Sayan Ghosal

CONTACT
INFORMATION

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PROFESSIONAL
SUMMARY

- Data science researcher with 5+ years of experience in complex, high dimensional, and structured data analysis with an application focus on computational biology and genomics.
- Current contributions include novel models to embed structured data as graphs to regularize whole-brain whole-genome data for pattern detection and feature selection.
- Developed and built a collaborative network (Erdös Number 3) with scientists across the globe, and engaged in multiple collaborative projects which led to 7 publications in peer reviewed conferences and journals.
- Passionate about merging the gap between machine learning and the scientific domain by fusing *a priori* scientific information about real-world datasets with data-driven approaches.

EDUCATION

Department of Electrical And Computer Engineering,
Johns Hopkins University, Ph.D., Spring 2023 (expected)

- Advisor: Prof. Archana Venkataraman

Department of Applied Mathematics And Statistics,
Johns Hopkins University, M.S.E., Spring 2021

- GPA: 4.0/4.0

Department of Electronics and Telecommunication Engineering,
Jadavpur University, B.E., 2017

- Honors Thesis: A novel non-rigid registration method for zebrafish larval images
- Advisor: Prof. Ananda Shankar Chowdhury
- CGPA: 9.3/10.0

RESEARCH
INTERESTS

Diagnostic Modeling, Multiview Learning, Machine Learning, Graph Learning, Deep Learning, Imaging Genetics, Genomic Association Study

RESEARCH SKILLS

- Predictive modeling.
- Designing robust optimization algorithms.
- Building data modality agnostic transferable and generalizable models.
- Graph representation
- Genetic association analysis.
- Interpretable Deep Learning.
- Incorporating hierarchical structures in deeplearning models.
- Developing interpretable biomarker detection techniques.

WORK
EXPERIENCE

Siemens Healthineers
Machine Learning Intern   2021
Project: Cardiac Outcome Prediction from Multi-Modal Data Leveraging
Prior Population Level Characteristics of the Disease

Department of Computing Science, University of Alberta
Mitacs Globalink Intern   2016
Project: Deformable registration of brain MRI using deep learning.

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RESEARCH
EXPERIENCE

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Johns Hopkins University
Graduate Research Assistant   2017 -
Advisor: Prof. Archana Venkataraman, Department of Electrical and Computer Engineering

- GUIDE: A Biologically Interpretable Graph Convolutional Network to Link Genetic Risk Propagations and Imaging Biomarkers of Disease

  - Developed a novel deep neural network for whole-brain and whole-genome analysis.
  - Tracks the flow of genetic risk through the biological pathways using hierarchical graph convolution and attention operations.
  - Fused the imaging and genetic embedding for disease classification.
  - Implemented a Bayesian feature selection strategy to extract the discriminative biomarkers of each modality.

- G-MIND: An End-to-End Multimodal Imaging-Genetics Framework for Biomarker Identification and Disease Classification

  - Developed a novel deep neural network to integrate high dimensional multimodal data like brain imaging and genetics data.
  - Performed a classification task, while handling missing data.
  - Identified and ranked features using an interpretable network.

- Bridging Imaging, Genetics, and Diagnosis in a Coupled Low-Dimensional Framework

  - Designed a novel generative-discriminative model for disease classification and feature selection.
  - Developed an ADMM based robust optimization strategy that enhances the reproducibility of the model.
  - Incorporated biological structures by using the interconnectedness information of different features.

University of Alberta, Canada
Research Assistant   2016
Advisor: Prof. Nilanjan Ray, Department of Computing Science Science.

- Deep Deformable Image Registration

  - Implemented a deep deformable registration algorithm for MRI images.
  - Improved the non-convex optimization of diffeomorphic demons by introducing Fully Convolutional Neural Networks (FCNN).

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PUBLICATIONS **S. Ghosal**, *et al.*, "A Biologically Interpretable Graph Convolutional Network to Link Genetic Risk Pathways and Neuroimaging Markers of Disease".biorXiv
Submitted in ICLR 2022

S. Ghosal, *et al.*, "A Generative Discriminative Framework that Integrates Imaging, Genetic, and Diagnosis into Coupled Low Dimensional Space". NeuroImage: 238:118200, 2021

S. Ghosal, *et al.*, "G-MIND: An End-to-End Multimodal Imaging-Genetics Framework for Biomarker Identification and Disease Classification", Proc. SPIE, Medical Imaging 2021: Image Processing. arXiv:2101.11656
Selected for Special Oral Presentation (<15% of Papers), and received best student paper award

S. Ghosal, *et al.*, "Bridging Imaging, Genetics, and Diagnosis in a Coupled Low-dimensional Framework", in MICCAI: Medical Image Computing and Computer Assisted Intervention, 2019. **Selected for Early Acceptance (Top 18% of Submissions)**

S. Ghosal, *et al.*, "A generative-predictive framework to capture altered brain activity in fMRI and its association with genetic risk: application to Schizophrenia", Proc. SPIE 10949, Medical Imaging 2019: Image Processing.

Sayan Ghosal, Nilanjan Ray, Deep deformable registration: Enhancing accuracy by fully convolutional neural net, Pattern Recognition Letters.

S. Ghosal, *et al.*, "A novel non-rigid registration algorithm for zebrafish larval images," 2017 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC).

REVIEWER
ACTIVITY
- NeuroImage
- MICCAI: Intl Conference on Medical Image Computing
  and Computer Assisted Intervention

TUTORING AND
MENTORSHIP
- Undergraduate Mentor
- Signals, Systems and Learning (TA)
- HopHacks2020 (Mentor)

HONORS AND
AWARDS
- MICCAI Student Participation Award   2020
- Dept. of Electrical and Computer Engineering, JHU, PhD fellowship   2017-2018
- Mitacs Globalink Research Fellowship Award   2016

RELEVANT SKILLS
Programming Languages: MATLAB, Python, LaTeX
Libraries: PyTorch, scikit-learn
Genomic Tools: PLink, IMPUTE2