

# Ricardo P. M. Cruz

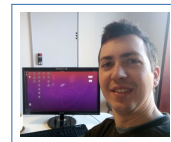
*PhD in Machine Learning and  
Computer Vision*

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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– **Invited Assistant Professor, University of Porto (FEUP)**

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

2021/09– **Invited Assistant 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– **Research Assistant on Machine Learning and Computer Vision**, *INESC TEC*  
 2021/08 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– **Research Grant on Mathematical Modelling Research**, *Mathematics Center of the University of Porto (CMUP)*  
 2014/12 Epidemiological models for HIV: differential equations, stochastic simulations, cellular automata.

## Publications

h-index

Google Scholar <a href="#">↗</a>	Scopus <a href="#">↗</a>	Web of Science <a href="#">↗</a>
8	5	4

Sources for the following metrics: • Impact Factor (IF) as reported by the journal’s webpage. • SJR rank quartiles are from Scimago and best quartile is chosen when multiple categories exist. • CORE rank is from ICORE for whatever last year is available for that conference. Last update: 2025-02-22

### 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=Q1** [↗](#)
- 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 [↗](#)
  - 2017 **R. Cruz**, K. Fernandes, J. Pinto Costa, J. Cardoso, “Constraining Type II Error: Building Intentionally Biased Classifiers”, *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)*, CORE=C [↗](#)
  - 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 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”, *International Work-Conference on Artificial Neural Networks (IWANN)* [↗](#)
  - 2017 **R. Cruz**, K. Fernandes, J. Pinto Costa, M. Pérez Ortiz, J. Cardoso, “Combining Ranking with Traditional Methods for Ordinal Class Imbalance”, *International Work-Conference on Artificial Neural Networks (IWANN)* [↗](#)

- 2017 **R. Cruz**, K. Fernandes, J. Pinto Costa, M. Ortiz, J. Cardoso, “Ordinal Class Imbalance with Ranking”, *Iberian Conference on Pattern Recognition and Image Analysis (IbPRIA)*, CORE=C [↗](#)
- 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 Rúben Monteiro, “Intelligent 3D Interaction”, *FEUP* (main supervisor: Rui Rodrigues, co-supervisor: R. Cruz)
- 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*
- 2023 Alankrita Asthana, “Iterative Inference for Point-Clouds”, *TUM*
- 2023 Rafael Cristino, “Introducing Domain Knowledge to Scene Parsing in Autonomous Driving [↗](#)”, *FEUP*
- 2023 José Guerra, “Uncertainty-Driven Out-of-Distribution Detection in 3D LiDAR Object Detection for Autonomous Driving (Internship at Bosch Car Multimedia) [↗](#)”, *FEUP*
- 2022 Pedro Silva, “Human Feedback during Neural Networks Training [↗](#)”, *FEUP*
- 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*

### BSc Project

- current Diogo Venade, “How Robust are Ordinal Regression Methods against Adversarial Attacks?”, *FEUP*
- current Bruno Ferreira, “Automatic Recognition of Pig Behavior”, *FEUP*
- current Isabel Sá, “Automatic Recognition of Pig Behavior”, *FEUP*
- 2024 João Monteiro, “Cross-vehicle collaboration using RGB cameras [↗](#)”, *FCUP*
- 2024 Diogo Mendes, “Automatic Recognition of Pig Activity in an Intensive Production System [↗](#)”, *FCUP*
- 2024 Beatriz Sá, “Research on Deep Augmentation for Ordinal Regression [↗](#)”, *FCUP*
- 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*
- 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*