



M. Sc. Peter Súkeník

PHD STUDENT

Expert in theory of deep learning with the focus on structure in neural representations, neural collapse, low-rank bias and the properties of weight decay. Math enthusiast, former representant of Slovakia on IMO.

AWARDS & ACHIEVEMENTS

- **International Mathematical Olympiad (IMO) 2016** - third prize (224th place)
- **European Union Science Olympiad 2014** - first prize (8th place, team)
- **International Mathematical Competition 2017, 2018, 2019** - third prize (3x) + Ivan the Confessor's fair play prize (2019)
- **Vojtech Jarník IMC 2017** - awarded
- **Vojtech Jarník IMC 2019** - 11th place + awarded
- **Physics olympiad 2016 (central round)** - 2nd place + special award for best experiment
- **Dean's prize for excellent bachelor's thesis 2019**
- **BAYHOST scholarship 2019-2021** - more than 20k euro in total
- **NeurIPS 2023 outstanding reviewer** - reviewed for the first time
- **ICML 2024 best reviewer award** - top 3% of reviewers

EDUCATION

- **INSTITUTE OF SCIENCE AND TECHNOLOGY AUSTRIA**
Sep 2021 - Present
 - **Field of PhD degree:** Theory of Deep Learning
 - **Supervisors:** Prof. Christoph Lampert, Prof. Marco Mondelli (co-supervision)
 - **External supervisors:** Prof. Mikhail Belkin, Prof. Nicolas Flammarion
 - **Research proposal title:** Implicit Bias of (S)GD Optimization on Training and Properties of Deep Neural Networks
 - **Research topics include:** (deep) neural collapse, implicit bias of SGD training, low-rank bias, effects of weight regularization, attention sinks, data efficiency, multi-objective learning, sparse training
- **TECHNICAL UNIVERSITY OF MUNICH**
Oct 2019 - Sep 2021
 - **Field of Master's degree:** Mathematics
 - **Final GPA: 1.098 - top 5% performance**
 - **Thesis title:** Improving Certifiable Robustness via Input-Dependent Randomized Smoothing (**later published at ICML 2022**)
 - **Thesis supervisor:** Prof. Stephan Günnemann
 - **Research project:** Active learning using sample-wise self-attention (a follow-up was **later published at NeurIPS 2022**)
- **COMENIUS UNIVERSITY IN BRATISLAVA (SLOVAKIA)**
Sep 2016 - Jun 2019
 - **Field of Bachelor's degree:** Economical and financial mathematics
 - **Final GPA: 1.0 - #1 in the class**
 - **Thesis title:** Choice Decisions Problems - Multi Armed Bandit
 - **Thesis supervisor:** doc. RNDr. Katarína Janková, CSC.

PUBLICATIONS

- Súkeník, Peter**, Christoph H. Lampert, and Marco Mondelli. "Neural Collapse is Globally Optimal in Deep Regularized ResNets and Transformers." **Advances in Neural Information Processing Systems 38 (2025)**
- Jacot, Arthur, **Súkeník Peter**, et. al. "Wide Neural Networks Trained with Weight Decay Provably Exhibit Neural Collapse." **ICLR 2025 oral**
- Súkeník, Peter**, Marco Mondelli, and Christoph H. Lampert. "Neural Collapse versus Low-rank Bias: Is Deep Neural Collapse Really Optimal?." **Advances in Neural Information Processing Systems 37 (2024)**
- Daniel Beaglehole, **Súkeník, Peter**, Marco Mondelli, and Mikhail Belkin. "Average gradient outer product as a mechanism for deep neural collapse." **Advances in Neural Information Processing Systems 37 (2024)**
- Súkeník, Peter**, Marco Mondelli, and Christoph H. Lampert. "Deep Neural Collapse Is Provably Optimal for the Deep Unconstrained Features Model." **Advances in Neural Information Processing Systems 36 (2023) spotlight**
- Kocsis, Peter, **Súkeník, Peter**, et. al. "The unreasonable effectiveness of fully-connected layers for low-data regimes." **Advances in Neural Information Processing Systems 35 (2022)**
- Súkeník, Peter**, and Christoph H. Lampert. "Generalization In Multi-Objective Machine Learning." **Neural Computing and Applications (2024)**
- Súkeník, Peter**, Aleksei Kuvshinov, and Stephan Günnemann. "Intriguing Properties of Input-Dependent Randomized Smoothing." **International Conference on Machine Learning. PMLR, 2022**

SKILLS & EXPERTISE

- **Education in applied mathematics on M.Sc. level**
- **Strong teaching experience**
- **Studied topics:** neural collapse, low-rank bias, attention sinks in large language models, randomized smoothing, implicit bias of weight regularization, multi-objective optimization, sparse training & structured sparsity, multi-armed bandit, low-data regimes
- **Languages:** Slovak, Czech, English - fluent; German - intermediate
- **Coding:** Python, R; advanced in pytorch, numpy

EXPERIENCE

- **Trojsten NGO, volunteer (2016-present)**
Organizing online high-school mathematical contests for talented students. I have reviewed and scored around 500 of students' solutions. Moreover, I have organized and participated in 10 mathematical camps for winners, where I have lectured (together with other Trojsten actions) more than 100 hours of interesting and useful mathematical topics.
- **Mathematical Olympiad, reviewer (2017-present)**
Correcting, and commentating hundreds of students' solutions from regional rounds to International Mathematical Olympiad team selections. Recently served as Slovak leader on MEMO 2023. I am a member of board of Slovak Mathematical Olympiad.
- **NeurIPS'23; ICML'24; ICLR'25, ICLR'26 reviewer**
- **G-Research Machine Learning Intern 2025**
 - Highly competitive - 12 out of cca 10000 applicants
 - Developed state-of-the-art ML methods on a real-world data problem
 - Collaborated with senior full-time researchers
 - Obtained vast amounts of ML and finance knowledge

CURRENT PROJECTS & FUTURE GOALS

- **CURRENT PROJECT:** Proving the global optimality of attention sinks in regularized transformers.
- **FUTURE GOALS:** To combine my deep theoretical knowledge and my creative engagement into design in ML and AI.