Willian T. Lunardi

AI Research Scientist at TII

Tel: +971-55-191-4491 – Email: wtlunar@gmail.com
Homepage: https://wtlunar.com/

Education

University of Luxembourg — Luxembourg
Ph.D. in Computer Science (highest distinction with thesis award) — 2016 – 2020

Pontifical Catholic University of Rio Grande do Sul — RS, Brazil
M.Sc. in Computer Science — 2014 – 2016

University of Passo Fundo — RS, Brazil
B.Sc. in Computer Science — 2010 – 2014

Professional Experience

Research Scientist — Jun 2021 – Present
Technology Innovation Institute — Abu Dhabi, UAE

Principal Researcher — Jan 2023 – Present

- Drove research in AI safety, image segmentation, graph regression, out-of-distribution (OOD) detection, and anomaly detection, with emphasis on developing novel models and advancing the state of the art.
- Worked closely with academic partners on joint research projects, shaping technical direction, co-authoring publications, and aligning efforts with a shared long-term vision.
- Built and deployed ML systems that translated research into practical applications.

Senior Researcher — Jun 2021 – Jan 2023

- Conducted research in OOD detection, anomaly detection, and AI safety.
- Worked on significant projects such as:
  - Designing contrastive learning methods to enhance in-distribution representation learning.
  - Implementing adversarial training techniques for robust anomaly detection.
  - Developing angular-based voice verification models optimized synthetic outlier strategies.
- Optimized machine learning models for deployment on resource-constrained devices.
- Collaborated with cross-disciplinary teams to design and implement AI systems.

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

- Conducted research in neural combinatorial optimization, focusing on solving logistical challenges and optimization problems in industrial applications.
- Designed and implemented models for predictive maintenance, improving fault detection
- Participated in interdisciplinary projects, working closely with industry stakeholders to translate research findings into practical solutions for optimization and predictive maintenance.

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

- Specialized in combinatorial optimization by developing innovative models for scheduling optimization and solving advanced problems under multiple constraints.
- Published research in top-tier journals and conferences, contributing to advancements in optimization and operations research.
- Collaborated with academic and industry partners to apply theoretical models to real-world problems, gaining practical experience in translational research.
- Explored and implemented neural combinatorial optimization methods, investigating their potential for scheduling and logistics challenges.

Selected Projects

Learning In-Distribution Representations for Anomaly Detection (FIRM)

- Proposed and developed a novel contrastive learning objective in PyTorch for in-distribution representation learning, implementing multiple losses (NT-Xent, SupCon, FIRM) from scratch
- Created custom augmentations for defect and semantic anomaly detection, enhancing in-distribution representation and synthetic outlier separation
- Achieved state-of-the-art semantic anomaly detection on CIFAR-10, CIFAR-100, FMNIST, and Cats-vs-Dogs, as well as defect anomaly detection on the MVTec Anomaly Detection Dataset.
- ML Libraries: PyTorch, Pandas, NumPy, PIL, SciPy, Scikit-learn

Sequence Modeling for Syscall Trace Classification

- Implemented large language models (BERT, RoBERTa) to classify syscall traces, using token-based processing and sequence modeling for anomaly detection
- Built and evaluated GNN and transformer-based models to analyze syscall patterns, achieving high accuracy on ADFA-LD dataset
- ML Libraries: PyTorch, Transformers, Scikit-learn

Lightweight Deep Anomaly Detection for Network Traffic

- Built LDPI for real-time anomaly detection in network traffic using 1D ResNets and BERT for resource-limited environments Deployed on Jetson AGX Xavier and Raspberry Pi devices
- Implemented SimCLR pretraining and Deep SAD fine-tuning for unsupervised detection, with flexibility for RNN and transformer encoders
- ML Libraries: Python, PyTorch, Scikit-learn, Transformers

Technical Skills

Languages: Python, C++, Javascript, C#, and Java
Libraries and Frameworks: PyTorch, Transformers, PyTorch Geometric, Torchaudio, Torchvision, PyTorch Lightning, Scikit-learn, SciPy, Numpy, Pandas, tsai, Matplotlib, Plotly, Seaborn, Albumentations, Optuna
Others: OpenMP, Boost (C++), Unity 3D (C#), p5js (JS), processing (Java)

Additional Information

Dual Citizenship: Brazil and Italy
Languages: Portuguese (native), English (fluent)

Selected Publications

[2024] M. Lau, H. Wang, A. Helbling, *et al.*, "Non-Robust Features are Not Always Useful in One-Class Classification," *arXiv preprint arXiv:2407.06372*, 2024.

[2024] M. Andreoni, **W. T. Lunardi**, G. Lawton, *et al.*, "Enhancing Autonomous System Security and Resilience with Generative AI: A Comprehensive Survey," *IEEE Access*, 2024.

[2024] A. S. Ali, G. Singh, **W. T. Lunardi**, *et al.*, "RF Jamming Dataset: A Wireless Spectral Scan Approach for Malicious Interference Detection," *IEEE Communications Magazine*, 2024.

[2023] **W. T. Lunardi**, M. A. Lopez, and J.-P. Giacalone, "ARCADE: Adversarially Regularized Convolutional Autoencoder for Network Anomaly Detection," *IEEE Transactions on Network and Service Management, Special Issue on Machine Learning and Artificial Intelligence*, vol. 20, no. 2, pp. 1305–1318, 2023, [URL].

[2023] M. Gallacher, M. A. Sankar, **W. T. Lunardi**, *et al.*, "Towards speaker identification on resource-constrained embedded devices," in *Proceedings of the ACM Conference on Embedded Networked Sensor Systems*, 2023, [URL].

