

Gabriella Contardo

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Research Interests: My current research is at the interface between Machine Learning, Data Mining and Astrophysics. My goal is to develop ML and data-mining methods that can help us deepen our understanding of the data, and discover unexplained or unexpected aspects within it. Most recently, I've worked on the detection of 'gaps' (i.e. under-densities) in datasets, as a way to discover new types of anomalies, framed as regions of the data-space instead of global outliers data-points. I'm also working on (weakly supervised) representation-learning for complex data (e.g. time-series), notably for anomaly detection and class-discovery. I'm also interested in applications in other scientific fields (e.g. structural biology, healthcare, neuroscience).

POSITIONS

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| Research Fellow Scuola Internazionale Superiore di Studi Avanzati (SISSA), Data Science Group | Sept 2022 - now Trieste, Italy |
| Flatiron Research Fellow Center for Computational Astrophysics (CCA), Flatiron Institute | July 2018 - July 2022 New York, USA |

EDUCATION

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| Ph.D in Computer Science / Machine Learning Sorbonne University - Pierre et Marie Curie (UPMC) – Title: Machine Learning Under Budget Constraints | 2013 –2017 Paris, France |
| MSc. Computer Science - Artificial Intelligence Sorbonne University - Pierre et Marie Curie - Major in “Intelligent Agents, Learning and Decision.” | 2011–2013 |
| BSc. Computer Science Sorbonne University - Pierre et Marie Curie - Final semester at Université de Montreal, Canada. | 2008–2011 |

TEACHING

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| Teaching Assistant Sorbonne University Pierre et Marie Curie, Paris, France – BSc. level courses (1 semester each): Python and Java project-oriented classes with Introduction to A.I. – Task automation – Web Technologies – A.I and Data Science – Computer Science and Statistics. – MSc. level courses: Machine Learning courses for the 'Big Data Certificate' in Mathematics' Master Program (1 semester lab-class) – Data Science and ML courses at ICS Summer School (15h lecture, Bsc / Msc students in Biology, Mathematics and Computer-Science) . | 2013 –2016 |
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MENTORING

- **Alex Gagliano** - Astronomy NSF Graduate Fellow at University of Illinois at Urbana-Champaign - CCA Pre-doctoral Program
Classification of transients events using host information and shallow learning
Co-advised with Dan Foreman-Mackey.
Jan 2022 - Sept 2022

- **Pa Chia Thao** - Astronomy Grad Student at UNC Chapel Hill - CCA Pre-doctoral Program Jan 2021 - August 2021
Machine Learning methods for detrending light-curves data
Co-advised with Trevor J. David and Dan Foreman-Mackey.
- **Malena Rice** - Astronomy Grad Student at Yale July 2020 - now
Using deep learning to find faint moving objects / Planet 9 in TESS data
Co-advised with Dan Foreman-Mackey.
- **Angeli Sandoval** - Astronomy Undergrad at CUNY Hunter - AstroCom Program June 2020 - Sept 2021
Influence of age on relative frequency of super-earths and sub-neptunes
Led to one publication at AJ. Co-advised with Trevor J. David.
- **Elaine C. Cui, Yuanxi Sun** - MSc. students at NYU Center for Data Science Oct 2019 - June 2021
Deep representation learning for cosmology: building 'interpretable' novel summary statistics.
Co-advised with Francisco Villaescusa-Navarro, Yin Li and Shirley Ho.
- **Ademola Oladosu, Philip Ekkfeldt, Tony Xu, Brian A. Kelly** - NYU CDS 2019 - 2020
Meta-learning One-Class Classification for stellar streams characterization.
Led to one paper.
- **Siddhanth Vinay, Gehua Zhang** - MSc. students at Columbia Data Science Institute 2019 - 2020
Features learning for galaxy formation.
Co-advised with Shy Genel.
- **Xinyue Zhang, Yanfang Wang, Wei Zhang, Yueqiu Sun** - MSc. students at NYU CDS 2018 - 2019
Jacky HT. Yip - MSc at Chinese University of Hong-Kong
Predicting galaxy distribution from dark-matter simulation with deep convolutional networks.
Led to one publication (ML4Physics Workshop NeurIPS). Co-advised with Siyu He and Shirley Ho.

