Leonardo C. T. Bezerra

My thesis on **computational intelligence (CI)** was seminal to my current research on **data science (DS)**, **artificial intelligence (AI)**, and their impact on **socially relevant problems**. Concerning DS, I supervise applied research projects with both the public and private sectors. Partners include the Brazilian Judicial Branch and Ministry of Education, as well as regional, national, and multi-national companies in fields as diverse as retail, telecommunications, and energy. Regarding AI, I supervise graduate students on theses involving deep and automated machine learning, as well as the intersection of multi-objective optimization with other CI domains, such as multi-dimensional visualization and dynamic optimization. Finally, regarding socially relevant problems, I have assisted in the fight against the COVID-19 pandemic through science publication and communication, in attempt to counter the intensive disinformation campaign held in Brazil.

History

Appointments

2017- **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

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

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

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

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

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

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

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

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

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

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*, h-index: 160.
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.

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2021 **Comparing community mobility reduction between first and second COVID-19 waves**, *Transport Policy*, h-index: 103.

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*, h-index: 84.

⋆2018 **A large-scale experimental evaluation of high-performing multi-and many-objective evolutionary algorithms**, *MIT Evolutionary Computation Journal*, h-index: 84.

⋆2016 **Automatic component-wise design of multiobjective evolutionary algorithms**, *IEEE Transactions on Evolutionary Computation*, h-index: 186.

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 CI, 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 M.Sc. 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 M.Sc. 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.

Supervision

Master's

2021 **A case study on customer segmentation of a supermarket chain**, *M.Sc. thesis supervisor*, Wellerson V. Oliveira, Information technology, Federal University of Rio Grande do Norte (UFRN), Brazil.

2021 **Sales forecasting for a supermarket chain in Natal, Brazil: an empirical assessment**, *M.Sc. thesis supervisor*, Fernanda M. de Almeida, Information technology, Federal University of Rio Grande do Norte (UFRN), Brazil.

2021 **Assessing irace for automated machine and deep learning in computer vision**, *M.Sc. thesis supervisor*, Carlos E. M. Vieira, Information technology, Federal University of Rio Grande do Norte (UFRN), Brazil.

2018 **Uma abordagem metaheurística para o problema de alocação de horário escolar no IFRN**, *M.Sc. thesis supervisor*, Lucas H. A. Dantas, Systems and computing, Federal University of Rio Grande do Norte (UFRN), Brazil.

2018 **Predizendo hotspots criminais com aprendizado de máquina**, *M.Sc. thesis co-supervisor*, Adelson D. de Araújo Júnior, Systems and computing, Federal University of Rio Grande do Norte (UFRN), Brazil.

Doctorate

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

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*

Publication list

Journals

Gabriela Cavalcante da Silva, Fernanda Monteiro de Almeida, Sabrina M. de Oliveira, Elizabeth F. Wanner, Leonardo C. T. Bezerra, Ricardo H.C. Takahashi, and Luciana Lima. Comparing community mobility reduction between first and second COVID-19 waves. *Transport Policy*, 112:114–124, 2021.

Sabrina M. de Oliveira, Leonardo C. T. Bezerra, Thomas Stützle, Marco Dorigo, Elizabeth F. Wanner, and Sérgio R. de Souza. A computational study on ant colony optimization for the traveling salesman problem with dynamic demands. *Computers & Operations Research*, 135:105359, 2021.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. Automatically designing state-of-the-art multi- and many-objective evolutionary algorithms. *Evolutionary Computation*, 28(2):195–226, 2019.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. A large-scale experimental evaluation of high-performing multi- and many-objective evolutionary algorithms. *Evolutionary Computation*, 26(4):621–656, 2018.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. Automatic component-wise design of multi-objective evolutionary algorithms. *IEEE Transactions on Evolutionary Computation*, 20:403–417, 2016.

