

# SAYANTAN KUMAR

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## RESEARCH INTERESTS

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**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

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**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

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**Graduate Research Assistant, Washington University in St. Louis**

March 2020 - Present

- *Advisors:* [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

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**Journal articles (\* indicates working and under review papers)**

1. \* **Kumar, S**, Oh, I, Schindler. S., Ghoshal. N., Abrams, Z., Payne, P. Revealing heterogeneity in dementia using data-driven unsupervised clustering of cognitive profiles. [PLOS One, **under preparation**]
2. \* Yang, B, Earnest, T, **Kumar, S**, Kothapalli, D, Gordon, B, Soritas, A. Evaluation of ComBat harmonization for reducing across-tracer biases in regional amyloid PET analyses. [Human Brain Mapping, **under preparation**]
3. \* **Kumar, S**, Yu, S, Michelson, A, Kannampallil, T, Payne, PRO. HiMAL: A Multimodal Hierarchical Multi-task Auxiliary Learning framework for predicting and explaining Alzheimer disease progression. [JAMIA Open, **under review**] [[ArXiv](#)]

4. \* **Kumar, S.**, Earnest, T., Yang, B.,... Sotiras, A. Analysing heterogeneity in Alzheimer Disease using multi-modal normative modelling on ATN biomarkers. [Alzheimer's & Dementia, **under review**] [[BioRxiv](#)]
5. \* Lou Y., **Kumar S.**, O Inez., Puri V.,... and Michelson A. Developing Approaches to Incorporate Donor Lung CT Images into Machine Learning Models to Predict Severe Primary Graft Dysfunction after Lung Transplantation [American Journal of Transplantation, **under review**]
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. \*Qiu, P, Yang, J, **Kumar, S**, Ghosh, S, Sotiras, A. AgileFormer: Spatially Agile Transformer UNet for Medical Image Segmentation. [MICCAI 2024, under review.] [[ArXiv](#)] [[Code](#)]
2. **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. **Accepted** in IEEE International Symposium in Biomedical Imaging (**IEEE ISBI**) 2024 [[Paper](#)] [[Code](#)]
3. **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](#)] [[Code](#)]
4. **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](#)] [[Code](#)]

#### Peer-reviewed workshops and abstracts

1. **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](#)] [[Code](#)]
2. **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](#)] [[Code](#)]
3. **Kumar, S**, Yu, S, Kannampallil, T, Abrams, Z, Michelson, A, and Payne, PR. Explaining Neural Network with Plausible Explanations. Symposium on Artificial Intelligence in Health (**SAIL 2022**).[**Poster**]
4. **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**]
5. **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**]
6. **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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- IEEE ISBI 2024, Athens, Greece - **Poster**
  - 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

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- **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%)** - Annual Review of Doctoral Students (PRODS) **2024**, **2023** and **2022**, 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

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- **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):** MICCAI 2024, ISBI 2024, MICCAI 2023, IJCNN 2023, ML4H 2022, ICLR Workshop TS4H 2024, 2022, EMNLP 2022 Workshop BlackboxNLP, ICML 2022 Workshop IMLH, AMIA Annual Symposium 2020-2023, AMIA Informatics Summit 2020-2023

## TEACHING EXPERIENCE

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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

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- **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

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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

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- [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.