Ved Shah

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About Me

Ved is a PhD student at Northwestern University, working at the intersection of machine-learning and time-domain astronomy. He is interested in developing state of the art deep learning systems for classifying and finding anomalies in astrophysical data, for large surveys producing several terabytes of data every night.

Education

Doctor of Philosophy — *Northwestern University*
in Astrophysics, Focus on Machine Learning methods [GPA: 4.0/4.0] — *2030*

Bachelor of Science — *University of Illinois Urbana-Champaign*
in Computer Science and Astronomy, Minor in Statistics [GPA: 3.9/4.0] — *May 2024*

Technical skills

Programming Languages	Python, Java, C++, C, R, OCaml, SQL
Libraries	TensorFlow/Keras, Pytorch, Numpy, Pandas, Astropy
Web frameworks	Spring boot, Django, Flask
Observing	Certified DECam Observer - 4m Blanco (2 full nights + 3 half nights)

Publications

Note: An up-to-date list of my published work can be found on Google Scholar or ORCiD.

Major Contributions

1. ***Shah, V. G.**, Gagliano, A., Malanchev, K., Narayan, G., LSST DESC (2024). ORACLE: A Real-Time, Hierarchical, Deep-Learning Photometric Classifier for the LSST. arXiv preprint 2501.01496* [Link]
2. ***Shah, V. G.**, Foley, R. J., Narayan, G. (2024). The Fastest Path to Discovering the Second Electromagnetic Counterpart to a Gravitational Wave Event. arXiv preprint 2411.09002.* [Link]
3. ***Shah, V. G.**, Narayan, G., Perkins, H. M., Foley, R. J., Chatterjee, D., Cousins, B., & Macias, P. (2024). Predictions for electromagnetic counterparts to Neutron Star mergers discovered during LIGO-Virgo-KAGRA observing runs 4 and 5. Monthly Notices of the Royal Astronomical Society, 528(2), 1109-1124.* [Link]

Minor Contributions

1. *Aleo, P. D., Engel, A. W., Narayan, G., Angus, C. R., Malanchev, K., Auchettl, K., ... & Villar, V. A. (including **Shah, V. G.**) (2024). Anomaly Detection and Approximate Similarity Searches of Transients in Real-time Data Streams. The Astrophysical Journal, 974(2), 172.* [Link]

Research Experience

Department of Astronomy - University of Illinois Urbana-Champaign [UIUC] — *Dec 2020 – Present*
Undergraduate Research Assistant — *Urbana, USA*

- Leading a paper on using deep learning for the hierarchical classification of transients and variable stars for LSST using both light curves and host galaxy information
- Led a paper on constraining kilonova discovery rates for the LVK O4 and O5 observing runs using Monte Carlo methods - published in the Monthly Notices of the Royal Astronomical Society
- Led the development of a Python package to simulate m-Dwarf flare light curves as part of LSST's ELAsTiCC project to create a comprehensive catalog of light curves for different astrophysical populations
- Developed a Gravity Collective Slack bot for streaming LVK O4 alerts to filter kilonova candidates

National Centre for Supercomputing Applications [NCSA] — *Jun 2021 – Aug 2021*
REU Research Intern — *Urbana, USA*

- Trained machine learning models to automatically anonymize text data to protect user privacy
- Engineered new features for the models and wrote the feature extraction code
- Retrained existing Extra Trees and Neural Net models with new features to reduce false positives and to improve accuracy
- Delivered $\sim 40\ \%$ speed improvement for the redaction process by implementing parallel processing

Indian Institute of Technology - Bombay [IIT - Bombay] *Aug 2019 – Jul 2020*
Research Intern *Mumbai, India*

- Developed the back-end for data delivery from radiosondes (weather monitoring device) back to base stations at the Centre of Studies in Resource Engineering
- Conceptualized and implemented a web-based global radiosonde tracking platform and delivered a release candidate
- Used JS, PHP and SQL to develop the tool, complete with user profiles and a scalable infrastructure

Industry Experience

Country Financial *Jan 2024 - May 2024*
Data Science Intern *Champaign, USA*

- Led efforts to automate Qualys scans on company machines as part of a broader effort to improve security and vulnerability management, saving ~ 7 hours per week and reducing errors introduced by humans.
- Developed REST API's (using Spring Boot) and a front-end (using Angular) to track changes to insurance policies made between different transactions between agents and underwriters.

