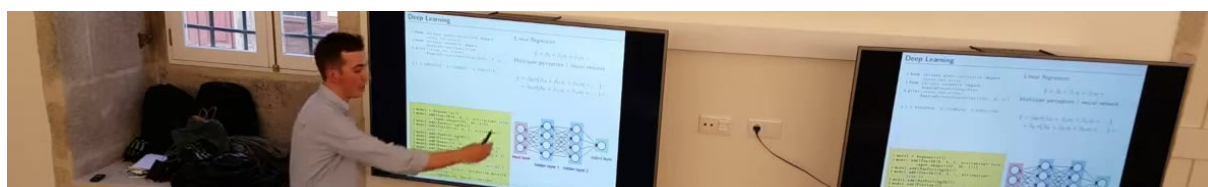# Ricardo Cruz, PhD

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I enjoy a good challenge. From mathematics to computer science, from research to engineering, from health applications to autonomous driving, I have been applying, proposing and teaching data science and artificial intelligence.

SKILLS: Python · C · C++ · Java · R · MATLAB · PyTorch · TensorFlow · OpenCV · SQL · Git

🎓 EDUCATION

2016–2021	**Ph.D. in Computer Science**	
	Joint Degree: University of Porto, Minho and Aveiro	
2013–2015	**MSc in Mathematical Engineering**	
	University of Porto (FCUP)	
2009–2012	**BSc in Computer Science**	
	University of Porto (FCUP)	

💼 EMPLOYMENT

2021–ongoing — **Autonomous Driving Post-Doc Researcher**
University of Porto (FEUP)
- Collaboration between the University of Porto and Bosch Car Multimedia to improve autonomous driving perception
- Frameworks developed for object detection using camera and LiDAR (2D discretization and raw point-clouds)
- Published new methods for efficient semantic segmentation and ordinal regression
- Supervised six master's theses, four bachelor's projects, and other team members
- Responsible for the HPC infrastructure (using Slurm)

2015–2021 — *6 years* — **Machine Learning and Computer Vision Researcher**
INESC TEC
- Research focus: re-thinking fundamentals about image classification and semantic segmentation (8+ publications)
- Some highlights: (1) a method for background invariance using adversarial training, (2) new losses that minimize absolute trade-offs between Type 1 and 2 errors instead of relative trade-offs, (3) using backpropagation also for inference to refine existing outputs, (4) deploying learning-to-rank methods for class imbalance
- Contributed to workshops, Summer School on Computer Vision (VISUM), and other events
- Twice awarded "outstanding recognition" for organizing workshops and helping with the HPC infrastructure

2014 — *6 months* — **Mathematical Modelling Research**
Mathematics Center of the University of Porto (CMUP)
- Epidemiological models for HIV. A little of everything: from differential equations to stochastic simulations to cellular automata.

⛨ Teaching

2021–2022 *1 year*	**Invited Auxiliary Professor (∼3h/week)** University of Porto (FEUP) • Programming Fundamentals (Python) [L.EIC] • Programming (C/C++) [L.EIC] • Data Structures and Algorithms (C/C++) [L.EEC]
2018–2021 *3 years*	**Invited Teacher Assistant (∼3h/week)** University of Porto (FEUP) • Programming Fundamentals (Python) [L.EIC] • Programming (C/C++) [L.EIC]

🗐 Publications

2023	**Two-Stage Framework for Faster Semantic Segmentation** 🔗 R. Cruz, D. Silva, T. Gonçalves, D. Carneiro, J. Cardoso. MDPI Sensors.
2023	**Rethinking Low-Cost Microscopy Workflow: Image Enhancement using Deep Based Extended Depth of Field Methods** 🔗 T. Albuquerque, L. Rosado, R. Cruz, M. Vasconcelos, T. Oliveira, J. Cardoso. Elsevier Intelligent Systems with Applications.
2022	**Two-stage Semantic Segmentation in Neural Networks** 🔗 R. Cruz, D. Silva, T. Gonçalves, D. Carneiro. Proceedings of the Fifteenth International Conference on Machine Vision (ICMV 2022).
2022	**Quasi-Unimodal Distributions for Ordinal Classification** 🔗 T. Albuquerque, R. Cruz, J. Cardoso. MDPI Mathematics.
2021	**Ordinal Losses for Classification of Cervical Cancer Risk** 🔗 T. Albuquerque, R. Cruz, J. Cardoso. PeerJ Computer Science.
2021	**Background Invariance by Adversarial Learning** 🔗 R. Cruz, R. Prates, E. Filho, J. Costa, J. Cardoso. IEEE 25th International Conference on Pattern Recognition (ICPR).
2019	**Automatic Augmentation by Hill Climbing** 🔗 R. Cruz, J. Costa, J. Cardoso. Springer 28th International Conference on Artificial Neural Networks (ICANN).
2019	**Averse Deep Semantic Segmentation** 🔗 R. Cruz, J. Costa, J. Cardoso. IEEE 41st Engineering in Medicine and Biology Conference (EMBC).
2019	**Insulator visual non-conformity detection in overhead power distribution lines using deep learning** 🔗 R. Prates, R. Cruz, A. Marotta, R. Ramos, E. Filho, J. Cardoso. Springer Journal Computers & Electrical Engineering.
2018	**A Class Imbalance Ordinal Method for Alzheimer's Disease Classification** 🔗 R. Cruz, M. Silveira, J. Cardoso. IEEE International Workshop on Pattern Recognition in Neuroimaging (PRNI)
2018	**Binary ranking for ordinal class imbalance** 🔗 R. Cruz, K. Fernandes, J. Costa, M. Pérez Ortiz, J. Cardoso. Springer Journal Pattern Analysis and Applications.

