Maxwell A. Xu

US Citizen

Personal Website: maxxu05.github.io

EDUCATION

University of Illinois Urbana-Champaign
PhD. in Computer Science
Advised by Dr. James M. Rehg
Expected 2026

Georgia Institute of Technology
M.S. in Computer Science

Johns Hopkins University
B.S. in Applied Math / Biomedical Engineering

AWARDS

- National Science Foundation Graduate Research Fellowship
- Georgia Tech President's Fellowship
- Apple AIML Scholar Fellowship Finalist
- 2nd Place at the 11th Annual Jump ARCHES Symposium
- Intuitive Surgical Best Deep Learning Project Award

SKILLS

Machine Learning: Time-Series, Self-Supervised Learning, Contrastive Learning, Imputation, Biosensors, Health

Programming: Pytorch, Jax, Flax, Tensorflow

SELECTED EXPERIENCE

Google Health — Seattle, WA
Student Researcher — Dec 2024 – Current

- Research on foundation models for wearable health biosignals on real-world production data.
- Developing scalable data and training pipelines for large-scale foundation model training using tensorflow-based infrastructure (i.e. Flax/Jax and TFDS).
- Collaborated across various interdisciplinary research efforts.

Apple — Seattle, WA
Health AI Research Intern — April 2024 – Sep 2024

- Spearheaded research efforts on self-supervised learning methods for a motion foundation model.
- Collaborated with an interdisciplinary team to use health-domain knowledge in model development.
- Heavily assisted in engineering efforts for machine learning pipeline and infrastructure.

Rehg Lab — Urbana, IL
PhD Student — Aug 2020 – Current

- Research interests include developing self-supervised learning methods for biosignal foundation models.
- Projects include a state-of-the-art motif-based time-series self-supervised learning method, physiological and health signal imputation via transformers, and disease progression modeling.
- First author published at ICLR (x2), NeurIPS, INSAR.

PUBLICATIONS

Xu, M.†, Narayanswamy, G.†, Ayush, K., Spathis, D., Liao, S., Tailor, S. A., Metwally, A., Heydari, A. A., Zhang, Y., Garrison, J., Abdel-Ghaffar, S., Xu, X., Gu, K., Sunshine, J., Poh, M.-Z., Liu, Y., Althoff, T., Narayanan, S., Kohli, P., Malhotra, M., Patel, S., Yang, Y., Rehg, J. M., Liu, X.°, & McDuff, D.° (2025). LSM-2: Learning from Incomplete Wearable Sensor Data. *In Review at NeurIPS 2025.* DOI: https://doi.org/10.48550/arXiv.2506.05321 (†Co-first authors, °Co-last authors)

Zhang, Y., Ayush, K., Qiao, S., Heydari, A. A., Narayanswamy, G., **Xu, M.**, Metwally, A. A., Xu, S., Garrison, J., Xu, X., Althoff, T., Liu, Y., Kohli, P., Zhan, J., Malhotra, M., Patel, S., Mascolo, C., Liu, X., McDuff, D. & Yang, Y. (2025). SensorLM: Learning the Language of Wearable Sensors. *In Review at NeurIPS 2025.* DOI: https://doi.org/10.48550/arXiv.2506.09108

Gu, K., Zhang, Z., Lin, K., Zhang, Y., Paruchuri, A., Yu, H., Kazemi, M., Ayush, K., Heydari, A. A., **Xu, M.**, Narayanswamy, G., Liu, Y., Poh, M.-Z., Yang, Y., Malhotra, M., Patel, S., Palangi, H., Xu, X., McDuff, D., Althoff, T. & Liu, X. (2025). RADAR: Benchmarking Language Models on Imperfect Tabular Data. *In Review at NeurIPS 2025.* DOI: https://doi.org/10.48550/arXiv.2506.08249

Saha, M.†, **Xu, M**†. A., Mao, W., Neupane, S., Rehg, J. M., & Kumar, S. (2025)**.** Pulse-PPG: An Open-Source Field-Trained PPG Foundation Model for Wearable Applications Across Lab and Field Settings. *Ubiquitous Computing (UbiComp), Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT).* DOI: https://doi.org/10.48550/arXiv.2502.01108 (†Co-first authors)

