

# Thomy Phan

## Curriculum Vitae

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### Contact Information

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Website <https://thomyphan.github.io>

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### Education

- 04/2018 – Present **Ph.D. in Computer Science**, *LMU Munich*, Germany.
- Focus on planning and learning in multi-agent systems
  - Ph.D. thesis: *"Emergence and Resilience in Multi-Agent Reinforcement Learning"*
    - Thesis committee: Claudia Linnhoff-Popien, Sven Koenig, Long Tran-Thanh
    - Based on work published in AAMAS, AAAI, IJCAI, and NeurIPS
    - Submitted on October 15th, 2022
    - Prospective date of defense: Winter semester 2022/23
- 10/2015 – 08/2017 **M.Sc. in Computer Science**, *LMU Munich*, Germany.
- Final grade: 1.01 (Excellent – best graduating student in 2017)
  - Focus on artificial intelligence, data science, and autonomous systems
  - Master thesis: *"EVADE: Emergent Value Function Approximation for Distributed Environments"*
    - Supervision: Claudia Linnhoff-Popien, Lenz Belzner
    - Results published in AAMAS 2018 as full paper
- 10/2011 – 06/2015 **B.Sc. in Computer Science**, *Munich University of Applied Sciences*, Germany.
- Final grade: 1.09 (Excellent – best graduating student in 2016)
  - Collaborative study program with the City of Munich
  - Focus on software development and image processing
  - Bachelor thesis: *"Quantification and Feature Extraction of 3D Single-Molecule Switching Microscopy Data"*
    - Supervision: Alfred Nischwitz, Joerg Bewersdorf
    - Practical work done at Bewersdorf Lab, Yale School of Medicine
    - Results published in Cell 2016 as journal paper (cover story)

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### Research Interests

I am interested in various topics related to artificial intelligence such as multi-agent systems, machine learning, pattern recognition, bio-inspired algorithms, automated planning, optimization, as well as validation and verification of self-learning systems. My current research focuses on *emergence and resilience in multi-agent systems* with industrial applications using planning and reinforcement learning techniques.

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## Professional Experience

- 10/2017 – Present **Research Assistant**, *Mobile and Distributed Systems Chair, LMU Munich, Germany.*
- Research focus on multi-agent systems
    - Over 40 papers published in AAMAS, AAAI, IJCAI, NeurIPS, GECCO, etc.
    - Regularly participating at top conferences as program committee or reviewer
  - Teaching more than 100 students per semester about autonomous systems and AI topics
  - Acquisition, coordination, and execution of research projects in collaboration with, e.g., Siemens AG and Fraunhofer IKS
  - Head of the *Technology and Research on Artificial Intelligence Laboratory (TRAIL)*
- 06/2015 – 06/2018 **Software Developer**, *it@M, City of Munich, Germany.*  
Development, maintainance, and integration of business applications.

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## Internships

- 02/2015 – 05/2015 **Visiting Scholar in Research**, *Bewersdorf Lab, Yale School of Medicine, New Haven, Connecticut, USA.*
- Practical work for the bachelor thesis
  - Data analysis and feature extraction of cellular structures in super-resolution microscopy data
  - Co-authored publication of methods and experimental results in Cell 2016 (cover story)
- 02/2012 – 09/2014 **Working Student (Collaborative Study Program)**, *City of Munich, Germany.*  
Regular internships focusing on IT architecture, project management, and software development during the semester holidays.

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## Teaching

- 04/2019 – Present **Autonomous Systems**, *LMU Munich, Germany.*
- Practical course of about 20 master students on planning and reinforcement learning
  - Primary supervising assistant
- 04/2019 – Present **Artificial Intelligence**, *LMU Munich, Germany.*
- Working group of over 100 bachelor and master students on current AI topics
  - Primary supervising assistant
- 04/2018 – Present **Thesis Supervision**, *LMU Munich, Germany.*
- 24 master theses
  - 21 bachelor theses
  - 8 individual research projects
- 04/2018 – 02/2019 **Mobile and Distributed Systems**, *LMU Munich, Germany.*
- Practical course of about 20 master students on mobile app development and on-device machine learning
  - Secondary supervising assistant

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## Research Projects

- 01/2022 – Present **AI-Fusion: Evaluation of Emergence in Distributed Intelligent Systems**, *Bavarian Ministry of Economic Affairs, Regional Development, and Energy, Munich, Germany.*  
Research on emergence in multi-agent learning.

