Harkirat Singh Arora

Ann Arbor, MI

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EDUCATION

Doctor of Philosophy, Biomedical Engineering 2026
University of Michigan, Ann Arbor, MI (expected)

Master of Science, Biomedical Engineering 2023
University of Michigan, Ann Arbor, MI

Bachelor of Technology, Chemical Engineering with minors in Computer Science 2021
Indian Institute of Technology Roorkee, Roorkee, India

RESEARCH EXPERIENCE

Graduate Student Research Assistant (Ph.D. Candidate) Ann Arbor, MI
Department of Biomedical Engineering, University of Michigan 08/2021 - Present
Ph.D. Advisor: Dr. Sriram Chandrasekaran

- Developed mechanistic metabolism-inspired Artificial neural network models to design drug combination therapies for E. coli and M. tuberculosis
- Advised the design of experimental work for the validation of computational predictions
- Simulating drug-protein interactions using deep learning models, aiming to predict potential toxicities in drug combination therapies and assist in designing safer therapeutics
- Working on a collaborative project to identify novel small molecule formulations using ML-based algorithms for preserving Cardiomyocytes homeostasis following Myocardial infarction

Undergraduate Research Assistant Roorkee, India
Department of Computer Science and Engineering, IIT Roorkee 12/2018 - 04/2021
Supervisor: Dr. Balasubramanian Raman

- Employed Radiomics for feature extraction and applied a range of feature selection methods in conjunction with Random Forest algorithms for accurate glioma classification
- Combined FAMD (Factor Analysis of Mixed Data) feature extraction with Random Forests and Support Vector Machines (SVMs) for the effective recognition of heart disease
- Conducted a comparative analysis of various normalization techniques and attention mechanisms to evaluate their influence on the performance of deep learning models for brain tumor segmentation

Undergraduate Research Assistant Roorkee, India
Department of Biotechnology, IIT Roorkee 10/2019 - 03/2021
Supervisor: Dr. Deepak Sharma

- Implemented various digital signal processing methods to determine the recurrence frequency of DNA sequence motifs
- Utilized a combination of sliding window analysis and comprehensive pattern search algorithms to pinpoint the positions of repeat sequences in DNA
- Contributed towards developing and maintaining web server application of the algorithm, https://compbio.iitr.ac.in/srf/

Dry Lab Member (Machine Learning) Remote
International Genetically Engineered Machine (iGEM), IIT Roorkee 04/2020 – 11/2020

- Participated in iGEM, the largest international synthetic biology contest, for students to address tangible problems through innovative biological solutions
- Implemented Random Forests to categorize *A. baumannii* strains based on their antibiotic resistance or susceptibility, utilizing their genomic profiles
- Employed Gini importance for model interpretation to discover the genomic factors of antibiotic resistance in *A. baumannii* strains
- Led a software development team in creating a web-based platform to precisely predict the secondary structure of newly engineered protein complexes

TEACHING EXPERIENCE

Graduate Student Instructor (GSI) Ann Arbor, MI
Department of Biomedical Engineering, College of Engineering, University of Michigan 01/2024 – 04/2024

- Served as GSI for BME 221 – Biophysical Chemistry and Thermodynamics, a fundamental undergraduate course in Biomedical Engineering, overseeing a class of 83 students
- Conducted weekly office hours, actively leading and orchestrating the efforts of a team of five Instructional Aides to enhance student learning and course efficiency
- Collaborated with the course instructor to design homework and exams, ensuring the meticulous grading of assignments and effective course administration

PROFESSIONAL ACTIVITIES

Consultant Ann Arbor, MI
miLEAD Consulting Group 10/2022 - Present

- Completed two consulting projects with miLEAD, a non-profit and student-run consulting group
- Executed a comprehensive market analysis and developed a pricing strategy for non-alcoholic fatty liver disease (NAFLD) treatments for a client aiming to penetrate the NAFLD therapeutics market
- Conducted detailed market research and analysis on existing diagnostic tests for ESKAPE pathogen infections and healthy aging, aiding a client's entry strategy into the diagnostic testing market
- Prepared and presented high-level summaries and results to clients via Zoom

