Research

My **thesis on fundamental artificial intelligence (AI)** resulted in **three journal and nine top-tier conference papers**, being seminal to my subsequent **Lectureships** in Brazil, where I worked **between 2016 and 2023** on **data science (DS)**, **AI**, and their impact on **socially relevant problems**:

- **I proposed and collaborated with applied DS projects with both the public and private sectors**. Partners included the **Brazilian Judicial Branch**, **Ministry of Education**, and **Public Safety Secretariats**, as well as **retail** and **energy companies**, e.g. **Neoenergia**, the Brazilian subsidiary of the Spanish utility company **Iberdrola**.
- **I supervised graduate students on theses involving deep and automated machine learning**, as well as the intersection of **multi-objective optimization** with other AI domains, such as **multi-dimensional visualization** and **dynamic optimization**. The quality of those theses is evidenced by the **10 conference and two journal papers** published as a result, including an **EMO best paper award nomination**.
- **I developed a deep concern for socially relevant problems**, having for instance **assisted in the fight against the COVID-19 pandemic through science publication and communication**. My Lectureships led to **contributions to policymaking in public health, law (enforcement), and higher education**, e.g. the revised and updated **Brazilian Standard Classification of Education** for census, evaluation, and regulation **sponsored by UNESCO**.

I relocated to the University of Stirling, UK in 2023, deepening my research focus on **assessing and addressing the social impacts of AI systems**:

- **I have joined a research consortium led by the University of Glasgow to propose methodologies and workbenches that enable stakeholders with diverse backgrounds to participate in AI harm auditing**. The consortium was awarded **£3.5 million by the Responsible AI Keystone Projects call funded by UKRI**. The project started in May 2024 and will last for 48 months. Importantly, the project currently has over **20 external partners** who will provide case studies and help devise and evaluate our AI harm auditing workbenches and methodologies.
- **I am applying for funding to promote a society where AI systems are fair, accountable, inclusive, responsible, transparent, ethical, carbon-neutral, and human-centred (FAIRTECH) by design.** To achieve this, I will:
  - structure an **Observatory of the Potentially Incurred Social Damage from Artificial Intelligence (PISD.ai)**, which will survey current (and future) relevant real-world examples where **the lack of appropriate AI regulation (potentially) incurs significant social damage.** A prototypical example is **the role of social media recommendation algorithms in disinformation** and its impact on **democracy, human rights, public health, and climate change**, and how this impact can be further **worsened by generative AI**.
  - survey the existing **AI regulation proposals** from major Western and non-Western democratic players, as well as **the legal, economical, and technical limitations for appropriate regulation**. Major player examples include **the European Union, the United Kingdom, the United States of America, Brazil, Chile, and Japan**.
  - propose **validation frameworks to assist AI regulators and policymakers** in their proposals and/or revisions. Examples include the **appropriate definition of artificial intelligence systems** to reduce the **risk of overregulation**.
  - structure an **educational framework** to promote a **FAIRTECH by design culture**, targeting government, academia, industry, and civil society more broadly. Relevant partners that have already demonstrated interest include the **Brazilian Computing Society**, **Brazilian Ministry of Human Rights and Citizenship**, and **Toyota Motor Europe**.

History

Appointments

2023- **Lecturer**, *University of Stirling*, Stirling, UK.

2017-2023 **Assistant professor**, *Federal University of Rio Grande do Norte*, Natal, RN, Brazil.

2016-2017 **Assistant professor**, *Federal University of Paraíba*, João Pessoa, PB, Brazil.

Awards

2024 **Keystone Project**, *Responsible AI UK* .

2024 **Research Culture Awards nomination**, *University of Stirling*.

2023 **Alain Bensoussan fellowship**, *European Research Consortium for Informatics and Mathematics (ERCIM)*.

2011-2016 **Ph.D. degree in Engineering and Technology**, *Université Libre de Bruxelles*, Brussels, Belgium.
A component-wise approach to multi-objective evolutionary algorithms: from flexible frameworks to automatic design

2011 **F.R.I.A doctoral fellowship**, *Fonds de la Recherche Scientifique (FNRS)*, Brussels, Belgium.

2009 **Best paper award**, *Brazilian Symposium on Augmented and Virtual Reality (SVR)*, Porto Alegre, Brazil.

