Shreyas Sunil Gaikwad

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EDUCATION

University of Texas at Austin — **Austin, Texas**
Ph.D. in Computational Science, Engineering, and Mathematics, GPA: 4.0/4.0 — *2020-2025*
M.S. in Computational Science, Engineering, and Mathematics, GPA: 4.0/4.0 — *2019-2021*

Indian Institute of Technology (IIT) Bombay — **Mumbai, India**
B.Tech with Honors in Mechanical Engineering (Minor in Computer Science), GPA: 9.32/10.0 — *2015-2019*

EXPERIENCE

- **Graduate Research Assistant, UT Austin** — *2020-Present*
  - Developed a Bayesian inversion framework for the ice sheet model SICOPOLIS by leveraging open-source **Automatic Differentiation** tools to perform back-propagation in a Fortran-based numerical model. [I][3]
  - Developing a novel feature importance method for Artificial Neural Networks using **XAI** method Layerwise Relevance Propagation using **Keras** to validate insights from deep learning against oceanic mechanisms. [1]
  - Developing deep learning emulators using **Keras** to efficiently simulate seaice dynamics in ocean models.
- **Visiting Scholar, Argonne National Laboratory** — *Summer 2022*
  - Interfaced **Automatic Differentiation** and **MPI**-based parallelism for a mountain glacier simulation in Julia.
  - Developed **first-ever open-source** Bayesian inversion framework for ocean circulation model MITgcm, establishing an **alternative to proprietary software that costs ∼$14,000** per year per individual [II][2]

RESEARCH PROJECTS

- **Machine Learning Applications in Geophysics** — *Spring 2021*
  - Developed CNNs in **Keras** for earthquake detection using data from stations, with **96% validation accuracy**.
  - Developed U-Nets in **Keras** for seismic faults detection through image segmentation, with **97% test accuracy**.
  - Leveraged Autoencoders in **Keras** to aid clustering through dimensional reduction into the latent space.
  - Built pipeline to pick mudrocks from real wireline logs using ML algorithms, with **87% test accuracy**.
- **Physics-Informed Machine Learning** — *Spring 2021*
  - Trained a Deep Neural Network in **PyTorch** to emulate a partial differential equation (PDE) based glacier model by leveraging **higher-order derivatives of the PyTorch computational graph**.
  - Enriched the framework using an expanded computational graph to infer unknown PDE parameters.
- **Laplacian 2D Finite Difference (FD) Solver Application** — *Fall 2020*
  - Features: OOP (C++), Solver (gauss, jacobi, PETSc), tests (bats, Travis CI, docker), 98% code coverage (lcov), 0% memory errors (valgrind), build (autotools), HPC env (SLURM), parser & logger (GRVY).

OPEN-SOURCE CONTRIBUTIONS

I **SICOPOLIS-AD v2**, open-source data assimilation framework for the ice sheet model SICOPOLIS.
II **MITgcm-AD**, open-source data assimilation framework for the general ocean circulation model MITgcm.
III **ARGOVIS**, OOP-style Python tools for community use in interactive plotting and binning of Argo data.

TECHNICAL SKILLS

Languages	Python (Keras, PyTorch), Julia, C/C++, Fortran-77/90, MATLAB
HPC toolkit	OpenMP, MPI, CUDA, SLURM, git, docker, shell scripts, CI, autotools, valgrind, lcov, GRVY

HONORS AND AWARDS

- President and Vice President, Austin Chapter of Society of Industrial & Applied Mathematics (SIAM). *2021-2023*
- Recipient of Peter O'Donnell Graduate **fellowship worth $24,000**. *2019*
- Ranked 509/1,500,000 (**99.97 percentile**) in nationwide university entrance exams, India. *2015*

SELECT COURSEWORK

Data Science	Machine Learning, ML applications in Geophysics, Engineering Data Mining
Algorithms	Differential Equations, Linear Algebra, HPC, Functional Analysis, Data Structures & Algorithms
Modeling	Uncertainty Quantification in Modeling, Mathematical Modeling, Quantum & Statistical Mechanics

INVITED TALKS

- **SS Gaikwad** et. al "Computational Science to enable Digital Twins of the Oceans",
  6th SIAM Texas-Louisiana Sectional Meeting (SIAM TX-LA) 2023.

JOURNAL ARTICLES

1. **SS Gaikwad** et. al "Pairing Neural Networks with Adjoints for Flexible Investigation and Robust Attribution of Ocean Variability." *In preparation for submission to Geophysical Research Letters (2024).*
2. **SS Gaikwad** et. al "MITgcm-AD v2: tangent linear and adjoint modeling framework for the oceans and atmosphere enabled by the Automatic Differentiation tool Tapenade." *Preprint on arXiv, submitted to JLESC-FGCS (2024).*
3. **SS Gaikwad** et. al "SICOPOLIS-AD v2: tangent linear and adjoint modeling framework for ice sheet modeling enabled by Automatic Differentiation tool Tapenade." *Journal of Open Source Software 8, no. 83 (2023): 4679.*