

Thomy Phan

Curriculum Vitae

Contact Information

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Research Interests

Multi-Agent Systems, Reinforcement Learning, Optimization, Heuristic Search

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 at 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 at AAMAS 2018 as a **full conference 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.
- 2018 – 2023 **Research Assistant**, *LMU Munich*, Germany
- Advisor: Claudia Linnhoff-Popien
 - Focus on emergence and resilience in multi-agent systems.
- 2015 – 2018 **Software Developer (Part-Time)**, *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

- 2024 **Nomination for the GI Dissertation Award 2023**, *Gesellschaft für Informatik e.V. (GI)*, Dagstuhl, Germany
Nominated candidate by LMU Munich for the dissertation award of the German Informatics Society. The selection process will start in May 2024.
- 2024 **CRA Travel Grant for the CCC Artificial Intelligence/Operations Research Workshop III**, *Computing Community Consortium (CCC)*, Washington, DC, USA
Invitation and financial support from the Computing Research Association (CRA).
- 2024 **ICAART 2024 – Springer Selection**, *Lecture Notes in Artificial Intelligence*
Invitation to submit an extended version of our ICAART 2024 paper "Multi-Agent Quantum Reinforcement Learning using Evolutionary Optimization" (co-author).
- 2023 **Outstanding Reviewer (Top 10%)**, *Conference on Neural Information Processing Systems (NeurIPS)*, New Orleans, LA, USA
Listed at <https://neurips.cc/Conferences/2023/ProgramCommittee>
- 2022 **Premier Paper of AAMAS 2022**, *Journal of the International Foundation for Autonomous Agents and Multi-Agent Systems (JAAMAS)*
Invitation to submit 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). More details at <https://sites.google.com/view/ad-hoc-teamwork/waht-2022>
- 2022 **Outstanding Reviewer (Top 10%)**, *International Conference on Machine Learning (ICML)*, Baltimore, MD, USA
Listed at <https://icml.cc/Conferences/2022/Reviewers>
- 2021 **ICAART 2021 – Springer Selection**, *Lecture Notes in Artificial Intelligence*
Invitation to submit an extended version of our ICAART 2021 paper "SAT-MARL: Specification Aware Training in Multi-Agent Reinforcement Learning" (co-author).
- 2019 **DAAD Travel Grant for AAMAS 2019**, *German Academic Exchange Service*, 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

- 2024 – Present **Causal Foundations of Decision-Making and Learning**, *National Science Foundation*, Los Angeles, CA, USA
Research on scalable causal reinforcement learning and planning.
- 2023 – Present **AI4OPT – AI Institute for Advances in Optimization**, *National Science Foundation*, Los Angeles, CA, USA
Research on multi-agent learning for scalable optimization.
- 2023 **Dependability of Machine Learning in Industrial Robotics**, *Siemens AG*, Munich, Germany
Research on robust machine learning in industrial robotics. Assisted acquisition.
- 2022 – 2024 **Intelligent and Cognitive 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 **Dependable MLOps in Industrial Environments**, *Siemens AG*, Munich, Germany
Research on adaptive testing in MLOps systems. Assisted acquisition.
- 2019 **Dependability of Machine Learning in Industrial Environments**, *Siemens AG*, Munich, Germany
Research on resilience in multi-agent reinforcement learning.
- 2018 **Coevolution in Machine Learning Based Industrial Environments**, *Siemens AG*, Munich, Germany
Research on scenario coevolution in reinforcement learning.
- 2018 – 2023 **InnoMI – Innovation Center Mobile Internet**, *Bavarian Ministry of Economic Affairs, Regional Development, and Energy*, Munich, Germany
Research on innovative mobile and distributed systems.

Selected Publications

Conferences

Extended abstracts (≤ 3 pages) with a full conference or journal version are not listed.

- 2024 [C20] **Confidence-Based Curriculum Learning for Multi-Agent Path Finding**
Thomy Phan, Joseph Driscoll, Justin Romberg, and Sven Koenig.
International Conference on Autonomous Agents and Multiagent Systems (**AAMAS**), pages 1558–1566, 2024.
- [C19] **Anytime Multi-Agent Path Finding Using Operator Parallelism in Large Neighborhood Search (Extended Abstract)**
Shao-Hung Chan, Zhe Chen, Dian-Lun Lin, Yue Zhang, Daniel Harabor, Sven Koenig, Tsung-Wei Huang, and Thomy Phan.
International Conference on Autonomous Agents and Multiagent Systems (**AAMAS**), pages 2183–2185, 2024.
- [C18] **Adaptive Anytime Multi-Agent Path Finding using Bandit-Based Large Neighborhood Search**
Thomy Phan, Taoan Huang, Bistra Dilkina, and Sven Koenig.
AAAI Conference on Artificial Intelligence (**AAAI**), pages 17514–17522, 2024.
- [C17] **Multi-Agent Quantum Reinforcement Learning Using Evolutionary Optimization**
Michael Kölle, Felix Topp, Thomy Phan, Philipp Altmann, Jonas Nüßlein, Claudia Linnhoff-Popien.
International Conference on Agents and Artificial Intelligence (**ICAART**), pages 71–82, 2024.
- [C16] **Challenges for Reinforcement Learning in Quantum Circuit Design**
Philipp Altmann, Jonas Stein, Michael Kölle, Adelina Bärligea, Maximilian Zorn, Thomas Gabor, Thomy Phan, Sebastian Feld and Claudia Linnhoff-Popien.
IEEE International Conference on Quantum Computing and Engineering (**QCE**), 2024. To appear.
- 2023 [C15] **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.
- [C14] **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.
- 2022 [C13] **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.

