Zeshan M. Hussain

Curriculum Vitae

Research Interests

My research deals with developing machine learning methods to assist and improve decision making in healthcare settings, with the ultimate goal of deploying robust and scalable clinical decision support systems. I am interested in deep generative models, causality, physician-AI interaction and machine learning in healthcare.

Education

2017–Present **M.D., Health, Sciences, and Technology (HST)**, *Harvard Medical School*, Longwood, MA

2019–2023 **Ph.D., Electrical Engineering and Computer Science**, *MIT*, Cambridge, MA, GPA: *5.0/5.0*, **Thesis**: *Towards Precision Oncology: A Predictive and Causal Lens*
MD-PhD Program at Harvard and MIT

2016–2017 **M.S., Computer Science**, *Stanford University*, Stanford, CA, GPA: *3.9/4.0*

2012–2016 **B.S., Computer Science**, *Stanford University*, Stanford, CA, GPA: *3.9/4.0*

Experience

Research

2019-2023 **Ph.D. Student**, *Clinical Machine Learning Group*, MIT
Thesis: "Towards Precision Oncology – A Predictive and Causal Lens"
Advisor: Prof. David Sontag.
- Developed machine learning algorithms to tackle problems in healthcare
- Worked on probabilistic inference in deep generative models, causality, and human-AI interaction

2016-2017 **M.S., Research Student**, *QIAI Lab* & *Hazy Research Lab*, Stanford
Advisors: Dr. Daniel Rubin, Prof. Chris Ré
- Worked on data augmentation for deep learning tasks on medical images
- Developed machine learning models to improve decision-making and diagnosis in radiology

2016-2017 **B.S., Research Intern**, *DIR Group*, Dayton Interventional Radiology
Advisor: Dr. Mubin Syed
- Developed ML model to predict tPA effectiveness based on blood clot signal over time
- Contributed to development of a novel bariatric embolization technique

Industry

2020–2021 **CTO** & **Co-Founder**, *Humaine*
Conversational AI coaching for training of medical personnel, including medical students, residents, and other trainees.
- Part of MIT Sandbox and Harvard iLab Venture Program
- Top 10 Startup at MIT 100K Accelerate Final, "Best Social Hack" at HackHarvard

2015 **Software Engineer Intern**, *Acupera*, San Francisco
Built a custom programming language and IDE to enable providers to "code" care management plans

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Publications

* indicates equal contribution.

Preprints

[1] Z. Hussain*, E. De Brouwer*, R. Boiarsky, S. Setty, N. Gupta, G. Liu, C. Li, J. Srimani, J. Zhang, R. Labotka, and D. Sontag, "Joint attention-based event prediction and longitudinal modeling in newly diagnosed and relapsed myeloma," 2024 **(under review)**.

[2] Z. Hussain*, B. D. Lam*, F. A. Perez, I. Riaz, M. Jacobs, A. Yee, and D. Sontag, "Evaluating physician-AI interaction for cancer management: Paving the path towards precision oncology," *https://arxiv.org/abs/2404.15187*, 2024 **(under review)**.

Peer-Reviewed Publications

[3] I. Demirel, E. De Brouwer, Z. Hussain, M. Oberst, A. A. Philippakis, and D. Sontag, "Benchmarking observational studies with experimental data under right-censoring," in *International Conference on Artificial Intelligence and Statistics*, pp. 4285–4293, PMLR, 2024.

[4] A. M. Alaa, Z. Hussain, and D. Sontag, "Conformalized unconditional quantile regression," in *International Conference on Artificial Intelligence and Statistics*, pp. 10690–10702, PMLR, 2023.

[5] Z. Hussain*, M.-C. Shih*, M. Oberst, I. Demirel, and D. Sontag, "Falsification of internal and external validity in observational studies via conditional moment restrictions," in *International Conference on Artificial Intelligence and Statistics*, pp. 5869–5898, PMLR, 2023.

[6] Z. Hussain*, M. Oberst*, M.-C. Shih*, and D. Sontag, "Falsification before extrapolation in causal effect estimation," *Advances in Neural Information Processing Systems*, vol. 35, pp. 6161–6174, 2022.

