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María Pérez Ortiz

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Education

02/2015 **Ph.D in Machine Learning**, *University of Córdoba (Spain)*, thesis available here.

Thesis: Exploiting decomposition methods, kernel algorithms and over-sampling techniques for ordinal regression. Cum Laude. International Doctor Mention.

07/2012 **M.Sc in Intelligent Systems**, *University of Córdoba (Spain)*, Mean grade: 9.3/10, graduation with distinction.

Master Thesis: Ordinal regression using metaclassifiers: Reformulating the one-vs-all paradigm.

09/2011 **B.Sc in Computer Science**, *University of Córdoba (Spain)*, Mean grade: 8/10.

BSc project: Ordinal classification based on local approximation. Applications in biomedicine.

Research experience

My research has been mainly focused on different branches of artificial intelligence: machine learning, computer vision and the application of these to real-world problems (mostly biomedicine and environmental applications).

2017-now **Research associate (≃1.5 years)**, *Computer Laboratory, Univ. of Cambridge (UK).*

Research on Bayesian inference, psychophysics, visual perception and deep learning.

2013/2017 **Visiting academic (7 months)**, *School of Computer Science, Univ. of Birmingham (UK).*

2015-2017 **Lecturer (≃2 years)**, *University Loyola Andalucía (Spain).*

Research on weakly supervised learners, time series analysis and data over-sampling.

2014-2015 **Research assistant (1.5 years)**, *Spanish National Research Council (Spain).*

Research on imaging and machine learning for sustainable agriculture.

2014 **Visiting academic (1 month)**, *University of Santiago de Compostela (Spain).*

2011-2014 **Research assistant (2.5 years)**, *University of Córdoba (Spain).*

Research on ordinal classification, kernel algorithms and biomedicine applications.

2010-2015 **Honorary student with research and teaching tasks**, *Dept. of Computer Science and Numerical Analysis, University of Córdoba (Spain).*

Research publications

I have published more than 60 peer-reviewed publications. This section includes a selection of these, the ones that I consider most relevant for describing my research trajectory. Further information about my publication record can be found on my Google Scholar profile.

- M. Pérez-Ortiz, P.A. Gutiérrez, P. Tino and C. Hervás-Martínez: "Over-sampling the minority class in the feature space", **IEEE Trans. on Neural Networks and Learning Systems**, 2015.
- M. Pérez-Ortiz, P.A. Gutiérrez, X. Yao and C. Hervás-Martínez: "Graph-based approaches for over-sampling in the context of ordinal regression", **IEEE Trans. on Knowledge and Data Engineering**, 2014.
- M. Pérez-Ortiz, P.A. Gutiérrez and C. Hervás Martínez: "Projection-based ensemble learning for ordinal regression", **IEEE Trans. on Cybernetics**, 2014.
- P.A. Gutiérrez, M. Pérez-Ortiz, J. Sánchez-Monedero, F. Fernández-Navarro and C. Hervás-Martínez: "Ordinal regression methods: survey and experimental study", **IEEE Trans. on Knowledge and Data Engineering**, 2015.