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Xu, M., Narain, J., Darnell, G., Hallgrimsson, H., Jeong, H., Forde, D., Fineman, R., Raghuram, K., Rehg, J. M. & Ren, S. (2025). RelCon: Relative Contrastive Learning for a Motion Foundation Model for Wearable Data. The Thirteenth International Conference on Learning Representations (ICLR). DOI: https://doi.org/10.48550/arXiv.2411.18822

Chow, W., Gardiner, L., Hallgrimsson, H., **Xu, M.**, & Ren, S. (2024). Towards Time-Series Reasoning with LLMs. (2024). Oral Presentation at 2024 NeurIPS Time Series in the Age of Large Models Workshop. DOI: https://doi.org/10.48550/arXiv.2409.11376

Xu, M., Moreno, A., Wei, H., Marlin, B., & Rehg, J. M. (2024). REBAR: Retrieval-Based Reconstruction For Time-series Contrastive Learning. The Twelfth International Conference on Learning Representations (ICLR). DOI: https://doi.org/10.48550/arXiv.2311.00519

Wei, H., **Xu, M.,** Samplawski, C., Rehg, J. M., Kumar, S., & Marlin, B. (2024). Temporally Multi-Scale Sparse Self-Attention for Physical Activity Data Imputation. Conference on Health, Inference, and Learning (CHIL). DOI: https://doi.org/10.48550/arXiv.2406.18848

Xu, M., Moreno, A., Nagesh, S., Aydemir, V., Wetter, D., Kumar, S., & Rehg, J. M. (2022). PulseImpute: A Novel Benchmark Task for Pulsative Physiological Signal Imputation. Advances in Neural Information Processing Systems, 35, 26874-26888. DOI: https://doi.org/10.48550/arXiv.2212.07514

Xu, M., Rehg, J., Rozga, A., McDaniel, J., Yoder, P., Watson, L., & Brady, N. (2022). Discovering Novel Predictors of Minimally Verbal Outcomes in Autism through Computational Modeling. International Society for Autism Research (Oral + Press Conference < 1% acceptance rate). Press release: https://twitter.com/AutismINSAR/status/1524427451069345825

Liu, Y., Moreno, A.†, **Xu, M.**†, Li, S., McDaniel, J., Brady, N., Rozga, A., Li, F., Song, L., Rehg, J. Efficient Learning and Decoding of the Continuous-Time Hidden Markov Model for Disease Progression Modeling. arXiv [cs.LG]. 2021 Retrieved From http://arxiv.org/abs/2110.13998 (†Co-second authors)

Pomeranz Krummel, D., Nasti T., Kaluzova, M., Kallay, L., Melms, J., Izar, B., **Xu. M**., Bhattacharya, D., Burnham, A., Ahmed, T., Li, G., Lawson, D., Kowalski, J., Cook, J., Medvedovic, M., Jenkins, A., Khan, M., Sengupta. S, Melanoma cell intrinsic GABAA receptor enhancement potentiates radiation and immune checkpoint inhibitor response by promoting direct and T cell-mediated anti-tumor activity. International Journal of Radiation Oncology. 2020. DOI: https://doi.org/10.1016/j.ijrobp.2020.10.025

Pomeranz Krummel, D.‡, Nasti, T.‡, Izar, B.†, Press, R.†, **Xu, M.**†, Lowder, L., Kaluzova, M., Kallay, L., Rupji, M., Rosen, H., Su, J., Curran, W., Olson, J., Weinberg, B., Schniederjan, M., Neill, S., Lawson, D., Kowalski, J., Khan, M., Sengupta, S. Impact of sequencing radiation therapy and immune checkpoint inhibitors in the treatment of melanoma brain metastases. Radiation Oncology. 2020. DOI: https://doi.org/10.1016/j.ijrobp.2020.01.043 (‡Co-first authors; †Co-second authors)

Kallay, L., Keskin, H., Ross, A., Rupji, M., Moody, O., Wang, X., Li, G., Ahmed, T., Rashid, F., Rajesh Stephen, M., Cottrill, K., Nuckols, T., **Xu, M.**, Martinson, D., Tranghese, F., Pei, Y., Cook, J., Kowalski, J., Taylor, M., Jenkins, A., Pomeranz Krummel, D., Sengupta, S. Modulating native GABAA receptors in medulloblastoma with positive allosteric benzodiazepine-derivatives induces cell death. Journal of Neuro-Oncology. 2019; 142(3):411-422. doi: 10.1007/s11060-019-03115-0