HONORS AND GRANTS

- Flatiron Fellowship 2018-2022
- Best Student Paper Award + Travel Grant Award, ICONIP Conference 2016
- Doctoral Grant / Scholarship (3 years funding) French Ministry of Research 2013-2016
- Support Grant / Scholarship for International Studies from Region Ile de France and from Sorbonne UPMC 2011

SERVICE & LEADERSHIP

- Organizer of the Machine Learning group meeting at CCA 2018 - 2022
- Co-organizer of the Flatiron Wide Conference on Algorithms and Mathematics 2019, 2020
- Co-organizer of the Machine Learning 'journal club' / seminar at CCA 2018 - 2020
- Member of the Flatiron Research Fellow Hiring Process Committee for CCA 2018 - 2020
- Reviewer for Machine Learning Journal, AAS Journals, Astronomy and Computing, Machine Learning and the Physical Science Workshop (NeurIPS)
- Reviewer for NSF and NASA panels grants

TALKS AND COMMUNITY EVENTS

Selected recent talks:

- Tri-State Cosmology x Data Science meeting (CCA), invited talk 2022
- Carnegie Observatories , Carnegie Tea, invited talk 2022
- SISSA (Trieste), Data Science Seminar, invited talk 2021
- AAS 238, Meeting-in-a-Meeting on Machine Learning, invited talk 2021

- Sarah Lawrence University, Science Seminar, invited talk 2020
- Michigan State University, Machine Learning Seminar, invited talk 2019
- NASA Goddard, Joint Exoplanet and Machine Learning Seminar, invited talk 2019
- Ringberg Machine Learning in Astronomy Workshop, contributed talk 2019
- Invited Teacher and participant of AstroHackWeek, Cambridge 2019

REFERENCES

- Shirley Ho (CCA) (sho@flatironinstitute.org)
- David W. Hogg (CCA/NYU) (dhogg@flatironinstitute.org)
- Ludovic Denoyer (Ubisoft)

PUBLICATIONS

* indicates refereed publications.

First author and co-lead papers:

- * **G. Contardo**, D. W. Hogg, J. A. Hunt, J. E. Peek, and Y.-C. Chen, “The emptiness inside: Finding gaps, valleys, and lacunae with geometric data analysis.”, *Accepted at AJ*, 2021.
- * A. Sandoval, **G. Contardo**, and T. J. David, “The influence of age on the relative frequency of super-earths and sub-neptunes”, *The Astrophysical Journal*, vol. 911, no. 2, p. 117, 2021.
- A. Oladosu, T. Xu, P. Ekfeldt, B. A. Kelly, M. Cranmer, S. Ho, A. M. Price-Whelan, and **G. Contardo**, “Meta-learning for one-class classification with few examples using order-equivariant network: Application in the milky way”, *arXiv preprint arXiv:2007.04459*, 2020.
- * K. W. Wong, **G. Contardo**, and S. Ho, “Gravitational-wave population inference with deep flow-based generative network”, *Physical Review D*, vol. 101, no. 12, p. 123 005, 2020.
- * J. H. Yip, X. Zhang, Y. Wang, W. Zhang, Y. Sun, **G. Contardo**, F. Villaescusa-Navarro, S. He, S. Genel, and S. Ho, “From dark matter to galaxies with convolutional neural networks”, in *Machine Learning and the Physical Sciences at NeurIPS*, 2019.
- G. Contardo**, “Machine learning under budget constraints”, Ph.D. dissertation, 2017.
- * **G. Contardo**, L. Denoyer, and T. Artières, “A meta-learning approach to one-step active learning”, in *AutoML Workshop at ECML-PKDD*, 2017.
- * **G. Contardo**, L. Denoyer, and T. Artières, “Sequential cost-sensitive feature acquisition”, in *International Symposium on Intelligent Data Analysis (IDA)*, Springer, 2016.
- * **G. Contardo**, L. Denoyer, and T. Artières, “Recurrent neural networks for adaptive feature acquisition”, in *International Conference on Neural Information Processing (ICONIP)*, Springer, 2016.
- * **G. Contardo**, L. Denoyer, and T. Artieres, “Representation learning for cold-start recommendation”, in *International Conference on Learning Representations (ICLR) Workshop*, 2015.
- * **G. Contardo**, L. Denoyer, T. Artieres, and P. Gallinari, “Learning states representations in pomdp”, in *International Conference on Learning Representations (ICLR) Workshop*, 2014.

