Giulia **Bertagnolli**

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Education

University of Trento & CoMuNe Lab, ICT, Fondazione Bruno Kessler — *Trento, Italy*

PhD in Mathematics, summa cum laude — *2019 - Dec. 2021*

- Thesis title: *Modelling the process-driven geometry of complex networks*
- Main supervisor: Dr. Manlio De Domenico
- Co-supervisor: Prof. Claudio Agostinelli

University of Trento — *Trento, Italy*

Master of Science in in Mathematics for Life Sciences — *2016 - 2018*

- Thesis title: *Complex Networks and Statistical Data Depths*
- Supervisors: Dr. Manlio De Domenico, Prof. Claudio Agostinelli

Bologna Business School, Alma Mater Studiorum - Università di Bologna — *Bologna, Italy*

1st level Master in Data Science — *2015 - 2016*

- With a scholarship from the Boston Consulting Group awarded on merit.

University of Trento — *Trento, Italy*

Bachelor in Mathematics — *2010 - 2014*

- Thesis Title: *Common Principal Component Analysis with Applications*
- Supervisor: Prof. Pierluigi Novi Inverardi

Liceo Bertrand Russell — *Cles (TN), Italy*

Diploma di Liceo Linguistico — *2005 - 2010*

- 4th exchange student in Germany (Grünberg, district Giessen, Hessen)

Experience

Department of Mathematics, University of Trento — *Trento, Italy*

Research fellow — *Dec 2021 - currently*

My research activity focuses on statistical methods for structured data, e.g. graphs and networks, distance and functional data. I am highly interested in the geometry of these data and, in general, of statistical models (information geometry).

Fondazione Bruno Kessler — *Trento, Italy*

INTERN at the CoMuNe Lab — *Dec 2018 - Oct 2018*

Research activity for the MSc thesis

TIM JOL SKIL Lab, Fondazione Bruno Kessler — *Trento, Italy*

DATA SCIENTIST INTERN — *May 2016 - Oct 2016*

Data Science on telecommunication data (CDRs), from the pre-processing to the analysis of communication patterns. See *Candeago, L. et al. EPJ Data Sci. 8 (1), 19.*

Residencehotel S.p.a. Trento — *Trento, Italy*

DATA ANALYST INTERN — *May 2015 - Oct 2015*

- I developed new macros and UDFs in Excel for the analysis of data (booking engine, social networks), programming in VBA (Visual Basic for Applications)
- I built the (old) website www.residencehotel.it with Joomla!3 and custom CSS and Javascript.

Publications

Lorenzo Fellin, **Giulia Bertagnolli**, Valerio Mazzoni, Gianfranco Anfora, and 3 more. Detection and characterization of incidental vibrations from Drosophila suzukii in infested fruits. Journal of Pest Science (2023) - preprint. doi:10.21203/rs.3.rs-3039806/v1

Gaia Colombani, **Giulia Bertagnolli**, Oriol Artime. Efficient network exploration by means of resetting self-avoiding random walkers. J. Phys Complexity (2023). doi:10.1088/2632-072X/acff33

Arsham Ghavasieh, **Giulia Bertagnolli**, Manlio De Domenico. Dismantling the information flow in complex interconnected systems. Phys. Rev. Research 5, 013084 (2023). doi:10.1103/PhysRevResearch.5.013084

Giulia Bertagnolli and Manlio De Domenico. Functional rich clubs emerging from the diffusion geometry of complex networks. Phys. Rev. Research 4, 033185 (2022). doi:10.1103/PhysRevResearch.4.033185

Giulia Bertagnolli, Riccardo Gallotti and Manlio De Domenico (2021). Quantifying efficient information exchange in real network flows. Commun. Phys. 4, 125 (2021). doi:10.1038/s42005-021-00612-5

Giulia Bertagnolli and Manlio De Domenico. Diffusion geometry of multiplex and interdependent systems. Phys. Rev. E 103, 042301 (2021). doi:10.1103/PhysRevE.103.042301

Riccardo Gallotti, **Giulia Bertagnolli**, Manlio De Domenico. Unraveling the hidden organisation of urban systems and their mobility flows. EPJ Data Sci. 10, 3 (2021). doi:0.1140/epjds/s13688-020-00258-3

Nina Verstraete, Giuseppe Jurman, **Giulia Bertagnolli**, Arsham Ghavasieh, Vera Pancaldi, Manlio De Domenico. CovMulNet19, integrating proteins, diseases, drugs, and symptoms: a network medicine approach to covid-19. Network and systems medicine, Volume 3, 1, 130–141 (2020). doi:10.1089/nsm.2020.0011.

