

# Shivvrat Arya

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## Professional Summary

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Assistant Professor of Computer Science at the Ying Wu College of Computing, New Jersey Institute of Technology (NJIT). My research advances interpretable, trustworthy, and efficient artificial intelligence by integrating learning, reasoning, and optimization. I specialize in neurosymbolic AI, tractable inference, and neural combinatorial optimization, developing algorithms for real-time, verifiable decision-making and foundation models for reasoning across language and vision. My research spans deep reinforcement learning for structured optimization, test-time and adaptive inference, and scalable explainable AI, with applications in computer vision, video understanding, and multimodal reasoning. My work has been recognized with Best Paper Awards and Spotlight/Oral presentations at leading AI and ML conferences, and has received support from DARPA, NSF, and AFOSR. I am dedicated to advancing the foundations of interpretable and trustworthy AI, while mentoring the next generation of researchers and promoting interdisciplinary collaboration across academia and industry.

## Educational Background

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### Ph.D. in Computer Science

THE UNIVERSITY OF TEXAS AT DALLAS, RICHARDSON, TEXAS

May 2025

GPA: 4.0/4.0

- **Dissertation Title:** Neural Solvers for Fast, Accurate Probabilistic Inference
- **Advisor:** Dr. Vibhav Gogate
- **Co-Advisor:** Dr. Yu Xiang

### M.S. in Computer Science

THE UNIVERSITY OF TEXAS AT DALLAS, RICHARDSON, TEXAS

May 2021

GPA: 4.0/4.0

### B. Tech. in Computer Science and Engineering

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY VADODARA, INDIA

May 2019

GPA: 8.39/10.0

## Research Interests

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Artificial Intelligence (AI); Machine Learning (ML); Deep Learning (DL); Neuro-Symbolic and Trustworthy AI; Neural Combinatorial Optimization; Deep Reinforcement Learning (DRL) for Optimization and Control; Tractable and Approximate Probabilistic Inference; Scalable and Adaptive Decision-Making; Explainable and Interpretable AI (XAI/IAI); Generative and Foundation Models for Reasoning; Computer Vision and Video Understanding.

## Employment History

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### Department of Computer Science, Ying Wu College of Computing, NJIT

ASSISTANT PROFESSOR

Newark, NJ

September 2025 – Present

### Center for Machine Learning, The University of Texas at Dallas

RESEARCH ASSISTANT

Richardson, TX

August 2021 - May 2025

- Developed and optimized real-time inference algorithms for probabilistic models in collaboration with faculty and research associates, achieving notable improvements in model accuracy and computational efficiency. These contributions earned Best Paper Awards, spotlight, and oral presentations at leading AI/ML conferences, including NeurIPS and AAAI.
- Played a key role in the **DARPA Perceptually-enabled Task Guidance (PTG)** program, advancing Neuro-Symbolic Dynamic Probabilistic Models for improved task representation and reasoning. Enhanced user performance in complex physical tasks by expanding skillsets and reducing error rates, leading to increased versatility and proficiency.
- Contributed to the **DARPA Explainable Artificial Intelligence (XAI)** program, developing interpretable AI systems to support transparent, reliable decision-making. Delivered high-performance, explainable models that preserved prediction accuracy, enabling human users to better understand, trust, and manage the next generation of AI partners.
- Participated in the **DARPA Assured Neuro Symbolic Learning and Reasoning (ANSR)** program, focusing on secure and reliable neuro-symbolic learning approaches. Engineered hybrid AI algorithms that integrate symbolic reasoning with data-driven learning, resulting in robust, assured, and trustworthy systems.
- Contributed to research grants funded by **National Science Foundation (NSF)** and **Air Force Office of Scientific Research (AFOSR)**.

- Researched and benchmarked deep learning architectures for multi-label classification.
- Developed the Kernelized Random Vector Functional Link (KRVFL) network for multi-label classification.

