Thomy Phan

Curriculum Vitae

Contact Information

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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 *multi-agent learning for optimization* of large-scale distributed and intelligent systems such as warehouse automation, fleet management, and drone delivery.

Education

2018 – 2023 **Ph.D. in Computer Science**, *LMU Munich*, Germany
- 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, NeurIPS, and ICML

2015 – 2017 **M.Sc. in Computer Science**, *LMU Munich*, Germany
- 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 a full paper

2011 – 2015 **B.Sc. in Computer Science**, *Munich University of Applied Sciences*, Germany
- Collaborative study program (duales Studium) 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 a journal paper (cover story)

Professional Experience

2023 – Present **Postdoctoral Scholar**, *University of Southern California*, Los Angeles, CA, USA
- Advisor: Sven Koenig
- Focus on multi-agent learning for optimization of distributed applications.

2017 – 2023 **Research Assistant**, *LMU Munich*, Germany
- Advisor: Claudia Linnhoff-Popien
- Focus on emergence and resilience in multi-agent systems.

2015 – 2018 **Software Developer**, *it@M, City of Munich*, Germany
Development, maintainance, and integration of business applications (part-time).

Internships

2015 **Visiting Scholar in Research (3 Months)**, *Yale University*, New Haven, CT, USA
- Advisor: Joerg Bewersdorf

- Focus on data analysis and feature extraction of cellular structures in super-resolution microscopy data. Co-authored publication in Cell 2016 (cover story).

2012 – 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.

Honors and Awards

2022 **Premier Paper of AAMAS 2022**, *Journal of the International Foundation for Autonomous Agents and Multi-Agent Systems (JAAMAS)*
Fast-track invitation to publish an extended version of our AAMAS 2022 paper "Emergent Cooperation from Mutual Acknowledgment Exchange" (main author).

2022 **Highlight Paper at the Workshop on Ad Hoc Teamwork**, *International Joint Conference on Artificial Intelligence (IJCAI)*, Vienna, Austria
Recognition of our AAMAS 2022 paper "Emergent Cooperation from Mutual Acknowledgment Exchange" (main author).

2022 **Top 10% Reviewer**, *International Conference on Machine Learning (ICML)*, Baltimore, MD, USA

2021 **ICAART 2021 – Springer Selection**, *Lecture Notes in Artificial Intelligence*
Fast-track invitation to publish an extended version of our ICAART 2021 paper "SAT-MARL: Specification Aware Training in Multi-Agent Reinforcement Learning" (co-author).

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

2012 – 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.

Research Projects

2023 – Present **AI4OPT – AI Institute for Advances in Optimization**, *National Science Foundation*, Los Angeles, CA, USA
Research on multi-agent learning for optimization of distributed and intelligent applications.

2023 **Dependability of Machine Learning in Industrial Robotics**, *Siemens AG*, Munich, Germany
Research on robust machine learning in industrial robotics. Assisted acquisition.

2022 – 2024 **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 in collaboration with Fraunhofer IKS. Assisted acquisition.

2022	**Validation and Verification of Modular Machine Learning Systems**, *Siemens AG*, Munich, Germany

Research on modular machine learning. Assisted acquisition.

2020 – 2021	**Federated Learning in Industrial Environments**, *Siemens AG*, Munich, Germany

Research on adaptive testing of federated learning systems. Assisted acquisition.

2019	**Dependability of Machine Learning in Industrial Environments**, *Siemens AG*, Munich, Germany

Research on resilient multi-agent reinforcement learning.

2018	**Coevolution in Machine Learning Based Industrial Environments**, *Siemens AG*, Munich, Germany

Research on coevolutionary reinforcement learning.

2017 – 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.

2017 – 2023	**InnoMI – Innovation Center Mobile Internet**, *Bavarian Ministry of Economic Affairs, Regional Development, and Energy*, Munich, Germany

Research on innovative mobile and distributed applications.

Selected Publications

Conferences

2023	[C14]	**Attention-Based Recurrence for Multi-Agent Reinforcement Learning under Stochastic Partial Observability**

Thomy Phan, Fabian Ritz, Philipp Altmann, Maximilian Zorn, Jonas Nüßlein, Michael Kölle, Thomas Gabor, and Claudia Linnhoff-Popien.
International Conference on Machine Learning (ICML), pages 27840–27853, 2023.

