AKHIL KUMAR

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RESEARCH EXPERIENCE

Tsankov Lab: *Associate Computational Researcher, Icahn School of Medicine at Mount Sinai* **Apr '23-Current**

- Led an independent project; co-mentored 2 rotation PhD students, guiding them through data analysis and interpretation
- Co–first author on 3 manuscripts, including a manuscript in preparation; assisted supervisor with grant preparation
- Integrated single-cell transcriptomics data from 205 treatment-naïve, microsatellite-stable colorectal cancer samples
- Developed a novel statistical approach with co-embedding and pseudobulk frameworks to define a subtype classification
- Performed multivariable regression to isolate mutation-specific effects while adjusting for co-mutations and clinical covariates
- Used a probabilistic mapping approach to localize subtypes in 10x Xenium spatial transcriptomics samples for validations

Perumal Lab: *Research Fellow, School of Biological Sciences, Indian Institute of Technology Delhi* **Feb '21-Nov '22**

- Led the computational work; refactored codebases to improve maintainability and enforced reproducible, test-driven practices
- Co–first author on 4 publications, including one under review; co-mentored a PhD student on project design and data analysis
- Quantified temporal shifts in CpG depletion across SARS-CoV-2 genomes to infer selection pressures shaping viral evolution
- Investigated evolutionary role of CpG dinucleotides and zinc-antiviral finger protein binding motifs in influenza virus adaptation
- Identified 11 long stretches of highly conserved sequences in over 6 million SARS-CoV-2 genomes to improve diagnostic assays

Multiscale Modeling Group: *Bachelor's Thesis, Indian Institute of Technology Delhi* **Fall '19**

- Assisted with the in silico design of small ligand molecules aimed at inhibiting early-stage insulin aggregation nucleation
- Identified EGCG and polyoxometalates as candidate ligands through extensive literature review and computational modeling
- Performed targeted docking of EGCG into a partially folded insulin intermediate using the Gray lab's ROSIE server

Perumal Lab: *Independent Study, School of Biological Sciences, Indian Institute of Technology Delhi* **Fall '19**

- Inspected temporal evolution of mono- and dinucleotides in human mtDNA by analysing sequences dated back to 50k BC
- Developed statistical frameworks to compare compositional shifts across time periods using curated ancient DNA datasets
- Identified a strand-specific compositional asymmetry with GC-rich ancient reads, indicating a directional mutational bias

Biomolecular Computational Group: *Research Intern, Indian Institute of Science Bangalore* **Summer '19**

- Evaluated the existing kinetic modeling approaches to translate metabolic networks of interest into a dynamic model
- Designed a convenience kinetics–based dynamic model comprising 92 reactions, 110 species using complex pathway simulator
- Distributed the reactions across 4 compartments and simulated its dynamic characterstics; examined robustness of the model

Srinivas Group: *Research Intern, University of Oxford* **Summer '18**

- Analysed single-cell transcriptomic profiles collected from early mouse embryos carrying a mutation in the ASPP2 gene
- Processed sequence data files, mapped sequence reads, performed quality control on the individual cells, normalized the data
- Identified distinct cell subtypes using an unbiased hierarchical clustering algorithm and delineated developmental heterogeneity

PUBLICATIONS

1. Zhao, W.†, Nguyen, T. T.†, Bhagwat, A.†, **Kumar, A.**†, Giotti, B.†, Kepecs, B., Weirather, J. L., Mahadevan, N. R., Segerstolpe, A., Dolasia, K., . . . Bueno, R., Rozenblatt-Rosen, O., Pfaff, K., Rodig, S., Hata, A. N., Regev, A., Johnson, B. E., Tsankov, A. M. (2025). A cellular and spatial atlas of TP53-associated tissue remodeling defines a multicellular tumor ecosystem in lung adenocarcinoma. Nature Cancer, 1–23.
2. Bairakdar, M. D.†, Lee, W.†, Giotti, B.†, **Kumar, A.**†, Stancl, P.†, Wagenblast, E., Hambardzumyan, D., Polak, P., Karlic, R., Tsankov, A. M. (2025). Learning the cellular origins across cancers using single-cell chromatin landscapes. Nature communications, 16(1). 1-20.
3. **Kumar, A.**, Kaushal, R., Sharma, H.; Sharma, K., Menon, M. B., and Vivekanandan, P. (2024). Mapping of long stretches of highly conserved sequences in over 6 million SARS-CoV-2 genomes. Briefings in Functional Genomics, 23(3). 256–264.
4. Mukherjee, S.†, **Kumar, A.**†, Samal, J., Gupta, E., Vivekanandan, P., Menon, M. B. (2023). Selective Depletion of ZAP-Binding CpG Motifs in HCV Evolution. Pathogens, 12(1), 43.

5. **Kumar, A.**†, Goyal, N.†, Saranathan, N., Dhamija, S., Saraswat, S., Menon, M. B., and Vivekanandan, P. (2022). The Slowing Rate of CpG Depletion in SARS-CoV-2 Genomes Is Consistent with Adaptations to the Human Host. Molecular Biology and Evolution, 39(3). msac029.

6. **Kumar, A.**†, Kaushal, R.†, Menon, M. B., and Vivekanandan, P.. Early recurrence of mutations in SARS-CoV-2 predicts predominant mutations. Under-review in Journal of Medical Virology.

†These authors contributed equally.

