Vaibhav Dixit

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Summary

Developer with a strong research affinity. At JuliaHub, I built 0-to-1 healthcare-focused deep tech products. I have 5+ years of experience developing open-source libraries widely used by researchers at MIT, Stanford, Princeton, and beyond. My expertise spans AI for scientific applications, non-linear optimization, fine-tuning LLMs and agentic applications. I am looking for Research Engineer or ML/AI Engineer roles.

Education

Massachusetts Institute of Technology **September 2023 - May 2025**
Computational Science and Engineering, GPA 4.8 *Research Master's*
Coursework: Optimization, Deep Learning (NLP), Robotics, High dimensional Statistics, Random matrix theory, GPU Programming

Indian Institute of Technology (BHU) **July 2016 - May 2021**
Mathematics and Computing *B.Tech and M.Tech*

Experience

CSAIL, MIT *Research Assistant* *September 2023 - Present*

- Developed optimization methods for constrained fine-tuning of LLMs, achieving a 5% improvement in alignment and 11% reduction in safety violations by integrating hybrid preference optimization with auxiliary objectives and augmented Lagrangian techniques.
- Developed novel batching strategies for dynamical model data and sharpness based learning rate scheduling, applied to neural network surrogate training for Izhikevich model of neurons leading to a reproducible and 30% more efficient training workflow.
- Developed sparsity-aware augmented Lagrangian and CCSA methods for optimization problems with stochastic objective and deterministic constraints, which arise in the Empirical Risk Minimization (ERM) framework with physical constraints.
- Created Disciplined Geodesically Convex Programming (DGCP), a framework for verifying geodesic convexity on the SPD Manifold and solving with global optimality certificate, for matrix-valued optimization problems in statistics and machine learning.

Mitsubishi Research *Research Intern* *June 2024 - August 2024*

- Performed comprehensive benchmarking and profiling of simulation code. Reduced allocations in the forward simulation of the HVAC Differential Algebraic model, leading to improvement in run-time by a factor of 30 enabling faster experimentation.
- Established a parameter calibration workflow for multi-physics models with tooling for numerical optimization and sensitivity analysis.

JuliaHub *Software Engineer* *January 2021 - August 2023*

- Developed Pumas software for maximum-likelihood and bayesian estimations in Non-Linear Mixed Effects (NLME) models for PK/PD. Implemented specialized optimization solver, NUTS (MCMC) sampler, statistical estimators and model analysis methods.
- Lead Developer of Lyv (clinical decision support software) and Pumas-CP (clinical pharmacology platform). Spearheaded the development of critical features in data handling, API design, low-latency computation, and integration into Epic and Cerner EHRs.
- Collaborated with front-end teams to deploy React and Node.js applications. Managed the CI/CD infrastructure and deployment on AWS Lambda for serverless backends and configured S3 with CloudFront for secure, optimized static hosting and delivery.
- Contributed to early development of deep learning approaches for surrogate modeling of Absorption, Distribution, Metabolization, and Excretion (ADME) profiles from clinical trial data using Neural ODEs and Universal Differential Equations (UDEs) architectures.

Publications

- **Vaibhav Dixit**, A. Cheng, and M. Weber, "Disciplined geodesically convex programming," *arXiv preprint arXiv:2407.05261*, 2024
- **Vaibhav Dixit**, Utkarsh, and Julian Samaroo et al., "Efficient gpu-accelerated global optimization for inverse problems," in *ICLR*, 2024
- Y. Ma and **Vaibhav Dixit** et al., "A comparison of automatic differentiation and continuous sensitivity analysis for derivatives of differential equation solutions," in *IEEE High Performance Extreme Computing Conference (HPEC)*, 2021
- R. Dandekar and **Vaibhav Dixit** et al., "Bayesian neural ordinary differential equations," in *POPL-LAFI*, 2021
- C. Rackauckas, **Vaibhav Dixit**, A. R. Gerlach, and V. Ivaturi, "Efficient precision dosing under estimated uncertainties via koopman expectations of bayesian posteriors with pumas," *BioRxiv*, 2021

Projects

- Achieved 3rd place in the AGI House-sponsored MIT Agent Hackathon 2024 for building an LLM-powered platform to automate inventory scheduling. The solution used a DPO-tuned LLaMA model to generate Python modeling code passed on to Gurobi, and provide a natural language summary of the solution, making complex scheduling outputs accessible to non-technical users. A lightweight deployment through AWS Lambda is currently being used by 5 SMBs such as pizzeria and florist in Cambridge area.
- Secured 4th place in the MIT AI Conference Hackathon for developing an AI-powered photo album designed for visually impaired users. The platform used voice descriptions fine-tuned through RLHF to describe uploaded images. AWS S3 bucket served as database via the Boto3 library, and audio descriptions were generated using OpenAI and Google Text-to-Speech (TTS) APIs.

Tools

- **Languages**: Python, C++, Julia, JavaScript
- **ML Libraries**: Pytorch, Jax, Scikit-learn, Scipy, Numpy, XGBoost
- **Technologies**: NodeJS, MySQL, Autogen, Langchain, AWS, Azure, CUDA, NeMO, Triton