SABYASACHI SAHOO

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Ph.D. researcher with industry experience (Nvidia) interested in building robust models for real-world deployment.

EDUCATION

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

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

Work on understanding and improving model robustness and generalization across various domains.

- **Test-Time Adaptation (TTA)** & **Continual Learning**: Online early stopping to learn new features during TTA without forgetting pretrained features [1], and low-rank approximation for continual learning improves robustness to task order and forgetting[2].
- **Out-of-Distribution (OOD)** & **Adversarial Robustness**: Mixup improves OOD detection in gradient space [3], output logits to cheaply detect samples vulnerable to adversarial attacks [4], and improved adversarial robustness using test time adaptation (TTA) [5].
- **Domain Generalization**: Improved generalization by minimizing out-of-distribution detection [6], or denoising classifier predictions using diffusion model [7].
- **Reinforcement Learning (RL)** & **Ensembles**: Reformulate the microservice partitioning problem as an RL problem [8], and simple ensemble approaches can outperform complex ensembling strategies [9].
- **Robotics**: Differentiable SLAM framework for LiDAR [10], to improve learning based robotics perception [11].

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

- **Multi-task learning**: for improved disease diagnosis from compressed chest X-ray images [13], which was deployed as an automatic report generation tool during the pandemic [14].
- **Explainability**: Non-negative matrix factorization for expert-aligned concept extraction [15, 16], and exposed vulnerability of popular saliency-based explanation methods to input perturbations [17].
- **Lidar generation**: Adversarial autoencoder-based model for self-driving cars [18], and improved scene flow prediction by adaptively fusing learning-based and geometry-based approaches [19].
- **ADAS** & **Image generation**: Cost-effective ADAS system optimized for adverse conditions on Indian roads [21], and Discrete Cosine Transform improves high-resolution image generation in Variational Autoencoders [22].

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

Worked on analyzing deep learning models and optimizing computational performance.

- **Deep Learning**: Extracted semantic relationships between visually similar classes using pretrained CNNs [23].
- **High-performance computing**: Multi-CPU hierarchical graph partitioning algorithm for scaling molecular dynamics [24] and efficient hybrid CPU-GPU implementation for Traveling Salesman Problem [25].

ONGOING WORKS

- Sabyasachi Sahoo, Mostafa ElAraby, Jonas Ngnawe, Yann Pequignot, Frédéric Precioso, and Christian Gagné. **A Mechanistic Interpretation and Improvement of Finetuning for Foundation Models**.
- Mahtab Sandhu, Sabyasachi Sahoo, Yann Pequignot, Samer Nashed, and Liam Paull. **Improving Zero-shot Image Classification of CLIP**.
- Mostafa ElAraby, Sabyasachi Sahoo, and Liam Paull. **Improving OOD detection via Pruning**.
- Jonas Ngnawe, Sabyasachi Sahoo, Yann Pequignot, Frédéric Precioso, and Christian Gagné. **Exploring Adversarially Vulnerable Fraction around Input Hyperspheres in Pretrained Models**.

INDUSTRY EXPERIENCE

Nvidia - Software Engineer II — Aug 2016 - May 2018

Led display team responsible for all self-driving platforms.

- Enhanced **display functionality** by designing and implementing new features while ensuring bug-free operation.
- Designed and modularized the **device tree module**, making it reusable across self-driving platforms.
- Led the implementation of these modules for the new **Jetson Xavier chip** to ensure a successful launch.

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 (35%) using a Seq2Seq model, pretrained on product descriptions, fine-tuned on noisy annotations, and top-k sampling with beam search.
- **Long Tail Text Classification**: Class imbalance aware LSTM sped inference (10%) & improved accuracy (5%).
- **Object Detection**: Built info extraction module from scratch by fine-tuning SSD model on product images.
- **Dataset Building**: for text normalization & object detection projects (collection, annotation, cleaning).

PREPRINTS (UNDER REVIEW)

[1] Sabyasachi Sahoo, Mostafa ElAraby, Jonas Ngnawe, Yann Pequignot, Frédéric Precioso, and Christian Gagné. **Layerwise Early Stopping for Test Time Adaptation**. In: *Under review at the European Conference on Computer Vision (ECCV)* (2024). [link].

[3] Mostafa ElAraby, Sabyasachi Sahoo, Yann Pequignot, Paul Novello, and Liam Paull. **GROOD: GRadient-aware Out-Of-Distribution detection in interpolated manifolds**. In: *Under review at the European Conference on Computer Vision (ECCV)* (2024). [link].

[4] Jonas Ngnawe, Sabyasachi Sahoo, Yann Pequignot, Frédéric Precioso, and Christian Gagné. **Detecting Brittle Decisions for Free: Leveraging Margin Consistency in Deep Robust Classifiers**. In: *Under review at the Neural Information Processing Systems (NeurIPS) Conference* (2024). [link].

PUBLICATIONS

[2] Jiaqi Li, Rui Wang, Yuanhao Lai, Changjian Shui, Sabyasachi Sahoo, Charles X Ling, Shichun Yang, Boyu Wang, Christian Gagné, and Fan Zhou. **Hessian Aware Low-Rank Weight Perturbation for Continual Learning**. In: *Transactions on Knowledge and Data Engineering (TKDE) Journal*. [link]. 2023.