Technical Lead Remote
NSF Innovation Corps™ Bay Area 06/2022 - 08/2022

- Applied the Lean LaunchPad Method and the Business Model Canvas to evaluate the commercial viability of in-house computational tools for drug combination therapy design
- Scheduled and conducted 100+ interviews with potential target customers
- Gained valuable perspective on the industrial drug discovery and development methods, leading to an enhanced PhD research proposal that targets critical deficiencies and gaps in existing methods

LEADERSHIP AND SERVICE EXPERIENCE

Member Ann Arbor, MI
DEI Subcommittee, BME Graduate Student Council, University of Michigan 01/2024 - Present

- Instrumental role in the ideation and development of "Celebrating Cultures," an event series dedicated to recognizing and appreciating the diverse cultural heritage, beliefs, and traditions within the department

- Successfully organized the inaugural event of this series, which highlighted and celebrated the distinct attributes of Chilean and Punjabi cultures, in April 2024

Project Member Ann Arbor, MI
Inclusive Teaching in BME (IT-BME) 05/2023 - 08/2023

- Joined the IT-BME initiative with a mission to create an inclusive teaching framework that promotes diversity within the Biomedical Engineering Department's classroom settings
- Developed a pre-course survey to assess student needs, implemented strategies for productive peer discussions, and crafted case studies that highlight the scientific contributions of underrepresented minority researchers
- Pioneered the integration of reflective questions in classroom evaluations, introduced exam wrappers, and refined the process for managing assignment extensions and regrading requests using semi-automated tools

Graduate Team Leader Ann Arbor, MI
Tau Beta Pi – Michigan Gamma (The Engineering Honor Society) 08/2022 - Present

- Facilitated the orientation and onboarding of new candidates and electees into the chapter's operations
- As the Graduate Students Activities Chair successfully coordinated five events aimed at fostering graduate student engagement within the chapter during the Fall of 2023
- Contributed as a volunteer to various initiatives, including Mindset and Cub Scouts Day, delivering educational and enrichment activities to nearly 50 middle school students
- Played a key role as a member of the judging panel for the College of Engineering's Distinguished Leadership Award for the 2022-23 academic year, selecting 12 awardees from a pool of ~50 nominees

General Secretary (President) Roorkee, India
National Service Scheme (NSS), IIT Roorkee 08/2017 - 06/2021

- NSS is a student-led organization committed to community service, with established chapters across numerous educational institutions in India
- Steered the NSS chapter at IIT Roorkee, orchestrating a variety of socially-driven projects by integrating technological advances with innovative approaches
- Coordinated over 100 social events, which included health check-up camps and clothing and food distribution drives, aimed at assisting impoverished and disadvantaged communities

SKILLS

- **Programming Languages:** Python, R, MATLAB
- **Libraries:** Keras, Scikit-learn, Numpy, Pandas, Matplotlib
- **Tools:** Spyder, Jupyter, RStudio
- **Languages:** Punjabi (conversational), Hindi (conversational)

CERTIFICATES, AWARDS, SCHOLARSHIPS AND RECOGNITIONS

Certificates

- Biotech Career Development Program (BCDP), University of Michigan 2024
- Great Lakes I-corps Course (Software & AI Jumpstart) 2024
- Inclusive Stem Teaching Project 2023
- NSF I-corps National Teams Program (Bay Area) 2022

Awards

- Poster award for "Most Likely to Make an Impact in Society": U-M MIDAS Symposium 2023
- Best Overall Poster: U-M MIDAS Symposium 2022
- Kedar Nath Agarwala I.S.E. Memorial Trophy, IIT Roorkee 2021
- Gold Medal, iGEM 2020

Scholarships

- Betz Family Doctoral Fellowship Fund in Biomedical Engineering 2021
- Merit cum Means scholarship, IIT Roorkee 2018-21

Recognitions

- Nominated by the University of Michigan for the Google PhD Fellowship 2024
- Recognized as Team with Exceptional Final Video and Presentation in NSF I-corps program 2023
- Nominated by the University of Michigan for the Apple Scholars in AI/ML PhD Fellowship 2023