Giulia Bertagnolli, Claudio Agostinelli, Manlio De Domenico. Network depth: identifying median and contours in complex networks. Journal of Complex Networks, Volume 8, Issue 4 (2019). doi:10.1093/comnet/cnz041

Lorenzo Candeago, **Giulia Bertagnolli**, Paolo Bosetti, Michele Vescovi, Francesco Sacco and Bruno Lepri. Cities of a feather flock together: a study on the synchronization of communication between Italian cities. EPJ Data Sci. 8 (1), 19 (2019). doi:10.1140/epjds/s13688-019-0198-4

Books

Oriol Artime, Barbara Benigni, **Giulia Bertagnolli**, Valeria D'Andrea, Riccardo Gallotti, Arsham Ghavasieh, Sebastian Raimondo, Manlio De Domenico (2022). Multilayer Network Science: From Cells to Societies (Elements in the Structure and Dynamics of Complex Networks). Cambridge: Cambridge University Press. doi:10.1017/9781009085809

Recent Talks

Workshop of the Italian chapter of the Complex Systems Society *online*

Workshop CSS/Italy *May 25 2022*

Giulia Bertagnolli and Manlio De Domenico. Functional rich-clus in complex networks. **Invited** talk.

Conference on Complex Systems *Lyon, FR*

CCS2021 *Oct 25-29 2021*

Giulia Bertagnolli and Manlio De Domenico. Diffusion geometry of multiplex and interdependent systems.

A Joint Sunbelt and NetSci Conference *IUNI Indiana, US*

Networks 2021 *Jul 5-10 2021*

Giulia Bertagnolli and Manlio De Domenico. Diffusion geometry of multiplex and interdependent systems.

International (Online) Conference on Complex Networks *Exeter, UK*

CompleNet Live 2021 *May 24-26 2021*

Giulia Bertagnolli and Manlio De Domenico. Diffusion geometry of multiplex and interdependent systems.

International (Online) Conference on Complex Systems *Thessaloniki, GR*

CCS 2020 *Dec 4-11 2020*

Giulia Bertagnolli and Riccardo Gallotti and Manlio De Domenico. Quantifying efficiencient information exchange in real network flows. DOI: 10.5281/zenodo.4419178

International School and Conference (Online) on Network Science *Rome, IT*

NETSCI 2020 *Sept 7-15 2020*

Giulia Bertagnolli and Riccardo Gallotti and Manlio De Domenico. Quantifying efficiencient information exchange in real network flows.

International School and Conference (Online) on Network Science *Rome, IT*

NETSCI 2020 - NetCent Satellite *Sept 7-15 2020*

Giulia Bertagnolli and Claudio Agostinelli and Manlio De Domenico. Network depth: identifying median and contours in complex networks.

Higher-order connectivity and correlations in complex systems *Vienna, AT*

CSH Workshop on Higher-order interactions *Nov 25-26 2019*

Giulia Bertagnolli and Manlio De Domenico. Diffusion processes and the functional organization of complex networks.

Teaching Activity

The geometry of statistical models *Trento, Italy*

Teaching *March 2023*

A short course (8h) to introduce some students of the master in Mathematics, curriculum: Mathematics and Statistics for Life and Social Sciences (track: Mathematics for data science) to Information geometry. Details on my webpage

Probability and Statistics Undergraduate Course *Trento, Italy*

Tutor *Spring sem. 2022/2023*

42h of tutoring/teaching in the Probability and Statistics course for the Undergraduate degree in Computer Science

Probability and Statistics Undergraduate Course *Trento, Italy*

Tutor *Spring sem. 2021/2022*

30h of tutoring/teaching in the Probability and Statistics course for the Undergraduate degree in Computer Science

Graphical models and network science *Trento, Italy*

Invited lecturer *12h Dec. 2021*

An introduction to network science for the Master degree in Mathematics, inside the course "Graphical models and network science" of prof. Veronica Vinciotti.

Fundamentals of network analysis: hands on *Trento, Italy*

Seminar *4h Spring 2021*

Seminar for the course "Network Science: theory and lab" of the MSc in Data Science.

Fundamentals of network analysis: hands on *Trento, Italy*

Seminar *6h Spring 2020*

Seminar for the course "Network Science: theory and lab" of the MSc in Data Science.

Probability and Statistics Undergraduate Course *Trento, Italy*

Tutor *Autumn sem. 2018/2019*

34h of tutoring/teaching in the Probability and Statistics course for the Undergraduate degree in Computer Science

Thesis supervision

I co-supervised the master thesis of G. Colombani, see the theses section on my unitn page. An article resulting from this work is under review in *Journal of Physics: Complexity*.