- 04/2022 – 12/2022 **Validation and Verification of Modular Machine Learning Systems**, *Siemens AG*, Munich, Germany.  
Research on modular machine learning.
- 04/2020 – 12/2021 **Federated Learning in Industrial Environments**, *Siemens AG*, Munich, Germany.  
Research on adaptive testing of federated learning systems.
- 01/2019 – 12/2019 **Dependability of Machine Learning in Industrial Environments**, *Siemens AG*, Munich, Germany.  
Research on resilient multi-agent reinforcement learning.
- 08/2018 – 12/2018 **Coevolution in Machine Learning Based Industrial Environments**, *Siemens AG*, Munich, Germany.  
Research on coevolutionary reinforcement learning.
- 10/2017 – 05/2019 **APVEL – Evaluation of Specialized Outpatient Palliative Care**, *Heidelberg University of Education*, Germany.  
Development of a mobile and privacy-preserving app helping patients to select a suitable type of palliative care.

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## Academic Activities

### Organizing Committee

- 2019 International Symposium on Applied Artificial Intelligence (ISAAI)

### Program Committee

- 2023 International Conference on Autonomous Agents and Multiagent Systems (AAMAS Blue Sky Ideas Track)
- 2021, 2022, 2023 AAAI Conference on Artificial Intelligence (AAAI)

### Reviewer

- 2023 International Conference on Autonomous Agents and Multiagent Systems (AAMAS Main Track)
- 2022 Conference on Neural Information Processing Systems (NeurIPS)
- 2022 International Conference on Machine Learning (ICML)
- 2018, 2022 International Symposium On Leveraging Applications of Formal Methods (ISoLA)
- 2021 PLOS ONE Journal
- 2020 International Journal on Software Tools for Technology Transfer (STTT)

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## Scholarships and Awards

- 2022 **Top 10% Reviewer**, *International Conference on Machine Learning (ICML)*, Baltimore, MD, USA.
- 2019 **Travel Grant for AAMAS 2019**, *DAAD*, Montreal, Canada.
- 2016 **Best Bachelor Award**, *Rohde & Schwarz GmbH & Co. KG*, Munich, Germany.
- 2016 **Award for an Outstanding Bachelor Thesis in the Field of Image Processing**, *Stemmer Imaging GmbH*, Munich, Germany.
- 01/2012 – 08/2017 **Scholarship**, *Studienstiftung des Deutschen Volkes*, Munich, Germany.  
In Germany, the top 0.5% of university or high school students get selected for funding by the German Academic Scholarship Foundation.

