



# Fabrizio Frasca

*Postdoctoral Fellow at Technion – Israel Institute of Technology*

Researching principled and effective learning over structured data, with a focus on Equivariance and Expressiveness. Working on learning from LLM computational traces and graph-structured data, and on the application of LLMs thereon. Experienced in collaborative, interdisciplinary research environments; dedicated, communicative, and adaptive.

## Education

- Sept 2018 - **PhD Computing**, *Imperial College London*, Advisor: Prof. M. Bronstein.  
Nov 2023 Dissertation title: *Expressive and Efficient Graph Neural Networks*.  
Geometric Deep Learning on graph-structured data. The thesis centres around the design and study of Graph Neural Network architectures attaining provable expressive power whilst retaining an advantageous computational complexity. Additionally, assisted the teaching of the BSc course of Linear Algebra. The PhD programme originally started at Università della Svizzera Italiana (Switzerland) and was then moved to Imperial College London to follow my advisor.  
**Examination passed *without corrections*.**
- Sept 2015 - **MSc Computer Science and Engineering**, *Politecnico di Milano*.  
Apr 2018 Dissertation title: *Data-driven Modeling of Epigenetic Transcriptional Regulation*.  
Gained comprehensive theoretical understanding in the related fields of data analysis, machine learning, artificial intelligence, complex systems and networks. Learnt about advanced and parallel algorithmic techniques.  
Grade: **110 cum laude / 110**
- Sept 2012 - **BSc Computer Science and Engineering**, *Politecnico di Milano*.  
Sept 2015 Comprehensively learnt about engineering and computer science fundamentals.  
Grade: **110 cum laude / 110**

## Work Experience

- Jan 2024 - **Postdoctoral Fellow**, *Technion – Israel Institute of Technology*, Host: Prof. H. Maron.  
now Researching Geometric Deep Learning and, in particular, Equivariance, Expressiveness, Graph Neural Networks.
- May 2019 - **Machine Learning Researcher**, *Twitter UK*.  
Feb 2023 Member of the Cortex Graph Learning Research team. Focus: theoretical underpinnings of Graph Neural Networks and their efficient application in industrial settings.
- February **Teaching Assistant**, *Università della Svizzera Italiana*.  
2019 - Assisted Teaching the BSc course of Linear Algebra taught by Prof. I. Pivkin. Held multiple exercise sessions, prepared and evaluated homework assignments and supported examinations.
- June 2019
- July 2018 - **Data Scientist**, *Fabula AI*.  
May 2019 Researched and developed Geometric Deep Learning techniques and pipelines for (fake) news classification. Fabula AI has been acquired by Twitter in May 2019.

Apr 2016 – **Course Tutor**, *Politecnico di Milano*.

June 2017 Tutored BSc and MSc students over the courses of Software Engineering and Computer Architecture and Operative Systems. Held theoretical lectures and exercise sessions.

