Prakhar **Verma**

Machine Learning Researcher · PhD Student

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Research Summary

My research spans both academic and industry through roles at Microsoft Research, Adobe Research, and University of Oxford, with publications at NeurIPS, ICML, AISTATS. I work at the intersection of probabilistic modeling, Bayesian inference, and LLMs, developing theoretically grounded methods with practical impact. I focus on principled approaches for reasoning, planning, and decision-making that enable uncertainty-aware, efficient, and interpretable machine learning at scale. Recent work includes efficient test-time planning for retrieval-augmented generation (RAG) and Bayesian sequential causal discovery with language models.

Education

Aalto University — *Finland*

Doctor of Philosophy (Ph.D.) — *2022 - June 2026*

- Research on scalable Bayesian inference, uncertainty quantification, and probabilistic machine learning with applications to sequential decision-making, LLMs, and efficient ML systems. Supervised by Prof. Arno Solin.
- **Thesis:** Scalable Probabilistic Inference for Sequential Stochastic Models

Aalto University — *Finland*

Master of Science (M.Sc.) - 4.7/5 (Pass with Honors) — *2019 - 2021*

- Major in Machine Learning, Data Science, and Artificial Intelligence and Minor in Mathematics
- **Thesis:** *Sparse Gaussian processes for stochastic differential equations* with AaltoML.

Uttarakhand Technical University — *India*

Bachelor of Technology (B.Tech.) - 79.03% (First Division with Honors) — *2012 - 2016*

- Specialization in Information Technology
- **Thesis:** *Development of automated GIS Tools on various platforms* with TomTom, India.

Experience

Inven — *Helsinki, Finland*

Senior Machine Learning Engineer — *October 2025 - Present*

- Researching scalable machine learning and LLM-based methods to transform unstructured business data into structured, searchable insights that power deal and market discovery.

Adobe Research — *Bangalore, India*

Research Intern — *June 2024 - August 2024*

- **Project:** Developed a novel **Bayesian causal discovery** framework in sequential data using **language models (LMs)**. The approach grounds *global*-LM knowledge into *local*-observational data, tackling **dual bias** (LM-bias and data-bias) enabling iterative causal structure refinement.
- **Outcome:** Resulted in a patent-pending method, and a research publication (under-review).

Microsoft Research — *Bangalore, India*

Research Intern — *March 2024 - May 2024*

- **Project:** Researched and developed **Plan*RAG**, a reasoning and planning framework for **Retrieval-Augmented Generation (RAG)**, optimizing multi-hop query performance by reducing latency and computational cost at test time; providing **traceable reasoning** DAG.
- **Outcome:** Resulted in a research publication at ICLR 2025 workshop available at link.

University of Oxford — *Oxford, United Kingdom*

Visiting Researcher — *July 2023 - September 2023*

- **Project:** Collaborated with Prof. Seth Flaxman and Elizaveta Semenova, focusing on **encoding prior** information and developing **efficient inference techniques** especially tailored for life sciences and medical applications.
- **Outcome:** Resulted in a research publication available at link.

Aalto University *Espoo, Finland*

Research Assistant *April 2020 - August 2022*

- **Project:** Member of the AaltoML group; focused on **probabilistic machine learning** to develop learning and **efficient approximate inference** methods for dynamical systems and stochastic differential equation (SDE) models.
- **Outcome:** Resulted in a research publication at NeurIPS 2021 available at link and contribution to an open-source project MarkovFlow.

SpectacularAI *Espoo, Finland*

Research Engineer (Part-time) *September 2021 - September 2022*

- Consulted for an electronics firm, researching methods to incorporate **uncertainty estimation** in deep learning models like MCDropout and Laplace approximation to improve robustness.

TomTom *Pune, India*

Software Engineer (R&D) *July 2016 - August 2019*

- Researched and developed a **semantic segmentation** solution for extracting map features from satellite imagery and automatically ingesting them into the database, removing human-in-the-loop.