Projects and funding

Proponent

2024-2028 **Participatory Harm Auditing Workbenches and Methodologies (PHAWM)**, *Responsible AI UK*, Southampton, UK, £3,500,000.00.

A significant barrier to reaping the benefits of predictive and generative AI is their unassessed potential for harms. Hence, AI auditing has become imperative, in line with existing and impending regulatory frameworks. Yet, AI auditing has been haphazard, unsystematic, and left solely in the hands of experts. Our project, bringing together a consortium of 7 academic institutions and 24 partner organisations, aims to fix this fundamental challenge through the novel concept of participatory AI auditing where a diverse set of stakeholders without a background in AI, such as domain experts, regulators, decision subjects and end-users, undertake audits of predictive and generative AI, either individually or collectively. Our research is grounded in four use cases: health, media content, cultural heritage and collaborative content generation. To enable stakeholders to carry out an audit, our project will produce workbenches that support them in assessing the quality and potential harms of AI. The participatory audits will be embedded in methodologies which guide how, when and who carries out these audits. We will further train stakeholders in carrying out participatory audits and work towards a certification framework for AI solutions.

2022-2023 **Technological innovation cell**, *Iberdrola Neoenergia COSERN*, Natal, RN, Brazil, R$359,234.61.

This project was a partnership with the energy distribution industry, comprising an innovation cell that includes applied research in design, development, and analytics. I was one of the proponents of the project, namely the lead investigator of the analytics team. Besides supervising talented students, another great aspect of the project is the continuous interaction with industry stakeholders and analysts, who were involved in the (bi)weekly activities. Over the course of 12 months, the analytics team delivered 12 products that used data science, artificial and computational intelligence techniques, namely prediction, simulation, optimization, and planning.

2020-2021 **Applied research and human resource education in hardware technologies for artificial intelligence**, *Huawei Telecommunications in Brazil*, São Paulo, SP, Brazil, R$455,375.00.

This project was a partnership with the telecommunications industry in the context of the Brazilian Informatics Law. Besides applied research involving specialized hardware and cloud infrastructure for artificial intelligence, the project also comprised an HCIA-AI certification training program. I was one of the proponents of the training program, having helped deliver machine and deep learning training with practical examples no computer vision for over 200 students during the COVID-19 pandemic.

2017-2018 **Revision and update of the Brazilian Standard Classification of Education (CINE Brasil 2018)**, *UNESCO & Brazilian Ministry of Education (MEC) – INEP, Brazil*, Brasília, DF, Brazil, R$1,000,000.00.

This project was a partnership with INEP, the federal institution associated with MEC that is responsible for (i) ENADE, the national higher education (HE) programme evaluation, and; (ii) the HE census. The census and now also ENADE adopt UNESCO's International Standard Classification of Education (ISCED), originally adapted for Brazil as Cine Brasil 2000. The goal of this project was to propose a 2018 revised and updated release of Cine Brasil. In this context, I helped (i) diagnose the most pressing issues and (ii) propose and implement the changes and updates needed. More importantly, I helped revise the classification of over 80,000 HE programmes in Brazil, a challenging practical data science task. In addition, the broad range of Brazilian HE programmes required a diverse and multi-disciplinary team, which I helped integrate from data science and information technology perspectives.

2011-2015 **Generalization of metaheuristics for optimization problems with three or more objectives**, *Fonds de la Recherche Scientifique (FNRS)*, Brussels, Belgium, €100,000.00.

I proposed and delivered this research project that was the topic of my PhD work. The original proposal focused on extending originally bi-objective metaheuristic algorithms such as ant colony optimization (MOACO) and two-phase local search (TPLS). Upon a literature review, we pivoted to multi-objective evolutionary algorithms (MOEAs), the most relevant multi-objective optimization community given their contributions. More importantly, the literature on MOEAs provided a rich scenario for the adoption of automated algorithm engineering, an approach that had recently proved successful with MOACO and TPLS. As a result, the project delivered three journal publications and nine top-tier conference papers, all of which have had significant impact in the MOEA community.

Collaborator

2023-2024 **Information technology postgraduate apprenticeship (class of 2024)**, *5th Region Federal Regional Court (TRF5)*, Recife, PE, Brazil, R$3,500,891.11.

2021-2023 **Information technology postgraduate apprenticeship (class of 2023)**, *5th Region Federal Regional Court (TRF5)*, Recife, PE, Brazil, R$2,816,840.00.

