

Ricardo Cruz

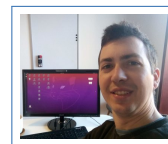
*PhD in Machine Learning and
Computer Vision*

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Ricardo Cruz has worked on a wide range of machine learning topics, with particular emphasis on theoretical aspects of deep learning and computer vision – with 20+ publications and 100+ citations in such topics as: • adapting ranking models for class imbalance; • making convolutional neural networks invariant to background; • making them faster by adjusting the computational effort to each image; • losses for ordinal regression. He has been working as a Post-doc Researcher on autonomous driving at the Faculty of Engineering, University of Porto, and a researcher at INESC TEC since 2015, where he completed his computer science PhD in 2021. He has a BSc in computer science and a MSc in applied mathematics. He has frequently been an invited professor at the Faculty of Engineering, University of Porto, where he earned a pedagogic award.

Skills

• PyTorch • TensorFlow • Python • R • Julia • MATLAB • Machine Learning • Git

Education

2021 PhD in Computer Science

Joint degree University of Porto, Minho and Aveiro

2015 M.Sc. in Mathematical Engineering

Faculty of Sciences, University of Porto

2012 B.Sc. in Computer Science

Faculty of Sciences, University of Porto

Work Experience

2023/07–2024/12 **Post-doctoral Researcher on Autonomous Driving, INESC TEC** [in partnership with Bosch]

2021/09–2023/06 **Post-doctoral Researcher on Autonomous Driving, University of Porto (FEUP)** [in partnership with Bosch]

Collaboration between the University of Porto and Bosch Car Multimedia to improve autonomous driving perception. I developed frameworks 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).

2023/09– **Invited Auxiliary Professor, University of Porto (FEUP)**

2024/02 Courses on Machine Learning (theoretical lessons): - OAT4001 [🔗](#), FACVC [🔗](#)

2021/09– **Invited Auxiliary Professor, University of Porto (FEUP)**

2022/08 Courses: Programming Fundamentals (practical lessons in Python): - L.EIC003 [🔗](#), Data Structures and Algorithms (practical lessons in C/C++): L.EEC009 [🔗](#)

2018/09– **Invited Teacher Assistant, University of Porto (FEUP)**

2021/08 Courses: Programming Fundamentals (practical lessons in Python): L.EIC003, Programming (practical lessons in C/C++): L.EIC009 [🔗](#)

- 2015/09–2021/08 **Research Assistant on Machine Learning and Computer Vision, INESC TEC**
 Research focus: re-thinking fundamentals about image classification and semantic segmentation (8+ publications), in particular (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. During the period, I contributed to workshops, the Summer School on Computer Vision (VISUM), and other events, and was twice awarded “outstanding recognition” for organizing workshops and helping with the HPC infrastructure.
- 2014/09–2014/12 **Research Grant on Mathematical Modelling Research, Mathematics Center of the University of Porto (CMUP)**
 Epidemiological models for HIV: differential equations, stochastic simulations, cellular automata.

Publications

h-index	Google Scholar ↗	Scopus ↗	Web of Science ↗
	7	5	4

Sources for the following metrics: • Impact Factor (IF) as reported by the journal’s webpage. • SJR rank quartiles are from Scimago and relate to the subject category closest to machine learning (not necessarily the best quartile). • CORE rank is from ICORE for whatever last year is available for that conference. Last update: 2024-12-20

Journal Publications

- [**3RD ROUND**] J. Cardoso, T. Albuquerque, **R. Cruz**, “Unimodal Distributions for Ordinal Regression”, *IEEE Transactions on Artificial Intelligence*, **SJR=Q1** [↗](#)
- [**3RD ROUND**] **R. Cruz**, R. Cristino, J. Cardoso, “Learning Ordinality in Semantic Segmentation”, *IEEE Access*, **IF=3.4**, **SJR=Q1** [↗](#)
- [**SUBMITTED**] D. Teixeira, **R. Cruz**, “Quantifying How Deep 3D Representations Promote Label Efficiency”, *Elsevier Neurocomputing*, **IF=5.5**, **SJR=Q1**
- [**SUBMITTED**] **R. Cruz**, J. Cardoso, “Navigating the Landscape of Deep Ordinal Methods: An In-Depth Review”, *IEEE Transactions on Neural Networks and Learning Systems*, **IF=10.2**, **SJR=Q1**
- [**SUBMITTED**] **R. Cruz**, “Spatial Early-Exit for Segmentation and Object Detection”, *Elsevier Computer Vision and Image Understanding*, **IF=4.3**, **SJR=Q1**
- 2025 J. Barbero-Gómez, **R. Cruz**, J. Cardoso, P. Gutiérrez, C. Hervás-Martínez, “CNN explanation methods for ordinal regression tasks”, *Elsevier Neurocomputing*, **IF=5.5**, **SJR=Q1** [↗](#)
- 2024 A. Bezerra, I. Pereira, M. Rebelo, D. Coelho, D. Oliveira, J. Costa, **R. Cruz**, “A case study on phishing detection with a machine learning net”, *Springer International Journal of Data Science and Analytics*, **IF=3.4**, **SJR=Q2** [↗](#)
- 2024 C. Pereira, **R. Cruz**, J. Fernandes, J. Pinto, J. Cardoso, “Weather and Meteorological Optical Range Classification for Autonomous Driving”, *IEEE Transactions on Intelligent Vehicles*, **IF=14**, **SJR=Q1** [↗](#)
- 2023 **R. Cruz**, D. Silva, T. Gonçalves, D. Carneiro, J. Cardoso, “Two-Stage Framework for Faster Semantic Segmentation”, *MDPI Sensors*, **IF=3.4**, **SJR=Q2** [↗](#)
- 2023 T. Albuquerque, L. Rosado, **R. Cruz**, M. Vasconcelos, T. Oliveira, J. Cardoso, “Re-thinking low-cost microscopy workflow: Image enhancement using deep based Extended Depth of Field methods”, *Elsevier Intelligent Systems with Applications*, **SJR=Q1** [↗](#)
- 2022 T. Albuquerque, **R. Cruz**, J. Cardoso, “Quasi-Unimodal Distributions for Ordinal Classification”, *MDPI Mathematics*, **IF=2.3**, **SJR=Q2** [↗](#)
- 2021 T. Albuquerque, **R. Cruz**, J. Cardoso, “Ordinal losses for classification of cervical cancer risk”, *PeerJ Computer Science*, **IF=3.8**, **SJR=Q1** [↗](#)

