Curriculum Vitae

Bruno Costa Alves Freire

Nationality: Brazilian

Date of birth: June 12, 1998

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Education:

École Normale Supérieure (ENS) Paris-Saclay – Master MVA
City: Gif-sur-Yvette, France
Master's (M2) at the MVA (Mathematics, Vision, Learning) program - from September 2023 to September 2024
GPA: 4.00/4.00
Coursework: **Convex Optimization**, **Stopping Times and Online Algorithms**, **Probabilistic Graphical Models**, **Deep Learning for Signal Processing**, **Machine Learning for Time Series**, **Reinforcement Learning**, **Graphs in Machine Learning** and **Geometry and Shape Spaces**

École Polytechnique (l'X) – Cycle Ingénieur Polytechnicien
City: Palaiseau, France
Master's (M1) student in Applied Mathematics - from October 2020 to August 2023
GPA: 3.80/4.00
Was granted the *Fulgence Bienvenüe Scholarship* from the École Polytechnique Foundation (FX)
Coursework focused on Mathematics, Applied Mathematics, Computer Science and Physics

ITA - Instituto Tecnológico de Aeronáutica (Technological Institute of Aeronautics)
City: São José dos Campos, SP - Brazil
Undergraduate Student Aerospace Engineering - from March 2017 to August 2020 (incomplete)
GPA: 3.79/4.00
Entrance Examination at ITA:
Ranking: 13th out of 12.484 candidates
Score: 7.6525 out of 10

Pensi Colégio e Curso
City: Rio de Janeiro, RJ
Preparation for military institutes' entrance exams – from January 2016 to December 2016

IFF – Campus Bom Jesus (Fluminense Federal Institute)
City: Bom Jesus do Itabapoana, RJ
High School and Technician Course in Informatics – from February 2013 to January 2016

Professional experience:

Research Intern in ML/QEC – Inria (May/2024 – September/2024)

Worked in the COSMIQ team at Inria Paris. Proposed and conducted a research project on the application of Reinforcement Learning techniques to the optimization of Quantum Error Correction codes, specifically of **quantum LDPC codes**. Researched the existing literature on the subject, designed a framework for the optimization of **Hypergraph Product (HGP) codes** as a search-based optimization problem and implemented numerical simulation tools for the benchmarking of such codes using **C/C++**. Used **Python** to implement optimization techniques based on Simulated Annealing and Projective Simulation, resulting on the discovery of quantum codes with **over one order of magnitude lower** logical error rates under the quantum erasure channel, as compared to those obtained by classical ad hoc techniques, namely Progressive Edge Growth.

Machine Learning Research Intern – Huawei (April/2023 – August/2023)

Worked in the Advanced Wireless Technology (AWT) Lab, in Huawei Paris Research Center. Worked on the Semantic In-Network Learning framework, both formalizing parts of the framework and in the development of a semantic inference fusion experiment set in the context of autonomous navigation. By using the CARLA simulator and state-of-the-art Scene Graph Generation models, created a dataset for fine-tuning the model to urban traffic environments. Developed a distributed scene graph fusion pipeline based on the local semantic extraction modules, and a fusion center capable of detecting common objects with over 98% accuracy.

Site Reliability Engineering Intern – Google (June/2022 – September/2022)

Worked in the Capacity Agility Squad, associated to the Cloud Infrastructure. My task was to redesign the user interface for a new internal tool aimed at simulating usage scenarios for capacity management. I used **Golang**, **protocol buffers** and the **Goa** framework in order to integrate the new tool to team's debug environment, allowing for better diagnosis of capacity management issues.

Quantitative Research Intern – Giant Steps Capital (January/2020 – February/2020)

Implemented statistical models on stock market data using **Python** and **Pandas**, and tested investment strategies hypotheses, providing insight for further development of high frequency trading algorithms.

Computer Literacy:

Language	*Experience Level*	*Associated Courses*	*Projects*
C/C++	Upper Intermediate	Algorithms for Data Analysis in C++ (l'X); Algorithms and Data Structures I, II (ITA).	Parallel MST-based Clustering Algorithms (link);
Python	Upper Intermediate	All courses at MVA; Machine Learning courses (l'X); AI for Mobile Robotics (CT-213), Object-Oriented Programming (ITA).	Path Planning Algorithms for Self-Driving Vehicles (link); CT-213 course projects (link); ML Internship Project at Huawei; RL for QEC project at Inria (link)
Java	Intermediate	Mechanisms of Object-Oriented Programming (INF371) (l'X).	INF371 coursework (link)
Golang	Intermediate	-	SRE Internship Project at Google
MATLAB	Intermediate	Numerical Analysis, Control for Computer Systems (ITA).	Numerical Analysis coursework (link); Control Systems coursework (link)

Awards and Honors:

- International Mathematics Championship for University Students (IMC): *First Prize (Gold Medal)* in **2023, 2022, 2021** and **2020**, *Second Prize (Silver Medal)* in **2024**, **2019**. Ranked first amongst all Brazilian and French students in 2021. Competed four times for École Polytechnique and twice for ITA.
- Latin American and Caribbean University Physics Olympiad (OLUF): *Bronze Medals* in **2019** and **2018**;
- Brazilian Olympiad of Mathematics University Level (OBM-U): *Silver Medal* in **2020**, *Bronze Medals* in **2021, 2019** and **2018** and *Honorable Mention* in **2017**;
- Brazilian Olympiad of Informatics (OBI): *Honorable Mention* in **2015** (ranked 19th nationwide) and *Bronze Medal* in **2014** (ranked 15th nationwide);
- Brazilian Olympiad of Astronomy and Astronautics (OBA): *Gold Medal* in **2015** and *Bronze Medal* in **2014**;

Course related projects:

Introduction to the Thermodynamical Formalism – (PSC) (September/2021 – May/2022)

Starting from physical analogies, studied the construction of the formalism in a space of sequences over a finite set of states, leading to a generalization of the well-known Perron-Frobenius's Theorem by Ruelle. Next, studied the mathematical definitions for entropy and pressure, and applied the newly acquired techniques to some number theory problems.

Minimum Spanning Trees for Clustering Algorithms – (PI) (March/2022 – May/2022)

Studied and implemented sequential and parallel versions of the most well-known MST algorithms, such as Kruskal, Prim and Boruvka, in C++ using the *Message Passing Interface* library MPI, and then compared the performance of the MST-based algorithms with conventional clustering methods, such as *k-means*.

Path Planning Algorithms for Autonomous Vehicles (ITA) (August/2020 – December/2020)

Studied and implemented path planning algorithms, namely A* and RRT*, in Python.

Extracurricular activities:

Coding Competitions (2021 – Present)

I Regularly participate in coding competitions such as Google KickStart, Google CodeJam, Meta HackerCup and Codeforces rounds.

Scientific Initiation/Master Program in Mathematics - PICME (August/2017 – December/2019)

Scientific program aimed at students who won any award in the Brazilian Olympiads of Mathematics. I studied topics on Dynamical Systems and Fourier Analysis, and later I took 6 master's courses at UNIFESP, having achieved good academic performance. Among the courses were **Applied Linear Algebra, Analysis in R^n, Analysis on Manifolds, Nonlinear Optimization, Abstract Algebra,** and **General Topology.** Moreover, I also completed a master's summer course in **Introduction to Number Theory** at IMPA (National Institute for Pure and Applied Mathematics), having achieved good academic performance.

Languages:

French: Advanced (C2) | **English**: Advanced (C2) | **German**: Beginner | **Portuguese:** Native speaker