These postgraduate apprenticeships are hosted in partnership with the Brazilian Judicial Branch, specifically the 5th Region Federal Regional Court (TRF5). In detail, TRF5 is the federal court responsible for overseeing the courts from six different states in the Northeast region of Brazil (and revising their decisions thereof). In the apprenticeships, graduate students comprise applied research teams that work in the partnering institution and are supervised by investigators from the university. I helped supervise the business intelligence teams in the class of 2023, which delivered for instance a heuristic monitor of repetitive (and possibly predatory) use of the justice system. The success of the projects delivered is evidenced by the novel apprenticeship class of 2024, which I also help supervise.

2017-2018 **SmartMetropolis**, *Multiple local and national government branches*, RN, Brazil, R$3,609,907.74.

This project proposes smart city solutions in partnership with local and national government branches. The project started in 2015 and is still ongoing, and during 2017 and 2018 I helped supervise students working in partnership with the Public Security Secretariat of Rio Grande do Norte (SSP-RN). Among other solutions, the applied research team I worked with delivered a criminal occurrence prediction system, improving insight availability for patrol planning. Importantly, this solution was originally developed by an undergraduate student who later wrote his dissertation on the topic and from follow-up collaborations was able to secure funding for his current PhD research overseas.

2015-2016 **Combinatorial optimization: metaheuristics and exact methods (COMEX)**, *Belgian Federal Science Policy Office (BELSPO)*, Brussels, Belgium, €500,000.00.

This project was funded by the Belgian government as a means to integrate the different research groups in Belgian universities that worked with similar topics. In this context, the COMEX project gathered researchers working with combinational optimization, metaheuristics, and exact methods. The project was instrumental to introduce me to the Belgian research network on these topics, and also as a means to fund the final year of my PhD work.

Key⋆ and relevant publications

disclaimer *An exhaustive publication list with full author description is provided at the end of the document.*

Journals (5)

⋆2021 **A computational study on ant colony optimization for the traveling salesman problem with dynamic demands**, *Computers & Operations Research*, Elsevier.

This paper was the main contribution from the first Ph.D. thesis I co-supervised, and demonstrates how multi-objective and dynamic optimization intersect. The relevance of this paper is evidenced by its best paper award nomination at the EMO 2019 conference, where a preliminary version of the journal paper was first published. In addition, this paper is a concrete example of how I bridge different research topics into multi-disciplinary work.

⋆2021 **Comparing community mobility reduction between first and second COVID-19 waves**, *Transport Policy*, Elsevier.

This paper was the main contribution of my efforts in science publication and communication to assist in the fight against the COVID-19 pandemic. Indeed, the first author of this paper is one of the undergraduate students that I helped mobilize in those initiatives. The relevance of this paper is evidenced by the number of different continents and COVID-19 waves included in the assessment. In addition, this paper is a concrete example of how I use computational intelligence in the context of socially relevant problems.

⋆2020 **Automatically designing state-of-the-art multi-and many-objective evolutionary algorithms**, *MIT Evolutionary Computation Journal*, MIT Press.

⋆2018 **A large-scale experimental evaluation of high-performing multi-and many-objective evolutionary algorithms**, *MIT Evolutionary Computation Journal*, MIT Press.

⋆2016 **Automatic component-wise design of multiobjective evolutionary algorithms**, *IEEE Transactions on Evolutionary Computation*, IEEE.

These papers comprise the contributions of my Ph.D. thesis, having been accepted for publication prior to my defense or shortly after. Their relevance is evidenced by their ongoing impact on the evolutionary computation community, one of the most important in the context of AI, and by the rigorous journals where they were published. More importantly, these papers demonstrate how I am able to plan and deliver on a research project. In detail, each paper meets an specific objective of my thesis proposal, incrementally achieving the general objective of the project.

Conference papers (11)

2022 **High school timetabling at a federal educational institute in Brazil**, *IEEE WCCI*.

2022 **Retail sales forecasting for a Brazilian supermarket chain: an empirical assessment**, *IEEE CBI*.

2022 **Supermarket customer segmentation: a case study in a large Brazilian retail chain**, *IEEE CBI*.

2018 **Time-series features for predictive policing**, *IEEE ISC2*.

2018 **Towards a crime hotspot detection framework for patrol planning**, *IEEE SmartCity*.