- 2019 R. Prates, **R. Cruz**, A. Marotta, R. Ramos, E. Simas Filho, J. Cardoso, “Insulator visual non-conformity detection in overhead power distribution lines using deep learning”, *Elsevier Computers & Electrical Engineering*, **IF=4.0, SJR=Q1** [↗](#)
- 2018 **R. Cruz**, K. Fernandes, J. Costa, M. Ortiz, J. Cardoso, “Binary ranking for ordinal class imbalance”, *Springer Pattern Analysis and Applications*, IF=3.7, SJR=Q2 [↗](#)
International Conference Proceedings
- 2023 F. Campos, F. Cerqueira, **R. Cruz**, J. Cardoso, “YOLOMM – You Only Look Once for Multi-modal Multi-tasking”, *Iberoamerican Congress on Pattern Recognition 2023 (CIARP)*, CORE=C [↗](#)
- 2023 D. e Silva, **R. Cruz**, “Condition Invariance for Autonomous Driving by Adversarial Learning”, *Iberoamerican Congress on Pattern Recognition 2023 (CIARP)*, CORE=C [↗](#)
- 2023 **R. Cruz**, A. Shihavuddin, M. Maruf, J. Cardoso, “Active Supervision: Human in the Loop”, *Iberoamerican Congress on Pattern Recognition 2023 (CIARP)*, CORE=C [↗](#)
- 2023 P. Serrano e Silva, **R. Cruz**, A. Shihavuddin, T. Gonçalves, “Interpretability-Guided Human Feedback During Neural Network Training”, *Iberian Conference on Pattern Recognition and Image Analysis 2023 (IbPRIA)*, CORE=C [↗](#)
- 2023 J. Barbero-Gómez, **R. Cruz**, J. Cardoso, P. Gutiérrez, C. Hervás-Martínez, “Evaluating the Performance of Explanation Methods on Ordinal Regression CNN Models”, *International Work-Conference on Artificial Neural Networks 2023 (IWANN)* [↗](#)
- 2023 D. Teixeira e Silva, **R. Cruz**, T. Gonçalves, D. Carneiro, “Two-stage semantic segmentation in neural networks”, *Fifteenth International Conference on Machine Vision (ICMV 2022)* [↗](#)
- 2021 **R. Cruz**, R. Prates, E. Simas Filho, J. Pinto Costa, J. Cardoso, “Background Invariance by Adversarial Learning”, *2020 25th International Conference on Pattern Recognition (ICPR)*, CORE=B [↗](#)
- 2019 **R. Cruz**, J. Pinto Costa, J. Cardoso, “Averse Deep Semantic Segmentation”, *2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, CORE=C [↗](#)
- 2019 **R. Cruz**, J. Pinto Costa, J. Cardoso, “Automatic Augmentation by Hill Climbing”, *International Conference on Artificial Neural Networks 2019 (ICANN)*, CORE=C [↗](#)
- 2018 K. Fernandes, **R. Cruz**, J. Cardoso, “Deep Image Segmentation by Quality Inference”, *2018 International Joint Conference on Neural Networks (IJCNN)*, CORE=B [↗](#)
- 2018 **R. Cruz**, M. Silveira, J. Cardoso, “A Class Imbalance Ordinal Method for Alzheimer’s Disease Classification”, *2018 International Workshop on Pattern Recognition in Neuroimaging (PRNI)* [↗](#)
- 2017 **R. Cruz**, K. Fernandes, J. Pinto Costa, J. Cardoso, “Constraining Type II Error: Building Intentionally Biased Classifiers”, *Lecture Notes in Computer Science*, CORE=B [↗](#)
- 2017 M. Pérez-Ortiz, K. Fernandes, **R. Cruz**, J. Cardoso, J. Briceño, C. Hervás-Martínez, “Fine-to-Coarse Ranking in Ordinal and Imbalanced Domains: An Application to Liver Transplantation”, *Lecture Notes in Computer Science*, CORE=B [↗](#)
- 2017 **R. Cruz**, K. Fernandes, J. Pinto Costa, M. Pérez Ortiz, J. Cardoso, “Combining Ranking with Traditional Methods for Ordinal Class Imbalance”, *Lecture Notes in Computer Science*, CORE=B [↗](#)
- 2017 **R. Cruz**, K. Fernandes, J. Pinto Costa, M. Ortiz, J. Cardoso, “Ordinal Class Imbalance with Ranking”, *Lecture Notes in Computer Science*, CORE=B [↗](#)

