Falak Pabari

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EDUCATION

Brown University *Comp Sci-Applied Math (ScB, **Honors**)*, 3.9/4.0 GPA Providence, RI | Expected Graduation: May 2026
Relevant Courses**:** Inference in Genomics & Molecular Bio, Computational Molecular Biology, Advanced Algs in Computational Biology, DL in Genomics, Foundations of ML, Statistical Inference, Quantitative Models of Biological Systems, ODEs, PDEs, Linear & Computational Linear Algebra, Probability, Optimization & Stochastic Calculus, Quantum Probability & Logic, Theory of Computation, Foundations in ML, Computational Linear Algebra, Computer Vision

Aquincum Institute of Technology, *Semester Abroad* 4.0/4.0 GPA Budapest, Hungary | January - May 2024

AWARDS

Undergraduate Teaching and Research Award ×2; Problem Solving Fellowship ×4; RAB Travel Grant (scverse conference, 2025)

RESEARCH EXPERIENCE

Singh Lab, *Undergraduate Research Assistant, Brown University* Providence, RI | May 2025 - Present

- Built large-scale pipelines for analyzing DNA methylation across ~473k CpG sites; extracted 23-dimensional CpG trajectory features (binned means, slope, curvature, amplitude) and showed |slope| strongly predicts age association (corr ≈ 0.62).
- Identified three dominant aging trajectory families consistent with epigenetic clock patterns (strongest CpGs r ≈ 0.67); benchmarking trajectory taxonomy against SNITCH (GAM-based nonlinear clustering).
- Developed and compared three deep learning models, vanilla VAE, contrastive encoder, and VAE + contrastive hybrid
- Earlier contrastive learning work revealed a hierarchy in methylation variation (ancestry > sex > age), clarifying why epigenetic age prediction requires strong supervision.
- Continuing through deep generative models for disentangling biological and technical variation in genomics.

Y. Ma Lab, *Undergraduate Research Assistant, Brown University* Providence, RI | July 2025 - Present

- Benchmarked ContrastiveVI across four large Perturb-seq screens (>109k cells), achieving improvement in perturbation recovery over baselines and up to 85% pathway classification accuracy using a unified multi-scale evaluation framework.
- Developed a perturbation-quality evaluation pipeline across 300+ perturbations, introducing metrics for escape rates, signature strength, and embedding compactness.
- Designed a dual-encoder VAE integrating adversarial regularization, Wasserstein-based escape modeling, HSIC disentanglement, Gaussian NLL reconstruction loss, and uncertainty-aware classification; achieved 98.6% classification accuracy, identified 11 escape candidates, and surfaced CEBPE among top salient gene loadings.

Humans to Robots Lab, *Undergraduate Research Assistant, Brown University* Providence, RI | May 2023 - July 2024

- Co-author, *Find It Like a Dog* (CogSci 2024): gesture-guided object search on Boston Dynamics Spot; achieved 83% accuracy.
- Designed evaluation using Euclidean distance, weighted accuracy, and perplexity on 6 human-dog pairs (72 trials).

PUBLICATIONS & MANUSCRIPTS

Contrastive Disentanglement of Methylation Variation Reveals Population-Structured Aging Trajectories Expected 2026
*(**Pabari F.**, Singh R.)*
Poster presented at scverse Conference (Stanford, 2025), and Broad ML for Drug Discovery Symposium

Uncertainty-Aware Detection of Perturbation Escapees in Large-Scale CRISPR Screens Expected 2026
*(**Pabari F.**, Lee J., Ma Y.; Chang S.)*
Manuscript in Preparation; Poster and oral presentation at the UTRA Research Symposium (2025)

Deep Learning Models for Robust Latent Structure in Single-Cell and Methylation Data April 2026
(***Pabari F.**, Advised by Singh R.*); Undergraduate Honors Thesis

Find It Like a Dog: Using Gesture to Improve Robot Object Search July 2024
*(He I., Pelgrim M., Lee K., **Pabari F.**, Buchsbaum D., Tellex S., Nguyen T.)*
Proceedings of the Cognitive Science Society (CogSci, 2024)
Presented at Robotics: Science and Systems (RSS 2024), Delft, Netherlands

TEACHING EXPERIENCE

Head TA - Machine Learning for Health (CSCI 1851) Providence, RI | October 2025 - Present

- Co-designed Spring 2026 curriculum with Prof. Singh: interactive homeworks on VAEs for single-cell, R-GCNs for drug-disease networks, and CNNs for medical imaging.
- Built the website, reproducible pipelines, autograders, CI workflows, and debugging scaffolds; validated all assignments for smooth semester execution.

