

# Sohir Maskey

PHD STUDENT · MATHEMATICAL FOUNDATIONS OF DEEP LEARNING

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## Education

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### Ludwig-Maximilians University of Munich

Munich

#### PHD ON MATHEMATICAL FOUNDATIONS OF DEEP LEARNING

04/2021 - present

- Working on the theoretical foundations and applications of geometric deep learning
- Research on generalization abilities and expressivity of graph neural networks
- Research on graph neural ODE and its applications in graph representational learning
- Applying novel graph learning methods on various datasets, mainly for chemical regression tasks
- Supported by NSF-Simons Research Collaboration on the Mathematical and Scientific Foundations of Deep Learning.
- Advisor: Prof Dr. Gitta Kutyniok

### Technical University of Berlin

Berlin

#### MS MATHEMATICS

10/2018 - 04/2021

- Master thesis on transferability of graph neural networks, Advisor: Prof Dr. Gitta Kutyniok
- Final grade: 1.0 (Top of the class)

### University of Heidelberg

Heidelberg

#### BS MATHEMATICS

10/2014 - 09/2017

- Minors in Economics
- Bachelor thesis on modular forms
- Final grade: 1.5 (Top 10%)

## Professional Experience

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### mayato GmbH

Berlin

#### WORKING STUDENT FOR ML APPLICATIONS

2020

- Implemented NLP models for Twitter sentiment analysis using Python.
- Authored technical white papers on the application of NLP models for business use cases.
- Conducted statistical analysis and designed experiments to validate model performance.

### SAP

Berlin

#### INTERN AT SAP (CLOUD BUSINESS GROUP)

2017-2018

- Developed cloud-based solutions for data integration and processing using Java and Python.
- Implemented several automations in Google Cloud Platform (GCP) via NodeJS/AngularJS.
- Collaborated with cross-functional teams to design and implement scalable software solutions.

### University Heidelberg, TU Berlin, LMU

Heidelberg, Berlin, LMU

#### ASSISTANT TEACHER

2016-2021

- Conducted tutorials and problem-solving sessions for undergraduate students.
- Assisted in the preparation and grading of exams, assignments, and quizzes.

## Publications

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### PUBLISHED AND TO APPEAR

**S. Maskey\***, R. Paolino\*, P. Welke, G. Kutyniok. Weisfeiler and Leman Go Loopy: A New Hierarchy for Graph Representational Learning. **NeurIPS 2024 (Oral)**.

**S. Maskey**, R. Levie, Y. Lee, G. Kutyniok. Generalization Bounds for Message Passing Networks on Mixture of Graphons, 2024. to appear in **SIAM Journal on Mathematics of Data Science**.

**S. Maskey\***, R. Paolino\*, A. Bacho, G. Kutyniok. A Fractional Graph Laplacian Approach to Oversmoothing. **NeurIPS 2023**.

**S. Maskey**, R. Levie, G. Kutyniok. Transferability of Graph Neural Networks: an Extended Graphon Approach, 2023. In **Applied and Computational Harmonic Analysis**

**S. Maskey\***, R. Levie\*, Y. Lee, G. Kutyniok. Generalization Analysis of Message Passing Neural Networks on Large Random Graphs. **NeurIPS 2022**.

**S. Maskey\***, Ali Parviz\*, Maximilian Thiessen, Hannes Stärk, Ylli Sadikaj, Haggai Maron. Generalized Laplacian Positional Encoding for Graph Representation Learning. NeurIPS 2022 Workshop on Symmetry and Geometry in Neural Representations.

**S. Maskey**, G. Kutyniok, R. Levie. Generalization in Graph Neural Networks on Random Graph Models, 2022. 56th IEEE Asilomar Conference on Signals, Systems, and Computers.

## Talks

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Summer 2021. *Transferability of Graph Neural Networks*. International Conference on Computational Harmonic Analysis, Online.

Summer 2021. *Transferability of Graph Neural Networks*. Theorinet Annual Retreat, Online.

Summer 2022. *Stability and Generalization Capabilities of Message Passing Graph Neural Networks*. Computational and mathematical methods in data science at GAMM 2022, Aachen, Germany.

Summer 2022. *Generalization Analysis of Message Passing Neural Networks on Large Random Graphs*. ICCHA 2022, Ingolstadt, Germany

Summer 2023. *Fractional Laplacians for Capturing Long Range Dependencies*. John-Hopkins-University, Baltimore, USA

## Student Supervision

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2022 **Sean Disaro**, Bachelor Thesis on "Overcoming Limitations in Expressivity of Graph Neural Networks", Ludwig-Maximilian University of Munich.

2024 **Ali Aksoy**, Bachelor Thesis on "Stability and Expressivity Positional Encodings", Ludwig-Maximilian University of Munich.

2024 **Tizian Schuhbeck**, Master Thesis on "Graph Neural Networks under the Lens of Homomorphisms", Ludwig-Maximilian University of Munich.

## Outreach & Professional Development

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**Research Visit at Chair of Prof. Dr. Alejandro Ribeiro** at Pennsylvania State University, 2023.

**Research Visit at Chair of Prof. Dr. Soledad Villar** at John-Hopkins University, 2023.

**Participated at Workshop on Interpretability, safety and security in AI** at Isaac Newton Institute for Mathematical Sciences, University of Cambridge, 2022.

**Participated at Workshop on Deep learning and partial differential equations** at Isaac Newton Institute for Mathematical Sciences, University of Cambridge, 2022.

**Participated at LOGML Summer School 2022: Geometry and Machine Learning**, Online, 2022.

## PEER REVIEWING

Asilomar Conference on Signals, Systems, and Computers, 2022.

IEEE Journal on Transactions on Signal Processing

ICML 2023, ICLR 2023 and NeurIPS 2023 (selected as a top reviewer)

ICML 2024, NeurIPS 2024