SABYASACHI SAHOO

sabyasachi.sahoo.1@ulaval.ca ◇ sabyasachis.github.io ◇ github.com/sabyasachis ◇

Ph.D. candidate with industry experience working on improving robustness and generalization of ML models.

EDUCATION

Mila/Inria/Université Laval Sep 2021 - Present
Ph.D. in Machine Learning. Advisors: Christian Gagné & Frédéric Precioso. (GPA: 3.9/4) (Expected: Aug 2026)

Indian Institute of Science (IISc), Bangalore Aug 2014 - Jul 2016
Masters in Computational and Data Science. Advisor: Sathish Vadhiyar. (Top 5 in class)

Sardar Vallabhbhai National Institute of Technology (NIT), Surat Aug 2010 - Jul 2014
Bachelors in Mechanical Engineering.

RESEARCH EXPERIENCE

Mila/Université Laval - Graduate Research Assistant Sep 2021 - Present

Broadly work on understanding and improving robustness and generalization of machine learning models.

- **Test-Time Adaptation (TTA)** & **Continual Learning**: We show that optimal layer selection can significantly improve adaptation to distribution shifts [1], self distillation can improve zero-shot image classification of CLIP [10], and low-rank approximation can reduce forgetting in continual learning [3].
- **Out-of-Distribution (OOD)** & **Adversarial Robustness**: We improved OOD detection by using gradients from OOD prototype [9], and we can improve adversarial defense by either using softmax predictions to cheaply detect vulnerable samples [2], or use test-time adaptation [11].
- **Domain Generalization**: We can improve generalization to distribution shifts by either using out-of-distribution methods [6], or by denoising incorrect predictions using diffusion models [12].
- **Reinforcement Learning (RL)** & **Ensembles**: We improved microservice partitioning by reformulating it as an RL problem [15], and we show simple ensembling (bagging/dropout) can outperform complex strategies [22].
- **Robotics**: We improved robotics perception [5] by building a differentiable SLAM framework for LiDAR [7].

ML Lab, IISc Bangalore - Research Assistant Feb 2019 - Aug 2021

Worked on improving model performance and explainability in healthcare and robotics applications.
Advisor: Chiranjib Bhattacharyya

- **Generative modelling**: We improved LiDAR generation using adversarial autoencoder [8], showed that Discrete Cosine Transformwith Variational Autoencoders can improve high-resolution image generation [24] and fused learning-based and geometry-based approaches to improve scene flow prediction [16].
- **Explainability**: We made concept extraction more aligned to humans [25], improved it using non-negative matrix factorization [13], and exposed adversarial vulnerabilities of popular explanability methods [14].
- **Multi-task learning**: We improved one-class classification using multi-object detection [4], deployed it as text-based report generation tool for doctors [23], and developed a cost-effective ADAS system for Indian roads [26].

Computational and Data Science, IISc Bangalore - Graduate Research Assistant Aug 2015 - Jul 2016

Worked on analyzing deep learning models and optimizing computational performance.

- **Representation Learning**: We extracted hierarchical relationships between visually similar classes [17].
- **High-performance computing**: We scaled molecular dynamics using a hierarchical graph partitioning algorithm [20] and proposed a hybrid CPU-GPU implementation for Traveling Salesman Problem [18].

ONGOING WORKS

- S. Sahoo *et al.* **Removing Easy Samples From Training Improves Generalization**.
- S. Sahoo *et al.* **Meta-learning Can Improve Test-Time Reasoning In Foundation Models**.
- M. ElAraby, S. Sahoo *et al.* **Model Pruning for Out-of-Distribution Detection**.
- J. Ngnawe, S. Sahoo *et al.* **Not All Layers Are Equally Robust to Adversarial Samples**.
- V. Kondameedi, S. Sahoo *et al.* **Data Poisoining Defense for Continual Learning**.
- K. Mani, S. Sahoo *et al.* **Test Time Reinforcement Learning**.

INDUSTRY EXPERIENCE

NVIDIA - System Engineer II — Aug 2016 - May 2018

Led display team responsible for all self-driving platforms.

- **Display Functionality**: Implemented various new features, reducing bugs (60%), improving user experience.
- **Device Tree Modularization**: Designed reusable module, cutting the development time (30%) across teams.
- **Jetson Xavier Chip Launch**: Implemented critical modules, for successful launch & performance boost (25%).

