of Geneva

* PhD student in Computer Science at the University of Geneva, Switzerland, in the ALGO team supervised by Arnaud Casteigts
* Design and analysis of algorithms related to graph theory, with a specific focus towards probabilistic analysis and the use of the quantum computational model
* Teaching assistant duties for the Bachelor's courses of "Formal Languages" and "Computability and Complexity", and the Master's course "Graph Algorithms"

Quantum Research Intern Mar. 2023 - Oct. 2023
PASQAL

* Quantum research internship at PASQAL, quantum scale-up founded by the Nobel prize in Physics Alain Aspect.
* Development of novel register design strategies to represent QUBO problems on the neutral-atom QPU.
* Implementation of an hybrid classical-quantum column generation solution for optimization problems.
* Acquired knowledge of quantum mechanics and quantum computing. Hands-on experience with OR solvers, Graph Neural networks, Partial differential equations and quantum algorithms (QAOA).

Research Intern Sep. 2022 - Feb. 2023
EdF Lab R&D Paris-Saclay

* Internship at the EdF (Électrité de France) R&D Laboratory of Paris-Saclay, at the OSIRIS (Optimisation Simulation Risques et Statistiques) departement.
* Development of a novel algorithmic framework, exploiting HPC architectures, targeted to a specific class of problems, using a family of iterative methods called Bundle methods.
* Mathematical modelling of the problem, with the theoretical development and analysis of a cooperating entity with multiple capabilities, enforcing collaboration between multiple algorithms.
* Theoretical extension of many existing Bundle methods with the aforementioned capabilities. C++ implementation and testing of the algorithmic framework on the Unit Commitment problem, showing timing improvement.

Research Fellow Apr. 2022 - Aug. 2022
University of Pisa

* Awarded of a fully funded scholarship by the Italian Ministry of Justice, in the context of an European project called "Giustizia Agile";
* Brought improvements to the law courts of Leghorn, Lucca and Pisa by improving the current ICT state-of-the-art, using novel technologies.
* Created an interactive webapp for storing/searching/visualize the different acts collected in the courts improving the old database-like system, by using the Flask framework of Python, HTML and Javascript for the website design and ElasticSearch for the search engine.
* Preliminary investigation of NLP techniques to analyze the different documents.

Teaching Assistant Multiple periods

University of Pisa

* Selected three times as teaching assistant by the Faculty Board of the Computer Science Department, for the practical lectures of "Fundamentals of Computer Science" and "Mobile Application Development" courses of the Bachelor's Degree in Computer Science.
* Provided help and feedback to the students improving their knowledge in the field, explaining them the basics of set operations, combinatorial math and graph theory.
* Created a simple application to let the students familiarize with Android development tools and correct implementation patterns, by using Android Studio framework and Kotlin language;

Research Intern Mar. 2020 - Jul. 2020

University of Pisa

Final project for my Bachelor's thesis. Developed a Machine Learning framework for classifying topics on StackOverflow, using theoretical aspects of Deep Learning, statistical Machine Learning and NLP method. Python implementation using the Tensorflow library.

Mobile App Developer Sep. 2019 - Mar. 2020

Omega Travel

* Developed a mobile application for the travel agency "Omega Travel" increasing the amount and profits of booked trips, using a proper software engineering approach, using the Flutter framework and coding everything in Dart language.

Projects

GoEmotions Jan. 2022 - Apr. 2022

Human Language Technologies course. Implementated different BERT-based models, training and testing them over the GoEmotions dataset, achieving F1 scoring w.r.t. the state-of-the-art, by using the Pytorch framework in Python, Colab/Kaggle machines and additional Python libraries.

Quadratic Disjoint Simplices Jul. 2021 - Dec. 2021

Computational Mathematics and Optimization course. Carried out a theoretical analysis of the ADAGRAD algorithm, then I implemented a solver for specific optimization problem, obtaining good timing and convergence results, using the Julia language.

Autonomous Driving Sept. 2021 - Dec. 2021

Team work for the "Eteam Squadra Corse" of the University of Pisa. Implemented part of an autonomous driving system for the "Formula Student" competition, covering the SLAM task to build the track, using Python/C++ language and the fundamentals of ROS (Robot Operating Systems).

Parallel Boruvka Sept. 2021 - Dec. 2021

Parallel and Distributed System course. Developed a parallel implementation of the "Boruvka algorithm", for finding the Minimum Spanning Tree of a given graph, achieving a good speedup. Exploiting an ad hoc data structure taylored for this problem ("Disjoint Sets"), C++ language and many of its funtionalities.

Smart Park May. 2021 - Jun. 2021

Developed an intelligent Smart park for bycicles, synchronizing bycicle locks smartly achieving good results in simulation of a crowded environment. The work was carried out using C and Python languages, by programming IoT sensors and a listening server for CoAP and MQTT.

Technical Skills

Subjects	Algorithms, Quantum Computing, Operations Research (OR), Reinforcement Learning (RL),
Languages	C++, Python, Julia, MATLAB, C, Java, Bash, Dart, Kotlin, MySQL
Software/Frameworks	CPLEX, Anaconda, Pytorch, Tensorflow, Git, QuTiP, ElasticSearch, ROS, Flutter, Android Studio, Flask

Languages

Italian	Mother tongue
English	Advanced
French	Intermediate