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## Publications

### Conferences

- 2022 [C29] **Emergent Cooperation from Mutual Acknowledgment Exchange.**  
Thomy Phan, Felix Sommer, Philipp Altmann, Fabian Ritz, Lenz Belzner, and Claudia Linnhoff-Popien.  
*International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, pages 1047-1055, 2022.
- [C28] **Towards Anomaly Detection in Reinforcement Learning (Blue Sky Ideas).**  
Robert Müller, Steffen Illium, Thomy Phan, Tom Haider, and Claudia Linnhoff-Popien.  
*International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, pages 1799-1803, 2022.
- [C27] **Capturing Dependencies within Machine Learning via a Formal Process Model.**  
Fabian Ritz, Thomy Phan, Andreas Sedlmeier, Philipp Altmann, Jan Wieghardt, Reiner Schmid, Horst Sauer, Cornel Klein, Claudia Linnhoff-Popien, and Thomas Gabor.  
*International Symposium on Leveraging Applications of Formal Methods (ISoLA)*, pages 249-265, 2022.
- 2021 [C26] **VAST: Value Function Factorization with Variable Agent Sub-Teams.**  
Thomy Phan, Fabian Ritz, Lenz Belzner, Philipp Altmann, Thomas Gabor, and Claudia Linnhoff-Popien.  
*Advances in Neural Information Processing Systems (NeurIPS)*, pages 24018-24032, 2021.
- [C25] **A Sustainable Ecosystem through Emergent Cooperation in Multi-Agent Reinforcement Learning.**  
Fabian Ritz, Daniel Ratke, Thomy Phan, Lenz Belzner, and Claudia Linnhoff-Popien.  
*Conference on Artificial Life (ALIFE)*, pages 74–83, 2021.
- [C24] **SAT-MARL: Specification Aware Training in Multi-Agent Reinforcement Learning.**  
Fabian Ritz, Thomy Phan, Robert Müller, Thomas Gabor, Andreas Sedlmeier, Marc Zeller, Jan Wieghardt, Reiner Schmid, Horst Sauer, Cornel Klein, and Claudia Linnhoff-Popien.  
*International Conference on Agents and Artificial Intelligence (ICAART)*, pages 28–37, 2021.
- [C23] **Resilient Multi-Agent Reinforcement Learning with Adversarial Value Decomposition.**  
Thomy Phan, Lenz Belzner, Thomas Gabor, Andreas Sedlmeier, Fabian Ritz, and Claudia Linnhoff-Popien.  
*AAAI Conference on Artificial Intelligence (AAAI)*, pages 11308-11316, 2021.
- 2020 [C22] **Cross Entropy Hyperparameter Optimization for Constrained Problem Hamiltonians Applied to QAOA.**  
Christoph Roch, Alexander Impertro, Thomy Phan, Thomas Gabor, Sebastian Feld, and Claudia Linnhoff-Popien.  
*International Conference on Rebooting Computing (ICRC)*, pages 50-57, 2020.
- [C21] **Towards Ecosystem Management from Greedy Reinforcement Learning in a Predator-Prey Setting.**  
Fabian Ritz, Felix Hohnstein, Robert Müller, Thomy Phan, Thomas Gabor, Carsten Hahn, and Claudia Linnhoff-Popien.  
*Conference on Artificial Life (ALIFE)*, pages 518-525, 2020.
- [C20] **Foraging Swarms using Multi-Agent Reinforcement Learning.**  
Carsten Hahn, Fabian Ritz, Paula Wikidal, Thomy Phan, Thomas Gabor, and Claudia Linnhoff-Popien.  
*Conference on Artificial Life (ALIFE)*, pages 333-340, 2020.
- [C19] **A Quantum Annealing Algorithm for Finding Pure Nash Equilibria in Graphical Games.**  
Christoph Roch, Thomy Phan, Sebastian Feld, Robert Müller, Thomas Gabor, Carsten Hahn, and Claudia Linnhoff-Popien.  
*International Conference on Computational Science (ICCS)*, pages 488-501, 2020.
- [C18] **Learning and Testing Resilience in Cooperative Multi-Agent Systems.**  
Thomy Phan, Thomas Gabor, Andreas Sedlmeier, Fabian Ritz, Bernhard Kempter, Cornel Klein, Horst Sauer, Reiner Schmid, Jan Wieghardt, Marc Zeller, and Claudia Linnhoff-Popien.  
*International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, pages 1055-1063, 2020.