[7] Z. Hussain*, R. G. Krishnan*, and D. Sontag, "Neural pharmacodynamic state space modeling," in *International Conference on Machine Learning*, pp. 4500–4510, PMLR, 2021.

[8] R. K. Karlsson, M. Willbo, Z. Hussain, R. G. Krishnan, D. Sontag, and F. D. Johansson, "Using time-series privileged information for provably efficient learning of prediction models," in *International Conference on Artificial Intelligence and Statistics*, pp. 5459–5484, PMLR, 2022.

[9] M. K. Sana, Z. Hussain, M. H. Maqsood, and P. A. Shah, "Artificial intelligence in celiac disease," *Computers in Biology and Medicine*, p. 103996, 2020.

[10] A. J. Ratner, H. R. Ehrenberg, Z. Hussain, J. Dunnmon, and C. Ré, "Learning to compose domain-specific transformations for data augmentation," *Advances in Neural Information Processing Systems*, vol. 30, p. 3239, 2017.

[11] Z. Hussain, F. Gimenez, D. Yi, and D. Rubin, "Differential data augmentation techniques for medical imaging classification tasks," in *AMIA Annual Symposium Proceedings*, vol. 2017, p. 979, American Medical Informatics Association, 2017.

[12] Z. Hussain, F. Gimenez, D. Yi, and D. Rubin, "Data augmentation for mammography classification," in *Advances in Neural Information Processing Systems ML4H Workshop*, 2016 **(Spotlight)**.

[13] M. I. Syed, R. Gallagher, Z. Hussain, A. Shaikh, P. J. Cain, K. Morar, M. Sebastian, R. Tyrrell, A. Guehl, and R. Erdelyi, "Combination of thrombolysis and glycoprotein iib/iiia inhibition in chronic peripheral thrombosis: A case report," *International Journal of Radiology and Radiation Oncology*, vol. 3, no. 1, pp. 004–006, 2017.

[14] E. D. SoRelle, O. Liba, Z. Hussain, M. Gambhir, and A. de la Zerda, "Biofunctionalization of large gold nanorods realizes ultrahigh-sensitivity optical imaging agents," *Langmuir*, vol. 31, no. 45, pp. 12339–12347, 2015.

Invited Talks & Presentations

2023 **Stanford University**, Stanford, CA
Stanford MedAI Seminar Series
Title: Benchmarking Causal Effects from Observational Studies using Experimental Data

2018 **Dana Farber Cancer Institute**, Boston, MA
Big Data and Precision Medicine Conference *Breakout Session*
Title: Disease Progression Modeling
Big Data and Precision Medicine Conference (Invited as co-author. Did not give talk)
Title: Forays into understanding multiple myeloma with machine learning

2018 **Harvard Medical School**, Longwood, MA
Soma Weiss Research Day *Poster Presentation*
Title: Modeling disease progression in multiple myeloma

2017 **AMIA Annual Symposium** *Oral Presentation*
Title: Differential data augmentation techniques for medical imaging tasks

2016 **NeurIPS ML4H Workshop** *Oral Presentation*
Title: Data augmentation for mammography classification

Teaching & Mentorship

Teaching

2022 Teaching Assistant for 6.871 (Machine Learning for Healthcare) at MIT

Mentorship

2021 Mentor, MIT Summer Research Program – Fernando Acosta Perez
Current PhD Student at University of Wisconsin-Madison

Service

Conferences

2022 Reviewer, Neural Information Processing Systems (NeurIPS)

2022 Reviewer, International Conference on Machine Learning (ICML)
Top Reviewer Award (Top 10%)

2021 Reviewer, International Conference on Machine Learning (ICML)

2021 Reviewer, Uncertainty in Artificial Intelligence (UAI)

Journals

2021 Reviewer, Journal of Machine Learning Research (JMLR)

Workshops

2023 Reviewer, Time Series Representation Learning for Health (ICLR Workshop)

Awards and Honors

2022 NIH Ruth L. Kirschstein National Research Service F30 Award Recipient

2022 Top Reviewer Award (Top 10%), ICML 2022

2016 Award of Excellence

Presented to top 10% of graduating seniors who exemplify leadership in the Stanford community

2013 AFRL Repperger Fellow

Competitive grant given to undergraduates to pursue research at the Air Force Research Lab (AFRL).