Collaborated publications:

- * H. Shao, F. Villaescusa-Navarro, S. Genel, D. N. Spergel, D. Anglés-Alcázar, L. Hernquist, R. Davé, D. Narayanan, **G. Contardo**, and M. Vogelsberger, “Finding universal relations in subhalo properties with artificial intelligence”, *The Astrophysical Journal*, vol. 927, no. 1, p. 85, 2022.

- * F. Villaescusa-Navarro, S. Genel, D. Angles-Alcazar, L. Thiele, R. Dave, D. Narayanan, A. Nicola, Y. Li, P. Villanueva-Domingo, B. Wandelt, *et al.*, “The camels multifield data set: Learning the universe’s fundamental parameters with artificial intelligence”, *The Astrophysical Journal Supplement Series*, vol. 259, no. 2, p. 61, 2022.
- T. J. David, R. Angus, J. L. Curtis, J. L. van Saders, I. L. Colman, **G. Contardo**, Y. Lu, and J. C. Zinn, “Further evidence of modified spin-down in sun-like stars: Pile-ups in the temperature-period distribution”, *arXiv preprint arXiv:2203.08920*, 2022.
- T. David, **G. Contardo**, A. Sandoval, R. Angus, Y. Lu, M. Bedell, J. Curtis, D. Foreman-Mackey, B. Fulton, S. Grunblatt, and E. Petigura, “VizieR online data catalog: Compared rotation periods for 1189 cks host stars (david+, 2021)”, *VizieR Online Data Catalog*, J–AJ, 2021.
- * W. E. Kerzendorf, C. Vogl, J. Buchner, **G. Contardo**, M. Williamson, and P. van der Smagt, “Dalek: A deep learning emulator for tardis”, *The Astrophysical Journal Letters*, vol. 910, no. 2, p. L23, 2021.
- * F. Villaescusa-Navarro, D. Anglés-Alcázar, S. Genel, D. N. Spergel, R. S. Somerville, *et al.*, “The camels project: Cosmology and astrophysics with machine-learning simulations”, *The Astrophysical Journal*, vol. 915, no. 1, p. 71, 2021.
- * V. A. Villar, M. Cranmer, E. Berger, **G. Contardo**, S. Ho, G. Hosseinzadeh, and J. Y.-Y. Lin, “A deep-learning approach for live anomaly detection of extragalactic transients”, *The Astrophysical Journal Supplement Series*, vol. 255, no. 2, p. 24, 2021.
- * T. J. David, **G. Contardo**, A. Sandoval, R. Angus, Y. L. Lu, M. Bedell, J. L. Curtis, *et al.*, “Evolution of the exoplanet size distribution: Forming large super-earths over billions of years”, *The Astronomical Journal*, vol. 161, no. 6, p. 265, 2021.
- * V. A. Villar, M. Cranmer, **G. Contardo**, S. Ho, and J. Y.-Y. Lin, “Anomaly detection for multivariate time series of exotic supernovae”, in *Machine Learning and the Physical Sciences Workshop at NeurIPS.*, arXiv preprint arXiv:2010.11194, 2020.
- * F. Villaescusa-Navarro, C. Hahn, E. Massara, A. Banerjee, A. M. Delgado, D. K. Ramanah, T. Charnock, E. Giusarma, Y. Li, E. Allys, *et al.*, “The quijote simulations”, *The Astrophysical Journal Supplement Series*, vol. 250, no. 1, p. 2, 2020.
- * A. Ziat, **G. Contardo**, N. Baskiotis, and L. Denoyer, “Learning embeddings for completion and prediction of relational multivariate time-series.”, in *European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning (ESANN)*, 2016.
- * A. Ziat, **G. Contardo**, N. Baskiotis, and L. Denoyer, “Car-traffic forecasting: A representation learning approach”, in *MUD at ICML*, 2015.