- M. Pérez-Ortiz, P.A. Gutiérrez, M. Carbonero-Ruz and C. Hervás-Martínez: "Semi-supervised learning for ordinal kernel discriminant analysis", **Neural Networks**, 2016.
- M. Pérez-Ortiz, P.A. Gutiérrez, M. Cruz-Ramírez, J. Sánchez-Monedero and C. Hervás-Martínez. 2014. "Kernelising the proportional odds model through kernel learning techniques", **Neurocomputing**, 2014.
- M. Pérez-Ortiz, M. Cruz-Ramírez, M. D. Ayllón-Terán, N. Heaton, R. Ciria and C. Hervás-Martínez: "An organ allocation system for liver transplantation based on ordinal regression", **Applied Soft Comp.**, 2014.
- M. Pérez-Ortiz, M. de la Paz-Marín, P.A. Gutiérrez and C. Hervás-Martínez. "Classification of EU countries' progress towards sustainable development based on ordinal regression techniques", **Knowledge-Based Systems**, 2014.
- M. Pérez-Ortiz, J.M. Peña, P.A. Gutiérrez, J. Torres-Sánchez, C. Hervás-Martínez and F. López-Granados: "A semi-supervised system for weed mapping in sunflower crops using unmanned aerial vehicles and a crop row detection method", **Applied Soft Computing**, 2015.
- M. Pérez-Ortiz, P.A. Gutiérrez, J. Sánchez-Monedero and C. Hervás-Martínez: "Evaluation of centred kernel-target alignment for multi-scale kernel optimisation", **Neural Processing Letters**, 2015.
- M. Pérez-Ortiz, P.A. Gutiérrez, M.D. Ayllón-Terán, N. Heaton, R. Ciria and C. Hervás-Martínez: "Synthetic semi-supervised learning in imbalanced domains: Constructing a model for donor-recipient matching in liver transplantation", **Knowledge-based systems**, 2017.
- M.D. Ayllón, R. Ciria, M. Cruz-Ramírez, M. Pérez-Ortiz, R. Valente, J. O'Grady, M. de la Mata, C. Hervás-Martínez, N. D. Heaton and J. Briceño: External validation of artificial neural networks as a methodology for donor-recipient matching for liver transplantation, **Liver transplantation**, 2016.
- M. Pérez-Ortiz, A.M. Durán-Rosal, P.A. Gutiérrez, J. Sánchez-Monedro, A. Nikolaou, F. Fernández-Navarro and C. Hervás-Martínez: "On the use of evolutionary time series analysis for segmenting paleoclimate data", **Neurocomputing**, 2017.
- M. Pérez-Ortiz, S. Jiménez-Fernández, P.A. Gutiérrez, E. Alexandre, C. Hervás-Martínez and S. Salcedo-Sanz: "A review of classification problems and algorithms in renewable energy applications", **Energies**, 2016.
- J. Sánchez-Monedero, M. Pérez-Ortiz, A. Sáez, P.A. Gutiérrez and C. Hervás-Martínez, "Partial order label decomposition approaches for melanoma diagnosis", **Applied Soft Computing**, 2018.
- R. Cruz, K. Fernandes, J.F. Pinto-Costa, M. Pérez-Ortiz and J.S. Cardoso: "Binary ranking for ordinal class imbalance", **Pattern Analysis and Applications**, 2018.
- M. Pérez-Ortiz, P.A. Gutiérrez, C. Hervás-Martínez, J. Briceño and M. de la Mata: An ensemble approach for ordinal threshold models applied to liver transplantation", **IEEE Int. Joint Conf. on Neural Networks**, 2012.
- M. Pérez-Ortiz, P.A. Gutiérrez, J. Sánchez-Monedero and C. Hervás-Martínez: Multi-scale support vector machine optimization by kernel-target alignment, **European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning**, 2013.
- J. Sánchez-Monedero, P.A. Gutiérrez, M. Pérez-Ortiz and C. Hervás-Martínez: A n-spheres based synthetic data generator for supervised classification, **Int. Work Conf. on Artificial Neural Networks**, 2013.
- M. Pérez-Ortiz, P.A. Gutiérrez and C. Hervás-Martínez: Log-gamma distribution optimisation via maximum likelihood for ordered probability estimates, **Int. Conf on Hybrid Art. Intell. Systems**, 2014.
- M. Pérez-Ortiz, P.A. Gutiérrez and C. Hervás-Martínez, Learning kernel label decompositions for ordinal classification problems, **Int. Conf. on Neural Comp. Theory and Applications**, 2014.
- M. Pérez-Ortiz, P.A. Gutiérrez and C. Hervás-Martínez: Incorporating privileged information to improve manifold ordinal regression, **Int. Conf. on Neural Comp. Theory and Applications**, 2014.
- M. Pérez-Ortiz, A. Saez, J. Sánchez-Monedero, P. A. Gutiérrez and C. Hervás-Martínez: Tackling the ordinal and imbalance nature of a melanoma image classification problem, **IEEE Int. Joint Conf. on Neural Networks**, 2016.
- P. A. Gutiérrez, M. Pérez-Ortiz, J. Sánchez-Monedero and C. Hervás-Martínez: Representing ordinal input variables in the context of ordinal classification, **IEEE Int. Joint Conf. on Neural Networks**, 2016.
- M. Pérez-Ortiz, P. A. Gutiérrez, M. Carbonero-Ruz and C. Hervás-Martínez: Adapting linear discriminant analysis to the paradigm of learning from label proportions, **IEEE Symposium Series on Computational Intelligence**, 2016.
- R. Cruz, K. Fernandes, J.F. Pinto-Costa, M. Pérez-Ortiz and J. S. Cardoso: Ordinal class imbalance with ranking, **Iberian Conference on Pattern Recognition and Image Analysis**, 2017.
- M. Pérez-Ortiz, K. Fernandes, R. Cruz, J.S. Cardoso, J. Briceño and C. Hervas-Martinez: Fine-to-coarse ranking in ordinal and imbalanced domains: An application to liver transplantation, **Int. Work Conf. on Artificial Neural Networks**, 2017.