These papers comprise the contributions of data science Masters' theses I (co-)supervised in partnership with public and private institutions. The relevance of these papers is evidenced by the socially relevant scenarios they address. In detail, the first paper focuses on the Brazilian Federal Network of Vocational, Scientific and Technological Education, which provides education to over two million students, with over half of the students that declared income, gender, and ethnicity coming from low income families, being women, and self-declaring as non-white. The remainder 2022 papers use AI techniques to model different business processes in the 3rd largest retail supermarket chain in the Northeast of Brazil, and is instrumental to assess the impact of the COVID-19 pandemic in the industry. Finally, the 2018 papers address predictive policing to assist the local government in the forecasting of criminal occurrences.

2021 **Evaluating anytime performance on NAS-Bench-101**, *IEEE CEC*.

⋆2021 **iSklearn: automated machine learning with irace**, *IEEE CEC*.

2021 **Comparing contextual embeddings for semantic textual similarity in Portuguese**, *BRACIS*.

These papers are the contributions of Masters' theses I supervised in deep and automated machine learning. The relevance of these papers is evidenced by the state-of-the-art techniques that were employed. In addition, the application domains considered are among the most relevant that use unstructured data, namely computer vision, natural language processing, and time series forecasting. Importantly, these papers demonstrate that I understand the technological complexity of current state-of-the-art AI models, their potential impact on society, and therefore their need for accountability.

2021 **Revisiting Pareto-optimal multi-and many-objective reference fronts for continuous optimization**, *IEEE CEC*.

⋆2019 **Archiver effects on the performance of state-of-the-art multi-and many-objective evolutionary algorithms**, *GECCO*.

⋆2017 **An empirical assessment of the properties of inverted generational distance on multi-and many-objective optimization**, *EMO*.

These papers comprise follow-up works on my Ph.D. thesis. The relevance of these papers is evidenced by their ongoing impact on the evolutionary computation community, as well as the conferences where they were published, which are among the top-tier venues in their field. More importantly, these papers are a concrete example that the work I conducted in my Ph.D. was seminal to relevant future work. In addition, they demonstrate that I understand that seeking autonomy as an independent researcher does not mean discontinuing previous research.

Communication

talk **FAIRTECH by design: assessing and addressing the social impacts of artificial intelligence**

2024 *Aerospace Centre of Excellence*, University of Strathclyde, UK

2024 *Chair for Artificial Intelligence Methodologies (AIM)*, RWTH Aachen University, Germany

2024 *Advanced Technology R&D Division*, Toyota Motor Europe, Belgium

2024 *IRIDIA Artificial Intelligence Lab*, Université Libre de Bruxelles (ULB), Belgium

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talk **Promoting and sustaining accountability in artificial intelligence applications**

2024 *Computing Science and Mathematics (CSM) Public Lectures*, University of Stirling, UK

2024 *Data Science Institute (DSI)*, London School of Economics and Political Sciences (LSE), UK

2024 *Information, Data, and Analysis (IDA) Section*, University of Glasgow, UK

2024 *Software Systems Engineering (SSE) Group*, University College London (UCL), UK

2023 *Computing Science and Mathematics (CSM) Seminars*, University of Stirling, UK

2023 *Aston Centre for Artificial Intelligence Research and Applications (ACAIRA)*, Aston University, UK

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workshop **Brazilian Standard Classification of Education (Cine Brasil 2018)**

2018 *Cine Brasil stakeholder training programme*, Brazilian Ministry of Education - INEP, Brazil

2018 *Cine Brasil stakeholder training programme*, Federal University of Ceará (UFC), Brazil

2018 *Cine Brasil stakeholder training programme*, Federal University of São Paulo (Unifesp), Brazil

2018 *Cine Brasil stakeholder training programme*, Federal University of Rio Grande do Norte (UFRN), Brazil

2018 *Computing Education Workshop (WEI@CSBC)*, Brazilian Computing Society Congress, Brazil

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workshop **AutoML with Python - machine learning made easy(ish)**

2018 *Python Brasil[14]*

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talk **A component-wise approach to multi-objective evolutionary algorithms: from flexible frameworks to automatic design**

2018 *Institute of Informatics*, Federal University of Rio Grande do Sul (UFRGS), Brazil

2018 *Centre of Informatics*, Federal University of Paraíba (UFPB), Brazil

2016 *Department of Automatic Control and Systems Engineering*, University of Sheffield, UK

