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# Lorenzo Bini

Geneva, Switzerland | [Lorenzo.Bini@unige.ch](mailto:Lorenzo.Bini@unige.ch) | [022 3790124](tel:0223790124) | [Webpage](#) | [linkedin.com/in/lorenzo-bini4](https://linkedin.com/in/lorenzo-bini4)  
[github.com/LorenzoBini4](https://github.com/LorenzoBini4)

## Education

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- University of Geneva**, Ph.D. Candidate - Department of Computer Science & CUI Nov 2022 – Ongoing
- Major: Artificial Intelligence and Machine Learning.
  - Research interests: Graph neural networks, adversarial learning, representation learning, active and self-supervised learning. Generative AI for medicine and healthcare, including 3D genomics and scRNA data generation. Implementation of robust adversarial models within weak/self-supervised training strategies to reduce label acquisition costs.
- Polytechnic of Turin**, Master of Science in Physics of Complex Systems Sep 2020 – Sep 2022
- GPA: 4.0/4.0
- Alma Mater Studiorum - University of Bologna**, Bachelor degree in Physics & Astronomy Systems Sep 2017 – Sep 2020
- GPA: 4.0/4.0

## Experience

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- Research Assistant**, Hôpitaux Universitaires de Genève (HUG) – Geneva, Switzerland Nov 2022 - Ongoing
- Detection of minimal residual disease (MRD) of acute lymphoblastic and myeloid leukemia (AML/ALL) from flow cytometry data.
  - Development of fast training/inference deep learning models (e.g, Graph Transformers) for single-cell classification in weak/self-supervised contexts.
  - Development of generative models (e.g., DDPMs) for 3D genomics, flow cytometry, scRNA-seq, spatial transcriptomic, and multiomics data.
  - LLMs to streamline routine hospital processes.
- Teaching Assistant**, University of Geneva – Department of Computer Science & CUI Nov 2022 – Ongoing
- Introduction to Computational Finance - [14X030](#);
  - TALN: Traitement de la langue approches linguistiques et approches empiriques (NLP) - [34C2161](#);
  - Information Retrieval - [14X060](#);
  - Data Science - Analyse et Traitement de l'Information - [14X026](#);
  - Selected Chapters - Game Theory - [14X060](#);
- Research Assistant - Intern**, [Quantum Technology Group](#) - University of Norway Feb 2022 - July 2022
- Worked on quantum theory for entanglement and non-locality in optomechanics continuous variable systems. Developed quantum frameworks to analyze two-cavity optomechanics systems.

## Publications

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- LapDDPM: A Conditional Graph Diffusion Model for scRNA-seq Generation with Spectral Adversarial Perturbations** Jun 2025  
*Lorenzo Bini*, Stéphane Marchand-Maillet  
[ICML'2025 + GenBio Workshop: The Second Workshop on Generative AI and Biology, Vancouver.](#)
- Self-Supervised Graph Learning via Spectral Bootstrapping and Laplacian-Based Augmentations** May 2025  
*Lorenzo Bini*, Stéphane Marchand-Maillet  
[Preprint. To appear in 2025, under double-blind review as a conference paper.](#)

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<b>Massive Activations in Graph Neural Networks: Decoding Attention for Domain-Dependent Interpretability</b>	Oct 2024
<i>Lorenzo Bini</i> , Marco Sorbi, Stéphane Marchand-Maillet	
<a href="#">ECAI'2025, Bologna + ICLR'2025 Workshop XAI4Science: From Understanding Model Behavior to Discovering New Scientific Knowledge, Singapore.</a>	
<b>Injecting Hierarchical Biological Priors into Graph Neural Networks for Flow Cytometry Prediction</b>	Jul 2024
<i>Lorenzo Bini</i> , Stéphane Marchand-Maillet	
<a href="#">ICML'2024 + Workshop on Accessible and Efficient Foundation Models for Biological Discovery, Wien, Austria.</a>	
<b>FlowCyt: A Comparative Study of Deep Learning Approaches for Multi-Class Classification in Flow Cytometry Benchmarking</b>	Jun 2024
<i>Lorenzo Bini</i> , Margarita Liarou, Thomas Matthes, Stéphane Marchand-Maillet	
<a href="#">Conference on Health, Inference, and Learning (CHIL'24), New-York, NY.</a>	
<b>Why Attention Graphs Are All We Need: Pioneering Hierarchical Classification of Hematologic Cell Populations with LeukoGraph</b>	Feb 2024
<i>Lorenzo Bini</i> , Thomas Matthes, Stéphane Marchand-Maillet	
<a href="#">Preprint arXiv:2402.18610, under double-blind review as a conference paper.</a>	
<b>HemaGraph: Breaking Barriers in Hematologic Single Cell Classification with Graph Attention</b>	Dec 2023
<i>Lorenzo Bini</i> , Thomas Matthes, Stéphane Marchand-Maillet	
<a href="#">Preprint arXiv:2402.18611, under double-blind review as a conference paper.</a>	