Pomeranz Krummel, D.‡, Tahseen, N.‡, Izar, B.†, **Xu, M.**†, Lowder, L., Press, R., Rupji, M., Kaluzova, M., Kallay, L., Burnham, A., Li, G., Ahmed, T., Chen, H., Curran, W., Kudchadkar, R., Olson, J., Schniederjan, M., Neill, S., Lawson, D., Cook, J., Weinberg, B., Jenkins, A., Kowalski, J., Khan, M., Sengupta, S. EXTH-12. Radiation enhances melanoma response to immunotherapy and synergizes with benzodiazepines to promote anti-tumor activity. Neuro-Oncology, 21(Supplement 6), November 2019, Page vi84, https://doi.org/10.1093/neuonc/noz175.346 (‡Co-first authors; †Co-second authors)

Kaluzova, M., Nasti, T., Chen, H-R., Lowder, L., Press, R., Rosen, H., Rupji, M., Kallay, L., Patel, R., Burnham, A., **Xu, M.**, Ross, A., Keskin, H., Connelly, E., Izar, B., Adamson, C., Olson, J., Su, J., Curran, W., Kudchadkar, R., Schniederjan, M., Neill, S., Lawson, D., Chan, M., Kowalski, J., Khan, M., Pomeranz

Krummel, D., Sengupta, S. Abstract 247: Identification of the GABAA receptor in melanoma brain metastases patient tumors and demonstration that it is a viable drug target using benzodiazepine-derivatives. In: Proceedings of the American Association for Cancer Research Annual Meeting 2019; 2019 Mar 29-Apr 3; Atlanta, GA. Philadelphia (PA): AACR; Cancer Res 2019;79(13 Suppl). https://doi.org/10.1158/1538-7445.AM2019-247

Kallay, L., Keskin, H., Ross, A., Rupji, M., Moody, O., Wang, X., Li, G., Ahmed, T., Rashid, F., Rajesh Stephen, M., Cottrill, K., N`uckols, A., **Xu, M.**, Martinson, D., Tranghese, F., Pei, Y., Cook, J., Kowalski, J., Taylor, M., Jenkins, A., Pomeranz Krummel, D., Sengupta, S. Abstract 2623: Modulating native GABAA receptors in medulloblastoma with positive allosteric benzodiazepine-derivatives induces cell death. Proceedings of the American Association for Cancer Research Annual Meeting 2019; 2019 Mar 29-Apr 3; Atlanta, GA. Philadelphia (PA): AACR; Cancer Res 2019;79(13 Suppl). https://doi.org/10.1158/1538-7445.AM2019-2623

Kowalski, J., Pomeranz Krummel, D., Rupji, M., Dwivedi, B., Keskin, H., Kallay, K., **Xu, M.**, Ross, A., Press, R., Rosen, H., Connelly, E., Patel, R., Izar, B., Adamson, C., Olson, J., Su, J., Kudchadkar, R., Schniederjan, M., Lowder, L., Neill, S., Curran, W., Lawson, D., Chan, M., Khan, M., Sengupta, S. COMP-22: Large scale transcriptomic analysis of melanoma brain metastases, Neuro-Oncology, Volume 20, Issue suppl_6, 1 November 2018, Page vi68, https://doi.org/10.1093/neuonc/noy148.277

Kowalski, J., Pomeranz Krummel, D., Rupji, M., Dwivedi, B., Keskin, H., Kallay, K., **Xu, M.**, Ross, A., Press, R., Rosen, H., Connelly, E., Patel, R., Izar, B., Adamson, C., Olson, J., Su, J., Kudchadkar, R., Schniederjan, M., Lowder, L., Neill, S., Curran, W., Lawson, D., Chan, M., Khan, M., Sengupta, S. CD131: Large scale transcriptomic analysis of melanoma brain metastases. Annals of Neurology 84(suppl 22), 2018.