Teaching Assistant - Brown University (Providence, RI)

- **DATA 1050: Data Engineering (Sep 2025 - Present):** Helped with data retrieval/management at scale, indexing, SQL, and OLTP/OLAP systems; guided students in query optimization and large-scale data workflows.

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- **MATH 0200: Multivariable Calculus (Sep - Dec 2024):** Ran weekly problem-solving sessions on gradients, curl, and multiple integrals; graded weekly homework for 100+ students with clear, constructive feedback.
- **CSCI 0200: Program Design & Data Structures (Sep - Dec 2023):** Socially Responsible TA integrating ethics, stakeholder analysis, and case studies into technical problem sets.

PROJECTS

SKIWI, *Co-founder* (www.skiwi.ai) Providence, RI | March 2025 - Present

- Built and deployed an AI dermatology web app (React/Node + Python/FastAPI CV services) for photo, lesion detection, ingredient-grounded guidance
- Shipped working demo to 30 pilot users and launched a 500+ waitlist.

Vera, Course Final Project Providence, RI | March 2026 - Present

- Developing a burn and wound classification app using fine-tuned EfficientNet/ConvNeXt classifiers and U-Net/DeepLabV3+ segmentation across four public wound datasets; includes longitudinal wound-area tracking, Grad-CAM saliency visualization, and per-Fitzpatrick-skin-type bias evaluation.

Atlas, Course Final Project (https://atlas-lime-eight.vercel.app/) Providence, RI | March 2026 - Present

- Full-stack web app that fetches real-time global news via GDELT, clusters it geographically, and renders a summarized interactive world map of interconnected geopolitical events with causal edge analysis.

Connect2, Project (https://connect2-beta.vercel.app/waitlist) Providence, RI | Oct 2025 - Present

- Two-sided marketplace (React/Node/Firebase); authentication, permissions, waitlist funnel, cloud deployment.

SafeTravels, Course Final Project Budapest, Hungary | Feb 2024 - Dec 2024

- Geospatial safety aggregation across 65k+ cities; Java/Spark backend with multi-API integration.

Advanced Predictive Analytics for RWQA in Kenya, *Data Scientist* Remote | May - Sept 2024

- Built ML models for remote water-quality assessment with an international team; led data collection/processing/modeling and assisted deployment for near-real-time assessments.

GeneExpress, ML for Gene Expression Modeling, Course Final Project Providence RI | Sept - Dec 2024

- Developed a neural architecture for predicting transcriptional profiles from sequence features; implemented model training pipelines, evaluation metrics, and ablation studies.

Schizophrenia GWAS Analysis, Course Final Project Providence RI | Feb 2025 - May 2025

- Implemented QC, association testing, and population stratification correction on large-scale genotype data.

SERVICE & LEADERSHIP

APMA Connect Program Providence, RI | Sept 2025 - Present

- Interviewed AMCS concentrators about advising clarity, faculty support, and departmental experience.
- Synthesized findings and presented recommendations to Applied Math leadership.

Problem Solving Fellows (PSF), *Fellow* Providence, RI | Sept 2024 - Present

- Co-developed intro STEM/math student experience survey; contributed to question design and piloting.
- Designed Study Abroad Preparation & Return workshop and contributed to PSF website.
- Participated in weekly pedagogy and curriculum meetings (TILT frameworks, qualitative methods).

Undergraduate Council of Students (UCS), *Outreach Committee & Treasurer* Providence, RI | Sept 2022 - May 2024

- Planned large-scale engagement events; coordinated student–administrator communication.
- Managed budgeting and financial oversight as Treasurer for the following semester.

SKILLS & INTERESTS

Languages: Python, R, MATLAB, Java, C, C++

ML/Scientific Computing: PyTorch, NumPy/Pandas, JAX, Bioconductor/DESeq2

Single-cell/Genomics: AnnData/Scanpy, scvi-tools, scikit-image/napari, pysam/htslib (basic), bedtools (basic)

Methods: VAE/CVAE/Contrastive learning, generative modeling, clustering, dimensionality reduction, calibration/uncertainty, large-scale genomic data integration

Pipelines & Repro: Snakemake, Conda/mamba, SLURM, GitHub Actions, pytest, DVC, WDL/Cromwell, Terra (familiar)

Data: Arrow/Parquet, HDF5/Zarr, memory-mapped shards; AWS/GCP basics (S3/GS)

Systems & Deployment: REST APIs, FastAPI, Node.js, Express, MongoDB, Firebase, Git/GitHub, Vercel/Render, Docker (basic)

Frontend (Product): React, TypeScript, HTML/CSS, UI state management, API integration, user analytics (basic)

Familiarity: Spatial transcriptomics (Visium/Slide-seq data structures), long-read basics (BAM/CRAM), lineage-tracing schema, microscopy image handling (OME-TIFF, napari)