Chris Pedersen

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RESEARCH INTERESTS

I am a research scientist in deep learning. My expertise is in the construction of bespoke machine learning (ML) models to solve problems across science, including cosmology, bioinformatics, and turbulence modelling in fluid dynamics.

EXPERIENCE

Stealth AI startup 2025 - *present*
Member of the Core Team, Member of Technical Staff
Topics: Developing the next generation of language models.

Courant Institute & Center for Data Science, New York University August 2022 - March 2025
Postdoctoral Associate
Topics: Deep learning (convolutional neural networks, vision transformers, diffusion models) applied to fluid dynamics and chaotic systems.

Center for Cosmology and Particle Physics, New York University September 2021 - August 2022
Postdoctoral Associate
Topics: Recovering properties of dark matter from data using wavelet scattering networks, convolutional neural networks.

Center for Computational Astrophysics, Flatiron Institute September 2021 - August 2024
Guest Researcher

EDUCATION

University College London September 2017 - August 2021
Ph.D. in Astrophysics

- Co-PI on a 4.5M CPU hour allocation on a Tier 1 machine: responsible for code performance evaluation, running simulations, data management, postprocessing, scientific analysis and publications.
- Development of simulation code in C/C++, construction of Bayesian inference and Gaussian process modelling pipelines in Python.
- This compute allocation led to 6 publications, 3 of which I was lead author. The methodology I developed is currently being used for the interpretation of data from a $100M cosmological survey.

Cardiff University September 2012 - July 2017
MPhys in Physics with Astronomy, First class honours

ML PROJECTS LED

Stabilising autoregressive rollouts with diffusion models (2024 - 2025):

- Developed the *thermalizer* - a novel algorithm using diffusion models to efficiently keep the state vector of autoregressive models in distribution (accepted at ICML 2025).

Neural emulation for improved turbulence modelling (2023):

- Responsible for model design and implementation, construction of hybrid model training, testing, and simulation analysis pipeline (PyTorch, Weights and Biases).
- Led to a workshop paper at ICML 2023 improving the stability and computational cost of turbulence simulations.

Cancer-net (2022 - 2023):

- Using graph neural networks to model the progression of prostate and brain cancer based on the genetic mutations within the tumor.
- Responsible for model design and implementation in PyTorch, model optimisation, and performance validation (preprint and code).

Wavelet scattering for cosmological inference (2022):

- Created a novel wavelet-based CNN to extract information from cosmological data, which is twice as performant as a standard CNN in the low-data regime.
- Led to a workshop paper at ICML 2022 and publicly available code.

Cosmology emulator (2020-2021):

- Built a surrogate model (or *emulator*) using Gaussian processes, enabling accurate Bayesian parameter inference of observational data from just 30 training simulations (publication and code).

TECHNICAL SKILLS

Computational skills	Python, Linux/Bash, git, LaTeX, High Performance Computing, PyTorch, TensorFlow, Jax, SciPy, scikit-learn, numerical methods, Docker
Statistics & ML	Bayesian inference, Markov chain Monte Carlo simulations, linear regression, logistic regression, SVM, PCA, Gaussian processes, convolutional neural networks, LLMs graph neural networks, autoencoders, wavelet scattering networks diffusion models, data parallelism (DDP), model parallelism (Deepspeed)
Software packages	thermalizer, cancer-net, torch-qg, LearnableWavelets, LaCE, cup1d, MP-Gadget (Contributor), fake_spectra (Contributor)

SELECTED PUBLICATIONS

Complete list available here

- **C. Pedersen**, L. Zanna, J. Bruna
  Thermalizer: Stable autoregressive neural emulation of spatiotemporal chaos, ICML 2025
- **C. Pedersen**, L. Zanna, J. Bruna, P. Perezhogin
  Reliable coarse-grained turbulent simulations through combined offline learning and neural emulation, ICML 2023 Synergy of Scientific and Machine Learning Modeling Workshop
- **C. Pedersen**, A. Font-Ribera, N. Y. Gnedin
  Compressing the cosmological information in one-dimensional correlations of the Lyman-α forest, *Astrophysical Journal* (2023)
- **C. Pedersen**, M. Eickenberg, S. Ho
  Learnable wavelet neural networks for cosmological inference,
  ICML 2022 Machine Learning for Astrophysics Workshop
- **C. Pedersen**, A. Font-Ribera, K. K. Rogers, P. McDonald, H. V. Peiris, A. Pontzen, A. Slosar
  An emulator for the Lyman-α forest in beyond-ΛCDM cosmologies, JCAP (2021)
- **C. Pedersen**, A. Font-Ribera, T. D. Kitching, P. McDonald, S. Bird, A. Slosar, K. K. Rogers, A. Pontzen
  Massive neutrinos and degeneracies in Lyman-alpha forest simulations, JCAP (2020)

REVIEWING SERVICE

Reviewer for Nature Communications, Neurips, ICML, Journal of Advances in Modeling Earth Systems, Artificial Intelligence for the Earth Systems, The Astrophysical Journal