2016 *IRIDIA Artificial Intelligence Lab*, Université Libre de Bruxelles (ULB), Belgium

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workshop **A practical introduction to irace**

2015 *Experimental Algorithms Lab*, Federal University of Rio Grande do Norte (UFRN), Brazil

2014 *IRIDIA Artificial Intelligence Lab*, Université Libre de Bruxelles (ULB), Belgium

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workshop **Automatic Generation of Multi-Objective ACO Algorithms for the Biobjective Knapsack**

2012 *Lakeside Labs*, Alpen-Adria-Universität Klagenfurt, Austria

Languages

Portuguese	**Fluent**	*Mother language*
English	**Fluent**	*TOEFL iBT Score 108*
Spanish	**Fluent**	*European Union Reference Level C1*
French	**Intermediate**	*European Union Reference Level B1*
Italian	**Intermediate**	*European Union Reference Level B1*

Teaching

My Lecturer positions have provided me with the opportunity to help (re)formulate different educational programmes (undergraduate and postgraduate) and supervise talented undergraduate, postgraduate apprenticeship, and Masters' students. I have also successfully co-supervised a PhD student, since I was not allowed to be a main PhD supervisor yet. Importantly, I have helped propose artificial intelligence (AI) and data science (DS) tracks for both the undergraduate and Masters' programmes, as well as a novel professional doctorate programme in information technology (IT). Finally, I have taken a proactive approach to learning, having designed and delivered 19 different course modules, which can be broadly categorized into computational thinking (ranging from abstract data types to coding interview preparation) and AI/DS (with a focus on non-programmers). All of these course modules were designed with an emphasis on self-taught learning, which made them ideal for the COVID-19 pandemic period (and online learning thereof). In addition to having published a book chapter about the methodology I have employed, I have also partnered with Huawei Telecommunications in Brazil to provide an HCIA-AI deep learning certificate training which was offered online.

Educational programmes

Academic post-graduate programmes

2023- **Artificial intelligence**, *MSc*, University of Stirling, United Kingdom.

2023- **Big data**, *MSc*, University of Stirling, United Kingdom.

2023- **Data science and mathematics**, *MSc*, University of Stirling, United Kingdom.

2022- **Systems and computing**, *DSc*, UFRN, Brazil.

2022- **Systems and computing**, *2-year MSc*, UFRN, Brazil.

I have helped the reformulation of these programmes in at least three important ways, though I have joined them recently. First, I helped merge two research lines that were similar in their topics, namely artificial intelligence and heuristic optimization. This merge reflects the current joint efforts observed in these research fields, and have helped update the programmes to match this trend. Second, I have proposed a policy framework to increase the international visibility of the programmes, particularly regarding dual degrees. Finally, I have proposed means for working students to pursue an MSc or a DSc degree, given that the number of students willing to enroll full-time in the programmes is very reduced. In detail, I have proposed alternative funding opportunities for students, as the official funding efforts from the government are not competitive with current IT market standards. In addition, I have proposed alternative course schedules, which were previously validated with industrial partners. Altogether, these improvements are expected to help the programmes establish themselves internationally in the near future.

Professional post-graduate programmes

Proponent **Information technology**, *Doctorate*, UFRN, Brazil.

2019-2021 **Information technology**, *Masters*, UFRN, Brazil.

2018-2019 **Software engineering**, *Masters*, UFRN, Brazil.

I was invited to join the professional Masters on Software Engineering at the end of 2017, in an effort to restructure and evolve the programme. I helped significantly reformulate the programme in at least three different ways. First, I helped the programme expand to a professional Masters on Information Technology, including two novel research lines, namely (i) computational intelligence (AI/DS) and (ii) IT infrastructure. Second, I helped increase the number of lecturers in the programme, as a result of (i) assessing the publications and deliverables records of the existing lecturers; (ii) identifying the key weaknesses the programme had to address, and; (iii) coordinating the recruitment process. Third, these contributions enabled the programme to be eligible for a professional doctorate programme, which I helped propose and was recently approved by the university.

Postgraduate apprenticeship

2021-2024 **Information technology**, *5th Region Federal Regional Court (TRF5)*, Recife, PE, Brazil.

2018-2024 **Information technology**, *Federal Justice Section of Rio Grande do Norte (JFRN)*, Natal, RN, Brazil.

