

# Philip Nielsen

*Fellow in Applied Mathematics specializing in Generative Modeling and RL*

Cambridge, MA

📞 718-913-7734

✉️ [pnielsen2@outlook.com](mailto:pnielsen2@outlook.com)

🌐 [pnielsen2](#)

US/EU Citizen

## Professional Summary

Highly motivated machine learning researcher with a strong mathematical background and hands-on experience in Reinforcement Learning and Generative Modeling. Proficient in implementing RL algorithms from scratch and applying them to various game environments. Skilled in using cloud computing for large-scale experiments and visualization tools for result analysis. Seeking opportunities to contribute to cutting-edge research in Generative Modeling, Reinforcement Learning, and AI safety.

## Education

- 2023 **MA in Statistics**, *Columbia University*, New York, NY, Completed one semester
  - Courses: Deep Probabilistic Generative Modeling, Reinforcement Learning, Probabilistic Modeling and Machine Learning.
- 2017–2021 **MA in Mathematics and Statistics (Integrated Masters)**, *University of Oxford*, Oxford, UK, Upper Second-Class Honors
  - Selected Courses: Theories of Deep Learning, Information Theory, Random Matrix Theory, Advanced Topics in Statistical Machine Learning, Applied Probability, Applied Statistics

## Research Experience

- 2024–Present **Fellow in Applied Mathematics**, *Harvard University, Koumoutsakos Lab*, Cambridge, MA
  - **Pioneered a novel Sora-inspired latent diffusion model** for forecasting the one-dimensional Kuramoto-Sivashinsky equation, significantly advancing generative modeling of chaotic PDEs.
  - Developed an innovative two-part model combining a Variational Autoencoder (VAE) and a diffusion forcing model, enabling the generation of arbitrarily long, stable trajectories that closely mimic the true PDE manifold.
  - Achieved rapid progress through high iteration velocity, leveraging automation and modular code design; published code on GitHub with advanced features for reproducibility and ease of experimentation.
  - Optimized computational efficiency by leveraging cloud-based H100 GPUs for large-scale training runs, accelerating model development and iteration cycles.
  - Delivered comprehensive research presentations to the lab group, effectively communicating complex ideas with engaging visualizations and prepared data, receiving commendations from Professor Koumoutsakos and peers.

- 2024 **Independent Researcher**, Cambridge, MA
- Developed a novel uncertainty quantification algorithm for reinforcement learning, aiming to improve sample efficiency in computer Go
  - Explored applications of advanced UQ techniques to enhance performance in complex game environments
  - Investigated the integration of uncertainty estimates into MCTS algorithms for enhanced exploration-exploitation balance
  - Achieved 15% improvement over tabular methods in solving 3x3 Go
- 2023 **Research Assistant**, *Columbia University*, New York, NY
- **Developed a novel self-replicating neural network** under Prof. Hod Lipson, achieving machine-precision accuracy with training times under a minute on a basic CPU.
  - Introduced a contraction mapping based on the Banach Fixed Point Theorem to the regeneration training process, guaranteeing convergence to a unique fixed point where the network predicts its own weights exactly.
  - Overcame instability and inaccuracy issues present in prior work, accomplishing a breakthrough that eluded others in the lab, including PhD students.
  - Prepared findings for publication, showcasing strong mathematical insight and innovation in neural network self-replication.
- 2020 **Independent Researcher**
- Reimplemented AlphaGo Zero algorithm from scratch, achieving near-perfect play on 5x5 Go board within 3.5 days of training
  - Implemented full Deep Convolutional neural network architecture using PyTorch, leveraging CUDA GPU training for 10x speedup
  - Developed efficient Go simulator and implemented PUCT algorithm and search trees for move selection
  - Utilized Matplotlib and Tensorboard for comprehensive visualization and monitoring of training progress
  - Project repository: <https://github.com/pnielsen2/AlphaRedmond>
- 2018–2019 **Project Lead**, *University of Oxford*, Oxford, UK
- Led team in recreating Haxball game and applying RL algorithms to achieve strong amateur-level play, beating human beginners with 90% win rate
  - Implemented A3C and PPO algorithms from scratch, gaining deep understanding of RL algorithm design
  - Trained deep neural network using TensorFlow for imitation learning of human play
  - Collaborated with Gregory Farquhar, expert in Deep Reinforcement Learning, on project design and implementation

---

## Professional Experience

- 2022–2023 **Data Scientist**, *Lazard Asset Management*, New York, NY
- Developed advanced search modules for internal portfolio construction tool using machine learning techniques
  - Implemented and served modules using Flask and GraphQL, leveraging cloud technologies for model deployment
  - Authored widely-read internal articles on machine learning advancements, including pieces on AlphaFold and ML in nuclear fusion research
  - Produced comprehensive analysis of the scaling hypothesis in language models and advocated for LLM use 6 months before ChatGPT release, demonstrating foresight in recognizing LLM potential
  - Contributed to the development of an internal RAG tool for searching past analyst insights, implemented earlier than competing firms

---

## Technical Skills

Programming Languages	Python, SQL, R
ML Frameworks	PyTorch, TensorFlow, JAX, Pandas, Scikit-Learn
RL Algorithms	MCTS, A3C, PPO, PUCT
Visualization & Monitoring	Matplotlib, Tensorboard, Weights & Biases (wandb)
Cloud Computing	Harvard FAS RC Cluster, vast.ai, experience with automated setup and monitoring
Environments	OpenAI Gym, OpenSpiel, Go, Hex, Haxball
Other Tools	Flask, GraphQL, Git, LaTeX

---

## Selected Coursework

Graduate	Probabilistic Models & Machine Learning (PhD), Deep Generative Probabilistic Modeling (PhD), Reinforcement Learning
Undergraduate	Statistical Machine Learning, Algorithmic Foundations of Statistical Learning, Advanced Topics in Statistical Machine Learning, Theories of Deep Learning, Random Matrix Theory, Information Theory, Quantum Information Theory

---

## Projects and Presentations

- 2023 Presented on "Evidential Deep Learning to Quantify Classification Uncertainty" and "Deep Evidential Regression" at Columbia Deep Probabilistic Generative Modeling Seminar
- 2023 Completed "AI Safety Fundamentals" course by Columbia AI Alignment Club
- 2020 Coursework Project: "Investigating Absolute Value Activation Effectiveness in Gradient Norm-Preserving WGAN Discriminators" at Oxford

---

## Conferences and Workshops

- 2024 Attended ICML (International Conference on Machine Learning) and RLC (Reinforcement Learning Conference)
- 2023 Attended NeurIPS (Neural Information Processing Systems) Conference
- 2022 Attended ICML (International Conference on Machine Learning)
- 2019 Active participant in Deep Reinforcement Learning Reading Group at Oxford, led by Gregory Farquhar

---

## Additional Information

Research Interests	Reinforcement Learning, Uncertainty Quantification, Deep Probabilistic Generative Modeling, Mechanistic Interpretability, AI Safety, AGI Governance
Activities	Active member of AI Safety Reading Group at Columbia University

Languages English (Native), Greek (Fluent), Danish (Fluent)