

# 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

in Astrophysics, Focus on Machine Learning methods [GPA: 4.0/4.0]

Northwestern University

2030

### Bachelor of Science

in Computer Science and Astronomy, Minor in Statistics [GPA: 3.9/4.0]

University of Illinois Urbana-Champaign

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

An automatically updated list of my published work can be found on [Google Scholar](#).

## Major Contributions

1. Li, W., Chen, H., Lin, Q., Rehemtulla N., **Shah, V. G.**, Wu, D., Miller, A. A., Liu, H (2025). *StarEmbed: Benchmarking Time Series Foundation Models on Astronomical Observations of Variable Stars*. arXiv preprint 2510.06200. [\[ADS\]](#)
2. **Shah, V. G.**, Gagliano, A., Malanchev, K., Narayan, G., Malz, A., & the LSST Dark Energy Science Collaboration (2025). *ORACLE: A Real-Time, Hierarchical, Deep-Learning Photometric Classifier for the LSST*. In Press - The Astrophysical Journal. [\[ADS\]](#)
3. **Shah, V. G.**, Foley, R. J., Narayan, G. (2025). *The Fastest Path to Discovering the Second Electromagnetic Counterpart to a Gravitational Wave Event*. Publications of the Astronomical Society of the Pacific, 137(2), p.024101. [\[ADS\]](#)
4. **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. [\[ADS\]](#)

## Other Publications

1. Gupta, R., Muthukrishna, D., Rehemtulla, N., & **Shah, V. G.** (2025). *Transfer Learning for Transient Classification: From Simulations to Real Data and ZTF to LSST*. Monthly Notices of the Royal Astronomical Society: Letters, slaf074. Also accepted to 3rd Machine Learning for Astrophysics Workshop at ICML. [\[ADS\]](#)
2. Miller, A. A., Abrams, N. S., Aldering, G., Anand, S., Angus, C. R., Arcavi, I., ... & Nugent, P. E. (including **Shah, V. G.**) (2025). *The La Silla Schmidt Southern Survey*. Publications of the Astronomical Society of the Pacific, 137(9), p.094204. [\[ADS\]](#)
3. 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. [\[ADS\]](#)

## Research Experience

**Department of Astronomy - University of Illinois Urbana-Champaign [UIUC]***Undergraduate Research Assistant*

Dec 2020 – May 2024

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 2 papers 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

Urbana, USA

*REU Research Intern*

- 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 ~ 40 % speed improvement for the redaction process by implementing parallel processing

**Indian Institute of Technology - Bombay [IIT - Bombay]**

Aug 2019 – Jul 2020

Mumbai, India

*Research Intern*

- 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, Computational Astrophysics, Stellar Astrophysics, Galaxies and the Universe, Interstellar Material and Star Formation, Planetary Systems, Fluid Dynamics, Observational Astronomy, Statistical Methods

**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, Probability and Statistics, Statistical Programming Methods

## Software Projects - Astronomy and Astrophysics

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### ORACLE

*Lead Developer*

Oracle is a hierarchical deep-learning model for real-time, context-aware classification of transient and variable astrophysical phenomena. It uses a recurrent neural network with Gated Recurrent Units (GRUs), and has been trained using a custom hierarchical cross-entropy loss function.

2025

[Github](#)

### Kilonovae rates

*Lead Developer*

A software framework for constraining BNS kilonovae discovery rates, with both GW and EM counterparts for LVK observing runs using Monte Carlo simulations. Simulations can be configured for different optical surveys as well as PSD's for current and future observing runs

2023

[Github](#)

### GW Slackbot

*Lead Developer*

Scimma's Slack alert bot for LIGO 04 gravitational wave alerts via Hopskotch to facilitate the discovery of future kilonovae. The bot is currently operating on the Gravity Collective and the ANTARES workspaces

2023

[Github](#)

### M-Dwarf flare model

*Lead Developer*

A python package to simulate m-dwarf flare light curves as part of LSST's ELAsTiCC. ELAsTiCC is an effort to create an alert stream for brokers in preparation for LSST

2021

[Github](#)

