# Ricardo P. M. Cruz

*PhD in Machine Learning and Computer Vision*

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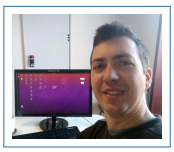

**Ricardo P. M. Cruz** received a B.S. degree in Computer Science and an M.S. degree in Applied Mathematics, both from the University of Porto, Portugal. Since 2015, he has been a researcher at INESC TEC, working in machine learning with a particular emphasis on computer vision. He earned his Ph.D. in Computer Science in 2021 with a special emphasis on computer vision and deep learning. After this, he was a post-doctoral researcher on autonomous driving under the THEIA research project. Currently, Cruz is an Assistant Professor at the Faculty of Engineering of the University of Porto. He works 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.

## Skills

• PyTorch • TensorFlow • Python • R • Julia • MATLAB • Machine Learning • C/C++

## 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

2024/02–(current) **Assistant Professor**, *University of Porto (FEUP)*

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).

2023/09–2024/02 **Invited Assistant Professor**, *University of Porto (FEUP)*
Courses on Machine Learning (theoretical lessons): - OAT4001, FACVC

2021/09–2022/08 **Invited Assistant Professor**, *University of Porto (FEUP)*
Courses: Programming Fundamentals (practical lessons in Python): - L.EIC003, Data Structures and Algorithms (practical lessons in C/C++): L.EEC009

2018/09–2021/08 **Invited Teacher Assistant**, *University of Porto (FEUP)*
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: 2025-02-16

### Journal Publications

**[3RD ROUND]** J. Cardoso, T. Albuquerque, **R. Cruz**, "Unimodal Distributions for Ordinal Regression", *IEEE Transactions on Artificial Intelligence*, **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**, "Spatial Early-Exit for Segmentation and Object Detection", *Elsevier Computer Vision and Image Understanding*, **IF=4.3, SJR=Q1**

**[SUBMITTED]** **R. Cruz**, J. Cardoso, "Interpretable Image Classification using Object Detection", *IEEE Transactions on Cybernetics*, **IF=9.4, SJR=Q1**

2025 **R. Cruz**, R. Cristino, J. Cardoso, "Learning Ordinality in Semantic Segmentation", *IEEE Access*, **IF=3.4, 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, "Rethinking 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 Sofía 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*