Country Financial *Jan 2022 – Aug 2022*
Software Engineering Intern *Champaign, USA*

- Designed and built machine learning models (Auto encoders, ECOD, OCSVM) for detecting outliers in insurance policies and identified the cause for decreased profitability for the actuarial department
- Developed templates and workflow pipelines for deploying Infrastructure as code (IAC) on Azure using Ansible and worked with the Dev Ops team to create playbooks for automating resource deployments
- Led the development of API's for a web app for the inventory management of items in insurance policies

Relevant Coursework

Physics and Astronomy	Cosmology, Classical Mechanics, Radiative Processes, Electricity and Magnetism, Intro to Astrophysics, Computational Astrophysics, Stellar Astrophysics, Galaxies and the Universe, Independent Study, Senior Thesis
Computer Science	Algorithms, Models of Computation, Data Structures, Deep Learning, ML for signals, Computer Architecture, Systems Programming, Software Studio
Mathematics	Calculus Sequence, Linear Algebra, Numerical Methods, Discrete Mathematics
Statistics	Probability and Statistics, Applied ML, Statistical Programming Methods

Talks and Posters

1. ***2024 - LSST-DESC CWP:*** *A Real-Time, Hierarchical, Deep-Learning Classifier for the LSST. [Talk]*
2. ***2024 - LSST-DESC MALT:*** *Towards a more interpretable classifier for LSST [Talk]*
3. ***2024 - UIUC UG Symposium:*** *A Monte Carlo framework for estimating KN discovery rates [Talk]*
4. ***2024 - Northwestern University:*** *A Monte Carlo framework for estimating KN discovery rates [Talk]*
5. ***2024 - AAS 243, New Orleans:*** *A Monte Carlo framework for estimating KN discovery rates [Talk]*
6. ***2023 - LSST PCW, Arizona:*** *KNe discovery rates during LVK O4 [Talk + Poster]*
7. ***2023 - UCSC Gravity Collective:*** *An alert system for following up on GW events [Talk]*

8. ***2023 - Astronomy Symposium:*** *KNe discovery rates during LVK O4 [Talk]*
9. ***2023 - UIUC Astrofest:*** *Optimizing KNe observing strategies [Poster]*
10. ***2023 - UIUC UG Symposium:*** *Optimizing KNe observing strategies [Poster]*
11. ***2022 - UIUC Astrofest:*** *m-Dwarf flare model for ELAsTiCC [Poster]*
12. ***2021 - NCSA SPIN Symposium:*** *Deep Learning for Text Anonymization [Talk]*

Honors

UIUC Astronomy	Stanley Wyatt Memorial Award, given to the graduating Astronomy major with the most outstanding GPA and track record of undergraduate research.	*2024*
UIUC Honors Program	LAS Honors College Medallion for outstanding academic performance	*2024*
UIUC Research Park	Best Technical Innovation Intern Award - Finalist	*2022*
UIUC Honors Program	James Scholar Honors	*2022 onwards*
NCSA	Outstanding Intern Award	*2021*
UIUC LAS	Deans List	*2020, 2022*
College Board	AP Scholar Award	*2020*

Awards

UIUC LAS Honors	USD 1500 Preble Scholarship	*2024*
UIUC Astronomy	USD 1000 Stanley Wyatt Memorial Award	*2024*
LSST Discovery Alliance	Travel and lodging award to present at LSST PCW in Tucson, Arizona	*2023*
LSST Corporation	USD 5000 - Science Catalyst Grant Award (PI - Narayan)	*2021*

Telescope Proposals

2024 - DECam	10.5 nights	*Co-Investigator*

Science Collaborations

LSST - Dark Energy Science Collaboration (DESC)	Member/ELAsTiCC team	*Since 2021*
Young Supernova Experiment (YSE)	Member	*2023 - 2024*
SCiMMA	Member	*2023 - 2024*

Outreach, Volunteering and Teaching

Department of Astronomy - University of Illinois Urbana-Champaign *April 2024*
Outreach Volunteer *Marion, IL, USA*

- Volunteered as an astronomer for the 2024 total solar eclipse in Marion, IL for over 1000 attendants at a local baseball stadium.
- Set up telescopes for observing the eclipse and answered about the eclipse and space in general.

Department of Computer Science - University of Illinois Urbana-Champaign *April 2023*
SAIL Instructor *Urbana, IL, USA*

- Taught a class on ”Computing in Astronomy” to high school students and to accepted freshmen to foster interest in computational astronomy research
- Designed interactive jupyter notebooks to guide students through coding examples using real data for exoplanet detection and tidal disruption events

Department of Computer Science - University of Illinois Urbana-Champaign *Jan 2021 - May 2021*
CS 125 - Course Assistant *Urbana, IL, USA*

- Held weekly office hours to help students work through issues with homework and machine projects
- Administered course forum to ensure effective communication between course staff and students

Lions Club International *Aug 2019 - March 2020*

Volunteer tutor *Mumbai, India*

- Volunteered as a Mathematics tutor at a local community school in India that enrolls students from socio-economically weaker sections of society