2018-2024 **Information technology**, *Regional Electoral Court of Rio Grande do Norte (TRE-RN)*, Natal, RN, Brazil.

2019-2021 **Information technology**, *Court of Accounts of Rio Grande do Norte (TCE-RN)*, Natal, RN, Brazil.

I have designed and delivered course modules for postgraduate apprenticeships in partnership with different branches of the Brazilian Judicial Branch. In most of the apprenticeships, I have also supervised students regarding their final project. More importantly, I have been one of the supervisors for the business intelligence, AI, and DS projects that were carried throughout the apprenticeship that was hosted by the most recent partner, the 5th Region Federal Regional Court (TRF5). This was the first apprenticeship where activities were carried online, in order to reflect the geographically distributed nature of the partner. Results exceeded expectations and led to the second round of the apprenticeship, for which I am also one of the project supervisors.

Undergratuate

2017- **Information technology**, *BSc*, UFRN, Brazil.

2017- **Computer science**, *BSc*, UFRN, Brazil.

2017- **Computer engineering**, *BEng*, UFRN, Brazil.

I have been lectured courses for these three, intertwined undergraduate programmes for over six years. In detail, the two initial years of these programmes share a common curriculum, which focuses on computer programming and mathematics. In this context, I have helped (re-)formulate the computer programming part of the shared curriculum, recasting it to a broader focus on problem-solving through computational thinking. The substantial changes I helped propose have made the curriculum more practical, up-to-date, and engaging for students, with also a deeper knowledge of algorithmic techniques, programming paradigms, and software development. Currently, my focus has been on stirring a novel branch in the shared curriculum, dedicated to the intersection between IT and society. Specifically, my goal is to help the curriculum promote student awareness regarding the problems in society that IT might help solve or create, as well as how to antecipate and respond to them. A second, important way in which I have helped reformulate the BSc in IT was the proposal of the DS and AI tracks, which are certified minors that students can enroll during their undergraduate studies. These proposals were both strategical and timely, as the demand in students with expertise on these topics from projects and the market surged over the past years.

2016-2017 **Mathematical computing**, *BSc*, UFPB, Brazil.

2016-2017 **Computer science**, *BSc*, UFPB, Brazil.

2016-2017 **Computer engineering**, *BEng*, UFPB, Brazil.

Course modules

Computational thinking

2023- **Abstract data types**, *BSc in Information technology, BSc in Computer science, BEng in Software engineering*, UFRN, Brazil.

2017- **Algorithms and data structures**, *BSc in Information technology, BSc in Computer science, BEng in Software engineering*, UFRN, Brazil.

I helped (re-)design and deliver these modules on abstract data types, algorithms, and data structures. In detail, the original course curriculum only comprised example algorithms and data structures, and had an above 50% failure rate. Two modifications helped change this scenario, as follows. First, introducing abstract data types and their applications prior to the data structures used to implement them significantly improved student engagement and awareness of the importance of data structures. Second, introducing iterative and recursive algorithmic techniques rather than algorithm examples (such as sorting) improved student understanding of how to implement efficient solutions, and therefore data structures. The success rate of the course after theses changes often surpasses 75%, in part due also to student evaluation, which is performed via tutorials as well as coding interviews and exercises. Indeed, the success of the revised module led to the creation of the abstract data types independent module, and the material used for the course is now publicly available as a GitHub repository.

2023- **Fundamentals of multi-paradigm, high-level software development**, *BSc in Information technology, BSc in Computer science, BEng in Software engineering*, UFRN, Brazil.

2017-2018 **Programming languages**, *BSc in Information technology, BSc in Computer science, BEng in Software engineering*, UFRN, Brazil.

I helped (re-)design and deliver these modules on the fundamentals of software development using multiple programming paradigms and high-level programming languages. In detail, the original course curriculum (i) only comprised computer programming, disregarding critical software development fundamentals such as testing, versioning, and deployment; (ii) only adopted the procedural and object-oriented programming paradigms, both from purist perspectives, and; (iii) adopted low-level programming languages. Altogether, these factors hindered student engagement as courses were seen as unrealistic, leading to an above 50% failure rate. Introducing software development fundamentals, how to benefit from multiple programming paradigms, and adopting high-level languages comprise a significant improvement that raised the success rate of students to above 75%.