2018	**Deep image segmentation by quality inference** 🔗
	K. Fernandes, R. Cruz, J. Cardoso. IEEE International Joint Conference on Neural Networks (IJCNN)
2017	**Constraining type II error: building intentionally biased classifiers** 🔗
	R. Cruz, K. Fernandes, J. Costa, J. Cardoso. Springer International Work-conference on Artificial Neural Networks (IWANN)
2017	**Fine-to-coarse ranking in ordinal and imbalanced domains: an application to liver transplantation** 🔗
	M. Pérez-Ortiz, K. Fernandes, R. Cruz, J. Cardoso. Springer International Work-conference on Artificial Neural Networks (IWANN).
2017	**Combining ranking with traditional methods for ordinal class imbalance** 🔗
	R. Cruz, K. Fernandes, J. Costa, M. Pérez-Ortiz, J. Cardoso. Springer International Work-conference on Artificial Neural Networks (IWANN)
2017	**Ordinal class imbalance with ranking** 🔗
	R. Cruz, K. Fernandes, J. Costa, M. Pérez-Ortiz, J. Cardoso. Springer Iberian conference on pattern recognition and image analysis (Ibpria).
2016	**Tackling class imbalance with ranking** 🔗
	R. Cruz, K. Fernandes, J. Costa, J. Cardoso. IEEE International Joint Conference on Neural Networks (IJCNN).

My favorite publications are in **highlight**. See my Google Scholar for more information: scholar.google.com/citations?user=pSFY_gQAAAAJ

🐙 Projects

Uber Pixor implementation 🔗
Implementation of a popular bird's eye view LiDAR object detection model.

objdetect package 🔗
Light-weight and versatile one-stage object detection framework

Apoo (virtual machine) GTK+ interface 🔗
I helped with the development of the GTK+ interface for Apoo (together with Profs Rogério Reis and Nelma Moreira), a virtual machine that is currently being used to teach Assembly. Apoo is written in Python and GTK+.

EatFeed 🔗
RSS/Atom reader written in C++ and GTK+

Google Summer of Code
I was awarded twice a Google grant to work on open-source projects. LibreOffice dynamic layouts (2007) and YaST port from GTK+ to Qt (2006).

SuperTux, co-author 🔗
While in high-school, I was part of the initial team developing this game. It is written in C++, SDL, and OpenGL.

See my github for more projects: github.com/rpmcruz

👥 SUPERVISIONS

on-going	**Introducing Domain Knowledge to Autonomous Driving** Rafael Valente Cristino
	Iterative Inference for Point-Clouds Alankrita Asthana (University of Munich)
	Academic Internship in Out of Distribution Detection – Autonomous Driving (Internship at Bosch Car Multimedia) José António Barbosa da Fonseca Guerra (co-supervisor: Prof Luís Teixeira)
2022	**Human Feedback during Neural Networks Training** 🔗 Pedro João Cruz Serrano e Silva (co-supervisor: Tiago Filipe Sousa Gonçalves)
	Environment Detection for Railway Applications based on Automotive Technology (Internship at Continental) 🔗 João Malheiro Baptista Marcos da Silva
	Phishing Detection with a Machine Learning Net (Internship at E-goi) 🔗 Ana Luís Carvalho Matos Bezerra (co-supervisor: Prof Joaquim Pinto da Costa)

🏅 AWARDS

2022	**Bosch for Mobility** 🔗 My students won Best New Participating Team in an autonomous driving competition
2021	**INESC TEC Outstanding Recognition Award** 🔗 Monthly award for INESC TEC collaborators, for maintenance of the HPC infrastructure
2021	**Pedagogic award (voted by students)** University of Porto (FEUP)
2021	**Best paper and presentation** 🔗 RECPAD conference
2018	**INESC TEC Outstanding Recognition Award** 🔗 Monthly award for INESC TEC collaborators, for organizing workshops
2017	**Kaggle Bronze Medal (competition) and Silver (engagement)**