- 2016 **R. Cruz**, K. Fernandes, J. Cardoso, J. Pinto Costa, “Tackling class imbalance with ranking”, *2016 International Joint Conference on Neural Networks (IJCNN)*, CORE=B [↗](#)

Supervisions

MSc Dissertation

- current João Ricardo Ramos Alves, “Self-supervised Occupancy Networks in Autonomous Driving (Bosch internship)”, *FEUP*
- current Luís Paulo da Rocha Miranda, “Unsupervised Active Learning: Which Frames are Most Important in Autonomous Driving?”, *FEUP*
- current Bruno Vieira Dias, “Trust or not to trust: When to trust the label prediction”, *FEUP*
- current Alexandre Ferreira Nunes, “Semi-supervised Learning on 2D Projections for Autonomous Driving”, *FEUP*
- current Sofia Lucía, “Ordinal losses for range estimation in autonomous driving”, *FEUP*
- 2024 Diana Teixeira Silva, “Quantifying How Deep 3D Representations Promote Label Efficiency [↗](#)”, *FEUP*
- 2024 Francisco Gonçalves Cerqueira, “Exploring Label Efficiency with Semi-Supervision and Self-Supervision Methods [↗](#)”, *FEUP*
- 2024 Airton Tiago, “Data Augmentation for Ordinal Data [↗](#)”, *FEUP* (with co-supervisor: Jaime Cardoso)
- 2023 Alankrita Asthana, “Iterative Inference for Point-Clouds”, *TUM*
- 2023 Rafael Cristino, “Introducing Domain Knowledge to Scene Parsing in Autonomous Driving [↗](#)”, *FEUP* (with co-supervisor: Jaime Cardoso)
- 2023 José Guerra, “Uncertainty-Driven Out-of-Distribution Detection in 3D LiDAR Object Detection for Autonomous Driving (Internship at Bosch Car Multimedia) [↗](#)”, *FEUP* (with co-supervisor: Luís Teixeira)
- 2022 Pedro Silva, “Human Feedback during Neural Networks Training [↗](#)”, *FEUP* (with co-supervisor: Tiago Gonçalves)
- 2022 João Silva, “Environment Detection for Railway Applications based on Automotive Technology (Internship at Continental) [↗](#)”, *FEUP*
- 2022 Ana Bezerra, “Phishing Detection with a Machine Learning Net (Internship at E-goi) [↗](#)”, *FCUP* (with co-supervisor: Joaquim Costa)

BSc Project

- 2024 João Monteiro, “Cross-vehicle collaboration using RGB cameras [↗](#)”, *FCUP* (with co-supervisor: Celso Pereira)
- 2024 Diogo Mendes, “Automatic Recognition of Pig Activity in an Intensive Production System [↗](#)”, *FCUP* (with co-supervisor: Nuno Lavado)
- 2024 Beatriz Sá, “Research on Deep Augmentation for Ordinal Regression [↗](#)”, *FCUP* (with co-supervisor: Jaime S. Cardoso)
- 2024 Eliandro Melo, “Resource Efficiency using Deep Q-Learning in Autonomous Driving”, *FCUP*
- 2024 Ivo Duarte Simões, “Resource Efficiency using PPO in Autonomous Driving”, *FCUP*
- 2023 Diana Teixeira Silva, “Condition Invariance for Autonomous Driving by Adversarial Learning”, *FEUP*
- 2022 Diana Teixeira Silva, “Semantic Segmentation in Neural Networks using Iterative Visual Attention”, *FEUP* (with co-supervisor: Tiago Gonçalves)

- 2022 Filipe Campos, Francisco Cerqueira, Vasco Alves, “Mobile App using Object Detection for Car Driving [↗](#)”, *FEUP*
- 2022 Bruno Gomes, Rafael Camelo, “Internship at ANO”, *FEUP*
[Internship](#)
- 2024 July Isabel Gomes de Sá, “Making Sense of Ordinal Images Without Labels [↗](#)”, *INESC TEC*