- M. Pérez-Ortiz and R. Mantiuk: A practical guide and software for analysing pairwise comparison experiments, **ArXiv pre-print**, 2017.
- A. Mikhailiuk, M. Pérez-Ortiz and R. Mantiuk: Psychometric scaling of TID2013 dataset, **International Conference on Quality of Multimedia Experience**, 2018.
- M. Pérez-Ortiz, P.A. Gutierrez, P. Tino, C. Casanova-Mateo and S. Salcedo-Sanz: A mixture of experts model for predicting persistent weather patterns, **IEEE Int. Joint Conf. on Neural Networks**, 2018.
- N. Ye, M. Pérez-Ortiz and R. K. Mantiuk: Trained perceptual transform for quality assessment of high dynamic range images and video, **IEEE Int. Conf. on Image Processing**, 2018.
- M. Pérez-Ortiz, J. Martinovic, R. K. Mantiuk and S. Wuerger: Luminance and chromatic contrast sensitivity at high light levels, **European Conference on Visual Perception**, 2018.

Qualifications, awards and achievements

2018 **Grant to attend the Dagstuhl Seminar on Automating Data Science**, *Leibniz-Zentrum für Informatik (Germany).*

2018 **Jury at the awards "Premio Rey Jaime I" in the area of new technologies (together with 18 Nobel laureates)**, *Valencia (Spain).*

2018 **Research associateship**, *Hughes Hall College, University of Cambridge (UK).*

2018 **Grant attend the 6th Heidelberg Laureate Forum (Fields, Abel & Turing laureates)**, *Heildelberg (Germany).*

2017 **Young Cordoba Awards: University and Innovation**, *Regional Government of Andalusia.*

2017 **Young researchers in Computer Science Award**, *5000€*, BBVA and Spanish Scientific Society for Computer Science.

2017 **Research annual award**, *University Loyola Andalucía.*

2016 **First honorary award - Phd Program of Engineering and Tech.**, *University of Córdoba.*

2015 **Award - Women in artificial intelligence**, Spanish Association for AI.

2013 **Third award and award of the public - "Your thesis in three minutes"**, *1500€*, Spanish Network for the Advance and Transfer of Applied Comp. Intelligence.

Organisation and management of scientific events

2017-2018 **Organizer of reading group**, *"Machine learning for imaging"*, Univ. of Cambridge (UK).

2018 **Organizer of workshop**, *"Neural computing and deep learning", Heildelberg Laurate Forum*, Heildelberg, Germany.

2017 **Organizer of special session**, *"Machine learning for imbalanced domains", International Work-Conference on Artificial Neural Networks*, Cádiz, Spain.

2016 **Organizer of special session**, *"Ordinal regression and ranking", World Conference on Computational Intelligence*, Vancouver, Canada.

2013–2018 **International journal reviewer**.

IEEE Transactions on Neural Networks and Learning Systems, IEEE Transactions on Cybernetics, IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Transactions on Image Processing, Neural Processing Letters, Neurocomputing

Invited talks

2018 **How to collect visual perception data and its application to image compression**, *Department of Applied Mathematics, University of Cambridge (UK).*

2018 **Learning from our visual perception**, *Virtual Reality observatory, Malaga (Spain).*

2018 **Understanding visual perception to improve computer displays**, *Hughes Hall College research showcase, University of Cambridge.*

2018 **Learning from humans and the law of comparative judgment**, *Women at the Computer Laboratory Talklet, University of Cambridge.*

2018 **My personal experience with research**, *Spanish Association of Women in STEM*, Seville (Spain).

