

# SABYASACHI SAHOO

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

## EDUCATION

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<b>Mila/Inria/Université Laval</b> Ph.D. in Machine Learning. Advisors: <a href="#">Christian Gagné</a> & <a href="#">Frédéric Precioso</a> . (GPA: 4/4)	Sep 2021 - Present (Expected: Aug 2026)
<b>Indian Institute of Science (IISc), Bangalore</b> Masters in Computational and Data Science. Advisor: <a href="#">Sathish Vadhiyar</a> . (Top 5 in class)	Aug 2014 - Jul 2016
<b>Sardar Vallabhbhai National Institute of Technology (NIT), Surat</b> Bachelors in Mechanical Engineering.	Aug 2010 - Jul 2014

## RESEARCH EXPERIENCE

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<b>Mila/Université Laval</b> - Graduate Research Assistant	Sep 2021 - Present
Broadly work on understanding and improving generalization & robustness of machine learning models.	
<ul style="list-style-type: none"><li>◦ <b>Test-Time Adaptation (TTA)</b> [1, 10]: Enhanced adaptation to distribution shifts using optimal layer selection for TTA and self-distillation of CLIP for zero-shot image classification.</li><li>◦ <b>Domain Generalization</b> [6, 12]: Improved generalization to distribution shifts using out-of-distribution methods, and denoising incorrect predictions using diffusion models.</li><li>◦ <b>Continual Learning</b> [3, 22]: Reduced forgetting in continual learning through hessian-aware low-rank approximation and showed that simple ensembling (bagging/dropout) can outperform complex strategies.</li><li>◦ <b>Adversarial Robustness</b> [2, 11]: Enhanced adversarial defense by using softmax predictions to detect vulnerable samples cheaply and by using test-time adaptation.</li><li>◦ <b>Out-of-Distribution (OOD)</b> [9, 15]: Improved OOD detection by using gradients from OOD prototype and optimized microservice partitioning by reformulating it into a Reinforcement Learning problem.</li><li>◦ <b>Robotics</b> [5, 7]: Advanced robotics perception by building a differentiable SLAM framework for LiDAR.</li></ul>	
<b>ML Lab, IISc Bangalore</b> - Research Assistant	Feb 2019 - Aug 2021
Worked on improving model performance and explainability in healthcare and robotics applications. Advisor: <a href="#">Chiranjib Bhattacharyya</a>	
<ul style="list-style-type: none"><li>◦ <b>Generative Modelling</b> [8, 16, 24]: Enhanced LiDAR generation using an adversarial autoencoder, improved high-resolution image generation using Discrete Cosine Transform (DCT)-based Variational Autoencoders (VAEs), and made scene flow prediction adaptive by fusing learning-based and geometry-based approaches.</li><li>◦ <b>Explainability</b> [13, 14, 25]: Aligned concept extraction with human understanding, improved it using non-negative matrix factorization, and exposed adversarial vulnerabilities in popular explainability methods.</li><li>◦ <b>Multi-Task Learning</b> [4, 23, 26]: Improved one-class classification using multi-object detection, deployed it as a text-based report generation tool for doctors, and developed a cost-effective ADAS system for Indian roads.</li></ul>	
<b>Computational and Data Science, IISc Bangalore</b> - Graduate Research Assistant	Aug 2015 - Jul 2016
Worked on analyzing deep learning models and optimizing computational performance.	
<ul style="list-style-type: none"><li>◦ <b>Representation Learning</b> [17]: Extracted hierarchical relationships between visually similar classes in CNNs.</li><li>◦ <b>High-Performance Computing</b> [18, 20]: Scaled molecular dynamics using a hierarchical graph partitioning algorithm and Traveling Salesman Problem using a hybrid CPU-GPU/CUDA implementation.</li></ul>	

## ONGOING WORKS

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- 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. Ngawee, S. Sahoo *et al.* **Not All Layers Are Equally Robust to Adversarial Samples.**
- V. Kondameedi, S. Sahoo *et al.* **Data Poisoning Defense for Continual Learning.**
- K. Mani, S. Sahoo *et al.* **Test Time Reinforcement Learning.**

## ENGINEERING EXPERIENCE

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**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

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- [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. [\[link\]](#). *NeurIPS Workshop*. 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. [\[link\]](#). *NeurIPS*. 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 Journal. [\[link\]](#). *TKDE*. 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. [\[link\]](#). *Nature*. 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. [\[link\]](#). *BMVC*. 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. [\[link\]](#). *MAIS*. 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. [\[link\]](#). *IROS Workshop*. 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 Conference. [\[link\]](#). *AAAI*. 2021.

## PREPRINTS

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- [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

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- [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

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- [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

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- [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

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- **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** of 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

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- 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](#).