Richard Bornemann

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Relevant Research Experience

Master's Thesis Student Mar 2024 - Sep 2024
Chair of Robotics, Artificial Intelligence and Real-time Systems, Technical University Munich

- Proposed and conducted research on distilling language-based reasoning from expert data into end-to-end trained language-conditioned visuo-motor policies for robotics
- Created Meta-CALVIN, a novel language-based meta-learning environment for robotics, adapted from the CALVIN environment
- Developed an LLM guided expert to generate rewarding trajectories in Meta-CALVIN to create a dataset for imitation learning
- Trained multiple billion parameter Vision-Language-Action models, coming within 96% of the average reward achieved by the LLM-based expert on the set of evaluation tasks

Research Intern Apr 2023 - Sep 2023
INRIA Bordeaux FLOWERS Laboratory

- Led research efforts on the emergence of open-ended cooperative exploration behaviors in decentralized multi-agent meta-learning settings
- Created a multi-agent meta-learning environment featuring an open-ended task space
- Developed a novel approach to train agents in single-and multi-agent scenarios simultaneously using decentralized PPO, improving individual agent performance by up to 50% over agents trained only in multi-agent settings
- Presented findings as the first author at the NeurIPS 2023 ALOE Workshop in New Orleans, USA.

Student Research Assistant Dec 2022 - Present
Chair of Artificial Intelligence and Machine Learning, LMU

- Contributed to the design and development of Compare-xAI, a comprehensive benchmark for 13 different Explainable AI methods
- Co-authored the Compare-xAI research paper and assisted in the creation of a public website for the benchmark results
- Implemented novel architectures for Bayesian Neural Networks, aimed at improving risk certificates for predictive performance on out-of-distribution datasets
- Trained and evaluated the models across a range of PAC-Bayes bounds for self-certified training

Student Research Assistant Jan 2022 - Jul 2022
Chair of Statistical Learning and Data Science, LMU

- Developed a framework to leverage learned approximations of Bregman Divergences as data-dependent distance metrics for contrastive self-supervised training of transformer-based models, aimed at improving learned representations for fine-tuning on downstream tasks
- Managed large-scale distributed training and evaluation of the models on the ImageNet and Conceptual Captions datasets

Education

Ludwig-Maximilians-Universität in Munich (LMU) Sep 2024
Master of Statistics. Final Grade: 1.28
Thesis Title: Language Conditioned Meta-Learning for Multi-Manipulation Tasks
Advisors: Prof. Alois Knoll, MSc. Xiangtong Yao
Grade: 1.0

University of Münster Mar 2020
Bachelor of Economics. Final Grade: 2.3
Thesis Title: Long-Term Interest Rate Movements in Early-Modern Central European Markets
Advisors: Prof. Pfister, Dr. Matthias Hartermann
Grade: 1.7

Publications

1. **Richard Bornemann**, Xiangtong Yao, Zhenshan Bing, Huang Kai, and Alois Knoll. Embodied reasoning for language-conditioned meta-learning in multi-manipulation task scenarios. *Preprint*, 2024
2. **Richard Bornemann**, Gautier Hamon, Eleni Nisioti, and Clément Moulin-Frier. Emergence of collective open-ended exploration from decentralized meta-reinforcement learning. *NeurIPS 2023 - Conference on Neural Information Processing Systems / ALOE Workshop*, 2023
3. Mohamed Karim Belaid, **Richard Bornemann**, Maximilian Rabus, Ralf Krestel, and Eyke Hüllermeier. Compare-xai: Toward unifying functional testing methods for post-hoc xai algorithms into a multi-dimensional benchmark. In *Explainable Artificial Intelligence*, pages 88–109, Cham, 2023. Springer Nature Switzerland

Relevant Knowledge

Programming Languages: Python, R

Developer Tools: Git, SLURM, Docker, Anaconda

Frameworks: Pytorch, PytorchLightning, Numpy, Huggingface, Pandas, PyBullet

OS: Windows, Linux

Languages: German (native), English (fluent)

Relevant Coursework

Deep Unsupervised Learning, Deep Learning, Deep Learning for Natural Language Processing, Multivariate Statistics, Decision Theory, Predictive Modelling, Generalized Regression, Statistical Inference

Interests

Formula 1, American Football, Chess, Hiking, Running