Zhecheng Sheng

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Research Interest

Trustworthy machine learning My current research interests focus on developing methods to ensure fairness and robustness of machine learning models and their application in Biomedicines. This involves addressing the presence of sensitive features or confounding shifts that may interfere with model performances. Besides, I am also interested in designing methods for probing Large Language Models(LLM) to assess the faithfulness of language generation and adapting it for downstream domain-specific tasks.

Education

University of Minnesota Twin Cities Minneapolis, MN *Aug. 2021 – May. 2025(Est.)*

Ph.D. in Health Informatics & Data Science
M.Sc. in Data Science, GPA: 3.99/4.00
Advisor: Serguei Pakhomov

Duke University Durham, NC *Aug. 2017 – May. 2019*

M.Sc. in Biostatistics, GPA: 3.82/4.00
Advisor: Benjamin Goldstein

Selected Publication

Sheng, Z.*, Zhang, T.*, Jiang, C.*, Kang, D. (2023). BBScore: A Brownian Bridge Based Metric for Assessing Text Coherence. *Accepted to The 38th Annual AAAI Conference on Artificial Intelligence (AAAI). Vancouver, Canada. (* equal contributions)*

Sheng, Z., Finzel, R., Lucke, M., Dufresne, S., Gini, M.,& Pakhomov, S. (2023). A Dialogue System for Assessing Activities of Daily Living: Improving Consistency with Grounded Knowledge. *In Proceedings of the Third DialDoc Workshop on Document-grounded Dialogue and Conversational Question Answering, pages 68–79, Toronto, Canada. Association for Computational Linguistics.*

Ding, X., **Sheng, Z.**, Hur, B., Chen, F., Pakhomov, S., & Cohen, T. (2023). Enhancing Robustness of Foundation Model Representations under Provenance-related Distribution Shifts. *In NeurIPS 2023 Workshop on Distribution Shifts: New Frontiers with Foundation Models. New Orleans, LA, USA.*

Sheng, Z., Finzel, R., Gaydhani, A., Lucke, M., Dufresne, S., Gini, M., & Pakhomov, S. (2023). A Chatbot for Activities of Daily Living Assessment Standardization. *In AMIA Annual Symposium. New Orleans, LA, USA.*

Sheng, Z., Bollig, E., Granick, J., Zhang, R., & Beaudoin, A. (2022). Canine Parvovirus Diagnosis Classification Utilizing Veterinary Free-Text Notes. *In 2022 IEEE 10th International Conference on Healthcare Informatics (ICHI) (pp. 614-615). Rochester, MN, USA: IEEE.*

Ding, X., **Sheng, Z.**, Yetişgen, M., Pakhomov, S., & Cohen, T. (2023). Backdoor Adjustment of Confounding by Provenance for Robust Text Classification of Multi-institutional Clinical Notes. *In AMIA Annual Symposium. New Orleans, LA, USA.*

Research Experience

Deconfound Deep Transformers Networks *Sep. 2022 – Present*

Mentor: Serguei Pakhomov, University of Minnesota Twin Cities

- Investigated language model's causal reasoning ability in dementia classification results and located weights within the deep network that associated with target labels.
- Developed an probabilistic evaluation framework to quantify distribution shift within subgroups.
- Discovered BERT model captures gender specific-tokens during fine-tuning which resulting in prediction bias at model deployment.
- Identified different training data distribution can cause a certain shift pattern at test time.

Dialogue System for Activity of Daily Living Assessments *July. 2022 – Present*

Mentor: Serguei Pakhomov, University of Minnesota Twin Cities

- Implemented transformer models like RoBERTa for text classification and improved classification accuracy by 10%.
- Fine-tuned Large Language Models such as LLaMA and Vicuna with clinical assessment notes for domain adaptation through parameter efficient methods(LoRA) and improved the usability of the system.
- Built a knowledge base for the dialogue system which reduces hallucinations from large language models.

Assess Text Coherence with Brownian Bridge *Jan. 2023 – Present*

Mentor: Dongyeop Kang, University of Minnesota Twin Cities

- Introduced a likelihood-based evaluation score motivated by Brownian Bridge for measuring global text coherence.
- Demonstrated the proposed score can detect incoherent text in both global and local artificial tasks.
- Showecased the score can be adapted for diverse downstream tasks, such as distinguishing between human and AI-generated text and detecting different LLM generated text from mixed corpus.

An Unified Machine Learning Fariness Notion via Sparsity *May. 2023 – Present*

Mentor: Enmao Diao, Duke University

- Proposed a novel machine learning fairness notion based on distributional difference and sparsity.
- Unified fairness evaluation measurements for both classification and regression problem.
- Extended the fairness notion for multiple sensitive group and multiple class scenarios.
- Implemented augmented ADMM in optimization for linear models with designated fairness constraint and provided theoretical gaurantees.

Canine Parvovirus Diagnosis Classification Utilizing Veterinary Free-Text Notes *Aug. 2021 – Jun. 2022*

Mentor: Rui Zhang, University of Minnesota Twin Cities

- Extracted and wrangled large EHR data containing veterianry notes from relational databases.
- Utilized rule-based NLP methods to identify Parvovirus free text notes.
- Built a pipeline with domain specific pretrained BERT models for document classification with accuracy and F1 score around 0.90.

Functional Analysis on Association between Vital Signs and In-hospital Outcome *May. 2018 – May. 2019*

Mentor: Benjamin Goldstein, Duke University

- Wrangled massive Electronic Health Records with time stamps.
- Differentiated healthy and risky cohorts using functional principle components analysis.
- Completed functional logistic regression to access most informative time period for different vital signs and identified 4-hour window prior to event demonstrates the most significant change in coefficient function.
- Poster accepted by AMIA Informatics Summit 2019.

Work Experience

Duke Cancer Institute *Durham, NC* *Aug. 2019 – Jul. 2021*

Bioinformatician I, Mentor: Kouros Owzar

- Designed and implemented an S4 R package for assessing sequencing and mapping quality of RNA-Seq data.
- Operated different bioinformatics pipelines through dockerized containers in remote HPC clusters.
- Delivered reproducible and well-documented reports and code.

Services & Awards

- Served as a reviewer of AMIA Informatics Summit 2024
- Served as a reviewer of EMNLP 2023
- Honorable Mention in Duke Data Fest 2018

Skills & Coursework

Programming Languages: Python, R, SAS, Shell, SQL, Java
Software: Pytorch, Huggingface, Scikit-learn, Pandas, Tidyverse, AWS
Relevant Coursework: Data Structure and Algorithms, Database Management System, Advanced Machine Learning, Artificial Intelligence, Statistical Programming with Big Data, Generalized Linear Model, Causal Inference, Computational Causal Analytics, Natural Language Processing with Deep Learning