## Publications (\* indicates equal contribution)

- [1] **Neural Message-Passing on Attention Graphs for Hallucination Detection**, [Frasca\\* F](#), [Bar-Shalom\\* G](#), [Ziser Y](#), [Maron H](#), (preprint).
- [2] **GraphBench: Next-generation graph learning benchmarking**, [Siraudin\\* A](#), [Qian\\* C](#), [Finkelshtein\\* B](#), [Parviz\\* A](#), [Weber\\* D](#), [Frasca\\* F](#), [Shavit\\* H](#), [Stoll\\* T](#), [Mielke\\* A](#), [Anastacio\\* M](#), [Müller\\* E](#), [Bechler-Speicher M](#), [Bronstein M](#), [Galkin M](#), [Hoos H](#), [Niepert M](#), [Perozzi B](#), [Tönshoff J](#), [Morris C](#), (preprint).
- [3] **Lost in Serialization: Invariance and Generalization of LLM Graph Reasoners**, [Herbst\\* D](#), [Karbevskaya\\* L](#), [Kumar\\* D](#), [Ahuja\\* A](#), [Gholamzadeh Nasrabadi\\* F](#), [Frasca F](#), (preprint).
- [4] **FS-KAN: Permutation Equivariant Kolmogorov-Arnold Networks via Function Sharing**, [Elbaz R](#), [Bar-Shalom G](#), [Eitan Y](#), [Frasca F](#), [Maron H](#), (preprint).
- [5] **On the Expressive Power of GNN Derivatives**, [Eitan Y](#), [Eliasof M](#), [Gelberg Y](#), [Frasca F](#), [Bar-Shalom G](#), [Maron H](#), (preprint).
- [6] **Beyond Token Probes: Hallucination Detection via Activation Tensors with ACT-ViT**, [Bar-Shalom\\* G](#), [Frasca\\* F](#), [Ziser Y](#), [Maron H](#), NeurIPS 2025.
- [7] **Beyond Next Token Probabilities: Learnable, Fast Detection of Hallucinations and Data Contamination on LLM Output Distributions**, [Bar-Shalom\\* G](#), [Frasca\\* F](#), [Lim D](#), [Gelberg Y](#), [Ziser Y](#), [El-Yaniv R](#), [Chechik G](#), [Maron H](#), Question ICLR 2025 workshop, **Spotlight presentation**.
- [8] **Understanding and Improving Laplacian Positional Encodings For Temporal GNNs**, [Galron Y](#), [Frasca F](#), [Maron H](#), [Treister E](#), [Eliasof M](#), ECML-PKDD 2025.
- [9] **Balancing Efficiency and Expressiveness: Subgraph GNNs with Walk-Based Centrality**, [Southern\\* J](#), [Eitan Y](#), [Bar-Shalom G](#), [Bronstein M](#), [Maron H](#), [Frasca\\* F](#), ICML 2025.
- [10] **Position: Graph Learning Will Lose Relevance Due To Poor Benchmarks**, [Bechler-Speicher\\* M](#), [Finkelshtein\\* B](#), [Frasca\\* F](#), [Müller\\* L](#), [Tönshoff\\* J](#), [Siraudin A](#), [Zaverkin V](#), [Bronstein MM](#), [Niepert M](#), [Perozzi B](#), [Galkin M](#), [Morris C](#), ICML 2025.
- [11] **Topological Blindspots: Understanding and Extending Topological Deep Learning Through the Lens of Expressivity**, [Eitan Y\\*](#), [Gelberg\\* Y](#), [Bar-Shalom G](#), [Frasca F](#), [Bronstein MM](#), [Maron H](#), ICLR 2025, **Oral presentation** (1.8% acceptance rate).
- [12] **Towards Foundation Models on Graphs: An Analysis on Cross-Dataset Transfer of Pretrained GNNs**, [Frasca F](#), [Jogl F](#), [Eliasof M](#), [Ostrovsky M](#), [Schönlieb CB](#), [Gärtner T](#), [Maron H](#), NeurIPS NeurIPS 2024 workshop.
- [13] **A Flexible, Equivariant Framework for Subgraph GNNs via Graph Products and Graph Coarsening**, [Bar-Shalom\\* G](#), [Eitan\\* Y](#), [Frasca F](#), [Maron H](#), NeurIPS 2024 & NeurIPS NeurIPS 2024 Workshop, **Best paper award and oral presentation** at the NeurIPS workshop.
- [14] **Position: Future Directions in the Theory of Graph Machine Learning**, [Morris C](#), [Frasca F](#), [Dym N](#), [Maron H](#), [Ceylan İl](#), [Levie R](#), [Lim D](#), [Bronstein MM](#), [Grohe M](#), [Jegelka S](#), ICML 2024.
- [15] **Edge Directionality Improves Learning on Heterophilic Graphs**, [Rossi E](#), [Charpentier B](#), [Di Giovanni F](#), [Frasca F](#), [Günemann S](#), [Bronstein MM](#), Learning on Graph 2023.
- [16] **Graph Positional Encoding via Random Feature Propagation**, [Eliasof M](#), [Frasca F](#), [Bevilacqua B](#), [Treister E](#), [Chechik G](#), [Maron H](#), ICML 2023.