- [C17] **Nash Equilibria in Multi-Agent Swarms.**  
Carsten Hahn, Thomy Phan, Sebastian Feld, Christoph Roch, Fabian Ritz, Andreas Sedlmeier, Thomas Gabor, and Claudia Linnhoff-Popien.  
*International Conference on Agents and Artificial Intelligence (ICAART)*, pages 234-241, 2020.
- [C16] **Multi-Agent Reinforcement Learning for Bargaining under Risk and Asymmetric Information.**  
Kyrill Schmid, Lenz Belzner, Thomy Phan, Thomas Gabor, and Claudia Linnhoff-Popien.  
*International Conference on Agents and Artificial Intelligence (ICAART)*, pages 144-151, 2020.
- [C15] **Uncertainty-Based Out-of-Distribution Classification in Deep Reinforcement Learning.**  
Andreas Sedlmeier, Thomas Gabor, Thomy Phan, Lenz Belzner, and Claudia Linnhoff-Popien.  
*International Conference on Agents and Artificial Intelligence (ICAART)*, pages 522-529, 2020.
- 2019 [C15] **Uncertainty-Based Out-of-Distribution Detection in Deep Reinforcement Learning.**  
Andreas Sedlmeier, Thomas Gabor, Thomy Phan, Lenz Belzner, and Claudia Linnhoff-Popien.  
*International Symposium On Applied Artificial Intelligence (ISAAI)*, pages 74-78, 2019.
- [C13] **Adaptive Thompson Sampling Stacks for Memory Bounded Open-Loop Planning.**  
Thomy Phan, Thomas Gabor, Robert Müller, Christoph Roch, and Claudia Linnhoff-Popien.  
*International Joint Conference on Artificial Intelligence (IJCAI)*, pages 5607-5613, 2019.
- [C12] **Subgoal-Based Temporal Abstraction in Monte-Carlo Tree Search.**  
Thomas Gabor, Jan Peter, Thomy Phan, Christian Meyer, and Claudia Linnhoff-Popien.  
*International Joint Conference on Artificial Intelligence (IJCAI)*, pages 5562-5568, 2019.
- [C11] **Scenario Co-Evolution for Reinforcement Learning on a Grid World Smart Factory Domain.**  
Thomas Gabor, Andreas Sedlmeier, Marie Kiermeier, Thomy Phan, Marcel Henrich, Monika Pichlmair, Bernhard Kempter, Cornel Klein, Horst Sauer, Reiner Schmid, and Jan Wieghardt.  
*Genetic and Evolutionary Computation Conference (GECCO)*, pages 898-906, 2019.
- [C10] **Emergent Escape-Based Flocking Behavior using Multi-Agent Reinforcement Learning.**  
Carsten Hahn, Thomy Phan, Thomas Gabor, Lenz Belzner, and Claudia Linnhoff-Popien.  
*Conference on Artificial Life (ALIFE)*, pages 598-605, 2019.
- [C9] **Memory Bounded Open-Loop Planning in Large POMDPs using Thompson Sampling.**  
Thomy Phan, Lenz Belzner, Marie Kiermeier, Markus Friedrich, Kyrill Schmid, and Claudia Linnhoff-Popien.  
*AAAI Conference on Artificial Intelligence (AAAI)*, pages 7941-7948, 2019.
- 2018 [C8] **Anomaly Detection in Spatial Layer Models of Autonomous Agents.**  
Marie Kiermeier, Sebastian Feld, Thomy Phan, and Claudia Linnhoff-Popien.  
*International Conference on Intelligent Data Engineering and Automated Learning (IDEAL)*, pages 156-163, 2018.
- [C7] **The Sharer's Dilemma in Collective Adaptive Systems of Self-Interested Agents.**  
Lenz Belzner, Kyrill Schmid, Thomy Phan, Thomas Gabor, and Martin Wirsing.  
*International Symposium on Leveraging Applications of Formal Methods (ISoLA)*, pages 241-256, 2018.
- [C6] **Action Markets in Deep Multi-Agent Reinforcement Learning.**  
Kyrill Schmid, Lenz Belzner, Thomas Gabor, and Thomy Phan.  
*International Conference on Artificial Neural Networks (ICANN)*, pages 240-249, 2018.
- [C5] **Risk-Sensitivity in Simulation Based Online Planning.**  
Kyrill Schmid, Lenz Belzner, Marie Kiermeier, Alexander Neitz, Thomy Phan, Thomas Gabor, and Claudia Linnhoff-Popien.  
*Joint German/Austrian Conference on Artificial Intelligence (KI)*, pages 229-240, 2018.
- [C4] **Preparing for the Unexpected: Diversity Improves Planning Resilience in Evolutionary Algorithms.**  
Thomas Gabor, Lenz Belzner, Thomy Phan, and Kyrill Schmid.  
*IEEE International Conference on Autonomic Computing (ICAC)*, pages 131-140, 2018.