[2023] D. Herzalla, **W. T. Lunardi**, and M. Andreoni, "TII-SSRC-23 Dataset: Typological Exploration of Diverse Traffic Patterns for Intrusion Detection," *IEEE Access*, 2023, [URL].

[2022] A. R. B. Nabila, E. K. Viegas, and **W. T. Lunardi**, "A Generative Adversarial Network-based Attack for Audio-based Condition Monitoring Systems," in *Proceedings of the IEEE Consumer Communications & Networking Conference*, 2022, [URL].

[2022] A. S. Ali, **W. T. Lunardi**, L. Bariah, *et al.*, "Deep Reinforcement Learning Based Anti-Jamming Using Clear Channel Assessment Information in a Cognitive Radio Environment," in *Proceedings of the IEEE International Conference on Advanced Communication Technologies and Networking*, 2022, [URL].

[2022] A. S. Ali, M. Baddeley, L. Bariah, *et al.*, "JamRF: Performance Analysis, Evaluation, and Implementation of RF Jamming Over Wi-Fi," *IEEE Access*, vol. 10, pp. 133 370–133 384, 2022, [URL].

[2022] A. S. Ali, M. Baddeley, L. Bariah, *et al.*, "Performance Analysis and Evaluation of RF Jamming in IoT Networks," in *Proceedings of the IEEE Global Communications Conference*, 2022, [URL].

[2021] **W. T. Lunardi**, E. G. Birgin, D. P. Ronconi, *et al.*, "Metaheuristics for the Online Printing Shop Scheduling Problem," *European Journal of Operational Research*, vol. 293, no. 2, pp. 419–441, 2021, [URL].

[2021] M. A. Lopez, M. Baddeley, **W. T. Lunardi**, *et al.*, "Towards Secure Wireless Mesh Networks for UAV Swarm Connectivity: Current Threats, Research, and Opportunities," in *Proceedings of the IEEE International Conference on Distributed Computing in Sensor Systems*, 2021, [URL].

[2020] **W. T. Lunardi**, E. G. Birgin, P. Laborie, *et al.*, "Mixed Integer Linear Programming and Constraint Programming Models for the Online Printing Shop Scheduling Problem," *Computers & Operations Research*, vol. 123, p. 105 020, 2020, [URL].

[2019] **W. T. Lunardi**, H. Voos, and L. H. Cherri, "An Effective Hybrid Imperialist Competitive Algorithm and Tabu Search for an Extended Flexible Job Shop Scheduling Problem," in *Proceedings of the ACM Symposium on Applied Computing*, 2019, [URL].

[2019] H. de Faria Jr, **W. T. Lunardi**, and H. Voos, "A Parallel Multi-Population Biased Random-Key Genetic Algorithm for Electric Distribution Network Reconfiguration," in *Proceedings of the ACM Genetic and Evolutionary Computation Conference*, 2019, [URL].

[2018] **W. T. Lunardi** and H. Voos, "An Extended Flexible Job Shop Scheduling Problem with Parallel Operations," *ACM SIGAPP Applied Computing Review*, vol. 18, no. 2, pp. 46–56, 2018, [URL].

[2018] **W. T. Lunardi**, H. Voos, and L. H. Cherri, "An Imperialist Competitive Algorithm for a Real-World Flexible Job Shop Scheduling Problem," in *Proceedings of the IEEE International Conference on Emerging Technologies & Factory Automation*, 2018, [URL].

[2018] **W. T. Lunardi**, L. H. Cherri, and H. Voos, "A Mathematical Model and a Firefly Algorithm for an Extended Flexible Job Shop Problem with Availability Constraints," in *Proceedings of the Springer International Conference on Artificial Intelligence and Soft Computing*, 2018, [URL].

[2018] **W. T. Lunardi** and H. Voos, "Comparative Study of Genetic and Discrete Firefly Algorithm for Combinatorial Optimization," in *Proceedings of the ACM Annual Symposium on Applied Computing*, 2018, [URL].

[2016] **W. T. Lunardi**, L. Amaral, S. Marczak, *et al.*, "Automated Decision Support IoT Framework," in *Proceedings of the IEEE International Conference on Emerging Technologies & Factory Automation*, 2016, [URL].

[2016] L. A. Amaral, E. De Matos, R. T. Tiburski, *et al.*, "Middleware Technology for IoT Systems: Challenges and Perspectives Toward 5G," in *Internet of Things (IoT) in 5G Mobile Technologies*. Springer, 2016, pp. 333–367, [URL].

[2015] E. de Matos, L. A. Amaral, R. Tiburski, *et al.*, "Context-Aware System for Information Services Provision in the Internet of Things," in *Proceedings of the IEEE Conference on Emerging Technologies & Factory Automation*, 2015, [URL].

[2015] **W. T. Lunardi**, E. de Matos, R. Tiburski, *et al.*, "Context-Based Search Engine for Industrial IoT: Discovery, Search, Selection, and Usage of Devices," in *Proceedings of the IEEE Conference on Emerging Technologies & Factory Automation*, 2015, [URL].

Work in Progress & Submitted Publications

[2024] **W. T. Lunardi**, D. Herzalla, and M. L. Andreoni, "Anonymized due to Double-Blind Review," 2024, Submitted to ICLR 2025.

[2024] **W. T. Lunardi**, S. Shrestha, and M. L. Andreoni, "Hierarchical Contrastive Learning of Time Series for Out-of-Distribution Detection with Outlier Exposure," 2024, Work in progress.

[2024] M. Gallacher, **W. T. Lunardi**, C. A. Boano, *et al.*, "Out-of-Set Speaker Identification on Resource-Constrained Embedded Systems," 2024, Work in progress.