BIOGRAPHICAL SKETCH

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NAME: Zhang, Kai

eRA COMMONS USER NAME (credential, e.g., agency login): KAZHANG

POSITION TITLE: Assistant Professor of Biomedical Informatics

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Shandong University of Science and Technology, China	B.S.	06/2012	Civil and Environmental Engineering
Beijing Institute of Technology, China	M.S.	03/2015	Electrical Engineering
Texas A&M University, College Station, TX	Ph.D.	05/2020	Electrical Engineering
The University of Texas Health Science Center at Houston, TX	Postdoc	05/2022	Biomedical informatics

A. Personal Statement

As an Assistant Professor in Biomedical Informatics, my research endeavors revolve around the crossroads of machine learning and healthcare. My foundational knowledge in Electrical Engineering, specifically in information theory, optimization, and data storage systems, arms me with a unique perspective to tackle challenges in biomedical sciences. My current machine learning interests span diverse areas such as Bayesian neural networks, irregularly sampled time series methods, multimodal learning, survival analysis, end-to-end trainable methods, fairness in machine learning, reinforcement learning, and causality, particularly when applied to health data science through the integration of domain-specific knowledge of biological systems. Additionally, I have a keen interest in the practical aspects of deploying robust, scalable machine learning models in real-world settings. This involves working on the scalability of causal structure learning algorithms and creating transparent, interpretable, and explainable AI tools that not only assist patients but also enhance the diagnostic capabilities of healthcare staff.

Publications:

1. Li C, Ding S, Zou N, Hu X, Jiang X, Zhang K. Multi-task learning with dynamic re-weighting to achieve fairness in healthcare predictive modeling. Journal of Biomedical Informatics. 2023 May 19:104399.
2. Ding S, Tang R, Zha D, Zou N, Zhang K, Jiang X, Hu X. Fairly predicting graft failure in liver transplant for organ assigning. In AMIA Annual Symposium Proceedings 2022 (Vol. 2022, p. 415). American Medical Informatics Association. (Best student paper finalist)
3. Zhang K, Karanth S, Patel B, Murphy R, Jiang X. A multi-task Gaussian process self-attention neural network for real-time prediction of the need for mechanical ventilators in COVID-19 patients. J Biomed Inform. 2022 Apr 27;130:104079. doi: 10.1016/j.jbi.2022.104079. Epub ahead of print. PMID: 35489596; PMCID: PMC9044651.
4. Zhang K, Jiang X, Madadi M, Chen L, Savitz S, Shams S. DBNet: a novel deep learning framework for mechanical ventilation prediction using electronic health records. In Proceedings of the 12th ACM Conference on Bioinformatics, Computational Biology, and Health Informatics 2021 Aug 1 (pp. 1-8).

Ongoing Research Support

U54HG012510 (Ohno-Machado) Role: Co-I 01/01/23 - 04/30/26
A FAIR Bridge2AI Center (FABRIC)
Total Funding: $1,467,976

OCGA MV0524-01 (MPIs Shams, Sood, Jiang) Role: Co-I 01/01/23 - 12/31/25
Employing Artificial Intelligence to Predict Clinical Outcomes in Ovarian Cancer

3R01AG066749-03S1 (PI Jiang), Role: Co-I 09/02/22 - 03/31/23
Finding combinatorial drug repositioning therapy for Alzheimer's disease and related dementias
Total Funding: $302,665

CPRIT Rising Stats Award: RR180012 (PI Jiang) Role: Co-I 05/01/18 - 02/28/24
Cancer Phenotyping for personalized combinatorial drug therapy
Total Funding: $4,000,000

B. Positions, Scientific Appointments, and Honors

Positions and Scientific Appointments

Since 2022	Assistant Professor, McWilliams School of Biomedical Informatics, University of Texas Health Science Center at Houston, Houston, TX

Honors

2023	Co-author of student best paper finalist of AMIA 2022
2022	Transformational Project Award from the American Heart Association
2015 - 2017	Chancellor Fellowship of The University of Tennessee Knoxville

Appointments

2023	National Science Foundation (NSF) SBIR/STTR reviewer board member
2022	Consulting reviewer, 25th International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI 2022)
2021	Reviewer board member, 2021 IEEE International Symposium on Information Theory (ISIT 2021)
2018	Reviewer board member, 2018 IEEE Journal on Selected Areas in Communications Caching Issue (JSAC-SI-CACHING'18)

C. Contributions to Science

1. My main research focused on fairness in healthcare predictive modeling, a growing concern as technology is increasingly being used in healthcare predictive modeling. AI systems are being used to make decisions that can have a direct impact on people’s lives, and it is essential to ensure that these decisions are being made fairly. The concept of model fairness in AI is based on the idea that the algorithms used to create AI systems should not discriminate against any particular group of people. This means that the algorithm should not be biased against any particular gender, race, or age group, and should be designed to produce results that are fair and equitable for all. In order to ensure model fairness in AI, organizations must take steps to ensure that their algorithms are designed in a way that is unbiased and equitable. This can include using data sets that are diverse and representative of the population, as well as designing machine learning models to reduce any potential bias.