- [17] **Graph Neural Networks for link prediction with subgraph sketching**, *Chamberlain\* BP, Shirobokov\* S, Rossi E, Frasca F, Markovich T, Hammerla N, Bronstein MM, Hansmire M*, ICLR 2023, **Notable top 5% paper**.
- [18] **Understanding and extending Subgraph GNNs by rethinking their symmetries**, *Frasca\* F, Bevilacqua\* B, Bronstein MM, Maron H*, NeurIPS 2022, **Oral presentation** (1.7% acceptance rate).
- [19] **Equivariant subgraph aggregation networks**, *Bevilacqua\* B, Frasca\* F, Lim\* D, Srinivasan B, Cai C, Balamurugan G, Bronstein MM, Maron H*, ICLR 2022, **Spotlight presentation** (5% acceptance rate).
- [20] **Accurate and highly interpretable prediction of gene expression from histone modifications**, *Frasca F, Matteucci M, Leone M, Morelli MJ, Masseroli M*, BMC Bioinformatics, 2022.
- [21] **Improving Graph Neural Network expressivity via subgraph isomorphism counting**, *Bouritsas G, Frasca F, Zafeiriou SP, Bronstein MM*, IEEE TPAMI, 2022.
- [22] **Weisfeiler and Lehman go cellular: CW networks**, *Bodnar\* C, Frasca\* F, Otter N, Wang Y, Liò P, Montúfar GF, Bronstein MM*, NeurIPS 2021.
- [23] **Weisfeiler and Lehman go topological: Message Passing Simplicial Networks**, *Bodnar\* C, Frasca\* F, Wang\* Y, Otter N, Montúfar\* GF, Liò P, Bronstein MM*, ICML 2021.
- [24] **Exposing and characterizing subpopulations of distinctly regulated genes by K-plane regression**, *Frasca F, Matteucci M, Morelli MJ, Masseroli M*, CIBB 2018, extended in Lecture Notes in Bioinformatics (LNBI), 2020.
- [25] **SIGN: Scalable Inception Graph Neural Networks**, *Frasca\* F, Rossi\* E, Eynard D, Chamberlain B, Bronstein MM, Monti F*, GRL+ ICML Workshop 2020.
- [26] **Temporal graph networks for deep learning on dynamic graphs**, *Rossi E, Chamberlain B, Frasca F, Eynard D, Monti F, Bronstein MM*, GRL+ ICML Workshop 2020.
- [27] **Learning interpretable disease self-representations for drug repositioning**, *Frasca\* F, Galeano\* D, Gonzalez G, Laponogov I, Veselkov K, Paccanaro A, Bronstein MM*, GRL NeurIPS Workshop 2019.
- [28] **Fake news detection on social media using geometric deep learning**, *Monti F, Frasca F, Eynard D, Mannion D, Bronstein MM*, RLGM ICLR Workshop 2019.
- [29] **Modeling gene transcriptional regulation by means of hyperplanes genetic clustering**, *Frasca F, Matteucci M, Masseroli MJ, Morelli M*, IJCNN 2018.

## Tutorials and Lectures

- Lecture **Graph Learning, Equivariance and Expressiveness**, Course on Groups and Deep Learning, Technion – Israel Institute of Technology, July 2025
- Lecture **Pack your subgraphs: A journey into subgraphs for powerful Graph Neural Networks**, Geometric Deep Learning Course, Oxford University, Mar 2023
- Tutorial **Exploring the practical and theoretical landscape of expressive Graph Neural Networks**, Lecture **Subgraph Networks**, Learning on Graph Conference 2022
- Tutorial **The expressive power of GNNs by the WL test**, London Geometry and Machine Learning Summer School 2021

## Talks

### Expressive (and efficient) Graph Neural Networks

- [9,18,19] ◦ **Keynote:** “Advances in Subgraph GNNs for Expressive and Efficient Learning on Graphs”, Learning on Graph Meetup, Siena, Dec 2024
- [18,19,22,23] ◦ “Towards Expressive and Efficient Graph Neural Networks”, Weekly Talks, Prof. T. Gärtner’s ML Research Unit, Mar 2024
- [18,19] **Subgraphs for expressive Graph Neural Networks**
  - Seminar at Imperial College London, UK (Host: Prof. Yves-Alexandre de Montjoye), Mar 2023
  - Learning on Graphs and Geometry Reading Group, Nov 2022
  - Seminar at Università Sapienza, Rome, Italy (Host: Prof. Simone Scardapane), Nov 2022
  - Meta AI orgs Reading Meeting, Nov 2022
  - Seminar at École Polytechnique, France (Host: Prof. Maks Ovsjanikov), July 2022
  - African Masters of Machine Intelligence, 2<sup>nd</sup> Geometric Deep Learning Course, July 2022
  - Learning on Graphs and Geometry Reading Group, Dec 2021
  - 3<sup>rd</sup> NAAMI Nepal Winter School in AI, Dec 2021
- [22,23] **Simplicial and Cellular Complexes for Graph Representation Learning**
  - Dagstuhl Seminars – Graph Embeddings: Theory meets Practice, Mar 2022
  - Learning on Graphs and Geometry Reading Group, Sept 2021
  - African Masters of Machine Intelligence, 1<sup>st</sup> Geometric Deep Learning Course, July 2021
  - TopoNets 2021 – Networks Beyond Pairwise Interactions, June 2021
  - Seminar at Cambridge University, UK (Host: Prof. Mateja Jamnik), May 2021
  - Math Machine Learning seminar MPI MIS + UCLA, Apr 2021

