Shabnam Sahay

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EDUCATION

Princeton University *2024–Present*
Doctor of Philosophy in Quantitative and Computational Biology

Indian Institute of Technology Bombay *2019–23*
Bachelor of Technology (Honors) in Computer Science & Engineering | CGPA: 9.22/10
Minor in Biosciences and Bioengineering | CGPA: 9.80/10
Thesis: *Probabilistic Edge Tuning of Boolean Networks to Influence Cell Fate Distributions*

PUBLICATION(S)

- **Sahay S**, Adhikari S, Hormoz S, Chakrabarti S. *An improved rhythmicity analysis method using Gaussian Processes detects cell-density dependent circadian oscillations in stem cells*. In: *Bioinformatics, Volume 39, Issue 10, October 2023*. doi: 10.1093/bioinformatics/btad602.

POSTERS

- Sherekar S, **Sahay S**, Viswanathan G. *Edge-tuning improves TNFα mediated cell-death during at ensemble-level TNFR1 signaling*. Presented by first author at: Workshop on Systems Biology Approaches to Understand Complex Cellular Dynamics, IIT Bombay, Mumbai, India; Feb 1-2 2024.
- **Sahay S**, Adhikari S, Hormoz S, Chakrabarti S. *Detecting circadian oscillations in lineage trajectories with Gaussian Processes*. Presented at: Simons Symposium - Cellular Lineages & Development, Alleppey, Kerala, India; Nov 1-4 2022.
- **Sahay S**, Wong BS, Li R. *Effects of chronic hypo-osmotic stress on the growth and cell cycle of Nalm6 cells*. Presented at: MUST Programme Poster Session, Mechanobiology Institute, National University of Singapore, Singapore; Jul 29 2022.

SCHOLARSHIPS

- MUST Programme Fellowship, Mechanobiology Institute, National University of Singapore *2022*
- Engineering Vacation Research Internship Scholarship, University of Sydney *2022*
- Matter To Life URO Fellowship, Max Planck Inst. for Medical Research (declined due to Covid) *2021*
- Aditya Birla Scholarship, Aditya Birla Foundation (**top 16** engineering students across India) *2019*
- Desai-Sethi Family Scholarship, IITB Alumni Assn. (**1st**-ranked female across India in JEE-Adv) *2019*

RESEARCH EXPERIENCE

Probabilistic Edge Tuning of Boolean Networks to Influence Cell Fate *2023*
Guide: Prof. Ganesh Viswanathan, Biomolecular Engineering Lab, IIT Bombay
- Modelling stochastic cancer signalling networks in a boolean framework with random asynchronous updates
- Manipulating steady state properties (corresponding to distribution of cell fates) via probabilistic edge tuning
- Verifying experimental edge-tuning outcomes and identifying biological entities key to influencing phenotype

Estimating the Dynamics of Large Boolean Networks *2022*
Guide: Prof. Ganesh Viswanathan, Biomolceular Engineering Lab, IIT Bombay
- Constructed partial state-transition graphs with minimal permutations recapitulating true network dynamics
- Derived minimal state spaces capable of reproducing true network flow and attractor absorption probabilities
- Utilised influence maximisation to identify minimal node sets driving the network towards specified attractors
- Evaluated derived approximations and mean-field estimates of network dynamics with suitable error metrics

Agent-Based Modelling of Cellular Proliferation and Movement Dynamics *2023*
Guide: Prof. Sandip Kar, Theoretical Systems Biology Lab, IIT Bombay
- Modelled heterogeneous single cells as hexagonal lattice agents having contact-based migration propensities
- Analysed corresponding experimental time-lapse microscopy data to extract information for model validation
- Performed statistical analyses to correlate cell cycle phase with cell velocity under varying culture conditions

Effects of Chronic Hypo-Osmotic Stress (CHS) on Suspension Cells *2022*

MUST Programme | Guides: Dr. Bin Shen Wong & Prof. Rong Li, Mechanobiology Institute, NUS