Other Projects

R package: diffudist Released on CRAN and gbertagnolli.github.io/diffudist CRAN, this R package collects the functions for the computation of diffusion distances on complex (single-layer) networks.

R package: intsegration Released on github.com/gbertagnolli/intsegration, this R package enables the evaluation of the efficiency of weighted networks. The main algorithm is written in C, as a variation on the classic Floyd-Warshall algorithm for computing weighted shortest paths and distances. This package collects the code used in the paper [EPJ Data Sci. 10, 3 (2021)] and [Commun. Phys. 4, 125 (2021)].

R package: muxViz 3.0 I contributed in this R package by Dr. Manlio De Domenico. In particular I built the R package, starting from R scripts, built the package website, using pkgdown, and helped deploying it on github.

Notte dei Ricercatori e della Ricerca 2019, 2021, 2023. Since the first year of my PhD, I always took part to the Researcher's night, with projects on networks and complex systems (2019, 2021) and on statistics (2023). In 2023, in particular, the demo is called "Statistica dove non te l'aspetti" and show-cases, among others, functional data analysis methods for the analysis of vibrational data.

Orientamento Dipartimento Matematica I often take part (2023, 2022, 2019) in *orientation* activities for high-school student, which aim to help students in the choice of a university course.

Research Visits

Research visit to prof. Nihat Ay *Hamburg, Germany*

TUHH - Institute for Data Science Foundations *April-May 2023*

Nihat Ay is an expert in the field of Information Geometry. Project: Ingormation geometry of graphs, in collaboration with Giovanni Pistone, another expert in the field.

Nonparametric Information Geometry Lecture Series and Seminar DIMA UNIGE *Genova, Italy*

GIANNIDIORESTINO.IT/HTMLS/2023-IG-SEMINAR.HTML *Spring 2023*

PhD course given by Giovanni Pistone to the research group of Eva Riccomagno.

Summer & Winter Schools

Mathematical foundations of Quantum Machine Learning *Trento, Italy*

DATASCIENCE.MATHS.UNITN.IT/EVENTS/QML2023 *July, 10-14 2023*

An introduction to the mathematical theory underlying Quantum Machine Learning, with three short courses held by professors G. De Palma, D. Trevisan, L. Banchi.

Machine Learning: From Data to Mathematical Understanding *Cetraro, Italy*

C.I.M.E. COURSE 2003 *July, 2-9 2023*

The school focuses on the interplay between nonlinearity, nonsmoothness, and nonconvexity in high-dimensional probability and optimization and to acquire a deep understanding of relevant practical applications, such as image processing and classification. Lecturers: Schönlieb, Rigollet, Rosasco, Tropp, Wright.

Semiparametric Learning *Trento, Italy*

DATASCIENCE.MATHS.UNITN.IT/EVENTS/SPL2021 *July, 26-30 2021*

An introduction to semiparametric methods in its general abstract form, and derive its detailed analytic forms in various applications including simple mean estimation, and more complex measurement error models, dimension reduction problems, missing data/causal inference problems. Lecturer: Yanyuan Ma.

Mediterranean School on Complex Networks *Salina (Sicily), Italy*

MEDITERRANEANSCHOOLCOMPLEX.NET/2019.HTML *August, 31-September, 7 2019*

The goal of this school is to provide a theoretical background to student (Master, PhD) and young researchers in the field, with particular attention to current trends in Network Science, and to promote philosophical and scientific exchange between all participants, lecturers and attendant.

Short courses *Trento, Italy*

VARIOUS *2019-2023*

I followed several short courses mosly in the fields of probability and statistics, among which “Asymptotics in statistics” by Alessandra Salvan, “Empirical processes” by Anand Vidyashankar, “An introduction to Malliavin calculus” by Luciano Tubaro, a reading-course on “Optimal transport”, “An introduction to Bayesian Non Parametrics” by Antonio Canale, “Algebraic statistics” by Kaie Kubjas, “Probabilistic Preference Learning with distance-based ranking models” by Valeria Vitelli.

Reviewer Activity

My peer review activity is documented on the Web of Science ResearcherID: GQB-0396-2022. I reviewed articles for:

- Information Geometry – Springer
- Statistics Surveys – Institute of Mathematical Statistics
- Journal of the Royal Statistical Society: Series A (Statistics in Society) – Royal Statistical Society
- Physical Review E – American Physical Society
- Journal of Physica A: Mathematical and Theoretical – IOP Publishing (Selected as an Outstanding Reviewer for Journal of Physics A: Mathematical and Theoretical for 2019)
- Physical Biology – American Physical Society