

SAYANTAN KUMAR

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RESEARCH INTERESTS

Deep Learning: Generative models, Large language models, Interpretability, Representation learning

Medical Imaging: Computer-aided diagnosis, computer vision in biomedical imaging, anomaly detection

Clinical applications: Machine learning for healthcare, Electronic Health Records (EHR), disease heterogeneity, Clinical Decision Support (CDS)

EDUCATION

Washington University in St. Louis

PhD in Computer Science and Engineering

- GPA = 3.97 (till Fall 2023)

St. Louis, Missouri, USA

Aug 2019 - Dec 2024 (expected)

Indian Statistical Institute

M.Tech in Computer Science

- First Class Honors with Distinction

Kolkata, West Bengal, India

Aug 2017 - July 2019

Jadavpur University

B.E in Electrical Engineering

- CGPA = 8.6, First Class Honors

Kolkata, West Bengal, India

Aug 2013 - May 2017

WORK EXPERIENCE

Graduate Research Assistant, Washington University in St. Louis

March 2020 - Present

- Advisor: [Dr Philip Payne](#), [Dr Aristeidis Sotiras](#)

- Thesis: Clinical explainability of complex deep learning models and their translational impact in healthcare.

M.Tech Research Student, Indian Statistical Institute, Kolkata

May 2018 - July 2019

- Advisor: Dr Swagatam Das

- Dissertation: On the Choice of Appropriate Combination of Classifier and Decomposition Scheme for Multiclass Imbalanced Data Classification : A Comparative Analysis.

Summer Research Fellow, Technische Universität Darmstadt, Germany

May 2018 - Aug 2018

- Advisor : Dr. Heinz Koepl

- Project: Modeling communication in social networks by approximating Markov Chains

Summer Internship, Indian Institute of Technology, Kharagpur, India

May 2016 - Aug 2016

- Advisor : Dr Ashish Dhara

- Project : Using deep learning to detect diabetic retinopathy from retinal fundus images.

PUBLICATIONS

Journal articles (* indicates working and under review papers)

1. * **Kumar, S**, Kannampallil, T, Sotiras, A, Payne, PRO. Hierarchical multi-task deep learning framework for jointly predicting and explaining Alzheimer's Disease progression. [To be submitted to Journal of Biomedical Informatics (JBI)]
2. * **Kumar, S.**, Earnest, T., Payne, P. R., Sotiras, A., and Alzheimer's Disease Neuroimaging Initiative. (2023). Analyse patient-level heterogeneity in Alzheimer's Disease using multimodal normative modelling bioRxiv, 2023-08 [To be submitted to Neurology]
3. * Lou Y., **Kumar S.**, O Inez., Puri V.,... and Michelson A. Fusing donor lung CT scans with clinical data to predict primary graft dysfunction after lung transplantation [To be submitted to American Journal of Transplantation]

4. * Lou SS, **Kumar S**, Avidan MS, Kheterpal S, Kannampallil T. External validation of a publicly available surgical transfusion risk prediction model: a multi-center perioperative outcomes group study.[To be submitted to Anesthesiology]
5. Li, F., Oh, I., **Kumar, S.**, Eteleeb, A., Gupta, A., Buchser, W., ... and Cruchaga, C. (2022). Loss of estrogen unleashing neuro-inflammation increases the risk of Alzheimer's disease in women. *bioRxiv*, 2022-09. [\[Paper\]](#)
6. **Kumar, S.**, Oh, I., Schindler, S., Lai, A. M., Payne, P. R., and Gupta, A. (2021). Machine learning for modeling the progression of Alzheimer disease dementia using clinical data: a systematic literature review. *JAMIA open*, 4(3), ooab052. [\[Paper\]](#)

Conference articles (* indicates working and under review papers)

1. * **Kumar, S**, Payne, PR, and Sotiras, A. (2023, April). Improving Normative Modeling for Multi-modal Neuroimaging Data using mixture-of-product-of-experts variational autoencoders. Submitted to IEEE International Symposium in Biomedical Imaging (**IEEE ISBI**) 2024 [\[Paper\]](#)
2. **Kumar, S**, Payne, PR, and Sotiras, A. (2023, April). Normative modeling using multimodal variational autoencoders to identify abnormal brain volume deviations in Alzheimer's disease. In **SPIE Medical Imaging 2023: Computer-Aided Diagnosis** (Vol. 12465, p. 1246503). **[Oral][Best paper award finalist]**[\[Paper\]](#)
3. **Kumar, S**, Yu, S, Kannampallil, T, Abrams, Z, Michelson, A, and Payne, PR. (2022, August). Self-explaining neural network with concept-based explanations for ICU mortality prediction. In Proceedings of the 13th ACM International Conference on Bioinformatics, Computational Biology and Health Informatics (pp. 1-9) (**ACM BCB**)**[Oral]** [\[Paper\]](#)