Publications

- **Prakhar Verma**, David Arbour, Sunav Choudhary, Harshita Chopra, Arno Solin, Atanu R. Sinha. Bayesian Sequential Causal Discovery with Language Model Priors. *(Under review)*
- **Prakhar Verma**, Sukruta Prakash Midigeshi, Gaurav Sinha, Arno Solin, Nagarajan Natarajan, Amit Sharma. Plan*RAG: Efficient Test-Time Planning for Retrieval Augmented Generation. Workshop on *Reasoning and Planning for Large Language Models* at ICLR 2025.
- **Prakhar Verma**, Vincent Adam, Arno Solin. Variational Gaussian Process Diffusion Processes. *International Conference on Artificial Intelligence and Statistics (AISTATS), 2024.*
- Paul Edmund Chang[*], **Prakhar Verma**[*], S.T. John, Arno Solin, Mohammad Emtiyaz Khan. Memory-based dual Gaussian processes for sequential learning. *International Conference on Machine Learning (ICML), 2023. (Oral Presentation)*
- Arno Solin, Ella Tamir, **Prakhar Verma**. Scalable Inference in SDEs by Direct Matching of the Fokker–Planck–Kolmogorov Equation. *Advances in Neural Information Processing Systems 35* (NeurIPS), 2021.
- **Prakhar Verma**, Paul Chang, Arno Solin, Mohammad Emtiyaz Khan. Sequential Learning in GPs with Memory and Bayesian Leverage Score. *Asian Conference in Machine Learning (ACML) workshop "Continual Lifelong Learning" 2022 (Contributed talk)*.
- Paul Chang, **Prakhar Verma**, ST John, Victor Picheny, Henry Moss, Arno Solin. Fantasizing with Dual GPs in Bayesian Optimization and Active Learning. *Gaussian Processes, Spatiotemporal Modeling, and Decision-making Systems, NeurIPS Workshop, 2022.*
- Elizaveta Semenova, **Prakhar Verma**, Max Cairney-Leeming, Arno Solin, Samir Bhatt, Seth Flaxman. PriorCVAE: Scalable MCMC parameter inference with Bayesian deep generative modelling. (Under review)
- **Prakhar Verma**, Vincent Adam, Arno Solin. Sparse Gaussian Processes for Stochastic Differential Equations. *The Symbiosis of Deep Learning and Differential Equations (DLDE), NeurIPS Workshop, 2021.*
- Fuzail Palnak[*], Kshitij Nikhal[*], **Prakhar Verma**[*], Ravi Panchani[*], and Sagar Rohankar[*]. M.A.G.E.C: machine assisted geometry extraction and creation. *Twelfth International Conference on Machine Vision* (ICMV 2019).

Skills

- **Areas of Expertise:** Probabilistic Machine Learning, Generative Modeling, Retrieval-Augmented Generation (RAG), Large Language Models (LLMs), Deep Learning, Gaussian Processes, Bayesian Learning, Uncertainty Quantification
- **Frameworks & Libraries:** PyTorch, JAX, Hugging Face Transformers, TensorFlow, GPflow, NumPy, scikit-learn, PySpark
- **Languages & Tools:** Python, Java, C, Git, AWS, Docker
- **MLOps:** Weights & Biases, Hydra

Accomplishments

- Awarded *"Nokia Scholarship"* in *2024* for exceptional progress and research excellence during doctoral studies.
- Awarded *"Dean Scholarship"* in *2020* and *2021* at Aalto University for commendable academic progress during MSc studies.
- Awarded *"Face of TomTom 2018"* for actively representing TomTom in conferences and promoting the brand.
- Winner of TomTom *"Innovation Day 2018"*, presented an AI plugin which bridges the gap between machines and cartographers.

- Tensorflow case study on how convolution neural networks can be used to extract road networks and airports from satellite imagery and how TFServing can host the models at Google Developers Group 2018.
- An end-to-end machine learning framework to detect and extract essential map features from satellite imagery and ingest them into the database removing human-in-the-loop at GeoSpatial World Forum 2018.

References

- Prof. Arno Solin (arno.solin@aalto.fi), Associate Professor, Department of Computer Science, Aalto University, Finland.
  Arno is my Ph.D. supervisor, with whom I have collaborated since 2020 at Aalto University.
- Dr. Atanu R Sinha (atr@adobe.com), Principal Scientist, Adobe Research India.
  I collaborated with Atanu during my research internship at Adobe Research on sequential causal discovery with language models.
- Dr. Amit Sharma (amshar@microsoft.com), Principal Researcher, Microsoft Research India.
  I collaborated with Amit during my research internship at Microsoft Research on efficient planning and reasoning in Retrieval-Augmented Generation (RAG).