

Akshat Sachin Valse

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*Stochastic analysis for machine learning: Langevin sampling, Bayesian inference,
and sequential (anytime-valid) statistics.*

EDUCATION

Iowa State University, Honors Program

Aug. 2024 – May 2028
(expected)

B.S. Statistics · B.S. Mathematics · B.A. Computer Science · B.S. Data Science

Cumulative GPA 3.85 / 4.00.

Graduate and advanced coursework, completed. Theory of Probability and Statistics (STAT 5430); Stochastic Process Models (STAT 5540); Multivariate Analysis (STAT 5750); Categorical Data Analysis (STAT 5770); Empirical Methods for the Computational Sciences (STAT 5830); Statistical Computing (STAT 5860); Numerical Methods for Differential Equations (MATH 5810); Analysis I (MATH 4140); Partial Differential Equations (MATH 3850); Theory of Linear Algebra, honors (MATH 3170); Concepts and Applications of Machine Learning, honors (DS 3030).

In progress, Fall 2026. Foundations of Probability Theory, measure-theoretic (STAT 6541); High-Dimensional Probability (MATH 6230); Graduate Real Analysis I (MATH 5150); Bayesian Statistics (STAT 5644); Advanced Topics in Machine Learning (COM S 6730); Convex Optimization (E E 5710); Introduction to Tensors (HON 3210).

PREPRINTS AND MANUSCRIPTS

1. *Large-Deviation-Guided Importance Sampling for Rare Events in the Mean-Field Join-the-Shortest-Queue Model.* With R. Wu. arXiv preprint forthcoming, end of 2026.
2. Manuscript in preparation with D. Herzog on Langevin dynamics and transport-coefficient estimation for molecular systems. Target: journal submission, end of Summer 2026.
3. Manuscript in preparation with P. Ma on sparse nonlinear Bayesian inference via Gaussian processes with spike-and-slab priors.

RESEARCH EXPERIENCE

Langevin Sampling and Diffusion Estimation for Molecular Systems

May 2026 – present

Research Collaborator, Department of Mathematics, Iowa State University. Advisor: Prof. David Herzog.

- Built an end-to-end Python simulation pipeline implementing MALA and projected Euler–Maruyama samplers for overdamped Langevin dynamics, staged from a one-dimensional periodic potential up to a solvated ion in a three-dimensional Lennard-Jones bath; estimated self-diffusion and mobility coefficients from long-run trajectory data.
- Derived the closed-form Lifson–Jackson diffusivity $D = 1/I_0(1)^2 \approx 0.62386$ as an exact benchmark, validating the estimators against it before scaling to three dimensions and reproducing published solvated-ion results.
- Delivered weekly technical reports, including a companion note supporting the team’s CLT-based error analysis.

Large Deviation Theory for Rare-Event Analysis in Queueing Systems

Nov. 2024 – present

Undergraduate Research Fellow, Department of Mathematics, Iowa State University. Advisor: Prof. Ruoyu Wu. Dean's High Impact Research Award.

- Developed the first importance-sampling methodology for rare-event estimation in the mean-field join-the-shortest-queue model, deriving state-dependent exponential tilting from the Budhiraja–Friedlander–Wu (2021) large-deviation rate function; stated a logarithmic-efficiency conjecture with a proof sketch via the Dupuis–Wang subsolution framework.
- Built a reproducible simulation framework (Python prototype, ported to C for performance; Xoshiro256** with deterministic seeding) validated across 27 configurations ($n \leq 100$, $\rho \in \{0.7, 0.9, 0.95\}$): estimates agree with crude Monte Carlo within 95% confidence intervals wherever crude Monte Carlo succeeds, and extend to probabilities as small as 10^{-31} , where it fails entirely.
- Designed and benchmarked two heuristic tilting families (rate-reversal, level-weighted) with pilot-run selection; diagnosed over-tilting at extreme rarity through likelihood-ratio calibration statistics, motivating ongoing computation of the optimal state-dependent tilt.

Stability Analysis of Cell-Average Neural Networks for PDEs

May 2026 – present

Undergraduate Researcher, Department of Mathematics, Iowa State University. Advisor: Prof. Jue Yan. Funded by the NSF D4 NRT.

- Adapting von Neumann stability analysis to neural-network PDE solvers: deriving the linearized network amplification factor and characterizing how perturbations propagate through the learned time-stepping scheme, toward stability conditions analogous to those of classical finite-difference methods.
- Porting the group's MATLAB solver to Python to enable systematic stability experiments across schemes and step sizes. Publication targeted for the end of Summer 2026.

AWARDS AND HONORS

- Dean's High Impact Undergraduate Research Award, Iowa State University, 2026.
- Schillmoeller Family Scholarship in Statistics.
- James L. Cornette Mathematics and Interdisciplinary Studies Award.

TECHNICAL SKILLS

Python (NumPy, SciPy, PyTorch, matplotlib), C, R, L^AT_EX, git, MATLAB. Simulations are kept as staged pipelines with recorded seeds and parameter sidecars, so every figure regenerates from saved results without rerunning the sampler.

SERVICE AND OTHER

- Research Ambassador, Iowa State University Honors Program.
- FAA Private Pilot Certificate, high-performance endorsement, 2025. Volunteer pilot and recruitment advisor, Pilots N Paws animal-rescue flights.