2020- **Fluent Python development**, *Graduate apprenticeship*, GERTEC Commercial and Banking Automation Technology, São Paulo, SP, Brazil.

This course was provided in the scope of a graduate apprenticeship programme sponsored by the private sector. I designed and delivered this course as a collection of valuable insights, tutorials, and lessons made available by the Python community, the most emblematic being the Fluent Python book by Luciano Ramalho. Part of the lessons used in this course are now publicly available as a GitHub repository.

2019- **Coding interview preparation**, *BSc in Information technology, BSc in Computer science, BEng in Software engineering*, UFRN, Brazil.

2018- **Algorithms and data structures**, *MSc in Information technology*, UFRN, Brazil.

I (re-)designed and delivered these modules on coding interviewing, which were created to help students prepare for real-world job interviews. The modules comprise coding interview problems and practice, allowing students to learn the most common techniques and abilities required in this type of scenario. For undergraduate courses, the module also comprises invited talks from alumni who have extensive experience in the industry (and interviewing), as well as invited recruiters from companies. These modules are very important and timely, as shortly after their first editions the demand for information technology professionals surged as a function of the COVID-19 pandemic.

2018- **Computational thinking**, *BSc in Information technology, BSc in Computer science, BEng in Software engineering*, UFRN, Brazil.

I helped design and deliver this introductory module on computational thinking. In detail, the original course curriculum introduced computer programming using a low-level textual programming language, hindering the problem-solving learning ability of the students and leading to an above 50% failure rate. Conversely, this module introduces computational thinking from a gamified visual programming perspective, which later evolves to high-level textual programming. Using these approaches, the course is able to focus on problem-solving through computational thinking, and the success rate of this module is often above 75%.

2016-2017 **Algorithm design and analysis**, *BSc in Computer science, BEng in Computer engineering*, UFPB, Brazil.

2016-2017 **Graph applications**, *BSc in Mathematical computing*, UFPB, Brazil.

2016-2017 **The scientific method**, *BSc in Mathematical computing*, UFPB, Brazil.

I helped redesign and deliver these courses at the Federal University of Paraíba (UFPB) to better address the needs of the students enrolled in the university undergraduate programmes. In detail, the course on algorithm analysis and heuristic optimization for computer science and engineering students was originally designed with a strong emphasis on theory, under the assumption that students did not present well-developed programming abilities. Yet, results when the original theoretical approach was combined with a practical perspective were exceptional, with students delivering final projects that were outstanding. Similarly, the mathematical computing curriculum only included graph theory, lacking the study of graph applications. Finally, the course on the scientific method was timely to counter the then incipient anti-science campaigns that would later significantly impact Brazil.

Artificial intelligence & Data science

UFRN **Unsupervised learning for time series analysis**, *Postgraduate apprenticeship in Information technology*.

UFRN **Deep learning for natural language processing**, *Postgraduate apprenticeship in Information technology*.

UFRN **MLOps**, *Postgraduate apprenticeship in Information technology*.

UFRN **Chatbots**, *Postgraduate apprenticeship in Information technology*.

Huawei **Deep learning for computer vision**, *HCIA-AI certificate training program*.

I helped formulate and deliver these modules on practically relevant machine learning techniques, domains, and applications which were offered in partnership with the public and private sector. Concerning the public sector, the modules were offered to complement the existing postgraduate apprenticeship curriculum, as follows. First, the traditional curriculum does not include more specific topics such as time series analysis, chatbots, nor MLOps. Second, these modules helped meet the timely needs of the institutions that sponsored the postgraduate apprenticeships. Regarding the private sector, the partnership with Huawei for certificate training enabled hundreds of students to study online with no tuition costs during the COVID-19 pandemic. Importantly, the students who got certified at the end of the course were strategically positioned to land jobs with the company of their choosing.

UFRN **Data-driven decision making**, *Federal Justice Section of Rio Grande do Norte (JFRN)*.

This course was provided in the scope of a continuing education programme sponsored by the public sector, namely the Brazilian Judicial Branch. I designed and delivered this course as a combination of (i) the data science for non-programmers course, which I designed and deliver yearly, and; (ii) my expertise on multi-decision criteria making, acquired over the years of my research career. Importantly, the audience enrolled in this course was mostly from social sciences, humanities, and health sciences, and so the successful results of the course serve as strong validation of the IT-agnostic methodology adopted.

