Sahil Akhtar

Physics + Computer Science & Engineering

Education

- **Massachusetts Institute of Technology (MIT)** *(2023-2027)*
  Bachelor of Science in Physics + Bachelor of Science in Computer Science with **GPA: 5.0/5.0**
  Relevant Coursework: Statistical Learning Theory, Inference and Information Theory, Non-Asymptomatic Statistics, Natural Language Processing, Symmetry and its application to ML, Algorithms I & II, Computation Structures, C and Assembly, Fundamentals of Python, Probability and Random Variables, Linear Algebra, Differential Equations, General Relativity, Quantum Physics II, Statistical Mechanics I.
- **Delhi Public School, Ruby Park** AISSCE (12th Grade): **96.0%** AISSE (10th Grade): **98.0%** *(2012-2023)*

Experience

Incoming AI Engineer Intern *(Sonatus Inc.)* *(May 2025-Present)*

- Researching and building **Knowledge-graph RAG** that incorporates multimodal data into a graph database.
- Improving relevant context retrieval and reasoning for agentic LLMs.

Quantitative Researcher *(Graviton Research Capital, India)* *(Jun 2024-Aug 2024)*

- Developed **novel regression methods**, with a focus on **robust** linear predictors for large financial datasets ($\sim 10^7$ entries) with **heavy-tailed and heteroskedastic** target variables.
- Engineered an **efficient, scalable pipeline in Python** for data cleaning, pre-processing and train-val-test splitting with a rolling out-sample setup. Implemented each custom model as a **module-based API** for efficient reusability and abstraction. Generated various **KPIs** to evaluate model performance across regimes. Used **Tensorflow** with **custom loss functions** for gradient descent on trainable parameters.
- New models **outperformed baseline** models by **10%** in correlations and significantly improved extreme buckets.

Undergraduate Researcher *(Center for Theoretical Physics, MIT)* *(Jan 2024-Present)*

- Applied Einstein's Field Equation model **primordial blackholes** (PBH), which are hypothesized to compose **dark matter**.
- System modelled as a charged blackhole surrounded by quasi-Abelian plasma. **Derived metric tensor** for curved spacetime as a function of screening strength and temperature. Further goals include evolving metric at various cosmological epochs.

Undergraduate Researcher *(Kanwisher Lab, Brain & Cognitive Sciences, MIT)* *(Sep 2024-Present)*

- Analyzed activation patterns in **ResNet-18** layers trained with **Momentum Contrast (MoCo) for unsupervised learning** on augmented ImageNet datasets.
- Identified **class-selective units** for target categories (e.g., faces, words) in layers of ResNet-18 using the fLoc probe set for functional localization, constructing **t-maps** to highlight statistically **significant activation regions** for each target class, based on the methodology of Konkle (2024) for emergence of selective units in deeper layers.

Key Projects

Invariant Representation Learning with Neural Isometries (NIso) *(Dec 2024)*

- Leveraged the **Neural Isometries (NIso)** architecture from Sitzmann et al. (2024) to train an autoencoder. This architecture learns to map the observation space to a latent space where **encodings are related by isometries** whenever their corresponding observations are geometrically related.
- Learned **invariant signatures** from the NIso latent space representations of images. Inspired by Poggio et al. (2014), the signature is formed by calculating the inner product of an image with elements in the orbit of a template image and constructing a soft cumulative distribution function (CDF).
- Achieved an accuracy of **90.1%** in classifying images from the **homography-perturbed MNIST dataset** using the**NIso backbone with the signature framework**. Demonstrated that signatures have higher classification power when the transformation group is more well-behaved, as evidenced by better accuracy in latent space compared to input space.

Real-time Beatbox to Drumset Classifier using CNN *(Sep 2024)*

- Developed a real-time beatboxing tool to convert vocals to real drumset audio using **1D Convolutional Neural Network**.
- Significantly **optimized network** for classification runtime **(<17ms)** by reducing bit precision, using "key" windows for robustness to noise along with **simplifying and tuning** the model. Recorded, processed and cleaned **own dataset** for training. Added specific **augmentations, noise** to dataset for **better generalization**.
- Developed a **rhythm game**, where users need to beat-box in real time at specific rhythms that trigger drumset sounds.

Predicting Consumer Price Index using Time-series Analysis *(Mar 2024)*

- Predicted Consumer Price Index (proxy for inflation) using MIT Billion Prices Project dataset using a custom **AR model**.
- Selected order of AR model using **partial autocorrelogram** and verifying **stationarity of residuals**. Improved model accuracy by including Break Even Rates (10 year average inflation rate by market standards) as **external regressors**.

Technical Skills

Languages	Python, C/C++, SQL, Javascript, HTML/CSS, RISC-V
Software and Packages	Pandas, Numpy, Scipy, Scikitlearn, Tensorflow, PyTorch, Seaborn, Matplotlib, Jupyter, Git
Other skills	Data Analysis, Machine Learning, Statistics, A/B Testing, Web Development

Honors/Awards

- Selected for multiple invite-only events by hedge funds such as **Citadel Datathon, D.E. Shaw Connect**. *(2024)*
- **Two-time** International Olympiad on Astronomy and Astrophysics **(IOAA) Gold Medalist**. *(2022, 2023)*
- **2nd highest Data Analysis score globally** at IOAA 2023, **1st/13,000**+ in National Astronomy Camp, India. *(2023)*
- Qualified for Indian National Math Olympiad thrice, and for **IMOTC (India MOP)** once **(top 100/30,000+)**. *(2021)*
- Secured **rank 1/125,000**+ in WBJEE, rank **99/1.1 million**+ in JEE Advanced and **99.9848%ile** in JEE Mains. *(2023)*
- **Atlas India Fellow**, amongst **top 10/3000**+ applicants in a pool of olympiad medalists and JEE rankers.
  Awarded $10,000 scholarship along with a camp at Oxford on AI alignment, Effective Altruism and critical thinking. *(2022)*
- **NTSE, KVPY** scholar (govt. of India organized national talent exams in STEM) with rank **39/100,000**+. *(2021)*

Extra-Curriculars/Campus Involvement

- Asst. Music Director for MIT Ohms - South Asian **Acapella** group. **Keyboardist** & **sound engineer** for MIT Live.
- **Advocacy chair** for Student Physics Society, **Social committee** for Undergraduate Math Association.
- **TA** for Differential Equations (18.03). MIT GTL-UK Teacher for Physics, Math and Comp Sci at Tonbridge School.
- Brother of **Pi Lambda Phi Fraternity**.