Phone: +447383755005
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Webpage: https://conj34.github.io

Updated: November '24

Domenico Mergoni

Curriculum

Education

2020 - now **PhD in Discrete Mathemathics**, London School of Economics, UK.
Expected: 2025

2018 - 2020 **MSc in Pure Mathematics**, ETH Zürich, Switzerland.
GPA: 5.77/6 'cum laude'

2015 - 2018 **BSc in Pure Mathematics**, University of Pisa, Italy.
GPA: 110/110

Working Experiences

- Applied Scientist (at Amazon),
  6 months internship, Jun-Dec 2024. Focus on the ILS Metaheuristics.
- Teaching (at London School of Economics):
  - Statistics and Machine Learning (2022-23):
    MA310: Machine Learning; MA455: Reinforcement Learning (MSc course).
  - Finance (2023):
    FM250: Finance; ME200: Comp. Methods in Financial Mathematics.
  - Management (2022-23) - Lecturer:
    Pre-sessional course for LSE Global Master's in Management.
  - Mathematics (2020-22):
    Discrete Mathematics, Fundamentals of Operations Research, etc.
- Other:
  - Research Assistant:

* 2023 **Supply chains** @LSE Management dept. Work on the *beer decision game*.

  - Managerial positions:

* 2021-now **Senior Subwarden**@ LSE. *Lead of a 10-people team to oversee students' wellbeing.*
2023 **Main organiser** for PCC2024. *Lead of a 4-people team.*

  - Internships:

2020 **PigeonLine**. *Applications of graph theory to statistical analysis of correlations.*
2019 **Operations Team**, ETH Entrepreneur Club.

Coding

* Python Advanced, *(Codeforces; GTA of MSc RL course)*
Kotlin Advanced, *Industry experience at Amazon*
R Intermediate, *(GTA of Machine Learning with R)*

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Awards and Grants

* 2022 **LMS Computer Science Small Grant**, London Mathem. Society.
2021 **LSE Contribution Award**, Dept. of Maths, LSE.

Papers (selected)

Areas: Pure Mathematics, Reinforcement Learning, Game Theory, Optimisation, Methodology.

Work in progress

* 2024++ **Reinforcement Learning for Combinatorial Games.**
* 2024++ **Methodology for carbon credit assessment**, with A. Perrella, G. Marastoni.
* 2024+ `Re-ILS`**: a metaheuristic approach for cardinality-constrained optimization**, with Amazon ATS team.
* 2024+ **Combinatorial theorems in extremely sparse random sets**, with P. Allen, J. Boettcher, J. Lada.

Submitted

* 2024 **Reinforcement Learning, Collusion, and the Folk Theorem**, with G. Ashkenazi-Golan, E. Plumb, https://arxiv.org/abs/2411.12725.
2024 **Dirac's theorem for graphs of bounded bandwidth**, with A.E. Díaz, P. Gupta, O. Parczyk, A. Sgueglia, https://arxiv.org/abs/2311.18796.
2023 **Product free sets in** $[n]$, with L. Mattos, O. Parczyk, https://arxiv.org/abs/2311.18796.

Accepted

* 2023 **The Ramsey numbers of squares of paths and cycles**, with P. Allen, B. Roberts, J. Skokan, The Electronic Journal of Combinatorics.

Relevant Talks and Conferences

Organiser

* 2024 **PCC**, Main Organiser, University of London (LSE, UCL, KCL),
2022/23 **PhD CGO Seminar**, *PhD Organiser*, LSE.

Summer Schools

* 2023 **EEML**, *Invited participant*, Summer School organised icw DeepMind,
2023 **Charles University Spring School**, *Invited Participant*.

Speaker (selected)

09/2023 **Invited Speaker**, *Ramsey number of* P_n^2, @DMV Ilmenau,
08/2023 **Contributed Talk**, *Hypergraph partition universality*, @EuroComb Prague,
07/2022 **Contributed talk**, *Chromatic profile of* $\{C_3, \dots, C_{2k-1}\}$, @RSA Poznan,
07/2022 **Contributed talk**, *Ramsey number of* P_n^2, @ICGT Montpellier,
06/2022 **Invited seminar**, *Ramsey number of* P_n^2, @TU Hamburg,
05/2019 **Mittagsseminar**, *Minimal Ramsey Graphs for Ciclicity*, ETHZ (Supervised by C. Knierim).

Languages (ordered by proficiency)

Italian	Native
English	C2 level; IELTS test score: 8.0 on July 2018
Spanish	C1 level
Portuguese	A1/A2; work in progress

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Statement

I am a PhD Student in Graph Theory with research interests also in Reinforcement Learning and Game theory. As such, I have been following the applications of Neural Networks and AI to finding counterexamples in Graph Theory since the first result of Wagner in 2021 and through the various positive and negative results since. I have also followed with interest the recent successes that are bridging every day more the world of mathematical proofs with the world of what we can attach via ML/RL and similar AI techniques. I see on one side the potential for many new applications of these techniques to Combinatorics (I think in particular of using RL to get insights on Combinatorial games, such as Maker-Breaker), on the other side I see the potential wider impact on working on tools to automate the verification of maths on a larger scale, and I would like to contribute to this process.
I am really excited to take part in this workshop, as I am convinced that my expertise in Graph Theory, Game Theory, and Reinforcement learning would be a useful contribution to the other members: RL is known to do well for Games, and there are contradictory results on whether it does well with Combinatorics, I believe it would be interesting to know if it does well in combinatorial games. Moreover, I hope from this workshop to get new insights of the techniques that are currently used in particular in the area of formalisation of theoretical proofs, and in AI assisted maths. I hope to gain useful contacts and resources to be part of this community for the long term.