Jonas Jäger

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Education

University of British Columbia Sep/2022 – Present
Ph.D. program in Computer Science and Applied Mathematics *Vancouver, Canada*

- *Add-on program*: Quantum Computing
- *NSERC CREATE Quantum Computing Scholarship:* Three year scholarship for quantum computing research
- *Los Alamos National Lab Quantum Computing Summer School 2024:* Research fellowship (21 of 700 applicants)
- *Research exchange at German Aerospace Center (DLR):* QuantiCoM team (Quantum Computing for Materials)
- *Visiting student at University of Victoria Jan-Apr 2023:* Computational Quantum Chemistry (Grad-level course)
- *Visiting student at Simon Fraser University Sep-Dec 2022:* Quantum Circuits & Compilation (Grad-level course)

Technical University of Darmstadt Oct/2019 – Aug/2022
Master's degree in Computer Science • GPA: 1.10 (excellent; 1.0 is max.)
Master's degree in Autonomous Systems • GPA: 1.06 (excellent; 1.0 is max.)
Darmstadt, Germany

- *Graduated with honors* in both Computer Science M.Sc. and Autonomous Systems M.Sc.
- *Deutschlandstipendium 2019-2022:* Yearly scholarship competition for top-class students at German universities
- *1st place, Turtlebot competition 2021:* Yearly TU Darmstadt autonomous robots competition (10 student teams)
- *Top student in Reinforcement Learning graduate course series (2019):* Among the best 3% of 188 students

University of British Columbia Sep/2021 – Dec/2021
Exchange semester *Vancouver, Canada*

- Sessional Average: 96.3%
- *DAAD Promos Scholarship Sep-Dec 2021:* Scholarship for studying abroad by DAAD

Technical University of Darmstadt Oct/2015 – Jun/2019
Bachelor's degree in Computer Science *Darmstadt, Germany*

- GPA: 1.33 (excellent; 1.0 is max.)
- *Deutschlandstipendium 2017/18:* One year scholarship for top-class students at German universities
- *Top student in Data Mining and Machine Learning graduate course (2018):* Among top 10 of over 200 examinees
- *Top student in Game Technology (2018):* Among the best 3% of the examinees

Experience

Research fellow and summer student June/2024 – Aug/2024
Quantum Computing Summer School 2024 (Los Alamos National Lab; LANL) *Los Alamos, USA*

- Cutting-edge quantum computing research with LANL scientists and post-docs & talks by global experts
- Project a: Provable and scalable Quantum Gaussian Process theory and regression via majorana formalism
- Project b: Study of absence and presence of barren plateaus in cost landscapes with correlated parameters

Researcher Oct/2023 – May/2024
Project QuantiCoM: Quantum Computing for Materials (German Aerospace Center; DLR) *Köln, Germany*

- Explore quantum computing for materials such as simulation, optimization and quantum machine learning
- Focus: Practical quantum machine learning, limitations in quantum data, quantum-aware (fermionic) optimization
- Collaboration with over 20 QuantiCoM researchers among three DLR institutes and industry partners

Teaching Assistant Jan/2023 – Apr/2023
Computational Optimization (University of British Columbia) *Vancouver, Canada*

- Upper-year & graduate course: Computational Optimization

Teaching Assistant Apr/2022 – Jul/2022
Quantum Computing Group (TU Darmstadt) *Darmstadt, Germany*

- Graduate course: Introduction to Quantum Computing

Research Assistant Jul/2019 – Jun/2020
ABB Corporate Research and Intelligent Autonomous Systems Group (TU Darmstadt) *Darmstadt, Germany*

- Robot Learning for industrial applications (assembly tasks)
- Implemented a model-free reinforcement learning algorithm (HiREPS)
- Set up the custom simulation environment and performance optimization by MPI multi-processing for HPCs

Teaching Assistant Oct/2018 – Feb/2019
Knowledge Engineering Group (TU Darmstadt) *Darmstadt, Germany*

- Graduate course: Data Mining and Machine Learning

Founder, Executive Manager, Technical Manager Jul/2012 – Apr/2016
PixoSoft – Jonas Jäger, Sebastian Nikles GbR *Dreieich, Germany*