Leonardo C. T. Bezerra, Elizabeth F. G. Goldbarg, Luciana S. Buriol, and Marco C. Goldbarg. Analyzing the impact of MOACO components: An algorithmic study on the multi-objective shortest path problem. *Expert Systems with Applications*, 40:345–355, 2013.

Book chapters

Marcus A. Nunes, Leonardo C. T. Bezerra, M. O. Adenomon, and T. V. Marques. New approaches to statistical learning in developing countries. In Olushina Olawale Awe, Kim Love, and Eric A. Vance, editors, *Promoting Statistical Practice and Collaboration in Developing Countries*. Taylor & Francis, 2022.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. Automatic configuration of multi-objective optimizers and multi-objective configuration. In P. Korošec et al., editors, *High-Performance Simulation Based Optimization*, Studies in Computational Intelligence, pages 69–92. Springer International Publishing, 2020.

Conference proceedings

Lucas H. A. Dantas, Romerito C. Andrade, and Leonardo C. T. Bezerra. High school timetabling at a federal educational institute in brazil. In *2022 IEEE Congress on Evolutionary Computation (CEC)*, pages 1–8, 2022.

Fernanda M. De Almeida, Allan M. Martins, Marcus A. Nunes, and Leonardo C. T. Bezerra. Retail sales forecasting for a brazilian supermarket chain: an empirical assessment. In *2022 IEEE 24th Conference on Business Informatics (CBI)*, volume 01, pages 60–69, 2022.

Wellerson V. Oliveira, Daniel S.A. Araújo, and Leonardo C. T. Bezerra. Supermarket customer segmentation: a case study in a large brazilian retail chain. In *2022 IEEE 24th Conference on Business Informatics (CBI)*, volume 01, pages 70–79, 2022.

José E. Andrade Junior, Jonathan Cardoso-Silva, and Leonardo C. T. Bezerra. Comparing contextual embeddings for semantic textual similarity in portuguese. In André Britto and Karina Valdivia Delgado, editors, *Brazilian Conference on Intelligent Systems (BRACIS 2021)*, pages 389–404, Cham, 2021. Springer International Publishing.

Gabriela Cavalcante da Silva, Elizabeth F. Wanner, Leonardo C. T. Bezerra, and Thomas Stützle. Revisiting pareto-optimal multi- and many-objective reference fronts for continuous optimization. In *2021 IEEE Congress on Evolutionary Computation (CEC)*, pages 1171–1178, 2021.

Carlos Vieira, Leslie Pérez Cáceres, and Leonardo C. T. Bezerra. Evaluating anytime performance on nas-bench-101. In *2021 IEEE Congress on Evolutionary Computation (CEC)*, pages 1249–1256, 2021.

Carlos Vieira, Adelson de Araújo, José E. Andrade, and Leonardo C. T. Bezerra. isklearn: automated machine learning with irace. In *2021 IEEE Congress on Evolutionary Computation (CEC)*, pages 2354–2361, 2021.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. Archiver effects on the performance of state-of-the-art multi- and many-objective evolutionary algorithms. In *Proceedings of the Genetic and Evolutionary Computation Conference*, GECCO '19, page 620–628, New York, NY, USA, 2019. Association for Computing Machinery.

Sabrina Oliveira, Elizabeth F. Wanner, Sérgio R. de Souza, Leonardo C. T. Bezerra, and Thomas Stützle. The hypervolume indicator as a performance measure in dynamic optimization. In Kalyanmoy Deb, Erik Goodman, Carlos A. Coello Coello, Kathrin Klamroth, Kaisa Miettinen, Sanaz Mostaghim, and Patrick Reed, editors, *Evolutionary Multi-Criterion Optimization*, pages 319–331, Cham, 2019. Springer International Publishing.

Adelson Araújo, Nélio Cacho, Leonardo C. T. Bezerra, Carlos Vieira, and Julio Borges. Towards a crime hotspot detection framework for patrol planning. In *2018 IEEE 20th International Conference on High Performance Computing and Communications; IEEE 16th International Conference on Smart City; IEEE 4th International Conference on Data Science and Systems (HPCC/SmartCity/DSS)*, pages 1256–1263, 2018.

