Lucas Emanuel Resck

Personal Information

Full name: Lucas Emanuel Resck Domingues
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My research interests are **Machine Learning** (ML), **Natural Language Processing** (NLP), and **Explainable Artificial Intelligence** (XAI). I am particularly interested in improving the degree of explainability of ML and NLP models.

Education

2022–present **MSc, Mathematical Modeling**
Fundação Getulio Vargas

2018–2021 **BSc, Applied Mathematics**
Fundação Getulio Vargas
GPA: 3.86/4.0 — 1st in class, 9.66/10.0, lowest passing grade of 6

2015–2017 **Technical Education, Mechatronics**
Federal Center for Technological Education of Minas Gerais (CEFET-MG), Brazil

Research Experience

2020–present **Visual Data Science Lab**
Fundação Getulio Vargas
Master's and Undergraduate Researcher
Supervisor: Jorge Poco

Design of a novel explainer for GNN node classification

- "Distill n' Explain" (**AISTATS 2023**) first distills the original GNN into an interpretable one and then explains the latter.
- Designed and proved lemmas and theorems that guarantee the method's explanation faithfulness.
- The proposed explainer outperformed previous methods in explanation accuracy while being orders of magnitude faster.

Development of a visual analytics system to explore citations in legal documents

- "LegalVis" (**TVCG 2023**, **VIS 2022**, BSc Thesis) employs ML, NLP, XAI, and data visualization to infer non-explicit citations in Brazilian legal documents.
- Tested a diverse set of NLP classifiers (Transformers, word embeddings, and bag-of-words) and achieved high accuracy (96%) in identifying citations.
- Employed a model-agnostic explainer (LIME) to explain the inferred citations.

2022 **Vision, Language, and Learning Lab**
Rice University, Houston, USA
Visiting Scholar (3 months)
Supervisor: Vicente Ordóñez
Explored training data attribution methods, e.g., influence functions, and ways to improve them. This activity continued after the visit.

2016–2017 **Federal Center for Technological Education of Minas Gerais**
High School Researcher Fellow and Volunteer

- Circuits for driving low power direct current motors (Fellow)
- Brazilian Robotics Olympiad (OBR) 2016, Practical Modality (Volunteer)

Publications

Conferences

1. Tamara Pereira, Erik Nascimento, **Lucas E. Resck**, Diego Mesquita, and Amauri Souza. Distill n' Explain: explaining graph neural networks using simple surrogates. In *International Conference on Artificial Intelligence and Statistics (**AISTATS**)*, April 2023. URL: https://proceedings.mlr.press/v206/pereira23a.html

Journal Publications

1. **Lucas E. Resck**, Jean R. Ponciano, Luis Gustavo Nonato, and Jorge Poco. LegalVis: Exploring and Inferring Precedent Citations in Legal Documents. *Transactions on Visualization and Computer Graphics (**TVCG**)*, 29(6), June 2023. Presented at Visualization and Visual Analytics (**VIS**) 2022. URL: https://doi.org/10.1109/TVCG.2022.3152450

Theses

1. **Lucas Emanuel Resck Domingues**. *Inferring and Explaining Potential Citations to Binding Precedents in Brazilian Supreme Court Decisions*. BSc thesis, Fundação Getulio Vargas, Rio de Janeiro, Brazil, December 2021. URL: https://hdl.handle.net/10438/31845

Technical Reports

1. **Lucas Emanuel Resck Domingues** and Júlia Gandini Blahun. Circuits for Driving Low Power Direct Current Motors. High school research project report, Federal Center for Technological Education of Minas Gerais, Varginha, Brazil, 2018
2. Júlia Gandini Blahun, Luiza de Souza Pinto Regina, and **Lucas Emanuel Resck Domingues**. Brazilian Robotics Olympiad – OBR'2016, Level II Practical Modality. High school research project report, Federal Center for Technological Education of Minas Gerais, Varginha, Brazil, 2016

Contributions to Other Papers

1. Beatriz Sabdin Chagas, Carla Marcondes Damian, and Raphäel Tinarrage. The Impact of the Súmula Vinculante 26 on the Decrease of Similar Demands at the STF: a Quantitative Analysis With Machine Learning Models. Chile, October 2022. URL: https://raphaeltinarrage.github.io/files/Paper_CONPEDI_Quantitativa.pdf
2. Ana Clara Macedo Jaccoud, Pedro Burlini de Oliveira, and Raphäel Tinarrage. Regime Progression for Heinous Crimes in Brazilian Supreme Court (STF): an Empirical Analysis of Súmula Vinculante 26. Chile, October 2022. URL: https://raphaeltinarrage.github.io/files/Paper_CONPEDI_Empirica.pdf

Other/Ongoing Research Projects

All projects are in the context of the Visual Data Science Lab at Fundação Getulio Vargas.

2023–present **Training Data Attribution**. Recent project on the exploration of methods to attribute model predictions to training data. Investigation of the intersection of attribution, data-modeling, and machine unlearning. Publications are expected in 2024.

2023–present **Legal Language Models and Topological Data Analysis**. Recent project on the exploration of the intersection between NLP and topological data analysis in legal documents.