## Awards & Oral Presentations

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<b>PhD Symposium - CHIL'24 at Cornell Tech University, NY</b>	Jun. 2024
<ul style="list-style-type: none"> <li>Winner of the PhD Symposium money-prize to attend and present PhD work "Adversarial Robust GNNs: Enhancing Learning with Knowledge Injection in Single-Cell Data" at <a href="#">CHIL'24</a>, conference held by Cornell Tech University, New York.</li> </ul>	
<b>CHAIR Structured Learning Workshop - Chalmers University of Technology</b>	Oct. 2023
<ul style="list-style-type: none"> <li>Oral presentation of the "Knowledge Distillation in Acute Myeloid Leukemia Classification: Tabular Data Meets Graph Neural Networks" poster at the <a href="#">AI Structured Learning 2023 Workshop</a> in Göteborg, Sweden.</li> </ul>	
<b>Winner of Thesis on Proposal 2021/2022</b>	Feb. 2022
<ul style="list-style-type: none"> <li>Winner of the "Thesis on Proposal 2021/2022" call for bids for Master's Thesis on "Entanglement and nonlocality in optomechanics continuous variable systems" under the supervision of Prof. Francesco Pietro Massel &amp; Prof. Vittorio Penna.</li> <li>Received grants for research period at USN-Kongsberg.</li> </ul>	

## Projects

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<b>Flow Cytometry Deep Learning Benchmark</b>	<a href="#">FlowCyt-Benchmark</a>
<ul style="list-style-type: none"> <li>Developed the first publicly available deep learning benchmark for single cell classification and clustering on flow cytometry data. Tested on a cohort of 30 patients selected by expert hematologists, from bone marrow and peripheral blood samples. Benchmarked SOTA classification/generative models including GNNs, GraphTransformers, Diffusion Models (DDPMs) and VAEs.</li> <li>Tools Used: Python, CSS, HTML.</li> </ul>	
<b>Hackathons &amp; Competitions</b>	2019 - Ongoing
<ul style="list-style-type: none"> <li>Regular participation at Kaggle/LeetCode competitions and Hackathons; runner-up BR41N.IO 2021 Hackathon@PoliTO, runner-up UNIBO-IBM-Unipol Hackathon 2019, 3rd classified QuHack4IA 2023.</li> <li>Tools Used: Python - Compitative Programming.</li> </ul>	

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**Math/Physics Olympiad**

Sep 2014 - Sep 2019

- 2x winner of the Italian Regional Math Olympiad.
- 1x winner of the Italian Regional Physics Olympiad.

**Visiting Student**, City Montessori School, Lucknow - Uttar Pradesh, India USN

Aug 2016 - Sep 2016

- Visited the City Montessori School together with the italian cultural association "CinemíCinéma" to provide help and needs to elementary/mid school students.

**Oxfam Volunteering**

2016 - Ongoing

- I do regularly serve as volunteer for charity organization, such as [Oxfam Italy](#).

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**Technologies**

- **Programming Languages:** Python, Julia, R, , Matlab, Mathematica, C/C++ , CUDA.
- **Frameworks:** Pytorch, Pytorch-Lightning, Tensorflow, Keras, Jupyter.
- **AI/ML:** SciPy, scikit-learn, Github, GitLab, Numpy, Pandas, Matplotlib, Seaborn, wandb, PyG.
- **Tools:** Git, Linux, ssh, SLURM, pip, Anaconda, Docker, VSCode, Bash (Shell).

**Software Licenses:** Kaluza Analysis Software, Zemax OpticStudio | Comprehensive Optical Design Software, TeXstudio, BioVinci Software.