a. Li C, Ding S, Zou N, Hu X, Jiang X, Zhang K. Multi-task learning with dynamic re-weighting to achieve fairness in healthcare predictive modeling. Journal of Biomedical Informatics. 2023 May 19:104399.
b. Ding S, Tang R, Zha D, Zou N, Zhang K, Jiang X, Hu X. Fairly predicting graft failure in liver transplant for organ assigning. In AMIA Annual Symposium Proceedings 2022 (Vol. 2022, p. 415). American Medical Informatics Association. (Best student paper finalist)
c. Li C, Jiang X, Zhang K. A Transformer-Based Deep Learning Approach for Fairly Predicting Post-Liver Transplant Risk Factors (Accepted). International Conference on Intelligent Biology and Medicine (ICIBM), 2023
d. Ding S, Zha D, Tang R, Zhang K, Zou N, Chen L, Jiang X, Hu X. FairAlloc: Learning Fair Organ Allocation Policy for Liver Transplant. Journal of Biomedical Informatics. (In Review). Journal of Biomedical Informatics.

2. Another research interest of mine is in developing deep learning-based prediction models considering data missingness and heterogeneities in multimodality data. EHR data are collected for billing purposes instead of research, and studies have shown that up to 70% of the diagnosis codes in the EHR data are inaccurate. We proposed an end-to-end neural network model that incorporates the Multi-task Gaussian Process to handle the data missing as well as the irregular sampling rate in observational data, together with a self-attention neural network for the prediction task. We also closely collaborate with our clinicians and successfully deploy our prediction model into our teaching hospital for monitoring the real-time risk of COVID-19 in-hospital patients**.** On the other hand, multi-modal EHR data (structured data, images, texts, audios, videos) also proposes challenges and asks for new methodologies to be able to explore, extract and fuse the useful information from them effectively. The DataBase neural NETwork (DBNET) model proposed by us shows great success in predicting COVID-19 patient's mechanical ventilation needs. The input format of the framework is highly flexible and could take single or multiple data modalities (including structured EHR, Radiology images, Clinical notes) to learn latent representations of each modality in a unified space.

a. Zhang K, Karanth S, Patel B, Murphy R, Jiang X. A multi-task Gaussian process self-attention neural network for real-time prediction of the need for mechanical ventilators in COVID-19 patients. J Biomed Inform. 2022 Apr 27;130:104079. doi: 10.1016/j.jbi.2022.104079. Epub ahead of print. PMID: 35489596; PMCID: PMC9044651.
b. Zhang K, Jiang X, Madadi M, Chen L, Savitz S, Shams S. DBNet: a novel deep learning framework for mechanical ventilation prediction using electronic health records. In Proceedings of the 12th ACM Conference on Bioinformatics, Computational Biology, and Health Informatics 2021 Aug 1 (pp. 1-8).
c. Zhang K, Lincoln JA, Jiang X, Bernstam EV, Shams S. Predicting multiple sclerosis disease severity with multimodal deep neural networks (in review). BMC Medical Informatics and Decision Making. http://arxiv.org/abs/2304.04062 arXiv:2304.04062
d. Lee CT, Zhang K, Li W, Tang K, Ling Y, Walji MF, Jiang X. Identifying predictors of tooth loss using a rule-based machine learning approach: A retrospective study at University-Setting Clinics. Journal of Periodontology.

3. Causality is an important topic in healthcare studies with wide applications from understanding the causes of diseases to finding adverse drug events. We performed a thorough review of the state-of-the-art causal structure learning algorithms and proposed a parallelizable, scalable, and fast causal structure learning algorithm. We have successfully applied our new algorithm on a study of the comorbidity risk factors in Alzheimer's disease and found statistically different set of risk factors were associated with two race groups (Caucasian, Africa America). We are also applying our new algorithm on various projects to promote new findings of causal relationships and generate hypotheses.

a. Kim Y, Zhang K, Savitz SI, Chen L, Schulz PE, Jiang X. Counterfactual analysis of differential comorbidity risk factors in Alzheimer's disease and related dementias. PLOS Digital Health. 2022 Mar 15;1(3): e0000018.
b. Upadhyaya P, Zhang K, Li C, Jiang X, Kim Y. Scalable Causal Structure Learning: Scoping Review of Traditional and Deep Learning Algorithms and New Opportunities in Biomedicine. JMIR Med Inform 2023 Jan 17;11:e38266. PMID:36649070

c. Samuel S, To C, Ling Y, Zhang K, Jiang X, Bernstam EV. Enoxaparin may be associated with lower rates of mortality than unfractionated heparin in neurocritical and surgical patients. Journal of Thrombosis and Thrombolysis. 2023 Jan 10:1-0.

Complete List of Published Work in MyBibliography:
https://www.ncbi.nlm.nih.gov/myncbi/k..z..1/bibliography/public/