## Professional Recognition and Honors

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*Certificate of Academic Excellence (PhD): Awarded for Outstanding Academic Performance in the Computer Science Graduate PhD Program*

**UTD**

*Certificate of Academic Excellence (MS): Awarded for Outstanding Academic Performance in the Computer Science Graduate Masters Program*

**UTD**

*Recognized as **Top Reviewer** (among the **top 8%** of reviewers) for NeurIPS 2024*

**NeurIPS 2024**

*"A Neural Network Approach for Efficiently Answering Most Probable Explanation Queries in Probabilistic Models" selected as **Spotlight: top 2% papers***

**NeurIPS 2024**

*"Neural Network Approximators for Marginal MAP in Probabilistic Circuits" selected for **oral presentation : top 3% papers***

**AAAI 2024**

***Best Paper Award** for "A Neural Network Approach for Efficiently Answering Most Probable Explanation Queries in Probabilistic Models"*

**TPM 2024**

*Awarded the Jonsson School Graduate Study Scholarship (2019)*

**UTD**

*Awarded the Central Sector Scheme of Scholarships for College and University Students (2015), covering the full duration of Undergraduate and Graduate studies*

**Department of Higher Education, India**

## Publications

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### HIGHLY REFEREED CONFERENCE PAPERS

- **Shivvrat Arya**, Smita Ghosh, Bryan Maruyama, Venkatesh Srinivasan, "RELINK: Edge Activation for Closed Network Influence Maximization via Deep Reinforcement Learning", *34th ACM International Conference on Information and Knowledge Management, CIKM*, 2025
- Brij Malhotra, **Shivvrat Arya**, Tahrima Rahman, Vibhav Giridhar Gogate, "Learning to Condition: A Neural Heuristic for Scalable MPE Inference", *39th Annual Conference on Neural Information Processing Systems, NeurIPS*, 2025
- **Shivvrat Arya**, Tahrima Rahman, Vibhav Gogate, "SINE: Scalable MPE Inference for Probabilistic Graphical Models using Advanced Neural Embeddings", *28th International Conference on Artificial Intelligence and Statistics, AISTATS*, 2025
- **Shivvrat Arya**, Tahrima Rahman, Vibhav Gogate, "A Neural Network Approach for Efficiently Answering Most Probable Explanation Queries in Probabilistic Models", *The Thirty-eighth Annual Conference on Neural Information Processing Systems, NeurIPS Spotlight: top 2% papers*, 2024
- Rohith Peddi, **Shivvrat Arya**, Bharath Challa, Likhitha Pallapothula, Akshay Vyas, Bhavya Gouripeddi, Qifan Zhang, Jikai Wang, Vasundhara Komaragiri, Eric Ragan, Nicholas Ruozzi, Yu Xiang, Vibhav Gogate , "CaptainCook4D: A Dataset for Understanding Errors in Procedural Activities", *The Thirty-eight Conference on Neural Information Processing Systems, Datasets and Benchmarks Track, NeurIPS: D&B*, 2024
- **Shivvrat Arya**, Tahrima Rahman, Vibhav Gogate, "Learning to Solve the Constrained Most Probable Explanation Task in Probabilistic Graphical Models", *27th International Conference on Artificial Intelligence and Statistics, AISTATS*, 2024
- **Shivvrat Arya**, Yu Xiang, Vibhav Gogate, "Deep Dependency Networks and Advanced Inference Schemes for Multi-Label Classification", *27th International Conference on Artificial Intelligence and Statistics, AISTATS*, 2024
- **Shivvrat Arya**, Tahrima Rahman, Vibhav Gogate, "Neural Network Approximators for Marginal MAP in Probabilistic Circuits", *The 38th Annual AAAI Conference on Artificial Intelligence, AAAI Oral Presentation: top 3% papers*, 2024
- Vikas Chauhan, Aruna Tiwari and **Shivvrat Arya**, "Multi-Label classifier based on Kernel Random Vector Functional Link Network", *International Joint Conference on Neural Networks, IJCNN*, 2020