- [C3] **Monitoring Autonomous Agents in Self-Organizing Industrial Systems.**  
Marie Kiermeier, Thomy Phan, Horst Sauer, and Jan Wieghardt.  
*IEEE International Conference on Industrial Informatics (INDIN)*, pages 653-658, 2018.
- [C2] **Accelerating Evolutionary Construction Tree Extraction via Graph Partitioning.**  
Markus Friedrich, Sebastian Feld, Thomy Phan, and Pierre-Alain Fayolle.  
*International Conference on Computer Graphics, Visualization, and Computer Vision (WSCG)*, 2018.
- [C1] **Leveraging Statistical Multi-Agent Online Planning with Emergent Value Function Approximation.**  
Thomy Phan, Lenz Belzner, Thomas Gabor, and Kyrill Schmid.  
*International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, pages 730-738, 2018.

## Journals

- 2023 [J5] **Emergent Cooperation from Mutual Acknowledgment Exchange in Multi-Agent Reinforcement Learning.**  
Thomy Phan, Felix Sommer, Fabian Ritz, Philipp Altmann, Jonas Nüßlein, Michael Kölle, Lenz Belzner, and Claudia Linnhoff-Popien.  
*Journal on Autonomous Agents and Multi-Agent Systems (JAAMAS)*, 2023. Under review.
- 2022 [J4] **Specification Aware Multi-Agent Reinforcement Learning.**  
Fabian Ritz, Thomy Phan, Robert Müller, Thomas Gabor, Andreas Sedlmeier, Marc Zeller, Jan Wieghardt, Reiner Schmid, Horst Sauer, Cornel Klein, and Claudia Linnhoff-Popien.  
*Springer Book of ICAART 2021*, pages 3-21, 2022.
- 2021 [J3] **Productive Fitness in Diversity-Aware Evolutionary Algorithms.**  
Thomas Gabor, Thomy Phan, and Claudia Linnhoff-Popien.  
*Natural Computing*, 20(3): 363-376, 2021.
- 2020 [J2] **The Scenario Coevolution Paradigm: Adaptive Quality Assurance for Adaptive Systems.**  
Thomas Gabor, Andreas Sedlmeier, Thomy Phan, Fabian Ritz, Marie Kiermeier, Lenz Belzner, Bernhard Kempter, Cornel Klein, Horst Sauer, Reiner Schmid, Jan Wieghardt, Marc Zeller, and Claudia Linnhoff-Popien.  
*International Journal on Software Tools for Technology Transfer (STTT)*, 22(4): 457-476, 2020.
- 2016 [J1] **Ultra-High Resolution 3D Imaging of Whole Cells (Cover Story).**  
Fang Huang, George Sirinakis, Edward S Allgeyer, Lena K Schroeder, Whitney C Duim, Emil B Kromann, Thomy Phan, Felix E Rivera-Molina, Jordan R Myers, Irnov Irnov, Mark Lessard, Yongdeng Zhang, Mary Ann Handel, Christine Jacobs-Wagner, C Patrick Lusk, James E Rothman, Derek Toomre, Martin J Booth, and Joerg Bewersdorf.  
*Cell*, 166(4): 1028-1040, 2016.

## Workshops

- 2020 [W3] **The Holy Grail of Quantum Artificial Intelligence: Major Challenges in Accelerating the Machine Learning Pipeline.**  
Thomas Gabor, Leo Sünkel, Fabian Ritz, Thomy Phan, Lenz Belzner, Christoph Roch, Sebastian Feld, and Claudia Linnhoff-Popien.  
*International Workshop on Quantum Software Engineering (Q-SE)* at ICSE, pages 456-461, 2020.
- [W2] **Insights on Training Neural Networks for QUBO Tasks.**  
Thomas Gabor, Sebastian Feld, Hila Safi, Thomy Phan, and Claudia Linnhoff-Popien.  
*International Workshop on Quantum Software Engineering (Q-SE)* at ICSE, pages 436-441, 2020.
- [W1] **A Distributed Policy Iteration Scheme for Cooperative Multi-Agent Policy Approximation.**  
Thomy Phan, Lenz Belzner, Kyrill Schmid, Thomas Gabor, Fabian Ritz, Sebastian Feld, and Claudia Linnhoff-Popien.  
*Adaptive and Learning Agents Workshop (ALA)* at AAMAS, 2020.