Donut Research Labs - Deep Learning Engineer — May 2018 - Feb 2019

Led NLP and computer vision projects for e-commerce applications.

- **Text Normalization**: Improved Walmart's brand name extraction accuracy (40%) using a Seq2Seq model, pretrained on product descriptions, fine-tuned on noisy annotations, and top-k sampling with beam search.
- **Object Detection**: Built custom information extraction module by fine-tuning Single Shot Detector (SSD) model on product images, enhancing product attribute identification (35%).
- **Long Tail Classification**: Class-imbalance aware LSTM improved accuracy (25%) and sped inference (10%).
- **Dataset Development**: for text normalization & object detection projects (collection, annotation, cleaning).

PUBLICATIONS

[1] S. Sahoo, M. ElAraby, J. Ngnawe, Y. Pequignot, F. Precioso, and C. Gagné. **A Layer Selection Approach to Test Time Adaptation**. In: *NeurIPS 2024 Workshop on Fine-Tuning in Modern Machine Learning: Principles and Scalability*. [link]. 2024.

[2] J. Ngnawe, S. Sahoo, Y. Pequignot, F. Precioso, and C. Gagné. **Detecting Brittle Decisions for Free: Leveraging Margin Consistency in Deep Robust Classifiers**. In: *Advances in neural information processing systems (NeurIPS)*. [link]. 2024.

[3] J. Li, R. Wang, Y. Lai, C. Shui, S. Sahoo, C. X. Ling, S. Yang, B. Wang, C. Gagné, and F. Zhou. **Hessian Aware Low-Rank Weight Perturbation for Continual Learning**. In: *Transactions on Knowledge and Data Engineering (TKDE) Journal*. [link]. 2023.

[4] M. Antony, S. T. Kakileti, R. Shah, S. Sahoo, C. Bhattacharyya, and G. Manjunath. **Challenges of AI driven diagnosis of chest X-rays transmitted through smart phones: a case study in COVID-19**. In: *Scientific Reports Journal, Nature*. [link]. 2023.

[5] P. Kumar, D. Vattikonda, V. B. S. Nadkarni, E. Dong, and S. Sahoo. **Differentiable SLAM Helps Deep Learning-based LiDAR Perception Tasks**. In: *British Machine Vision Conference (BMVC)*. [link]. 2023.

[6] S. Sahoo, F. Zhou, Y. Pequignot, J. Ngnawe, F. Precioso, and C. Gagné. **Domain Generalization by Minimizing Out-of-Distribution Detection**. In: *Montreal AI Symposium (MAIS)*. [link]. 2022.

[7] F. Aryan, D. Vattikonda, E. Dong, and S. Sahoo. **Grad-lidar-SLAM: Fully differentiable global SLAM for lidar with pose-graph optimization**. In: *IROS Workshop on Probabilistic Robotics in the Age of Deep Learning (IROSW)*. [link]. 2022.

[8] S. Sahoo, P. Kumar, V. Shah, V. Kondameedi, A. Jain, A. Verma, C. Bhattacharyya, and V. Vishwanath. **Dynamic to static lidar scan reconstruction using adversarially trained auto encoder**. In: *Association for the Advancement of Artificial Intelligence (AAAI) Conference*. [link]. 2021.

PREPRINTS

[9] M. ElAraby, S. Sahoo, Y. Pequignot, P. Novello, and L. Paull. **GROOD: GRadient-aware Out-Of-Distribution detection in interpolated manifolds**. In: *arxiv. Under review* (2024). [link].

[10] M. Sandhu, Y. Pequignot, S. Nashed, S. Sahoo, and L. Paull. **CLIP-Enhance: Improving CLIP Zero-Shot Classification via von Mises-Fisher Clustering**. In: *Under review* (2024). [link].

TECHNICAL REPORTS

[11] K. Samanta, S. Sahoo, and C. Gagné. **Test Time Adaptation as an Adversarial Defense Strategy**. Internship Report. [link]. 2023.

[12] A. Verma, S. Sahoo, and C. Gagné. **Diffusion based Pseudolabeling under Distribution Shifts**. Internship Report. [link]. 2023.