- Full stack app development and design for iPhone and iPad

Research Projects

Limits of Quantum Advantage in Variational Quantum Algorithms (VQAs) | *UBC* May/2023 – Aug/2023
- Ph.D. Research Proficiency Evaluation at UBC. Commitee: Roman Krems, Michael Friedlander, Daochen Wang
- Proved efficient classical tensor network simulation for shallow local VQAs free from barren plateaus
- Analyzed properties of the initial states and their impact on the efficiency of the classical simulation

Neural network quantum tomography | *Quantum Computing group (TU Darmstadt)* Feb/2022 – Aug/2022
- Master's thesis research
- Compared Restricted Boltzmann Machine Quantum Tomography to a recent Transformer-based development
- Designed advanced evaluation scheme using entanglement theory

Quantum Machine Learning | *Dr. Roman Krems' group (UBC)* Sep/2021 – Apr/2022
- Researched benchmark data sets of complexity-theoretic (BQP) hardness
- Proved the expressive power of Quantum-enhanced Support Vector Machines
- Co-supervised a follow-up research project studying properties of the data set for practical application

Robot Learning | *Intelligent Autonomous Systems Group (TU Darmstadt)* Apr/2020 – Sep/2020
- Integrated supervised dimensionality reduction in reinforcement learning algorithms
- Improved sample efficiency for Sim2Real algorithms

Regularization of Deep Neural Networks | *Knowledge Engineering Group (TU Darmstadt)* Dec/2018 – Jun/2019
- Bachelor's thesis research
- Designed and evaluated a novel method for regularizing neural networks to mitigate over-fitting

Personal

Programming Languages: Python, Java, C, C++, Objective C, Swift, Matlab, Prolog, Racket, Julia
Scripting and Description Languages: HTML, CSS, JS, php, SQL, Matlab, LaTeX, Verilog, Bluespec, Mathematica
Developer Tools & Libraries: PyCharm, git, PyTorch, Qiskit, Pennylane, Tangelo, SciKit Learn, pandas, numpy
Sports: Rock climbing, indoor climbing, bouldering, hiking, running, biking, kayaking, fencing
Arts: Piano, guitar, keyboard, drawing

Publications

Jäger, Jonas, et al. "Fast gradient-free optimization of excitations in variational quantum eigensolvers". *arXiv preprint arXiv:2409.05939*, 2024.

Jäger, Jonas and Roman V. Krems. "Universal expressiveness of variational quantum classifiers and quantum kernels for support vector machines". *Nature Communications*, vol. 14, no. 1, Feb. 2023. doi:10.1038/s41467-023-36144-5.

Jäger, Jonas, et al. "Bring Color to Deep Q-Networks: Limitations and Improvements of DQN Leading to Rainbow DQN". *Reinforcement Learning Algorithms: Analysis and Applications*, Springer, 2021, pp. 135–149.

Scharf, Fabian, et al. "Actor vs Critic: Learning the Policy or Learning the Value". *Reinforcement Learning Algorithms: Analysis and Applications*, Springer, 2021, pp. 123–133.

Jäger, Jonas. "Self-Imitation Regularization: Regularizing Neural Networks by Leveraging Their Dark Knowledge". (B.Sc. thesis). *Technische Universität Darmstadt*, 2019.

Pending Publications

Kairon, Pranav, et al. "Equivalence between exponential concentration in quantum machine learning kernels and barren plateaus in variational algorithms".

Patents

Jäger, Jonas, et al. "Method for determining energies and energy states *(unofficial title translation)*". German patent DE102024115387.3 *Submitted*, 2024.

Presentations

Quantum Machine Learning Workshop, *Introduction to Quantum Machine Learning Methods*, University of British Columbia Quantum Club, 2023.

Quantum Computing Grand Challenge Workshop, *On the Quantum Advantage of Quantum Machine Learning*, Stewart Blusson Quantum Matter Institute, Vancouver BC, 2023.

Workshop on Quantum Computing and Operations Research, *Universal Expressiveness of Quantum Machine Learning Classifiers* (Poster), Fields Institute, Toronto ON, 2022.