	[C13]	**CROP: Towards Distributional-Shift Robust Reinforcement Learning using Compact Reshaped Observation Processing**

Philipp Altmann, Leonard Feuchtinger, Fabian Ritz, Jonas Nüßlein, Claudia Linnhoff-Popien, and Thomy Phan.
International Joint Conference on Artificial Intelligence (IJCAI), pages 3414–3422, 2023.

	[C12]	**Adaptive Bi-Nonlinear Neural Networks Based on Complex Numbers with Weights Constrained along the Unit Circle**

Felip Guimerà Cuevas, Thomy Phan, and Helmut Schmid.
Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD), pages 355–366, 2023.

2022	[C11]	**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.

	[C10]	**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.

2021	[C9]	**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.

	[C8]	**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 [C7] **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.

[C6] **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.

2019 [C5] **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.

[C4] **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.

[C3] **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.

[C2] **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 [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 (fast-track invitation).

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

Workshop papers with a conference or journal version are not listed.

2023 [W4] **DIRECT: Learning from Sparse and Shifting Rewards using Discriminative Reward Co-Training**
Philipp Altmann, Thomy Phan, Fabian Ritz, Thomas Gabor, and Claudia Linnhof-Popien.
Adaptive and Learning Agents Workshop (ALA) at AAMAS, 2023.

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.

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.

Academic Activities

Organizing Committee

2019 International Symposium on Applied Artificial Intelligence (ISAAI)

Program Committee

2021 – 2024 AAAI Conference on Artificial Intelligence (AAAI)

2023 International Joint Conference on Artificial Intelligence (IJCAI – AI and Social Good)

2023 International Joint Conference on Artificial Intelligence (IJCAI – Main Track)

2023 European Conference on Artificial Intelligence (ECAI)

2023 International Conference on Autonomous Agents and Multiagent Systems (AAMAS – Blue Sky Ideas)

Reviewer

2024 International Conference on Learning Representations (ICLR)

2022 – 2023 Conference on Neural Information Processing Systems (NeurIPS)

2022 – 2023 International Conference on Machine Learning (ICML)

2023 International Conference on Autonomous Agents and Multiagent Systems (AAMAS – Main Track)

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)

Teaching

Spring 2024   **CSCI 599: Autonomous Decision-Making (Upcoming)**, *University of Southern California*, Los Angeles, CA, USA

- Special topics lecture for master students on planning, reinforcement learning, and multi-agent systems
- Primary instructor
- Syllabus available at https://classes.usc.edu/term-20241/course/csci-599/

2019 – 2023   **Autonomous Systems**, *LMU Munich*, Germany

- Practical course of 12-18 master students on planning and reinforcement learning
- Primary supervising assistant until summer semester 2022
- Registration count for summer semester 2022 provided at https://uni2work.ifi.lmu.de/course/S22/IfI/ASP

2019 – 2023   **Working Group "Artificial Intelligence"**, *LMU Munich*, Germany

- Voluntary working group of over 100 bachelor and master students on current AI topics
- Primary supervising assistant
- Registration count for summer semester 2022 provided at https://uni2work.ifi.lmu.de/course/S22/IfI/AIAG

2018 – 2019   **Mobile and Distributed Systems**, *LMU Munich*, Germany

- Practical course of 12-18 master students on mobile app development and on-device machine learning
- Secondary supervising assistant

2017 – 2023   **Student Mentoring**, *LMU Munich*, Germany

- 26 master theses
- 24 bachelor theses
- 8 individual research projects

Talks

Invited Talks

07/2022   **Emergent Cooperation from Mutual Acknowledgment Exchange**, Workshop on Ad Hoc Teamwork at IJCAI 2022 (virtual)
Highlight presentation of our AAMAS 2022 paper *"Emergent Cooperation from Mutual Acknowledgment Exchange"* (main author).

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.

Presentations at Conferences as Main Author

07/2023   **Attention-Based Recurrence for Multi-Agent Reinforcement Learning under Stochastic Partial Observability**, Honolulu, Hawaii, USA
International Conference on Machine Learning (ICML).

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).

08/2019 **Adaptive Thompson Sampling Stacks for Memory Bounded Open-Loop Planning**, Macao, China
International Joint Conference on Artificial Intelligence (IJCAI).

05/2019 **Distributed Policy Iteration for Scalable Approximation of Cooperative Multi-Agent Policies**, Montreal, Canada
International Conference on Autonomous Agents and Multiagent Systems (AAMAS).

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 (Oberbayern).