Mohit Joshi

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Research Interests: Consciousness In Language Models, Non-Rewardable Reinforcement Learning, Uncertainty-aware language models, Scientific Computing and Computer Vision

Education

Institute of Advanced Research *Jul 2022 – Jun 2026 (anticipated)*
B.Tech. in Biotechnology
CGPA: 8.2/10.0 | Top 10% of class

Indian Institute of Technology Bombay *Jan 2026 – Jun 2026*
Semester Exchange Researcher, Koita Centre for Digital Health, Department of CSE | ***Thesis*** | ***Slides***
Coursework: Computer Vision (medical imaging for MRI and CT) and Biophysics
Advisor: Dr. Kshitij Jadhav

Poster Presentations

- **Enhancer Hijacking in Medulloblastoma**. CME Immunology, Institute of Advanced Research, Feb 2025. **Best Poster Presenter Award.**
- **Dairy Wastewater Treatment Research Project**. Annual Research and Innovation Conclave (ARIC), Institute of Advanced Research, Mar 2024. **Best Poster Presenter Award.**

Honors & Awards

- IITB Research Internship Awards 2025–26: selected for an exchange semester at IIT Bombay from a pool of 3,000 candidates.
- Project funding: secured INR 100,000 for data-driven innovation projects (2022–2024) for Bubble Labs and Curiosy.
- Hackathon winner: 3rd place in Solutions for Healthcare Challenges (Gujarat Government Statewide Hackathon, 2024).

Research Appointments

Visiting Researcher (Collaboration), University of California San Francisco (UCSF) *Apr 2026 – Present*
Advisor: Dr. Vivek Rudrapatna | Department of Medicine

Visiting Researcher (Internship), IIT Bombay (IITB) *Aug 2025 – Present*
Advisor: Dr. Kshitij Jadhav | Koita Centre for Digital Health, Department of CSE

Visiting Researcher (Internship), IIT Jodhpur (IITJ) *May 2025 – Jun 2025*
Advisor: Dr. Sucharita Dey | Biosciences and Bioengineering Department

Research Projects

Drug Repurposing and EHR Environment Emulation (ongoing) *Apr 2025 – Present*
Advisor: Dr. Vivek Rudrapatna | Department of Medicine, UCSF
Theme: Offline RL & Causal Inference

- Modeling Markov decision processes over EHR data with latent state representations to address sparsity, including methods such as Q-value gradients.
- Building an offline RL emulation framework to evaluate drug-repurposing candidates using public resources, including LINCS L1000.

Acute Ischemic Stroke Prognostication (ongoing; patent anticipated) *Jan 2025 – Present*
Advisor: Dr. Kshitij Jadhav | Koita Centre for Digital Health, IIT Bombay | ***Project Page***
Theme: Computer Vision and novel loss design

- Designed a multimodal medical imaging model using CT, CTA, DWI/ADC, and FLAIR for stroke lesion segmentation and outcome prediction, integrating volumetric features, vascular topology, and clinical variables in a U-Net-based architecture.
- Developed a novel "Size Penalty Loss" to enforce lesion-scale priors, improving convergence stability and enabling finer-grained infarct segmentation in low-signal, small-lesion settings.
- Building an end-to-end framework combining 3D segmentation, vessel-level occlusion modeling, and state-space learning to estimate clot burden and predict 90-day outcomes (mRS) within < 24h of admission.

Uncertainty-Aware Medical Reasoning in Language Models *Aug 2025 – Dec 2025*
Advisor: Dr. Kshitij Jadhav | Koita Centre for Digital Health, IIT Bombay
Theme: Uncertainty quantification in language models

- Developed a Bayesian region-detection model combining Monte Carlo Dropout for epistemic uncertainty with direct prediction of aleatoric variance, enabling robust, uncertainty-aware X-ray report generation.
- Implemented a Gaussian negative log-likelihood objective that predicts bounding-box coordinates together with their inherent standard deviation (σ), allowing the system to flag spatially ambiguous anatomical regions for review.
- Developed an uncertainty-aware gating mechanism that suppresses auto-generated sentences for low-confidence regions and prioritizes radiologist review using a risk-based queue.

Mechanistic Deep Learning for Predicting Neurodegenerative Disease Progression *Aug 2025 – Dec 2025*

Advisor: Dr. Kshitij Jadhav | *Koita Centre for Digital Health, IIT Bombay*
Themes: Physics-informed neural networks (PINNs) | *RL in systems biology*

- Developed a parameter-efficient, BLIP-2-inspired architecture that interfaces frozen foundation models (Swin-UNETR for 3D MRI and scGPT for omics) with trainable Q-Formers to distill high-dimensional ADNI data into compact latent representations.
- Explored Amyloid-beta and Tau pathologies as a multi-agent biological game, using cross-modal attention to identify mechanistic drivers of disease progression and improve interpretability.
- Prototyped a continuous-time forecasting head using neural ODE/SDE formulations, with adversarial training via the Gillespie algorithm to generate more realistic patient-state trajectories.

Protein–DNA Affinity Interface Tool *May 2025 – Jun 2025*

Advisor: Dr. Sucharita Dey | *Biosciences & Bioengineering Department, IIT Jodhpur* | ***Code*** | ***Report***

- Developed an automated protein–DNA interface analysis pipeline in Snakemake to process multichain PDB files, integrating Python, Fortran, and shell scripts with Naccess, HBPLUS, and FreeSASA for comprehensive aggregation.
- Containerized the workflow with Docker, reducing setup time by over 90% while improving reproducibility and deployment for researchers.
- Conducted under the supervision of Dr. Sucharita Dey and submitted a detailed report covering objectives, protocol, and findings.

Immune Signature Analysis in Post-Acute COVID-19 Lung Sequelae *Jan 2025 – Apr 2025*

Self-supervised | ***[code]***

- Engineered a scalable scRNA-seq pipeline in R (Seurat and SCTransform) to analyze post-COVID lung T cells, identifying a persistent pro-inflammatory signature marked by IL32, CCL5, CD8A, and NKG7 in convalescent patients.
- Revealed drivers of post-acute immune dysregulation through Reactome and DAVID pathway analysis, highlighting sustained T-cell cytotoxicity and interferon-gamma signaling.
- Proposed an ordinary differential equation model to translate static gene signatures into a dynamic hypothesis of post-acute lung damage, creating a reproducible framework for therapeutic exploration.

Technical Skills

- **Machine learning:** Computer Vision, Fine Tuning and Pre Training Foundational Models, PyTorch,Tensorflow, Keras, JAX, Triton, Physics Informed Neural Networks.
- **Programming Languages:** Python (NumPy, Pandas, BioPython), R (Seurat, DESeq2), SQL, Jupyter Notebook,Git/GitHub (Version Control System), Docker, Kubernetes , Matplotlib, Seaborn, SQL.