RESEARCH POSTERS AND PRESENTATIONS

- Intelligent Systems for Molecular Biology (Conference) - Montreal, Canada 2024
- ASM Microbe (Conference) - Atlanta, GA 2024
- U-M BME Annual Symposium 2022, '23, '24
- U-M DATA (NSF IUCRC) Industry Advisory Board Meeting 2023, '24
- U-M MIDAS Symposium 2022, '23
- iGEM Global Meetup – Workshop speaker 2020

PUBLICATIONS

- **Arora, H.S.**, Lev, K., & Chandrasekaran, S. (*manuscript in-preparation*). Metabolism-inspired Mechanistic Deep Learning for Uncovering Mechanisms of Action Governing Antibiotic Resistance.
- Sambarey, A. Smith, K., Chung, C., **Arora, H.S.**, Yang, Z., Agarwal, P., & Chandrasekaran, S. (2024) Integrative analysis of clinical health records, imaging and pathogen genomics identifies personalized predictors of disease prognosis in tuberculosis. *iScience* 27(2), 109025. https://doi.org/10.1016/j.isci.2024.109025
- Kumar, R., Gupta, A., **Arora, H.S.** & Raman, B. (2022) CBSN: Comparative measures of normalization techniques for brain tumor segmentation using SRCNet. *Multimedia Tools and Applications 81*, 13203–13235. https://doi.org/10.1007/s11042-021-10565-0
- Gupta, A., Kumar, R., **Arora, H.S.** & Raman, B. (2022) C-CADZ: computational intelligence system for coronary artery disease detection using Z-Alizadeh Sani dataset. *Applied Intelligence, 52*, 2436–2464. https://doi.org/10.1007/s10489-021-02467-3
- Kumar, R., Gupta, A., **Arora, H.S.** & Raman, B. (2022) IBRDM: An Intelligent Framework for Brain Tumor Classification Using Radiomics- and DWT-based Fusion of MRI Sequences. *ACM Transactions on Internet Technology 22*(1) Article 9, 1-30. https://doi.org/10.1145/3434775
- Gupta A., **Arora, H.S.**, Kumar, R. & Raman, B. (2021) DMHZ: A Decision Support System Based on Machine Computational Design for Heart Disease Diagnosis Using Z-Alizadeh Sani Dataset. *2021 International Conference on Information Networking (ICOIN), Jeju Island, Korea (South)*. pp. 818-823, https://doi.org/10.1109/ICOIN50884.2021.9333884
- Kumar, R., Gupta, A., **Arora, H.S.** & Raman, B. (2021) GRGE: Detection of Gliomas Using Radiomics, GA Features and Extremely Randomized Trees. *2021 International Conference on Information Networking (ICOIN), Jeju Island, Korea (South)*. pp. 379-384,

https://doi.org/10.1109/ICOIN50884.2021.9334021

- Kumar, R., Gupta, A., **Arora, H.S.**, Pandian, G.N. & Raman, B. (2020) CGHF: A Computational Decision Support System for Glioma Classification Using Hybrid Radiomics- and Stationary Wavelet-Based Features. *IEEE Access 8*, 79440-79458. https://doi.org/10.1109/ACCESS.2020.2989193
- Banerjee, S., **Arora, H.S.**, & Mitra, S. (2020) Ensemble of CNNs for segmentation of glioma sub-regions with survival prediction. In: Crimi, A., Bakas, S. (eds) Brainlesion: Glioma, Multiple Sclerosis, Stroke and Traumatic Brain Injuries. BrainLes 2019. Lecture Notes in Computer Science, Vol 11993. Springer, Cham. https://doi.org/10.1007/978-3-030-46643-5_4
- Gupta, A., Kumar, R., **Arora, H.S.** & Raman, B. (2020) MIFH: A Machine Intelligence Framework for Heart Disease Diagnosis. *IEEE Access 8*, 14659-14674. https://doi.org/10.1109/ACCESS.2019.2962755