UFRN **Data mining**, *Postgraduate apprenticeship in Information technology*.

UFRN **Data science**, *MSc in Systems and computing, MSc in Information technology, BSc in Information technology*.

UFRN **Machine learning**, *BSc in Information technology*.

I designed and delivered these course modules on data science, data mining, and machine learning to help prepare students for the increasing industrial and academic demand on these topics. Importantly, these modules where designed so that they can be delivered at different levels of education and for students with different levels of IT proficiency. Indeed, the modules have been offered a total 14 times over the past four academic years, evidencing the strong demand for this skill set. The modules adopt the project-based learning methodology, where external collaborators propose topics and act as stakeholders throughout the modules. This approach allows students to understand the whole data science and machine learning process, starting at the formulation of relevant questions and ending with the communication of relevant insights. The active and IT-agnostic methodology proposed for these modules was published as a chapter in a book organized by the LISA international network for statistical learning, and the material used in the courses are freely available as public GitHub repositories.

Educational objects

2020 **scikit-zero**, *Machine learning before programming*, Editor, GitHub.

2020 **pandas-zero**, *Data science before programming*, Editor, GitHub.

2020 **ds-zero**, *Data science before prediction*, Organizer, GitHub.

2019 **leetcode-hero**, *Abstract data types and algorithmic techniques to solve programming interview problems*, Organizer, GitHub.

2019 **python-tads**, *Abstract data types with Python*, Organizer, GitHub.

2019 **pensamento-computacional**, *Unplugged computational thinking*, Creator, GitHub.

2018 **python-hero**, *Learning the Zen of Python from the community*, Organizer, GitHub.

2018 **python-zero**, *Computational thinking with Python*, Creator, GitHub.

Supervision

Undergraduate (final year)

2021 **Comparing contextual embeddings for the semantic textual similarity in Portuguese**, *BEng in Computer engineering*, José Estevam de Andrade Junior, UFRN, Brazil.

2021 **Assessing irace for automated machine learning**, *BSc in Computer science*, Carlos Eduardo Morais Vieira, UFRN, Brazil.

2019 **Using artificial intelligence to aid depression detection**, *BEng in Computer engineering*, Deângela Caroline Gomes Neves, UFRN, Brazil.

Postgraduate apprenticeship

2021 **Municipal revenue at the Rio Grande do Norte state**, *Information technology*, Paulo Roberto Oliveira de Melo, Court of Accounts of Rio Grande do Norte, UFRN, Brazil.

2020 **A data-driven approach to aid payment auditing in the Court of Accounts of the State of Rio Grande do Norte**, *Information technology*, Gabriel Felipe Azevedo de Sousa, Court of Accounts of Rio Grande do Norte, UFRN, Brazil.

2020 **Business intelligence to aid electoral accounts auditing in Rio Grande do Norte**, *Information technology*, Giuliard Cosmo Rodrigues, Regional Electoral Court of Rio Grande do Norte, UFRN, Brazil.

2020 **Workflow management tool review for ETL orchestration at TRE-RN**, *Information technology*, Thiago de Oliveira, Regional Electoral Court of Rio Grande do Norte (TRE-RN), UFRN, Brazil.

2-year MSc

2021 **A case study on customer segmentation of a supermarket chain**, *Supervisor*, Wellerson V. Oliveira, Information technology, UFRN, Brazil.

2021 **Sales forecasting for a supermarket chain in Natal, Brazil: an empirical assessment**, *Supervisor*, Fernanda M. de Almeida, Information technology, UFRN, Brazil.

2021 **Assessing irace for automated machine and deep learning in computer vision**, *Supervisor*, Carlos E. M. Vieira, Information technology, UFRN, Brazil.

2018 **A metaheuristic approach to the high school timetabling problem at IFRN**, *Supervisor*, Lucas H. A. Dantas, Systems and computing, UFRN, Brazil.

2018 **Predspot: predicting crime hotspots with machine learning**, *Co-supervisor*, Adelson D. de Araújo Júnior, Systems and computing, UFRN, Brazil.

Doctorate

2022 **Design configuration for the MMAS algorithm applied to the travelling salesman problem with dynamic demands**, *Co-supervisor*, Sabrina M. de Oliveira, Computational mathematical modeling, Federal Center of Technological Education of Minas Gerais (CEFET-MG), Brazil.

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