2017 **Learning from humans: A broad overview of approaches to model preferences, skills and perception**, *Computer Laboratory, University of Cambridge.*

2014 **Ordinal classification and time series segmentation: Potential applications**, *Centro Singular de Investigación en Tecnoloxías da Información, University of Santiago de Compostela.*

2012 **Ensemble methodologies for ordinal regression**, *University of Granada (Spain).*

Teaching experience

I have mainly contributed to courses related to machine learning, statistics and programming. I have also collaborated in some teaching innovation projects and tutored three degree final projects.

2018 **Past, present and future of Artificial Intelligence**, *Summer School at St Catharine's College*, University of Cambridge, Lectures.

2018 **Artificial Intelligence I**, *B.Sc in Computer Science*, University of Cambridge, Supervisions.

2017-2018 **Probabilistic Machine Learning**, *M.Sc in Computer Science*, University of Cambridge, Grading.

2016-2017 **Business Statistics I (120 hours)**, *B.Sc in Business and Administration*, University Loyola Andalucía, Lectures.

2016 **Final student project tutoring**, *Analysing country positioning according to the potential index for different industries (grade: distinction)*, University Loyola Andalucía.

2015-2017 **Different seminars on programming and machine learning (90 hours)**, *Phd Program in Data Science*, University Loyola Andalucía, Lectures.

2012-2014 **Collaboration in Introduction to Machine Learning as honorary student**, *B.Sc in Computer Science*, University of Córdoba.

2013 **Final student project tutoring**, *Softcomputing models in ordinal regression (grade: distinction)*, University of Córdoba.

2013 **Final student project tutoring**, *Ordinal regression for manifold learning (grade: distinction)*, University of Córdoba.

2013-2014 **Collaboration in a teaching innovation project:**, *Improvement of a teaching tool for knowledge acquisition in Evolutionary Computing and Artificial Neural Networks in the Computer Science Degree and Intelligent Systems Master Degree in the University of Córdoba*, University of Córdoba, collaborator.

Research interests

- **The future of machine learning and its impact on our society**
  Machine learning and AI have been successfully applied to very different domains and are changing the society we live in at an abrupt pace. It is imperative that we study and anticipate how these changes impact our society and the world economy and analyse the ethical issues that this new technological area might raise to develop robust and fair algorithms.

- **Automatisation of data science**
  With the advent of the big data era and the increased popularity of machine learning, the question of whether it is possible to automate data science has raised. This would undoubtedly leverage the whole process of knowledge extraction and impulse data science to the next level, simplifying data preprocessing and hyperparameter tuning, and progressing towards the "automated statistician".

- **Weakly supervised learners**
  The recently coined term weak supervision refers to those classification problems where labelling information is not as accessible as in fully-supervised problems. There is a wide range of applications nowadays that match this definition and I believe machine learning should move towards this paradigm in order not to use more data, but to use it in a smarter way.

- **Inter-disciplinary applications of machine learning and the inclusion of expert knowledge**
  The use of specific knowledge and a deep understanding of the problem at hand are necessary prerequisites for applying data science successfully. It is of special interest how to infuse classifiers with such expert knowledge (e.g. using learning with privileged information, transfer, incremental or active learning).

- **Interpretable machine learning**
  There are many questions that arise within this topic, starting from the pure notion of interpretability, how interpretable the decision process of human beings actually is or how the induced knowledge can be interpreted in a transparent manner. I find this topic fascinating and I believe that its study will makes us closer to the new era of AI.

- **Reinforcement learning and adaptive machine learning**
  We already have the necessary hardware to create a machine with the computational capabilities of a human brain. However, we still do not know how to truly make it learn. Our limited knowledge of neuroscience and learning mechanisms impose a slow moving barrier. I believe, however, that further research in the topics of reinforcement learning and adaptive ML will change the whole subject at an abrupt pace, as algorithms will resemble the learning to which we are exposed to during our whole life.

Research projects and scientific networks

This section includes research projects and scientific networks in which I have collaborated as co-investigator.

