

Lorenzo Bini

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Education

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

PhD Researcher , 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, Flow Matching) 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.	
PhD Researcher , Jian Ma's Lab - Comp. Science Dept., Carnegie Mellon University	Sep 2025 - Mar 2026
• Developed and implemented symmetry-aware flow-matching models for 3D genome ensembles operating directly in 3D coordinate space.	
• Built multi-modal conditioning pipelines combining genomic data sources to generate realistic chromosome conformational ensembles.	
• Designed and integrated LLM-based multi-modal encoders to fuse epigenomic signals and imaging data.	
• Implemented scalable training & inference (subchain batching, sparse graphs, RMSD alignment) and evaluation tooling (contact-map, SCC, insulation score, radius-of-gyration).	
• Optimized memory and runtime (sparse attention) to enable large-region generation.	

Publications

LapDDPM: A Conditional Graph Diffusion Model for scRNA-seq Generation with Spectral Adversarial Perturbations	Jun 2025
<i>Lorenzo Bini, Stéphane Marchand-Maillet</i>	
<i>ICML'2025 + GenBio Workshop: The Second Workshop on Generative AI and Biology, Vancouver.</i>	
Self-Supervised Graph Learning via Spectral Bootstrapping and Laplacian-Based Augmentations	May 2025
<i>Lorenzo Bini, Stéphane Marchand-Maillet</i>	
<i>Preprint. To appear in 2025, under double-blind review as a conference paper.</i>	
Massive Activations in Graph Neural Networks: Decoding Attention for Domain-Dependent Interpretability	Oct 2024
<i>Lorenzo Bini, Marco Sorbi, Stéphane Marchand-Maillet</i>	
<i>ECAI'2025, Bologna (oral presentation) + ICLR'2025 Workshop XAI4Science: From Understanding Model Behavior to Discovering New Scientific Knowledge, Singapore.</i>	
Injecting Hierarchical Biological Priors into Graph Neural Networks for Flow Cytometry Prediction	Jul 2024
<i>Lorenzo Bini, Stéphane Marchand-Maillet</i>	
<i>ICML'2024 + Workshop on Accessible and Efficient Foundation Models for Biological Discovery, Wien, Austria.</i>	
FlowCyt: A Comparative Study of Deep Learning Approaches for Multi-Class Classification in Flow Cytometry Benchmarking	Jun 2024
<i>Lorenzo Bini, Margarita Liarou, Thomas Matthes, Stéphane Marchand-Maillet</i>	
<i>Conference on Health, Inference, and Learning (CHIL'24), New-York, NY.</i>	
Why Attention Graphs Are All We Need: Pioneering Hierarchical Classification of Hematologic Cell Populations with LeukoGraph	Feb 2024
<i>Lorenzo Bini, Thomas Matthes, Stéphane Marchand-Maillet</i>	
<i>Preprint arXiv:2402.18610, under double-blind review as a conference paper.</i>	
HemaGraph: Breaking Barriers in Hematologic Single Cell Classification with Graph Attention	Dec 2023
<i>Lorenzo Bini, Thomas Matthes, Stéphane Marchand-Maillet</i>	
<i>Preprint arXiv:2402.18611, under double-blind review as a conference paper.</i>	

Awards & Oral Presentations

Oral Presentation at the Second Workshop on Explainable Artificial Intelligence for the Medical Domain - ECAI'25, Bologna	Oct. 2025
• Invited oral presentation of the accepted paper "Massive Activations in Graph Neural Networks: Decoding Attention for Domain-Dependent Interpretability" at European Conference on Artificial Intelligence (ECAI'25) , Bologna.	
Winner of Swiss National Science Foundation PhD Mobility Grant	Sep. 2025
• Winner of the Swiss National Science Foundation (SNSF) PhD Mobility Grant for a 6-month internship at Ray and Stephanie Lane Computational Biology Department - Carnegie Mellon University (CMU), Pittsburgh USA.	
PhD Symposium - CHIL'24 at Cornell Tech University, NY	Jun. 2024
• 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 CHIL'24 , conference held by Cornell Tech University, New York.	
CHAIR Structured Learning Workshop - Chalmers University of Technology	Oct. 2023
• Oral presentation of the "Knowledge Distillation in Acute Myeloid Leukemia Classification: Tabular Data Meets Graph Neural Networks" poster at the AI Structured Learning 2023 Workshop in Göteborg, Sweden.	

Winner of Thesis on Proposal 2021/2022

Feb. 2022

- 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 & Prof. Vittorio Penna.
- Received grants for research period at USN-Kongsberg.

Projects

Flow Cytometry Deep Learning Benchmark

[FlowCyt-Benchmark](#)

- 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.
- Tools Used: Python, CSS, HTML.

Hackathons & Competitions

2019 - Ongoing

- 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.
- Tools Used: Python - Competitive Programming.

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 Montessory School, Lucknow - Uttar Pradesh, India USN

Aug 2016 - Sep 2016

- Visited the City Montessory School together with the italian cultural association "CinemíCinemá" 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](#).

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.

Reviewing Duties

- International Conference on Learning Representations (ICLR). 2023 - Ongoing
- International Conference on Machine Learning (ICML). 2022 - Ongoing
- Learning on Graphs Conference (LOG). 2023 - Ongoing
- AAAI Conference on Artificial Intelligence. 2025 - Ongoing
- IEEE Transactions on Computational Biology and Bioinformatics. 2023 - Ongoing