Peer-reviewed workshops and abstracts

1. Lou SS, **Kumar S**, Avidan MS, Kheterpal S, Kannampallil T. External validation of a publicly available surgical transfusion risk prediction model: a multi-center perioperative outcomes group study. **World Congress of Anaesthesiologists 2024**. **[Oral]**
2. **Kumar, S.**, Kannampallil, T., Sotiras, A., and Payne, P. (2023, October). Explaining Longitudinal Clinical Outcomes using Domain-Knowledge driven Intermediate Concepts In XAI in Action: Past, Present, and Future Applications Workshop **NeurIPS 2023**. **[Poster]** [\[Paper\]](#)
3. **Kumar, S.**, Payne, P., and Sotiras, A. (2023, October). mmNormVAE: Normative Modeling on Multimodal Neuroimaging Data using Variational Autoencoders. In Deep Generative Models for Health Workshop **NeurIPS 2023**. **[Poster]** [\[Paper\]](#)
4. **Kumar, S**, Yu, S, Kannampallil, T, Abrams, Z, Michelson, A, and Payne, PR. Explaining Neural Network with Plausible Explanations. Interpretable Machine Learning in Healthcare (IMLH) workshop (**ICML 2022**).**[Poster]**
5. **Kumar, S**, Abrams, Z, Oh, I, Gupta, A, Schindler SE, Ghoshal, N, Lai, AM, Payne, PRO. Identifying Interpretable Clinical Subtypes within Heterogeneous Dementia Clinic Population. **AMIA 2022 Informatics Summit**.**[Oral]**
6. **Kumar, S**, Oh, I, Gupta, A, Oh, I, Lai, AM, Payne, PRO. Leveraging Electronic Health Records Data for Predicting Alzheimer's Disease Progression. **AMIA 2021 Informatics Summit**.**[Poster]**
7. **Kumar, S**, Gupta, A, Oh, I, Schindler, S, Lai, AM, Payne, PRO. Simplified Form of Recurrent Neural Networks for Predicting Alzheimer Disease Progression. **Pacific Symposium on Biocomputing (PSB 2021)**. **[Poster]**

TALKS/PRESENTATIONS

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- XAI in Action: Past, Present, and Future Applications Workshop NeurIPS 2023, New Orleans, USA - **Poster**
 - Deep Generative Models for Health Workshop NeurIPS 2023, New Orleans, USA - **Poster**
 - SPIE Medical Imaging 2023, San Diego, USA - **Oral**
 - Symposium on Artificial Intelligence on Health (SAIL) 2022, Bermuda - **Poster**

- Interpretable Machine Learning in Healthcare (IMLH) Workshop ICML 2022 [Virtual] - **Poster**
- ACM International Conference on Bioinformatics, Computational Biology and Health Informatics 2022 - **Oral**
- AMIA Informatics Summit 2022, Chicago, USA - **Oral**
- AMIA Informatics Summit 2021 [Virtual] - **Poster**

AWARDS AND HONORS

- **Student Travel Award**, SPIE Medical Imaging 2023
- **Robert F. Wagner All-Conference Best Paper Award Finalist** - Computer-Aided and Diagnosis track, SPIE Medical Imaging 2023
- **Honors (top 5%)** - Periodic Review of Doctoral Students (PRODS) **2022** and **2023**, Department of Computer Science and Engineering, Washington University in St. Louis
- **Prize money for outstanding academic performance (>90% aggregate marks)** in 3rd and 4th semesters of M.Tech, Indian Statistical Institute, Kolkata
- **State Rank of 422 (99.6 percentile)** in West Bengal Joint Entrance Examination (WBJEE) 2013, among 427196 participants applicants.

PROFESSIONAL SERVICE

- **Conference co-organizer:** Machine Learning for Health (ML4H 2022)
- **Member:** SPECTRA, SPIE Student Chapter, Washington University in St. Louis
- **Reviewer (journal):** Journal of Biomedical Informatics (JBI), IEEE Access, JAMIA Open
- **Reviewer (conference/workshops):** ISBI 2024, MICCAI 2023, IJCNN 2023, ML4H 2022, EMNLP 2022 Workshop BlackboxNLP, ICML 2022 Workshop IMLH, AMIA Annual Symposium 2020-2023, AMIA Informatics Summit 2020-2023

TEACHING EXPERIENCE

Washington University in St. Louis

Aug 2021 - Dec 2021

*Assistant Instructor, **Introduction to Machine Learning***

- Supervised undergraduate graders with grading assignments and held weekly office hours to help students in assignments.

Washington University School of Medicine

Aug 2020 - Dec 2020

*Teaching Assistant, **Introduction to Biomedical Data Science II***

- Presented tutorials on dimensionality reduction and feature extraction algorithms on electronic health records and imaging data, supervised and unsupervised models for predictive modeling.
- Guided students in homeworks and final projects on machine learning with real-world healthcare datasets.

TECHNICAL SKILLS

- **Programming:** Python, MATLAB, R, C/C++
- **Deep Learning & Computer Vision:** Supervised and Unsupervised Learning, Deep Generative Models, GAN, VAE, Diffusion Models, U-Net, Large language models
- **Frameworks and Tools:** PyTorch, Keras, Sklearn
- **Databases:** MySQL, PostgreSQL

RELEVANT COURSES

Large Language Models, Bayesian Machine Learning, Introduction to Machine Learning, Human-in-the Loop Computation, Data Mining, Artificial Intelligence, Cognitive Science, Natural Language Processing, Computer Vision, Pattern Recognition and Image Processing, Advanced Pattern Recognition

REFERENCES

- [Dr Philip Payne](#), Director, Institute for Informatics, Data Science and Biostatistics (I2DB), Associate Dean for Health Information and Data Science, School of Medicine and Affiliated Faculty in CS, Washington University.
- [Dr Aristeidis Sotiras](#), Assistant Professor, Department of Radiology and affiliated faculty at Institute for Informatics, Data Science and Biostatistics (I2DB), Washington University School of Medicine.
- [Dr Thomas Kannampallil](#), Associate Professor of Anesthesiology, Washington University School of Medicine
- [Dr Andrew Michelson](#), Assistant Professor of Medicine, Division of Pulmonary & Critical Care Medicine, Washington University School of Medicine.