- [C12] **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 [C11] **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.
- [C10] **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.
- [C9] **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.
- 2020 [C8] **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.
- [C7] **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 [C6] **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.
- [C5] **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.
- [C4] **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.
- [C3] **Distributed Policy Iteration for Scalable Approximation of Cooperative Multi-Agent Policies (Extended Abstract)**
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.
- [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

- 2024 [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), 38(34), 2024. Invited from AAMAS 2022.
- 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. Invited from ICAART 2021.
- 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 [W3] **DIRECT: Learning from Sparse and Shifting Rewards using Discriminative Reward Co-Training**
Philipp Altmann, **Thomy Phan**, Fabian Ritz, Thomas Gabor, and Claudia Linnhoff-Popien.
Adaptive and Learning Agents Workshop (**ALA**) at AAMAS, 2023.
- 2020 [W2] **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 2020, pages 456–461, 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.

Academic Activities

Organizing Committee

- 2019 International Symposium on Applied Artificial Intelligence (ISAAI). More details at <https://digitaleweltmagazin.de/digicon-2019/symposium/>

Action Editor

- 2024 Transactions on Machine Learning Research (TMLR)

Program Committee

- 2021 – 2025 AAAI Conference on Artificial Intelligence (AAAI)
2022 – 2024 Conference on Neural Information Processing Systems (NeurIPS)

- 2023 – 2024 International Joint Conference on Artificial Intelligence (IJCAI)
- 2022 – 2024 International Conference on Machine Learning (ICML)
- 2024 International Conference on Automated Planning and Scheduling (ICAPS)
- 2024 International Conference on Learning Representations (ICLR)
- 2023 – 2024 European Conference on Artificial Intelligence (ECAI)
- 2024 Genetic and Evolutionary Computation Conference (GECCO)
- 2023 International Conference on Autonomous Agents and Multiagent Systems (AAMAS – Blue Sky Ideas)

Reviewer (of Individual Papers)

- 2024 Journal on Autonomous Agents and Multi-Agent Systems (JAAMAS)
- 2024 Artificial Intelligence Journal (AIJ)
- 2024 AAAI 2024 Workshop on Cooperative Multi-Agent Systems Decision-making and Learning (CMASDL)
- 2023 International Conference on Autonomous Agents and Multiagent Systems (AAMAS)
- 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

University of Southern California, USA

- Spring 2024 **CSCI 599: Autonomous Decision-Making**
 - Self-developed lecture on reinforcement learning, planning, and multi-agent systems
 - Primary instructor
 - Syllabus and registration count provided at <https://classes.usc.edu/term-20241/course/csci-599/>
- Spring 2024 **CSCI 499: Foundations of Multi-Agent Systems (Guest Lecture)**
 - Lecture on multi-agent algorithms and applications given by Prof. Sven Koenig
 - Guest lecturer for two sessions on multi-agent reinforcement learning
 - Syllabus and registration count provided at <https://classes.usc.edu/term-20241/course/csci-499/>

LMU Munich, Germany

- 2019 – 2023 **Autonomous Systems**
 - Self-developed practical course for 12 – 18 master students on planning and reinforcement learning
 - Primary supervising assistant until summer semester 2022
 - Syllabus and registration count for summer semester 2022 provided at <https://uni2work.ifi.lmu.de/course/S22/IfI/ASP>
- 2019 – 2023 **Working Group "Artificial Intelligence"**
 - Voluntary working group for more than 100 bachelor and master students on current AI topics
 - Primary supervising assistant
 - Syllabus and registration count for summer semester 2022 provided at <https://uni2work.ifi.lmu.de/course/S22/IfI/AIAG>
- Winter 2022 **Computational Intelligence (Guest Lecture)**
 - Lecture on intelligent optimization algorithms given by Dr. Thomas Gabor
 - Guest lecturer for one session on multi-agent optimization
 - Syllabus and registration count provided at <https://uni2work.ifi.lmu.de/course/W22/IfI/CoIn>

- 2018 – 2019 **Mobile and Distributed Systems**
- Practical course for 12 – 18 master students on mobile app development and on-device machine learning
 - Secondary supervising assistant
- 2018 – 2023 **Student Mentoring**
- 26 master theses
 - 24 bachelor theses
 - 8 individual research projects

Talks

Invited Talks

- 06/2024 **Towards Scalable Optimization via Multi-Agent Reinforcement Learning, Interactive Visualization and Intelligence Augmentation Lab (IVIA)**, ETH Zürich (virtual), Switzerland
Invited talk at the IVIA-lab headed by Prof. Mennatallah El-Assady.
- 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). More details at <https://sites.google.com/view/ad-hoc-teamwork/waht-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. More details at <https://digitalestadtmuenchen.de/event/safe-intelligence/>
- 12/2020 **"Künstliche Intelligenz: Wie lernen Roboter?"**, Gymnasium Berchtesgaden, Germany (virtual)
P-seminar talk for high school students and the Junior Science Café. I received an invitation because of my successful talk at the Unitag event of LMU Munich in 2019 (see below).
- 03/2019 **Building Autonomous Systems with AI**, University of Augsburg, Germany
AI workshop for students of the Software Engineering Elite Graduate Program in Bavaria.

Presentations at Conferences as the Main Author

- 02/2024 **Adaptive Anytime Multi-Agent Path Finding Using Bandit-Based Large Neighborhood Search**, Vancouver, Canada
AAAI Conference on Artificial Intelligence (AAAI).
- 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 – "Künstliche Intelligenz: Wie lernen Roboter?"**, *LMU Munich*, Germany
University event for gifted high school students from Upper Bavaria.