Kallay, L., Keskin, H., Ross, A., Moody, O., Cottrill, K., Nuckols, A., Li, G., Ahmed, T., Rashid, F., Rajesh Stephen, M., **Xu, M.**, Martinson, D., Macdonald, T., Kowalski, J., Wang, X., Taylor, M., Cook, J., Jenkins, A., Pomeranz Krummel, D., Sengupta, S. PDTM-45: Positive modulation of native gabaa receptors in medulloblastoma cancer cells with benzodiazepines induces rapid mitochondrial fragmentation and tp53-dependent, cell cycle-independent apoptosis. Neuro-Oncology, Volume 20, Issue suppl_6, 1 November 2018, Page vi213, https://doi.org/10.1093/neuonc/noy148.884

FURTHER EXPERIENCE

Systems & Technology Research Boston, MA
Machine Learning Researcher Jan 2020 – Aug 2020

- Conducted machine learning research for identifying vulnerabilities in speech-processing programs with reinforcement learning and representation learning techniques.
- Worked on frontend UI and backend data retrieval, visualization, and unit testing

Medtronic plc New Haven, CT
Data Science Engineer Contractor May 2019 – Dec 2019

- Predicted lung cancer recurrence from tabular clinical data.
- Utilized survival analysis with Kaplan-Meier curve visualizations to identify cancer recurrence risk factors.

BioSwift Biomedical Engineering Design Team Baltimore, MD
Former Chief Executive Officer and Co-Founder Aug 2018 – Dec 2019

- Patent pending design of inhaler attachment to assist pediatric asthmatic patients
- Secured over $10,000 in funding, including from the Johns Hopkins Student Initiatives Fund
- Won 1st place in the 2019 ASAIOfyi Student Design Competition, 1st place at Fall 2019 Johns Hopkins FastForward U Spark Accelerator Competition, 3rd place at 2019 Johns Hopkins BPC
- Press release:
  - https://ventures.jhu.edu/news/bioswift-aquatas-fast-forward-u-accelerator-demo-days/
  - https://www.jhunewsletter.com/article/2019/11/fastforward-u-teams-innovate-with-new-and-old-technologies
  - https://www.facebook.com/JohnsHopkinsBME/photos/a.131397713949264/692413781180985/?type=3&theater

Modeling A Transferable Histopathological Image Analysis System Baltimore, MD
Personal Project Dec 2019

- Developed a deep clustering representation learning method for histopathology images

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- Won Intuitive Surgical Best Deep Learning Project Award ($800 cash prize)
- Press Release: https://www.cs.jhu.edu/2020/01/28/deep-learning-course-prepares-students-for-success-in-ai-careers/

Johns Hopkins Department of Computer Science Baltimore, MD
Data Structures Teaching Assistant Jan 2019 – Dec 2019

- Collaborated with team of faculty during weekly meetings and actively contributed to course content
- Worked with students to enhance student understanding of content such as heaps, AVL trees, hashmaps

Sengupta-Krummel Lab at the Emory Winship Cancer Institute Atlanta, GA
Cancer Genomics Bioinformatics Researcher May 2017 – Dec 2019

- Employed hierarchical clustering techniques for analysis of RNA-seq gene expression data
- Used DESeq2 method to identify differentially expressed genes followed by pathway analysis
- Conducted survival analysis with the Kaplan-Meier estimator and Cox PH Regression Model

Johns Hopkins Department of Applied Mathematics and Statistics Baltimore, MD
Probability and Statistics Teaching Assistant Jan 2019 – May 2019

- Nominated for Spring 2019 Teaching Award for demonstrating an extraordinary commitment to pedagogy

Johns Hopkins University PILOT Learning Program Baltimore, MD
Head PILOT Leader of Organic Chemistry Aug 2017 – May 2019

- Gave lectures to enhance student understanding of content, directed other PILOT leaders in their roles to teach students, and developed problem sets to be distributed among the entire program

Centers for Disease Control and Prevention Atlanta, GA
Outbreak Surveillance Biostatistics Intern May 2018 – Aug 2018

- Utilized whole genome multilocus sequence typing data to detect disease clusters
- Employed machine learning techniques to develop this disease cluster detection method for *Listeria monocytogenes*. Validated identified clusters with Simpson's Index of Diversity with PulseNet cluster codes and Chi-Squared ranked overlap between multi-dimensional independent hierarchical clustering