2017-2019 **A spatio-chromatic colour appearance model for retargeting high-dynamic-range image appearance across viewing conditions**.
322.345£

Apple and UK Engineering and Physical Sciences Research Council

2016-2017 **Advanced diversification of learning machines**.
35.000€

Spanish Ministry of Economy and Competitiveness

2015–2017 **Ordinal classification algorithms and renewable energy prediction**.
79.200 €

Spanish Ministry of Economy and Competitiveness

2014–2015 **RECUPERA 2020: Monitoring of crops and weeds using Unmanned Aerial Vehicles with infrared sensors for improving agricultural management**.
320.000€

CSIC-MINECO-FEDER (technological funds)

2013–2014 **Climate Tipping Points: detection and analysis of patterns using an ordinal regression approach**.
25.000 €

European Space Agency

2012–2014 **Advanced Neuromodelling for nominal and ordinal classification with hybrid learning algorithms. Application to remote sensing in agriculture and transplantation in biomedicine**.
64.377€

Spanish Ministry of Research, Development and Innovation

2012–2014 **NEMOTECH: Neuromodelling techniques with hybrid learning algorithms. Applications to biomedicine, transplantation, agronomy and predictive microbiology**.
65.461€

Spanish Ministry of Research, Development and Innovation

2010–2012 **Data Mining and Machine Learning Spanish Network**.
12.000€

Spanish Ministry of Education and Science

Other qualifications

2015 **Proficiency Certificate in English (C2 level)**, *University of Cambridge.*

2007–2008 **Intermediate level of German (B1 level)**, *Official Language School of Córdoba (2008) and GLS Sprachenzentrum in Berlin (2007).*

Open-source developed code

- **Ordinal regression framework** (Matlab and Octave)
- **Toolbox for pairwise comparison experiments** (Matlab)
- **Projection-based ensemble learning** (Matlab)
- **Over-sampling in the feature space** (Matlab)
- **Kernelised Proportional Odds Model** (Matlab)
- **Graph-based over-sampling in ordinal regression** (Matlab)
- **Synthetic data generator** (Matlab)

Media coverage

- Advances in Engineering (press): **Weed mapping using drones**.
- El pais (press, English and Spanish): **Can we build truly intelligent machines?**
- Book chapter: **Artificial intelligence and freedom**, to be published in a book on empowerment of citizens through technology.
- Collaboration in the book **What robot stole my cheese? Looking for answers in the automatization labyrinth** (in Spanish).
- El Pais (press, in Spanish): **Liver transplantation organ allocation system in Spain**.
- ABC (press, in Spanish): **AI can save lifes**.
- The Objective (press, in Spanish): **Young researchers in the technological revolution**.

Personal statement

I have felt attracted to artificial intelligence for as long as I can remember. During my undergrad studies I started experimenting with an AI model for a three player chess and simple AI models for videogames. I joined a research group when I was 20 years old and there I realised the impact that AI could have on the world. The first challenge I was presented with was the problem of finding the most compatible recipient for a donor in liver transplantation, so as to maximise expected survival. Seven years after starting the project, now the model is in virtual validation in several Spanish hospitals, as the last step before being implanted as a decision system for organ allocation. Since then, I have been enthusiastic about applying machine learning to different real-world domains. Some examples are a model using drones and image analysis to construct a weed coverage map and minimise the amount of herbicide applied to crops, an early warning system for abrupt climate change in collaboration with the European Space Agency or a non-invasive model for early detection of cancer skin. At the moment, I'm involved in a project in collaboration with Apple to understand human visual perception at high luminance levels, with applications in virtual and augmented reality, cinema and image compression.

Personal information and non-academic interests

- I am social event organiser of the society "Women at the Computer Laboratory" (University of Cambridge) and I collaborate with different associations in the UK and Spain to motivate young women to start a career in science/technology.
- Dancing has been in my life since I was three years old. I have completed the first part of the Dance conservatoire in Spain, focusing on ballet and flamenco. At the moment I'm interested in the use of dancing as a way of meditation and mindfulness.
- I'm also interested in nutrition. Since 2016, I'm a certified health coach by the Institute for Integrative Nutrition in the US.
- I love reading and writing. I am currently working on a book on AI for children.