- Compared the effects of CHS on cell cycle and growth in suspension (Nalm6) cells and adherent (RPE) cells
- Characterised variations in population growth and viability through cell counting and time-lapse microscopy
- Performed western blotting independently with positive controls to quantify upregulation in p53 expression
- Identified significant increase in cell cycle arrest of RPE cells relative to Nalm6 cells under CHS via FACS

Detecting Oscillations in Biological Data with Gaussian Processes *2021-22*

Guide: Prof. Shaon Chakrabarti, Simons Centre, National Centre for Biological Sciences

- Developed an R package combining GP regression with Bayesian model selection to detect noisy oscillations
- Identified and adapted gaussian process kernels best-suited for capturing non-stationary oscillatory patterns
- Evaluated performance against existing methods on exhaustive simulated datasets through ROC curves

EMPLOYMENT

Software Engineer | *Azure Networking Team, Microsoft IDC India* *Aug '23 - Aug '24*

- Worked on real-time buildout and maintenance activities of regional network infrastructure in Azure cloud
- Automated validation of service fabric upgrade operations, reducing required manual contribution by >50%
- Augmented and verified deconstruction of service buildout workflows to increase efficiency via parallelization

Research Trainee | *Goloborodko Lab, Institute of Molecular Biotechnology, Vienna* *May '23 - Aug '23*

- Implemented the Dissipative Particle Dynamics thermostat in Python for simulation of 3D genome dynamics
- Optimised performance with vectorised operations and integrated code into the existing public Jax codebase
- Incorporated the novel ABOBA integration scheme and validated thermodynamic accuracy across systems

Software Engineer Intern | *Azure Networking Team, Microsoft IDC India* *May '22 - Jun '22*

- Built a predictive maintenance model for link flaps, integrating device metrics and link configuration data
- Designed custom features to enable forecasting and evaluated multiple classifiers for maximal f1-scores
- Deployed the optimised model as a web-service for real-time flap prediction, achieving $\geq 70\%$ accuracy

TEACHING AND MENTORING EXPERIENCE

Undergraduate Teaching Assistant | *IIT Bombay* *Apr '21 - Feb '23*

- Mathematical Foundations of AI & ML (NCM-CEP) | Spring 2023 | Instructor: Prof. S. Kalyanakrishnan
- Computer Systems Bootcamp | Summer 2022 | Instructors: Prof. Mythili Vutukuru and Prof. P. Kulkarni
- PH 107 - Quantum Physics and its Applications | Autumn 2021 | Instructor: Prof. Shankaranarayanan S.
- BB 101 - Biology | Spring 2021 | Instructors: Prof. Ambarish Kunwar and Prof. Neeta Kanekar

Designed and verified coding assignments, conducted tutorials and help sessions, and graded examinations

Department Academic Mentor | *Student Mentorship Program, IIT Bombay* *Jun '21 - Mar '22*

- Selected out of 70+ applicants through a rigorous procedure based on interviews and strong peer reviews
- Aided 7 sophomores with curriculum-planning and balancing their academic and extracurricular endeavours

ACADEMIC ACHIEVEMENTS

- Achieved **All India Rank 10** among over 240,000 aspirants in the JEE Advanced *2019*
- Attained the **Highest Mark in India** in A-Level Physics in March-June Cambridge Examinations *2019*
- Secured **3rd Place in India** for Best Across 3 A-Levels in March-June Cambridge Examinations *2019*
- Achieved All India Rank 256 in the KVPY Fellowship Examination conducted by IISc Bangalore *2018*

EXTRACURRICULAR ACTIVITIES

- Trained for 9 years and completed **Arangetram** (graduation) in the classical dance Bharatanatyam *2015*
- Awarded **1st Position** in Solo Classical and Folk Dance competition held for all freshmen at IITB *2019*
- Choreographed & performed classical dance in IITB's Annual Dance Show for a 2000+ audience *2023*
- Member of the IITB contingent securing **1st Position** in Scrabble at the **Inter-IIT** Cultural Meet *2023*
- Secured 2nd runner-up position in IITB's Word Games General Championship among 50+ teams *2023*
- Represented IITB at the inaugural internationally rated and WESPA certified IITB Scrabble Open *2022*
- Secured 2nd runner-up position in the IITB Institute Scrabble League among 80+ participants *2021*