

# 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

<b>Programming Languages</b>	Python, Java, C++, C, R, OCaml, SQL
<b>Libraries</b>	TensorFlow/Keras, Pytorch, Numpy, Pandas, Astropy
<b>Web frameworks</b>	Spring boot, Django, Flask
<b>Observing</b>	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](#).

### First Author Publications

3. **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*. *The Astrophysical Journal* 995, 1, 4. [\[ADS\]](#)
2. **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. [\[ADS\]](#)
1. **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. [\[ADS\]](#)

### 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*. [\[ADS\]](#)

### Other Publications

7. Wu, J., O'Brien, J., Li, J.I., Krafczyk, M.S., **Shah, V.G.**, Wasserman, A., Apley, D.W., Narayan, G., & Samia, N.I. (2026). *SELDON: Supernova Explosions Learned by Deep ODE Networks*. *The 40th Annual AAAI Conference on Artificial Intelligence*. [\[ADS\]](#)
6. Perkins, H.M., Narayan, G., Fields, B.D., **Shah, V.G.**, & Schroeder, G. (2026). *Searching for Neutron Star Mergers in the Absence of Gravitational Waves with Optical Afterglow Emission*. *arXiv preprint 2602.13471*. [\[ADS\]](#)
5. *The LSST Dark Energy Science Collaboration (including Shah, V. G.) (2026). Opportunities in AI/ML for the Rubin LSST Dark Energy Science Collaboration*. *arXiv preprint 2601.14235*. [\[ADS\]](#)

4. Rehemtulla, N., Miller, A. A., Walmsley, M., **Shah, V. G.**, Laz, T. J. D., Coughlin, M. W., ... & Kasliwal, M. M. (2025). Pre-training vision models for the classification of alerts from wide-field time-domain surveys. arXiv preprint 2512.11957. [\[ADS\]](#)
3. 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 The 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. [\[ADS\]](#)
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. [\[ADS\]](#)

## Research Experience

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### Department of Astronomy - University of Illinois Urbana-Champaign [UIUC]

Dec 2020 – May 2024

Undergraduate Research Assistant

Urbana, USA

- Led 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

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 ~ 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

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### 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 of 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

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<b>Physics &amp; Astronomy</b>	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
<b>Computer Science</b>	Algorithms, Models of Computation, Data Structures, Deep Learning, ML for signals, Computer Architecture, Systems Programming, Software Studio, Deep Reinforcement Learning
<b>Mathematics</b>	Calculus Sequence, Linear Algebra, Numerical Methods, Discrete Mathematics, Probability and Statistics, Statistical Programming Methods

## Software Projects - Astronomy and Astrophysics

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<b>ORACLE</b> <i>Lead Developer</i>	2025 <a href="#">Github</a>
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	
<b>Kilonovae rates</b> <i>Lead Developer</i>	2023 <a href="#">Github</a>
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	
<b>GW Slackbot</b> <i>Lead Developer</i>	2023 <a href="#">Github</a>
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	
<b>M-Dwarf flare model</b> <i>Lead Developer</i>	2021 <a href="#">Github</a>
A python package to simulate m-dwarf flare light curves as part of LSST's ELASiCC. ELASiCC is an effort to create an alert stream for brokers in preparation for LSST	

## Software Projects - Machine Learning and Computation

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<b>Brick Breakers</b> <i>Lead Developer</i>	Spring 2021 <a href="#">Github</a>
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	
<b>Phishy AI</b> <i>Co-Lead Developer</i>	Winter 2020 <a href="#">Github</a>
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	

## PDFCast

Summer 2020

Lead Developer

[Github](#)

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

## Signature

Summer 2020

Co-Lead Developer

[Github](#)

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

## Too Many Matrices

Summer 2020

Co-Lead Developer

[Github](#)

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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### Contributed Talks and Posters:

17. **2026 - TDABench@SkAI:** *On the role of multi-modality for real-time hierarchical classification.* [Talk]
16. **2025 - OpenSkAI:** *ORACLE: A Real-Time, Hierarchical Classifier for the LSST and ZTF.* [Talk]
15. **2025 - Harvard IAIFI Summer School:** *ORACLE: A Real-Time, Hierarchical Classifier for LSST.* [Talk]
14. **2025 - Rutgers Transient Soirée:** *ORACLE: A Real-Time, Hierarchical Classifier for LSST.* [Talk]
13. **2025 - CIERA Observers Group:** *ORACLE: A Real-Time, Hierarchical Classifier for LSST.* [Talk]
12. **2025 - OpenMMA (February Meeting):** *Optimizing LVK strategy to maximize KNe discovery.* [Talk]
11. **2024 - LSST-DESC CWP:** *ORACLE: A Real-Time, Hierarchical Classifier for the LSST.* [Talk]
10. **2024 - LSST-DESC MALT:** *Towards a more interpretable classifier for LSST.* [Talk]
9. **2024 - UIUC UG Symposium:** *A Monte Carlo framework for estimating KN discovery rates.* [Talk]
8. **2024 - AAS 243, New Orleans:** *A Monte Carlo framework for estimating KN discovery rates.* [Talk]
7. **2023 - LSST PCW, Arizona:** *KNe discovery rates during LVK O4.* [Talk + Poster]
6. **2023 - UCSC Gravity Collective:** *An alert system for following up on GW events.* [Talk]
5. **2023 - UIUC Astronomy Symposium:** *KNe discovery rates during LVK O4.* [Talk]
4. **2023 - UIUC Astrofest:** *Optimizing KNe observing strategies.* [Poster]
3. **2023 - UIUC Undergraduate Symposium:** *Optimizing KNe observing strategies.* [Poster]
2. **2022 - UIUC Astrofest:** *m-Dwarf flare model for ELAsTiCC.* [Poster]
1. **2021 - NCSA SPIN Symposium:** *Deep Learning for Text Anonymization in LLM training data.* [Talk]

## Honors

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<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

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<b>UIUC LAS Honors</b>	\$1500 Preble Scholarship	2024
<b>UIUC Astronomy</b>	\$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>	\$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>La Silla Southern Survey (LS4)</b>	Member	2025 - Present
<b>Zwicky Transient Facility (ZTF)</b>	Member	2025 - Present
<b>LSST - Dark Energy Science Collaboration (DESC)</b>	Member/ELAsTiCC team	2021 - Present
<b>Young Supernova Experiment (YSE)</b>	Member	2023 - 2024
<b>SCiMMA</b>	Member	2023 - 2024

### Outreach, Volunteering, and Teaching

**Department of Physics & Astronomy - Northwestern University** Winter 2026  
 Graduate Teaching Assistant (Astronomy 101-2) Evanston, IL, USA

- Led weekly observing sessions for ~ 20 undergrads for the introductory Cosmology class.
- Held weekly office hours and graded quizzes/exams.

**Department of Physics & Astronomy - Northwestern University** Fall 2025  
 Graduate Teaching Assistant (Physics 135-2) Evanston, IL, USA

- Led discussion sections for ~ 30 undergrads for the calculus-based Electricity and Magnetism class.
- Held weekly office hours and graded weekly quizzes/exams.

**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