[6] Sabyasachi Sahoo, Fan Zhou, Yann Pequignot, Jonas Ngnawe, Frédéric Precioso, and Christian Gagné. **Domain Generalization by Minimizing Out-of-Distribution Detection**. In: *Proceedings of the Montreal AI Symposium (MAIS)*. [link]. 2022.

[10] FNU Aryan, Dheeraj Vattikonda, Erqun Dong, and Sabyasachi 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]. 2022.

[11] Prashant Kumar, Dheeraj Vattikonda, Vedang Bhupesh Shenvi Nadkarni, Erqun Dong, and Sabyasachi Sahoo. **Differentiable SLAM Helps Deep Learning-based LiDAR Perception Tasks**. In: *Proceedings of the British Machine Vision Conference (BMVC)*. [link]. 2023.

[13] Mariamma Antony, Siva Teja Kakileti, Rachit Shah, Sabyasachi Sahoo, Chiranjib Bhattacharyya, and Geetha 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.

[18] Sabyasachi Sahoo, Prashant Kumar, Vanshil Shah, Vineetha Kondameedi, Abhinav Jain, Akshaj Verma, Chiranjib Bhattacharyya, and Vinay Vishwanath. **Dynamic to static lidar scan reconstruction using adversarially trained auto encoder**. In: *Proceedings of the Association for the Advancement of Artificial Intelligence (AAAI) Conference*. [link]. 2021.

OTHER WORKS

[5] Kunal Samanta, Sabyasachi Sahoo, and Christian Gagné. **Test Time Adaptation as an Adversarial Defense Strategy**. Internship Report. [link]. Université Laval, 2023.

[7] Apoorva Verma, Sabyasachi Sahoo, and Christian Gagné. **Diffusion based Pseudolabeling under Distribution Shifts**. Internship Report. [link]. Université Laval, 2023.

[8] Sabyasachi Sahoo and Khaled Sellami. **Automated Microservice Extraction using Reinforcement Learning**. [link]. Université Laval, 2021.

[12] Sabyasachi Sahoo, Frédéric Precioso, and Christian Gagné. **Test-time Out-of-Distribution Generalization**. PhD Proposal. [link]. Université Laval, 2022.

[15] Darshika Tiwari, Rachit Shah, Sabyasachi Sahoo, and Chiranjib Bhattacharyya. **Enhancing Explainability in Medical Images using Global Methods**. Masters Thesis. [link]. IISc Bangalore, 2022.

[17] Gaurav Parashar, Sabyasachi Sahoo, and Chiranjib Bhattacharyya. **Adversarial Robustness for Local Interpretable Methods**. Masters Thesis. [link]. IISc Bangalore, 2021.

[19] Dhiraj Shanbag, Sabyasachi Sahoo, Chiranjib Bhattacharyya, and Vinay V. **An Approach For Accurate Sceneflow Prediction for LiDAR-based Sensors**. Masters Thesis. [link]. IISc Bangalore, 2020.

[23] Sabyasachi Sahoo and Vineetha Kondameedi. **Establishing Semantic relationships among Object Classes using Deep Networks for Image Classification**. [link]. IISc Bangalore, 2015.

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

[25] Sabyasachi Sahoo and Vineetha Kondameedi. **Hybrid Execution of Travelling Salesman Problem**. [link]. IISc Bangalore, 2015.

PROJECTS

[9] Sabyasachi Sahoo, Sara Karami, Arman Safarnejadian, and Adam Tupper. **Deep Ensemble Methods for Vehicle Classification**. [link]. Université Laval. 2021.

[14] Sabyasachi Sahoo, Rachit Shah, Siva Teja Kakileti, Chiranjib Bhattacharyya, and Geetha Manjunath. **A new AI-driven platform will facilitate early-COVID interventions over Whatsapp**. [link]. Department of Science and Technology, Government of India. 2021.

[16] Sabyasachi Sahoo, Abhinav Jain, Rachit Shah, and Chiranjib Bhattacharyya. **Improving Automatic Concept Extraction for Global Model Explainability**. [link]. Niramai Health Analytix. 2021.

[20] Sabyasachi Sahoo, Prashant Kumar, Chiranjib Bhattacharyya, and Vinay V. **Proximal Pose Search for Adapting SLAM in Dynamic Environments on Slow Moving UGVs**. [link]. Ati Motors. 2019.

[21] Vineetha Kondameedi, Santosh Shet, Akshaj Verma, Sabyasachi Sahoo, Prashant Kumar, Chiranjib Bhattacharyya, and Soma Biswas. **Frugal Advanced Driver Assistance System (ADAS) for Indian Roads**. [link]. TATA Motors. 2020.

[22] Tezuesh Varshney, Sabyasachi Sahoo, and Chiranjib Bhattacharyya. **DCT-VAE: Capturing Low-level and High-level Features for Image Generation**. [link]. IISc Bangalore. 2021.

TEACHING AND LEADERSHIP ROLES

- **Teaching Assistant** of Machine Learning course at Université Laval (fall 2022/2023): Conducted weekly tutorial sessions and graded homework/exams.
- **Student Mentor**, SHARE Research Labs (2020-21): Teaching and mentoring students on the platform 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.