

Xinyu (Rain) Wei

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Education

Columbia University | New York, NY Sep 2020 - May 2024
B.S. in Computer Science, Intelligent Systems Track, *summa cum laude* GPA: 4.092; top 5%
Honors and funding: Bonomi Research Scholar (2023); Electrical Engineering Summer Research Grant (2023); Mathematical Modeling Research Grant (2021); Tau Beta Pi, junior inductee (2022); Upsilon Pi Epsilon (2024).
Teaching Assistant: Machine Learning (COMS 4771), Computer Science Theory (COMS 3261), and Discrete Mathematics (COMS 3203); led office hours and assessed coursework.
Advanced coursework: Completed 20 graduate and advanced technical courses. Selected: Mathematics of Deep Learning; High-Dimensional Probability; Reliable Statistical Learning; Foundations of Graphical Models; Robot Learning; Convex Optimization; Machine Learning; Unsupervised Learning.

Professional Experience

Capula Investment Management New York, NY & London, UK
Quantitative Analyst Oct 2024 - Present

- Architected an end-to-end research platform integrating data ingestion, statistical modeling, and interactive analysis; implemented regime-classification models across 300+ global assets and deployed analytical tools for pricing and risk.
- Accelerated volatility-surface computation $5\times$ through tensorization, multiprocessing, and multithreading; implemented numerical models incorporating stochastic volatility and correlated interest-rate dynamics.
- Built and deployed a cross-platform computational pipeline for hedging analysis and automated risk and performance reporting, eliminating manual handoffs between internal systems.
- Formulated constrained portfolio-allocation models and evaluated convergence signals through historical backtesting, supporting live investment decisions.

Quantitative Research and Trading Intern Jun 2024 - Sep 2024

- Reformulated a nonconvex constrained portfolio problem as mixed-integer optimization; evaluated the resulting cross-currency strategy on 20 years of historical data, achieving a 1.2 Sharpe ratio net of transaction costs.

Research Experience

Columbia University | Undergraduate Researcher New York, NY
Trainable Template Optimization on Low-Dimensional Manifolds Apr 2023 - Jun 2024
Faculty Advisor: Prof. John Wright

- Led the core theoretical analysis of TpopT, independently designing the proof strategy and establishing curvature-dependent convergence guarantees for Riemannian gradient descent under Gaussian noise.
- Proved accuracy bounds governed primarily by intrinsic rather than ambient dimension and characterized the resulting computational advantage over matched filtering.
- Presented this work as an invited speaker at the NSF AI Institute in Dynamic Systems' Machine Learning for Science & Engineering Workshop (2023).

Neural Tangent Kernel Analysis for Noisy Manifold Data Apr 2022 - Apr 2023
Faculty Advisor: Prof. John Wright

- Developed and proved components of a theoretical framework for analyzing neural-network denoising of noisy manifold-structured data in the neural tangent kernel regime.
- Contributed proofs involving kernel concentration, local manifold geometry, smooth-function approximations, and certificate construction to study convergence of training error.

Adaptive Statistical Learning and Multi-Task Learning Aug 2022 - Jun 2024
Faculty Advisor: Prof. Kaizheng Wang

- Analyzed Gaussian multi-task estimation to characterize when pooling related tasks improves over separate estimation, deriving the bias-variance tradeoff and critical task-heterogeneity scale.
- Derived K-fold cross-validation estimators for regularized Gaussian mean estimation and compared their risk against MLE, Bayesian, and oracle benchmarks through analytical calculations and Monte Carlo experiments.

Research Experience (continued)

End-to-End Variational Inference for Portfolio Construction

Apr 2023 - Jun 2024

Faculty Advisor: Prof. Garud Iyengar

- Derived gradient expressions for end-to-end training through a stochastic portfolio-optimization layer, including task-loss differentiation via KKT-based implicit differentiation.
- Contributed to the PyTorch implementation and numerical experiments for the variational inference system, evaluating models trained for downstream decision quality rather than prediction error alone.
- Presented *End-to-End Variational Inference for Robust Portfolio Construction*, Columbia DSI Financial and Business Analytics Center (2023).

Publications & Intellectual Property

- J. Yan, S. Wang, **X. R. Wei**, Z. Márka, S. Márka, and J. Wright. *Systems and Methods for Efficient Trainable Template Optimization on Low Dimensional Manifolds for Use in Signal Detection*. U.S. Patent Application Publication US20250077872A1, 2025.
- J. Yan, S. Wang, **X. R. Wei**, J. Wang, Z. Márka, S. Márka, and J. Wright. *TpopT: Efficient Trainable Template Optimization on Low-Dimensional Manifolds*. arXiv:2310.10039, 2023.
- T. Wang, **X. R. Wei**, and J. Wright. *Slab Certificate: Neural Tangent Kernel Analysis for Learning Noisy Manifold-Structured Data*. Research manuscript, 2023.

Entrepreneurship & Leadership

Axon | Co-founder & Chief Technology Officer

Mar 2026 - Present

- Design and build expert-conditioned AI agents that elicit tacit knowledge from heterogeneous evidence and construct persistent representations of individual decision processes, beliefs, uncertainty, and context-dependent judgment.
- Develop architectures for retrieval, memory, belief updating, and tool-augmented reasoning, together with evaluation pipelines measuring expert-judgment fidelity, consistency under evolving information, calibrated uncertainty, and generalization to unseen decision scenarios.

Elite Youth Education | Founder & Chief Executive Officer

2020 - 2023

- Founded and scaled an international education company to AUD 200,000 in annual revenue; led 70+ tutors and team members across curriculum, operations, sales, and student delivery.

Competitive International Latin Dance | Dancer and Instructor

2004 - Present

- Pursue professional training in International Latin dance; teach private and group lessons alongside academic research and full-time quantitative work.
- **Selected results:** Semifinalist, The Open Worlds Latin Solo (2026); 3rd, The Open Worlds ProAm Latin A (2025); 1st, Philadelphia ProAm Latin Scholarships Open A (2024). Additional medals and finals at International Dance Festival, US Dance Championship, Paragon Open, King's Ball, Emerald Ball, and New York Dance Festival.

Columbia University Student Organizations | Executive Board Member

2020 - 2024

Data Science Society; Ballroom Dance Columbia; Venture Capital Club

Additional Honors

ATAR 99.95 (2019); NSW Advanced Mathematics Top Achievers Award, top 16 of 18,000+ (2019); High Distinction, Australian Physics and Chemistry Olympiads (2018).

Technical Skills

Programming Languages: Python, Java, C/C++, MATLAB, HTML/CSS, JavaScript, SQL, Ruby, Rust.

Scientific Computing: PyTorch, JAX, NumPy, SciPy, scikit-learn, pandas, Matplotlib.

Developer Tools: Unix/Linux, Jupyter Notebook, Conda, Shell (sh, bash, zsh), Git, GitHub, GitHub Actions, CI/CD, Docker, AWS, Microsoft Azure.