[13] D. Tiwari, R. Shah, S. Sahoo, and C. Bhattacharyya. **Enhancing Explainability in Medical Images using Global Methods**. Masters Thesis. [link]. 2022.

[14] G. Parashar, S. Sahoo, and C. Bhattacharyya. **Adversarial Robustness for Local Interpretable Methods**. Masters Thesis. [link]. 2021.

[15] S. Sahoo and K. Sellami. **Automated Microservice Extraction using Reinforcement Learning**. [link]. 2021.

[16] D. Shanbag, S. Sahoo, C. Bhattacharyya, and V. V. **An Approach For Accurate Sceneflow Prediction for LiDAR-based Sensors**. Masters Thesis. [link]. 2020.

[17] S. Sahoo and V. Kondameedi. **Establishing Semantic relationships among Object Classes using Deep Networks for Image Classification**. [link]. 2015.

[18] S. Sahoo and V. Kondameedi. **Hybrid Execution of Travelling Salesman Problem**. [link]. 2015.

THESES

[19] S. Sahoo, F. Precioso, and C. Gagné. "**Test-time Out-of-Distribution Generalization**". PhD Proposal. [link]. Mila/Université Laval, 2022.

[20] S. Sahoo and S. S. Vadhiyar. "**Hierarchical Task Mapping on Dragonfly topology for Scaling Molecular Dynamics**". Masters Thesis. [link]. IISc Bangalore, 2016.

[21] S. Sahoo, M. N. Yadav, V. Savalia, R. Soni, R. Agarwal, N. Lomash, and H. B. Naik. "**Thermoacoustic Energy Conversion Using Piezoelectric Diaphragm/Bi-Morph**". Bachelors Thesis. [link]. SVNIT Surat, 2014.

PROJECTS

[22] S. Sahoo, S. Karami, A. Safarnejadian, and A. Tupper. **Deep Ensemble Methods for Vehicle Classification**. [link]. Université Laval. 2021.

[23] S. Sahoo, R. Shah, S. T. Kakileti, C. Bhattacharyya, and G. Manjunath. **A new AI-driven platform will facilitate early-COVID interventions over Whatsapp**. [link]. Department of Science and Technology, Government of India. 2021.

[24] T. Varshney, S. Sahoo, V. Kondameedi, and C. Bhattacharyya. **DCT-VAE: Capturing Low-level and High-level Features for Image Generation**. [link]. IISc Bangalore. 2021.

[25] S. Sahoo, A. Jain, R. Shah, and C. Bhattacharyya. **Improving Automatic Concept Extraction for Global Model Explainability**. [link]. Niramai Health Analytix. 2021.

[26] V. Kondameedi, S. Shet, A. Verma, S. Sahoo, P. Kumar, C. Bhattacharyya, and S. Biswas. **Frugal Advanced Driver Assistance System (ADAS) for Indian Roads**. [link]. TATA Motors. 2020.

[27] S. Sahoo, P. Kumar, C. Bhattacharyya, and V. V. **Proximal Pose Search for Adapting SLAM in Dynamic Environments on Slow Moving UGVs**. [link]. Ati Motors. 2019.

TEACHING AND LEADERSHIP ROLES

- **Teaching Assistant**, Machine Learning course, Université Laval (2022/2023/2024): Involved with designing and grading quizzes/homeworks, and conducting tutorial sessions.
- **Student Mentor**, SHARE Research Labs (2020-21): Teaching and mentoring students for working towards a research paper for top-tier conferences.
- **Organizer**, various reading groups on topics like Machine Learning (2022-23), Out-of-Distribution (2022-24), and Autonomous Navigation (2019-20).
- **Placement Coordinator**, IISc (2015-16): Invited, organized, and coordinated on-campus placement for numerous industries and startups.

HONORS AND AWARDS

- Awarded IID Excellence scholarship 2022.
- Secured research funding from DEEL (2021-Present).
- Secured research funding from Ati Motors (2019-21), and ARTPARK (2021).
- Awarded distinction for my master's thesis.
- Won various competitions: 1st place in NeurIPS 2017 Challenge, top finalist in NVIDIA Reinforcement Learning Competition 2018, 3rd place in SO1 Product Recommendation Competition 2018.