Vittorio **Erba**

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Brief presentation

During my Ph.D. I focused on the study of Euclidean disordered systems, i.e. systems in which quenched disorder appears in the form of a random point process in Euclidean space. I studied analytically and numerically models of combinatorial optimization problems, amenable to exact solutions in 1d, and models of Euclidean data structure in Data Science and Machine Learning, amenable to exact solutions in the limit of infinite dimension.

Future position: Postdoc at Statistical Physics of Computation Laboratory   Starting Fall 2021
École polytechnique fédérale de Lausanne   Lausanne (CH)

- − Supervisor: Lenka Zdeborová
- − Research topics: Statistical physics of machine learning

Current position: Ph.D. in Theoretical Physics   2018 - 2021 (expected)
Università degli Studi di Milano   Milano (IT)

- − Supervisor: Sergio Caracciolo
- − Research topics: Euclidean random combinatorial optimization, Machine learning, Disordered systems
- − Main collaborators: Sergio Caracciolo, Marco Gherardi, Pietro Rotondo, Andrea Sportiello

Education

M.Sc. in Physics (110 cum laude/110)   2016 - 2018
Università degli Studi di Milano   Milano (IT)

- − Thesis supervisor: Sergio Caracciolo
- − Thesis title: Random Euclidean bipartite matching with concave cost functions in 1d

B.Sc. in Physics (110 cum laude/110)   2013 - 2016
Università degli Studi di Milano   Milano (IT)

- − Thesis supervisor: Luca Molinari
- − Thesis title: Slater decomposition of fractional quantum Hall states

Publications

8. **Self-induced quenched disorder in multimodal cavity quantum electrodynamics.** Erba, Pastore, Rotondo. Physical Review Letters (2021).

7. **The number of optimal matchings in the Euclidean assignment problem on the line.** Caracciolo, Erba*, Sportiello. Journal of Statistical Physics (2021)

6. **The p-Airy distribution.** Caracciolo, Erba*, Sportiello. Preprint Arxiv (2020)

5. **Statistical learning theory of structured data.** Pastore, Rotondo, Erba, Gherardi. Physical Review E (2020, Editor's suggestion)

4. **Random geometric graphs in high dimension.** Erba, Ariosto, Gherardi, Rotondo. Physical Review E (2020)

3. **The Dyck bound in the concave 1-dimensional random assignment model.** Caracciolo, D'Achille, Erba*, Sportiello. Journal of Physics A (2020)

2. **Intrinsic dimension estimation for locally undersampled data.** Erba, Gherardi, Rotondo. Scientific Reports (2019)

1. **Unified Fock space representation of fractional quantum Hall states.** Di Gioacchino, Molinari, Erba, Rotondo. Physical Review B (2017)

*: authors are listed in alphabetical order. I had a major role in the research projects and writing related to these papers.

I have been a reviewer for the following international journals: Physica A: Statistical Mechanics and its Applications

Schools & Internships

School — Glassy Systems and Inter-Disciplinary Applications   07/2021
Institut d'Etudes Scientifiques   Cargèse (FR)

- Lectures and research seminars on the physics of glassy systems, both from a theoretical and a phenomenological point of view, and on inter-disciplinary applications in biology, economics, material engineering and machine learning.

School — Mathematical and Computational Aspects of Machine Learning   10/2019
Ennio De Giorgi center   Pisa (IT)

- Lectures on optimal transport, mean field Bayesian inference, numerical methods in machine learning and approximation theory

School — Lectures on Statistical Field Theories   02/2019
Galileo Galilei Institute   Firenze (IT)

- Lectures on tensors networks, Floquet physics, Luttinger liquids and transport phenomena in 1d

Internship — ESRF/ILL International Student Summer Programme   09/2015
European Synchrotron Radiation Facility   Grenoble (FR)

- Lectures on X-ray and neutron physics and on imaging techniques
- Experimental project with the ID26 - "X-ray absorption and emission spectroscopy" group (PI: Pieter Glatzel) on the measurement of Eu3+ fluorescence spectrum

Talks and Posters

Seminar | Data structure in machine learning: estimators and models   15/12/2020
Lenka Zdeborová's group, École polytechnique fédérale de Lausanne   Virtual

Seminar | Intrinsic dimension estimation for locally undersampled data   12/11/2019
Michele Parrinello's group, Università della Svizzera Italiana   Lugano (CH)

Talk | Intrinsic dimension estimation for locally undersampled data   31/10/2019
Complex System Meeting, Università degli Studi di Milano   Milano (IT)

Poster | Intrinsic dimension estimation for locally undersampled data   24/06/2019
XXIV Statistical Physics Meeting, Università degli Studi di Parma   Parma (IT)

Honors & Awards

Ph.D Scholarship   2019 - 2021
Awarded by Università degli Studi di Milano

Excellence Scholarship   2015 - 2017
Awarded by Università degli Studi di Milano to students complying with annual courses requirements

Skills

- **Programming:** Julia, C++, Mathematica, Python
- **M. Learning/Optimization::** PyTorch, Flux, JuMP, CPLEX
- **Tools/Techs:** Bash, LaTeX, Inkscape
- **Web:** HTML, CSS

Languages

- **Italian:** Mothertongue
- **English:** Fluent, CEFR C1 (Certifications: Cambridge BULATS C1 (2019), Cambridge FCE B2 (2012))

Teaching

Tutoring for university courses   Spring 2019 - Present
University of Milan   Milano (IT)

- Spring 2021: Mathematical methods in physics (complex and functional analysis)
- Fall 2020: Numerical treatment of experimental data (C++, OOP and numerical methods)
- Fall 2020: Precourse of mathematics for freshmen in physics (basic maths)
- Spring 2020: Mathematical methods in physics (complex and functional analysis)
- Fall 2019: Recovery course of mathematics for freshman in natural sciences (basic maths)
- Spring 2019: Mathematical methods in physics (complex and functional analysis)

Thesis supervision   Fall 2019
University of Milan   Milano (IT)

- Fall 2019, Sebastiano Ariosto, "Random geometric graphs in high dimension"
- Fall 2019, Mirko Rossini, "Geometry of structured datasets via multi-scale persistency analysis"

Substitute physics teacher for a secondary public school   10/2016 - 06/2017
Istituto Professionale "L. Einaudi"   Varese (IT)

Participation to conferences

Symposium on Explanation in Neuroscience and Artificial Intelligence   02/2021
Virtual venue

Brain Criticality Meeting   10/2020
Virtual venue

Complex Systems Meeting   10/2019
University of Milan   Milano (IT)

XXIV Statistical Physics Meeting   06/2019
University of Parma   Parma (IT)

International Conference of Physics Students 2016 & 2017
Organized by IAPS (International Association of Physics Students)

Italian Conference of Physics Students 2015, 2016 & 2017
Organized by AISF (Italian Association of Physics Students)

Other experiences

Student job at the office for didactics 11/2017 - 03/2018
Università degli Studi di Milano, Maths dept. Milano (IT)

- Responsible for exams' scheduling
- Responsible for the update of the informations on courses, professors and exams on the department websites

Secretary and IT contributor 09/2014 - 12/2017
Italian Association of Physics Students

- Responsible for the bureaucracy of the non-profit association
- Contributor to the development of the public website and the private online database of the association
- Organizer of the PAPAP16 event, a visit to the Gran Sasso national laboratories with 40 participants from all around Europe
- Organizer of outreach events in high schools
- Volunteer for the XXXII International Conference of Physics Students