## Software Projects - Machine Learning and Computation

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### Brick Breakers

*Lead Developer*

Spring 2021

[Github](#)

Built the physics engine for brick breaker from scratch in C++. Developed the collision logic for particles and used Cinder for visualization. Implemented a level design mechanism and game state saves to improve the user experience

Winter 2020

[Github](#)

### Phishy AI

*Co-Lead Developer*

Developed a machine learning model to identify phishing websites based on 14 features. Built tools for feature extraction and trained a SVM model (Scikit learn) for binary classification [Safe or Phish]. Achieved an Accuracy of 91 percent and a F1 Score of 0.90. Built a webapp and free public REST API (Flask) to enable access to phishing prevention technology through an intuitive interface

Summer 2020

[Github](#)

### PDFCast

*Lead Developer*

Developed a command line tool for converting PDF documents into podcast. The tool can convert chapter of a textbook or novel into episodes of a podcast

Summer 2020

[Github](#)

### Signature

*Co-Lead Developer*

Developed a multi-platform app that uses image-processing (OpenCV and Pillow) to convert noisy images into e-signatures. App is distributed on Windows, MacOS and Linux

Summer 2020

[Github](#)

### Too Many Matrices

*Co-Lead Developer*

Developed a web app for linear algebraic computations using Python. Used Numpy and Django for the back-end along with HTML/CSS for the front-end. The project has been deployed to Heroku

## Talks and Posters

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1. **2025 - OpenSkAI:** ORACLE: A Real-Time, Hierarchical Classifier for the LSST and ZTF. [Talk]
2. **2025 - Harvard IAIFI:** ORACLE: A Real-Time, Hierarchical Classifier for the LSST. [Talk]

3. **2025 - Rutgers Transient Soirée:** ORACLE: A Real-Time, Hierarchical Classifier for the LSST. [Talk]
4. **2025 - CIERA Observers Group:** ORACLE: A Real-Time, Hierarchical Classifier for the LSST. [Talk]
5. **2025 - OpenMMA (February Meeting):** Optimizing LVK strategy to maximize KNe discovery. [Talk]
6. **2024 - LSST-DESC CWP:** ORACLE: A Real-Time, Hierarchical Classifier for the LSST. [Talk]
7. **2024 - LSST-DESC MALT:** Towards a more interpretable classifier for LSST [Talk]
8. **2024 - UIUC UG Symposium:** A Monte Carlo framework for estimating KN discovery rates [Talk]
9. **2024 - AAS 243, New Orleans:** A Monte Carlo framework for estimating KN discovery rates [Talk]
10. **2023 - LSST PCW, Arizona:** KNe discovery rates during LVK O4 [Talk + Poster]
11. **2023 - UCSC Gravity Collective:** An alert system for following up on GW events [Talk]
12. **2023 - UIUC Astrofest:** Optimizing KNe observing strategies [Poster]
13. **2023 - UIUC UG Symposium:** Optimizing KNe observing strategies [Poster]
14. **2022 - UIUC Astrofest:** m-Dwarf flare model for ELAsTiCC [Poster]
15. **2021 - NCSA SPIN Symposium:** Deep Learning for Text Anonymization [Talk]

## Honors

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

## Awards

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

## Telescope Proposals

<b>2024 - DECam</b>	10.5 nights	Co-Investigator
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## Science Collaborations

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

## Outreach, Volunteering, and Teaching

<b>Department of Physics &amp; Astronomy - Northwestern University</b>	Fall 2025
Teaching Assistant (Physics 135-2)	Evanston, IL, USA
<ul style="list-style-type: none"> <li>• Led discussion sections for a class of ~ 30 undergrads in the introductory calculus-based Electricity and Magnetism class.</li> <li>• Administered and graded weekly exams.</li> </ul>	

**Department of Astronomy - University of Illinois Urbana-Champaign***Outreach Volunteer**April 2024**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***SAIL Instructor**April 2023**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***CS 125 - Course Assistant**Jan 2021 - May 2021**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***Volunteer tutor**Aug 2019 - March 2020**Mumbai, India*

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