

# Shabnam Sahay

Trainee, IMBA, Vienna BioCenter

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shabnamsahay.github.io

## RESEARCH INTERESTS

Computational and Systems Biology, Biological Networks, Cell Cycle, Chromatin Organization

## EDUCATION

### Indian Institute of Technology Bombay

2019-23

Bachelor of Technology (Honors) in Computer Science and Engineering | GPA: 9.16/10

Minor in Biosciences and Bioengineering | GPA: 9.80/10

## PREPRINTS/PUBLICATIONS

- **S. Sahay**, S. Adhikari, S. Hormoz, S. Chakrabarti. "An improved rhythmicity analysis method using Gaussian Processes detects cell-density dependent circadian oscillations in stem cells." [bioRxiv 2023.03.21.533651](https://doi.org/10.1101/2023.03.21.533651)

## RESEARCH EXPERIENCE

### Estimating the Dynamics of Large Boolean Networks

Ongoing

Undergraduate Thesis | Guide: [Prof. Ganesh Viswanathan](#), IIT Bombay

- Incorporating random asynchronous update schemes to reflect the stochastic nature of biological networks
- Constructing partial state-transition graphs with minimal permutations recapitulating true network dynamics
- Manipulating steady state properties of the network (corresponding to cell fate) via probabilistic edge tuning

### Agent-Based Modelling of Cellular Proliferation and Movement Dynamics

Ongoing

In-Semester Undergraduate Research Programme | Guide: [Prof. Sandip Kar](#), IIT Bombay

- Modelling heterogeneous single cells as hexagonal lattice agents having contact-based migration propensities
- Analysing corresponding experimental time-lapse microscopy data to extract information for model validation
- Inferring the interplay between cell cycle phase duration and movement 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](#), MBI, 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 experimental data and exhaustive simulated datasets

## WORK EXPERIENCE

### Software Engineering Intern | Hyperscale Networking Team, Microsoft RnD India

2022

- Built a predictive maintenance model for optical link flaps with 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 predictions of flaps achieving  $\geq 70\%$  accuracy

### Engineering Research Intern | Applied and Plasma Physics Lab, University of Sydney

2022

- Built, tested, and refined a deformable mesh model in C++ to simulate the rolling-adhesion of leukocytes
- Utilised a variable mesh to enable design of DNA origami nanorobots that can act as synthetic leukocytes

### Undergraduate Teaching Assistant | IIT Bombay

2021-23

- Courses: Biology, Quantum Physics, Computer Systems Bootcamp, Mathematical Foundations of AI & ML
- Designed and verified problem statements, conducted tutorials and help sessions, and graded examinations

## ACADEMIC ACHIEVEMENTS

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- 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
- Scored 120/120 in TOEFL iBT, and 170/170 (Quantitative) + 164/170 (Verbal) in GRE General 2022
- Awarded the AP grade for exceptional performance (**top 8** out of 295) in Environmental Studies 2022
- Achieved All India Rank 256 in the KVPY Fellowship Examination conducted by IISc Bangalore 2018

## SCHOLARSHIPS

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- Awarded the **MUST Programme** Fellowship by the National University of Singapore 2022
- Received the **Engineering Vacation Research Scholarship** from the University of Sydney 2022
- Offered the **MtL-URO** Fellowship by the Max Planck Institute for Medical Research 2021
- Awarded the prestigious **Aditya Birla Scholarship** (**top 16** engineering students across India) 2019
- Received the Desai-Sethi Family Scholarship for ranking **1st** among all females in JEE Advanced 2019

## WORKSHOPS AND CONFERENCES

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- Attended the IIT Delhi Theoretical Computer Science Winter School as one of 40 selected students 2022
- Presented a poster at the Simons Symposium: Cellular Lineages & Development, Alleppey, India 2022
- Presented a poster at the MBI MUST Programme Poster Session, National University of Singapore 2022

## TECHNICAL PROJECTS

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**Generating 3D Chromatin Configurations** | Guide: *Prof. Ranjith Padinhateeri, IIT Bombay* 2022

- Constructed 3D SBS polymer ensembles modelling chromatin loci corresponding to experimental Hi-C input
- Implemented Simulated Annealing Monte Carlo optimization to derive the model best describing the input

**Compiler for a C-Like Language** | *CS316: Implementation of Programming Languages Lab* 2022

- Built a compiler to generate Abstract Syntax Tree, Three Address Code, and Register Transfer Language
- Integrated support for arithmetic and relational expressions, control flow statements, and function usage
- Implemented the scanner in lex, parser in yacc and constructed an object-oriented AST representation
- Developed an efficient procedure for conversion from AST to RTL through appropriate register allocation

**Anti Tic-Tac-Toe** | *CS747: Fundamentals of Intelligent and Learning Agents* 2021

- Encoded Tic-Tac-Toe with the winning conditions reversed into a Markov Decision Process for each player
- Derived each player's optimal MDP policy utilising Howard's Policy Iteration given a fixed opponent policy
- Implemented an iterative reward-maximisation algorithm to compute the best possible policy for both players

## KEY COURSEWORK

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**Computer Science:** Data Structures, Design & Analysis of Algorithms, Geometric Algorithms, Logic for Computer Science, Automata Theory, Implementation of Programming Languages, Data Analysis & Interpretation

**Biology:** Cell and Molecular Biology, Metabolism and Bioenergetics, Immunology, Biochemistry, Molecular Biophysics, Topics in Evolution, Bioinformatics, Quantitative Biology Workshop (MITx on edX)

## TECHNICAL SKILLS

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**Programming:** C++, C, Python, Perl, Java, R, Bash, Awk, Numpy, Scipy, Matplotlib, SQL, Pandas

**Software:** L<sup>A</sup>T<sub>E</sub>X, Git, MATLAB, PyMOL, BLAST, LAMMPS, ImageJ, Doxygen, Beamer

## EXTRACURRICULAR ACTIVITIES

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- Trained for 9+ years and completed **Arangetram** (graduation) in the classical dance Bharatanatyam 2015
- Awarded **1st Position** among all freshmen at IITB in the Solo Classical and Folk Dance competition 2019
- Choreographed and performed classical dance in IITB's Annual Dance Show for a 2000+ audience 2023
- Member of the IITB contingent securing **runner-up** position in the **Inter-IIT** Scrabble League 2021
- Secured **2nd runner-up** position in IITB's Institute Scrabble League among 80+ participants 2021