## Extended Abstracts

Extended abstracts with a conference or journal version are not listed.

- 2023 [E2] **Attention-Based Recurrency for Multi-Agent Reinforcement Learning under State Uncertainty.**  
Thomy Phan, Fabian Ritz, Jonas Nüßlein, Michael Kölle, Thomas Gabor, and Claudia Linnhoff-Popien.  
*International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, 2023.  
To appear.
- 2019 [E1] **Distributed Policy Iteration for Scalable Approximation of Cooperative Multi-Agent Policies.**  
Thomy Phan, Kyrill Schmid, Lenz Belzner, Thomas Gabor, Sebastian Feld, and Claudia Linnhoff-Popien.  
*International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, pages 2162-2164, 2019.

## Other

- 2020 [O3] **Artificial Intelligence – The New Revolutionary Evolution.**  
Thomy Phan, Sebastian Feld, and Claudia Linnhoff-Popien.  
*Digitale Welt*, 4(1):7-8, 2020.
- 2018 [O2] **Bayesian Variational Optimization in Sensor Networks.**  
Steffen Illium, Thomas Gabor, and Thomy Phan.  
*GI/ITG KuVS Fachgespräch Sensornetze*, page 45, 2018.
- [O1] **Reinforcement Learning am Beispiel Schach.**  
Thomy Phan.  
*Digitale Welt*, 2(4):28-29, 2018.

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## Talks

### Invited Talks

- 07/2022 **Emergent Cooperation from Mutual Acknowledgment Exchange**, Workshop on Ad Hoc Teamwork at IJCAI 2022 (virtual).  
Highlight presentation of a paper previously published in AAMAS 2022.
- 06/2021 **Stability in AI-Systems**, Digitale Stadt München e.V., Germany (virtual).  
DigiTalk event on Safe Intelligence of the Digital City Association of Munich.
- 12/2020 **Artificial Intelligence – How Do Robots Learn?**, Gymnasium Berchtesgaden, Germany (virtual).  
P-seminar talk for high school students and the Junior Science Café.
- 03/2019 **Building Autonomous Systems with AI**, *University of Augsburg*, Germany.  
AI workshop for students of the Software Engineering Elite Graduate Program.

### Oral Presentations at Conferences and Workshops

- 05/2022 **Emergent Cooperation from Mutual Acknowledgment Exchange**, virtual.  
International Conference on Autonomous Agents and Multiagent Systems (AAMAS).
- 12/2021 **VAST: Value Function Factorization with Variable Agent Sub-Teams**, virtual.  
Conference on Neural Information Processing Systems (NeurIPS).
- 02/2021 **Resilient Multi-Agent Reinforcement Learning with Adversarial Value Decomposition**, virtual.  
AAAI Conference on Artificial Intelligence (AAAI).
- 05/2020 **Learning and Testing Resilience in Cooperative Multi-Agent Systems**, virtual.  
International Conference on Autonomous Agents and Multiagent Systems (AAMAS).
- 05/2020 **A Distributed Policy Iteration Scheme for Cooperative Multi-Agent Policy Approximation**, virtual.  
Adaptive and Learning Agents Workshop (ALA) at AAMAS.

- 08/2019 **Adaptive Thompson Sampling Stacks for Memory Bounded Open-Loop Planning**, Macao, China.  
International Joint Conference on Artificial Intelligence (IJCAI).
- 02/2019 **Memory Bounded Open-Loop Planning in Large POMDPs using Thompson Sampling**, *Honolulu*, Hawaii, USA.  
AAAI Conference on Artificial Intelligence (AAAI).
- 07/2018 **Leveraging Statistical Multi-Agent Online Planning with Emergent Value Function Approximation**, Stockholm, Sweden.  
International Conference on Autonomous Agents and Multiagent Systems (AAMAS).

#### Other Talks

- 2019 **Unitag: Artificial Intelligence – How Do Robots Learn?**, *LMU Munich*, Germany.  
University event for gifted high school students from Upper Bavaria.