Julio Borges, Daniel Ziehr, Michael Beigl, N. Cacho, A. Martins, A. Araujo, Leonardo C. T. Bezerra, and Simon Geisler. Time-series features for predictive policing. In *2018 IEEE International Smart Cities Conference (ISC2)*, pages 1–8, 2018.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. An empirical assessment of the properties of inverted generational distance on multi- and many-objective optimization. In H. Trautmann

et al., editors, *Evolutionary Multi-Criterion Optimization (EMO 2017)*, volume 10173 of *Lecture Notes in Computer Science*, pages 31–45. Springer International Publishing, 2017.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. Comparing decomposition-based and automatically component-wise designed multi-objective evolutionary algorithms. In A. Gaspar-Cunha et al., editors, *Evolutionary Multi-Criterion Optimization (EMO 2015)*, volume 9018 of *Lecture Notes in Computer Science*, pages 396–410. Springer International Publishing, 2015.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. To DE or not to DE? Multi-objective differential evolution revisited from a component-wise perspective. In A. Gaspar-Cunha et al., editors, *Evolutionary Multi-Criterion Optimization (EMO 2015)*, volume 9018 of *Lecture Notes in Computer Science*, pages 48–63. Springer International Publishing, 2015.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. Automatic design of evolutionary algorithms for multi-objective combinatorial optimization. In Thomas Bartz-Beielstein, Jürgen Branke, Bogdan Filipič, and Jim Smith, editors, *Parallel Problem Solving from Nature – PPSN XIII*, volume 8672 of *Lecture Notes in Computer Science*, pages 508–517. Springer International Publishing, 2014.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. Deconstructing multi-objective evolutionary algorithms: an iterative analysis on the permutation flowshop problem. In Panos M. Pardalos, Mauricio G.C. Resende, Chrysafis Vogiatzis, and Jose L. Walteros, editors, *Learning and Intelligent Optimization (LION 2014)*, volume 8426 of *Lecture Notes in Computer Science*, pages 157–172. Springer International Publishing, 2014.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. An analysis of local search for the bi-objective bidimensional knapsack problem. In Martin Middendorf and Christian Blum, editors, *Evolutionary Computation in Combinatorial Optimization (EvoCOP 2013)*, volume 7832 of *Lecture Notes in Computer Science*, pages 85–96. Springer Berlin Heidelberg, 2013.

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. Automatic generation of multi-objective ACO algorithms for the bi-objective knapsack. In M. Dorigo et al., editors, *Swarm Intelligence (ANTS 2012)*, volume 7461 of *Lecture Notes in Computer Science*, pages 37–48. Springer-Verlag, 2012.

Leonardo C. T. Bezerra, Elizabeth F. G. Goldbarg, Luciana S. Buriol, and Marco C. Goldbarg. GRACE: A generational randomized ACO for the multiobjective shortest path problem. In R. H. C. Takahashi et al., editors, *Evolutionary Multi-Criterion Optimization (EMO 2011)*, volume 6576 of *Lecture Notes in Computer Science*. Springer, 2011.

Wagner Schmitt, Leonardo César Teonácio Bezerra, Luciana Salete Buriol, Elizabeth Ferreira Gouvêa Goldbarg, Marco César Goldbarg, and Marcus Ritt. Um estudo experimental do problem de caminhos mínimos multiobjetivo. In *Anais do XLIII Simpósio Brasileiro de Pesquisa Operacional (SBPO 2011)*, Ubatuba, SP, 2011. SBC.

Selan R. dos Santos, Leonardo C. T. Bezerra, Silvano Malfatti, and Antonino A. Feitosa Neto. FAITH: A desktop virtual reality system for fingerspelling. In *Proceedings of the XI Symposium on Virtual and Augmented Reality (SVR 2009)*, Porto Alegre, RS, 2009. SBC. Best full paper award.