2022–present **"LegalAnalytics" project**. Application of ML, NLP, XAI, and visualization methods for the creation of the LegalAnalytics system to assist judicial experts in the application of understandings from the Brazilian Supreme Court. Publications are expected in 2024.

2021–present **Exploring Human Annotations to Improve NLP Model Explanations**. This project is my MSc thesis. Paper is under review at ACL Rolling Review and its publication is expected in 2024.

2021–present **Machine Learning and Súmulas Vinculantes**. Exploration of computational methods, especially ML, NLP, and topological data analysis, in legal documents that cite Brazilian binding precedents ("Súmulas Vinculantes"). The project also explored the annotation of legal documents by experts. Resulted in Contributions to Other Papers 1 and 2. Other publications, as a co-author, are expected in 2024.

Teaching Experience

2023 **Fundação Getulio Vargas**
Professor of Introduction to Programming in a Web Systems Development course.

2020–2021 **Fundação Getulio Vargas**
Teaching assistant of Ordinary Differential Equations, Calculus in Several Variables, and Calculus in One Variable.

Professional Experience

12/2019–02/2020 **EloGroup**
Summer Intern in Data Science
Conducted time series analysis, exploratory data analysis, sanity checks on databases, and data preprocessing.

01/2019–02/2019 **PSR Power Systems Research**
Summer Intern in Optimization
Developed and implemented optimization models for maintenance schedules and dispatch of power plants, utilizing Julia and optimization packages.

Honors, Awards, & Scholarships

2022–present MSc scholarship holder at Fundação Getulio Vargas (FGV). Tuition fee and monthly stipend.

2023 Invited speaker at Colégio União, Três Corações, Brazil. Presentation "How the mathematics olympiads transformed my life" to motivate students, at the invitation of professor Aguinaldo Borba.

2022–2023 Scholarship (tuition fee) holder in the Graduate Support Program for Private Education Institutions (PROSUP) of the Coordination for the Improvement of Higher Education Personnel (CAPES).

2022 Academic distinguished undergraduate award. Ranked 1st in my undergraduate class at FGV. Recognition of academic excellence (grades and research).

2018–2021 Scholarship holder in the Undergraduate Research and Master's Program (PICME). This was possible because of mathematical olympiads medals before college. I had the opportunity to start research and take graduate courses during my undergraduate studies, while receiving a scholarship.

2018–2021 Selected by the Talent Selection program from the Center for the Development of Mathematics and Sciences (CDMC) of FGV. BSc scholarship holder (tuition fee and monthly stipend). I was selected based on my performance in mathematical olympiads and in the entrance exam.

2017 1st place at FGV's entrance exam in Applied Mathematics (out of 24 candidates).

2017 Scholarship holder at CEFET-MG and the National Council for Scientific and Technological Development (CNPq) in the High School Research Fellowship.

2012–2017 Brazilian Public School Mathematics Olympiad (OBMEP). Gold (1 medal), silver (3), and bronze (1) medals, and honorable mention (1).

2012–2017 Brazilian Astronomy and Astronautics Olympiad (OBA). Silver (2) and bronze (1) medals.

Languages and Skills

Languages: Portuguese (native) and English (advanced). TOEFL iBT 112, 30 reading/listening, 26 speaking/writing.

ML Frameworks: PyTorch, scikit-learn, HuggingFace Transformers, TensorFlow, Keras.

Programming Languages: Python, C++, Julia, R, MATLAB/Scilab, LaTeX.

Technologies: Git, Pandas, NumPy, Linux.

Volunteering

2018–2019 Treasurer at the Academic Directory of Applied Mathematics at FGV.

2018 Support team member at the International Congress of Mathematicians 2018, in Brazil, hosted by the Brazilian Institute for Pure and Applied Mathematics (IMPA).

Events, Schools, & Workshops Attended

2024 Tropical Probabilistic AI School 2024 at FGV. Presentation of a poster of my MSc work.

2023 Seminar for Postgraduate Students at the School of Applied Mathematics of FGV (SEPEMAp). Presentation of my MSc work.

2023 XLII Brazilian Congress of Applied and Computational Mathematics (CNMAC 2023) in Bonito, Brazil.

2023 Latin American Congress on Industrial and Applied Mathematics (LACIAM) 2023 at FGV.

2023 Summer School on Data Science at FGV.

2022 IEEE VIS: Visualization & Visual Analytics 2022 in Oklahoma City, USA. Presentation of **LegalVis** paper.

2022 8th Workshop on Mathematical Solutions for Industrial Problems at the Research Center in Mathematics Applied to Industry (CeMEAI) at the University of São Paulo.

2018 International Congress of Mathematicians (ICM) 2018 in Rio de Janeiro, Brazil.

2016 High school research course (Mentores) in mathematics (plane analytical geometry) for medalists of OBMEP. Scholarship holder at CNPq.

2013–2015 High School Research Program (PIC-Jr) in mathematics for medalists of OBMEP. Scholarship holder at CNPq.

Rio de Janeiro, Brazil, February 3, 2024