

Foreword

We are witnessing an unprecedented growth in the volume and complexity of astronomical data: current surveys, telescopes and instruments are providing massive amounts of raw data, images and spectra. This situation will become even more extreme in the future, in particular with the upcoming telescopes LSST, SKA, and Euclid. In the era of "Big Data", a new generation of astronomers will need to deal routinely with tera- and even petabytes of information. The analysis of these data cannot be carried out by humans in the traditional way, and key decisions in the process will have to rely on numerical algorithms. In that sense, accessing and digesting data and extracting the relevant information from them will pose significant challenges to astronomers, both at the technical and at the analytical level. Machine learning techniques, which belong to the realms of computer science, applied mathematics and statistics, provide key tools to be used for the task.

Acknowledging the importance for the IAC to take part in this revolution from an early stage, the XXX Canary Islands Winter School allowed students to become acquainted with the main current developments in this field, and with the new techniques to be used. The Winter School consisted of interdisciplinary lectures and practical work focussed on dealing with big astronomical data sets. Five renowned specialists in the field lectured on the following topics:

- General overview on the use of machine learning techniques in astronomy: past, present and perspectives. (S. George Djorgovski)
- Data challenges and solutions in forthcoming surveys. (Mario Juric)
- Machine learning methods for non-supervised classification and dimension reduction techniques. (Dalya Baron)
- Supervised learning: classification and regression. (Michael Biehl)
- Deep learning. (Marc Huertas-Company)

This eBook compiles the legacy material associated with the XXX Canary Islands Winter School of Astrophysics. It consists of summaries with the contents of each of the lectures (referred to as Lectures Notes), followed by the recorded lectures (Lecture #) and the slides used for them (Slides). References, tutorials, and suggestions for additional reading are also included.



Participants of the XXX Canary Islands Winter School of Astrophysics

Acknowledgements

We would like to express our gratitude to all the lecturers for delivering such fantastic presentations and for preparing the materials contained in this eBook.

We also wish to thank all the support staff of the Instituto de Astrofísica de Canarias. The organization of the School was a pleasant and smooth journey and, to a large extent, this was because we had your help and support: The School would not have been possible without you. First of all, we want to thank the Comisión de Enseñanza and Head of the Graduate Studies Division, Ignacio González Martínez-Pais, for supporting this School since the very beginning, when it was no more than an idea in our minds. Special thanks to Gabriel Pérez Díaz, for designing the Poster of the School and to Jorge Andrés Pérez Prieto, for setting up the webpages of the school (<http://www.iac.es/winterschool/2018/>) and of this eBook. We are grateful to the IT people, in particular Francisco Javier López, who made the video recording possible. Thanks to the UC3 team, Alejandra Rueda, Silvia Granja, and Carmen del Puerto, and Miguel Briganti for the media coverage. We also thank the IAC students and postdocs that helped us with different organizational issues during the School: Ana Esteban Gutierrez, David Rosado Belza, Ignacio del Moral Castro, Salvatore Taibi, Simón Díaz García. Social activities were a key component of the School to promote the interaction between students, and with the lecturers. We want to thank those that made them possible: Javier Licandro, Frédéric Poidevin, during the visits to the Izaña and Roque de los Muchachos Observatories, Alfred Rosenberg during the Public Talk, and Carlos Westendorp, Monique Gómez, Luis Fernando Rodríguez Ramos and Marcos Reyes García Talavera during the visit to the IAC headquarters. Finally, we want to give our warmest gratitude to Lourdes González Pérez for her continuous and invaluable assistance before, during, and after the School.

The key asset of this School were the participants, for whom we organized this School. We want to express here our sincere gratitude to all the students and postdocs that took part in the School. Your enthusiastic participation, both at the lectures and the different social activities were fundamental to create the incredible atmosphere that we lived during the School.

The Organizers

Ana Monreal Ibero, Jorge Sánchez Almeida, Johan Knapen



The secretary and organizers of the XXX Canary Islands Winter School of Astrophysics: from left to right Lourdes, Ana, Jorge, and Johan