#### About peer-reviewing

- “Reviewing at LOG 2022, my experience and unsolicited thoughts”, Learning on Graph 2022

## Other Academic Experiences

### Mentor – London Geometry and Machine Learning Summer School 2025.

Selected to mentor five students on the proposed project “Beyond Text: Exploring Adaptations of LLMs for Graph-Based Tasks”. Led to [3].

### Cofounder and organizer – Graph Learning On Wednesdays Reading Group, Oct 2024 - Now.

Founded and leading the organisation of GLOW (Graph Learning On Wednesdays), an online reading group fostering the dissemination of the latest developments in Graph Machine Learning and interactive discussions and panels on the future thereof. Moderated several interactive, panel-like discussions.

### Panelist – The future and challenges of Graph Learning.

Invited to take part into the Graph Learning Social’s panel at ICML 2024 to discuss on the future and challenges of Machine Learning on graphs in the era of foundation models and generative AI.

### Postdoctorate Research Visitor, TU Wien, March 2024 - Sept 2024.

Visited Prof. Thomas Gärtner’s Machine Learning unit. Explored approaches for the development of Graph Foundation Models, led to [12].

### Student Attendee – London Geometry and Machine Learning Summer School 2022.

Selected as contributor in the project: “Equivariant poset representations”.

### Student Attendee – London Geometry and Machine Learning Summer School 2021.

Selected as main contributor in the project: “Improved expressive power for message-passing networks via subgraph aggregation”, which led to a the ICLR publication [19].

### Postgraduate Research Visitor, Imperial College London, Oct 2018 - Jan 2019.

Visited Dr. Kirill Veselkov for applications of Geometric Deep Learning to Drug Repurposing; led to [27].

## Team Lead – Distributed and Outsourced Software Engineering, 2015, Politecnico di Milano.

Led a distributed team in software design, development and inspection at the 2015 Distributed and Outsourced Software Engineering (DOSE) Project organised by ETH Zurich.

## Awards

**Aly Kaufman Fellowship**, *Awarded the Aly Kaufman Post-Doctoral Fellowship (two nominees per year)*, Technion – Israel Institute of Technology, Academic Year 2024/2025.

**Top reviewer**, *Selected amongst the top reviewers (best 8,7%)*, NeurIPS, 2024.

**Finci-Viterbi Fellowship**, *Awarded the Andrew and Erna Finci Viterbi Post-Doctoral Fellowship*, Faculty of Electrical and Computer Engineering, Technion – Israel Institute of Technology, Academic Year 2023/2024.

**Best reviewer**, *Selected amongst the top 20 reviewers*, Learning on Graph (LoG) Conference, 2022.

**Third placement**, *Bug-finding competition*, DOSE Project, 2015.

## Reviewing Activity

- International Conference on Learning Representations (ICLR)
- International Conference on Machine Learning (ICML)
- Neural Information Processing Systems (NeurIPS)
- AAAI Conference on Artificial Intelligence (AAAI)
- Learning On Graph Conference (LOG)
- Mining and Learning with Graphs Workshop @ ECMLPKDD 2025 (MLG)
- Graph Representation Learning and Beyond Workshop @ ICML 2020 (GRL+)

## Skills

Python [PyTorch (Geometric), TensorFlow/Keras, Sci-kit Learn, PySpark] · Java · C · MATLAB · Eiffel

## Languages

Italian · English · German (A1) · French (middle school)