Willian T. Lunardi

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Education

University of Luxembourg — Luxembourg City, Luxembourg
Doctor of Philosophy (Ph.D.) in Computer Science — 2020
Recipient of the Excellent Thesis Award for outstanding research.

PUC of Rio Grande do Sul — Porto Alegre, Brazil
Master of Science (M.Sc.) in Computer Science — 2016
Recipient of two scholarships from Dell in recognition of academic excellence.

University of Passo Fundo — RS, Brazil
Bachelor of Science (B.Sc.) in Computer Science — 2014
Recipient of a full scholarship and an undergraduate research scholarship in recognition of academic excellence.

Research Experience

Technology Innovation Institute — Dubai, United Arab Emirates
Senior Machine Learning Researcher — Jun 2021 – Present

- Developed adversarial/contrastive deep learning approaches for learning representations for one-class classification and anomaly detection, applied to on network security, jamming detection, and radio frequency fingerprinting.
- Designed and implemented an adversarial approach for traffic anomaly detection in network traffic, which was successfully deployed on embedded devices. This research was published in the prestigious IEEE Transactions on Network and Service Management journal.
- Generated a new dataset for jamming detection based on a new jamming approach developed in-house, and validated it using classical machine learning approaches as well as rule-based policies. Successfully deployed the developed jamming detection and jamming avoidance methods on embedded devices.
- Conducting ongoing research on one-class classification approaches for radio frequency fingerprinting, which enable the authentication of devices such as drones and other aerial vehicles based on their radio fingerprints.
- Conducting ongoing research on reinforcement learning approaches and one-class classification methods for improved jamming detection and jamming avoidance performance.

University of Luxembourg — Luxembourg City, Luxembourg
Research Associate — Jun 2020 – Jun 2021

- Developed Neural Combinatorial Optimization approaches, leveraging the power of graph neural networks and reinforcement learning to learn effective heuristics for solving a set of optimization problems.
- Developed neighborhood functions and metaheuristics for a complex vehicle routing problem, which involved optimizing the routing and scheduling of delivery vehicles subject to covering and energy constraints.
- Successfully deployed parallel C++ scheduling and vehicle routing algorithms in an industrial environment for a European-wide company based in Germany, leading to significant improvements in efficiency and productivity.
- Contributed to multiple research projects, collaborating with team members and external partners to design and implement novel optimization algorithms and mathematical models.
- Mentored and supervised graduate students and junior researchers, providing guidance on methodology, technical skills, and scientific writing.

University of Luxembourg — Luxembourg City, Luxembourg
Doctoral Researcher — Jun 2016 – Jun 2020

- As a paid Doctoral Researcher at the University of Luxembourg, developed novel MILP and CP models for an industrial scheduling problem with complex availability, overlapping, and sequence-dependent setup constraints.
- Developed novel optimization algorithms achieving state-of-the-art results for well-known scheduling problems, as evidenced by publications in more than 10 international scientific conferences and journals, including the European Journal of Operational Research and Computer & Operations Research.
- Collaborated with European-wide companies to deploy and validate the proposed models in practice, leading to significant improvements in production capacity and revenue for several companies.

Skills

- Strong background in machine learning and deep learning, including neural networks, convolutional neural networks, recurrent neural networks, generative models, and reinforcement learning.
- Knowledge of mathematical optimization techniques, including convex and non-convex optimization, integer programming, mixed-integer programming, constraint programming, and metaheuristics.
- Proficient in programming languages such as Python, C++, C#, Java, and Javascript, with experience developing and deploying machine learning models and algorithms.
- Experience with machine learning frameworks such as PyTorch, and Scikit-Learn, as well as libraries such as NumPy, Pandas, and SciPy.
- Familiarity with software development tools and practices, including version control (Git), continuous integration, and containerization (Docker).
- Strong problem-solving skills and ability to analyze complex data and derive meaningful insights.

Additional Information

Dual Citizenship: Brazil and Italy.

Languages: Portuguese (native), English (fluent), Spanish (basic), and Italian (basic).

Programming Languages: Python, C++, Javascript, C#, and Java.

ML Libraries and Frameworks: Pytorch, Scikit-Learn, Numpy, SciPy, among others.

Additional Libraries: OpenMP, Boost (C++), Unity 3D (C#), p5js (JS), processing (Java).

Interests: Video games, Electric Guitar, Gym, and Kayak Fishing.

Personal Projects

Adversarial Training for Anomaly Detection: Developed an adversarial training strategy using WGAN and SSIM loss to improve the performance of convolutional autoencoders for anomaly detection. Evaluated the model on benchmark and real-world datasets, achieving near-perfect F1-scores on most malware and 99% on attacks with only two packets as input. With five packets as input, the model can detect DDoS attacks with an F1-score of 91%.

Multi-variate Time Series Jamming Detection: Developed a jamming detection system based on multivariate time series analysis using SepConv and GRU models, achieving over 99% accuracy. Implemented custom time series augmentations such as RandomCropResize, Time Warp, and Window Warp, and deployed the model on a Raspberry Pi after quantization.

Olympic Games Event Recognition: Used state-of-the-art image models such as EfficientNetV2 to achieve 99% accuracy in recognizing Olympic Games events from images. Implemented well-known image augmentations such as MixUp, CutMix, Hybrids, AutoAugment, RandAugment, and TrivialAugment, and state-of-the-art training recipes.

Semi-supervised Anomaly Detection: Applied the Deep SVDD approach to a custom dataset generated using the p5js data generator for semi-supervised anomaly detection. Evaluated the resilience of the method to corruption resulting from mislabeling anomalies as normal and measured its performance as the number of correctly labeled anomalies increased.

Data Generator for Machine Learning: Created a p5js data generator that allows users to generate data by drawing with a mouse on a canvas. Several shortcuts can be used to define different data types, and the data is saved for use in machine learning applications.

Procedural Placement of Triangles: Implemented a procedural placement of transparent triangles to resemble a target painting. Used gradient-free optimizers such as Differential Evolution and Parameter-exploring Policy Gradients with clipped updates to minimize the mean squared error between the drawing and target painting.

Visualization of Metaheuristic Behavior: Developed a p5js project for visualizing the behavior of single-solution metaheuristics on well-known functions such as the Cross-In-Tray Function and Ackley Function.