Julian M. Urban, Ph.D.

Research Scientist, Machine Learning

Postdoctoral Associate at **MIT**

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SUMMARY

Computational physicist with 7 years of experience in designing machine learning models and stochastic sampling algorithms for the simulation of complex systems and statistical analysis of large datasets. Pioneering applications of modern probabilistic modeling techniques in computational quantum field theory research with a focus on generative neural networks and Gaussian process regression. Leading and contributing to scientific software projects in interdisciplinary collaborations with researchers from academia and industry, ranging from the development of reference libraries for statistical inference methods to the implementation of highly parallelized simulations powered by deep learning and deployed on exascale HPC platforms with thousands of GPUs.

EXPERTISE

Conceptual	Probabilistic modeling, statistical inference, stochastic processes, MCMC algorithms, numerical optimization
Programming	Proficient: scientific Python (numerical / ML libraries including PyTorch, NumPy, SciPy) Basics: C++, Bash, PHP, SQL, Mathematica
Technologies	GNU/Linux, HPC scheduling (Slurm, PBS), AIMHub, Git, Jupyter, Emacs
Languages	English, German (native)

PROJECTS

Generative Modeling for Lattice QCD: Collaboration with *Google DeepMind* to build large neural network architectures for the generative modeling and stochastic sampling of complex data distributions found in lattice quantum chromodynamics research.

Bayesian Fredholm Inversion: Developing the *fredipy* package for solving heavily ill-conditioned linear inverse problems probabilistically using advanced Gaussian process regression and numerical optimization techniques.

Topological Data Analysis: Extracting stable features from high-dimensional noisy data using persistent homology.

ACADEMIC POSITIONS

2022 - current	**Postdoctoral Associate**, Center for Theoretical Physics	**MIT**
2021 - 2022	**Research Affiliate**, Laboratory for Nuclear Sciences	**MIT**
2020 - 2022	**Research and Teaching Assistant**, Institute for Theoretical Physics	**U Heidelberg**

EDUCATION

2018 - 2022	**Ph.D.**, Machine learning for computational quantum field theory	**U Heidelberg**
2015 - 2018	**M.Sc.**, Machine learning for computational quantum field theory	**U Heidelberg**
2012 - 2015	**B.Sc.**, Detector physics for collider experiments	**U Heidelberg**

NON-ACADEMIC WORK

2010 - 2013	**Software Developer**, Web/Database Applications	**DLI Trier**

SELECTED PUBLICATIONS

arXiv:2203.01243	*Flow-based density of states for complex actions*	**Phys.Rev.D**
arXiv:2107.13464	*Reconstructing QCD spectral functions with Gaussian processes*	**Phys.Rev.D**
arXiv:2003.01504	*Towards novel insights in lattice field theory with explainable machine learning*	**Phys.Rev.D**
arXiv:1811.03533	*Reducing autocorrelation times in lattice simulations with generative adversarial networks*	**Mach.Learn.Sci.Tech.**

INVITED TALKS

11/2023	**Workshop**, Large-scale lattice QCD simulation and application of machine learning	**U Tsukuba**
9/2023	**Conference**, European network for particle physics, lattice field theory and extreme computing	**HU Berlin**
5/2023	**Seminar**, Institute for Nuclear Theory	**U Washington**
3/2023	**Seminar**, Applied Mathematics	**UC Berkeley**

MISCELLANEOUS

Contributor	Found and fixed a high priority issue in `torch.distributions.von_mises.VonMises`	**GitHub/PyTorch**
Organizer	Organized an interdisciplinary workshop on Machine Learning and the Renormalization Group	**ECT* Trento**
Mentor	Advised students on five Bachelor's and four Master's thesis projects during Ph.D.	**U Heidelberg**