EDUCATION

Indian Institute of Technology Delhi: **Class of 2020**

• Awarded Bachelor of Technology in Chemical Engineering, GPA: 6.738/10 (First Class), US equivalent GPA by WES: 3.4/4.0

• Relevant coursework: Statistics, Epigenetics, Structural Biology, Computer science, Linear algebra and Differential equations, Calculus, Physics, Bioprocessing and Bioseparations, Industrial biotechnology, Numerical methods, Biology for engineers

AWARDS, SCHOLASTIC ACHIEVEMENTS, AND HONORS

2025 500 USD award for outstanding performance at a storytelling in science event held by Story Collider and Mount Sinai

2019 Award for outstanding contributions to the Student Affairs council which is the apex student body of the institution

2017 Honored with Best Academic Improvement Award by the Chemical Engineering Society for exceptional academic progress

2016 Ranked 1580 (top 0.1 percent) nationwide in the Joint Entrance Examination among 1.5 million engineering aspirants

2016 Ranked 4th among 15,000 candidates in the Jammu and Kashmir Engineering Entrance Examination; topper in Chemistry

2015 Kendriya Vidyalaya special recognition for best all round performance amongst the graduating batch of 300 students

2014 State Rank 3 in the National Standard Examination in Biology conducted by the Indian Association of Physics Teachers

2014 State Rank 2 in the National Standard Examination in Physics conducted by the Indian Association of Physics Teachers

2013, 2012 Winner in Quizzing and Debating contests at regional and sub-regional level KVS Social Science Exhibition

COMMUNITY ENGAGEMENT, SERVICE, AND OUTREACH

• Digitized an NGO's complete child welfare database under committee supervision, improving accessibility and data accuracy

• Delivered 8 weeks of educational and personal development sessions supporting holistic growth of children at an orphanage

• Designed and 3D-printed a tactile Scrabble game for blind students, integrating inclusive design and accessible education; conducted a demo session to teach gameplay and donated the finished product to enhance learning through recreation

• Conducted door-to-door fundraising and awareness campaigns for an elderly non-profit, advocating dignity, care, and inclusion

• Volunteered in a community clean-up event, collecting litter, repainting park structures, and restoring 35 bags of waste

• Coached badminton to underprivileged youth and organized a tournament promoting inclusion of specially-abled athletes

TEACHING, POSITIONS OF RESPONSIBILITIES

Bioinformatics Tutor: *Center for Excellence in Youth Education* **Summer '23, Summer '24, Summer '25**

• Mentored 10 high-school students in an introductory Bioinformatics program on cancer genomics for 3 consecutive years

• Taught Python-based bioinformatics workflows and explained biological context of breast cancer transcriptomic datasets

• Helped students develop scientific reasoning, interpret results, perform literature research, and present findings effectively

Student Mentor: *Board for Student Welfare, Indian Institute of Technology Delhi* **Jul '19-May '20**

• Selected from 950 applicants; worked in a 3-tier team of 145+ to support first-year students' transition to undergraduate life

• Mentored 5 freshmen; conducted 4 sessions per semester, including orientation and academic guidance meetings

International Affairs Coordinator: *Alumni Affairs & International Programs, IIT Delhi* **Apr '18-Apr '19**

• Led a team of 6 to initiate MoU outreach; helped revive 10 inactive MoUs by liaising across institute administrative divisions

• Revamped the buddy system for 30+ exchange students and introduced a 3:1 peer-mentorship model, pairing them with domestic peers for close support. Organized 5 events to improve onboarding, community-building, and cultural integration

• Co-led a team of 16 members in hosting the Dalai Lama, coordinating with Delhi Police and institute security officials

• Coordinated with the alumni association to organize silver and golden jubilee celebrations for 25- and 50-year graduating classes

Student Representative: *Student Affairs Council, Indian Institute of Technology Delhi* **Apr '18-Apr '19**

• Represented the pressing issues of 8000+ students in a Senate of Deans and Associate Deans, headed by the Institute Director

• Conceptualized, structured, and launched the Student Research Mentorship Program to bridge undergraduate–postgraduate research communities, foster cross-level collaboration, and create sustained mentorship opportunities across departments

Tennis Captain: *Karakoram House, Indian Institute of Technology Delhi* **Apr '17-Apr '19**

• Led the team to the semi-finals of the institute-level tennis championship and organized 2 intra-house tennis tournaments

• Conducted 7 group and individual sessions to promote inclusivity by nurturing new talent from non-tennis backgrounds

SKILLS AND PERSONAL PURSUITS

Technical	Python, R, bash, Containerization (Apptainer), Snakemake, version control with git, HPC, Markdown, LaTeX 2_ε
Fun	Ultramarathons (50-milers including a certified Fastest Known Time for Staten Island perimeter route, NY, 2024), Biking, Chess, Badminton, Tennis, Foosball, Cricket (recognized as top performer representing Mount Sinai team)

SELF-DIRECTED LEARNING (ONLINE RESOURCES)

Computer Science	CS50's Introduction to Computer Science (CS50x HarvardX), Introduction to Computer Science and Programming Using Python (6.00.1x MITx), CS50's Understanding Technology (CS50T HarvardX) CS50's Introduction to Programming with Python (CS50x HarvardX)
Mathematics	Probability (6.431x MITx), Linear Algebra by Gilbert Strang (18.06SC MIT OCW)
Biology	Introductory Biology (7.016 MIT OCW), Introduction to Biology (7.00x MITx)
Bioinformatics	Quantitative Biology Workshop (7.QBWx MITx), Rosalind problems — platform for learning bioinformatics and programming through problem solving