### REFEREED WORKSHOP PAPERS

- **Shivvrat Arya**, Tahrima Rahman, Vibhav Gogate, "A Neural Network Approach for Efficiently Answering Most Probable Explanation Queries in Probabilistic Models", *UAI Tractable Probabilistic Modeling, TPM: Best Paper Award*, 2024
- **Shivvrat Arya**, Tahrima Rahman, Vibhav Gogate, "Neural Network Approximators for Marginal MAP in Probabilistic Circuits", *UAI Tractable Probabilistic Modeling, TPM*, 2024
- Benjamin Rheault, **Shivvrat Arya**, Akshay Vyas, Jikai Wang, Rohith Peddi, Brett Benda, Vibhav Gogate, Nicholas Ruozzi, Yu Xiang, Eric Ragan, "Predictive Task Guidance with Artificial Intelligence in Augmented Reality", *IEEE Conference on Virtual Reality and 3D User Interfaces, IEEE VR*, 2024

- Rohith Peddi, **Shivvrat Arya**, Bharath Challa, Likhitha Pallapothula, Akshay Vyas, Qifan Zhang, Jikai Wang, Vasundhara Komaragiri, Nicholas Ruozzi, Eric Ragan, Yu Xiang, Vibhav Gogate, “Put on your detective hat: What’s wrong in this video?”, *DMLR Data-centric Machine Learning Research, DMLR Workshop*, 2023

## JOURNAL PAPERS

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- Chiradeep Roy\*, Mahsan Nourani\*, **Shivvrat Arya**\*, Mahesh Shanbhag, Tahrima Rahman, Eric D. Ragan, Nicholas Ruozzi, Vibhav Gogate, “Explainable Activity Recognition in Videos using Deep Learning and Tractable Probabilistic Models”, *ACM Transactions on Interactive Intelligent Systems, TiIS*, 2023; (\*These authors contributed equally)

## Student Mentorship

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### RESEARCH ADVISEMENT

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#### **Department of Computer Science, The University of Texas at Dallas**

RESEARCH MENTOR

Richardson, TX

August 2022 - Present

- **Graduate Level:** Guided Ph.D. and Master’s students in artificial intelligence, machine learning, and computer vision research, resulting in conference and journal publications, as well as successful thesis completions.
- **Undergraduate Level:** Mentored undergraduate students in artificial intelligence, machine learning, and computer vision research projects.
- **Responsibilities:** Provided technical guidance, reviewed research manuscripts, conducted regular progress meetings, and assisted in experimental design and implementation.

## Classroom Teaching

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#### **Department of Computer Science, The University of Texas at Dallas**

TEACHING ASSISTANT

Richardson, TX

August 2020 - August 2021

- **Courses:** Statistical Methods in AI and Machine Learning, Database Systems, Discrete Mathematics for Computing II
- **Responsibilities:** Graded assignments, held office hours, conducted project demonstrations, and developed supplementary materials and homework solutions for the courses.

#### **Department of Computer Science, The University of Texas at Dallas**

GUEST LECTURER

Richardson, TX

Jan. 2024 - May 2024

- **Course:** Artificial Intelligence (Senior Level)
- **Responsibilities:** Delivered lectures and facilitated class activities, with a focus on core topics in Artificial Intelligence.

#### **Department of Computer Science, The University of Texas at Dallas**

GUEST LECTURER

Richardson, TX

August. 2024 - December 2024

- **Course:** Artificial Intelligence (Graduate Level)
- **Responsibilities:** Taught lectures and guided class discussions, concentrating on advanced topics in Artificial Intelligence.

#### **Department of Computer Science, The University of Texas at Dallas**

GUEST LECTURER

Richardson, TX

August. 2024 - December 2024

- **Course:** Machine Learning (Graduate Level)
- **Responsibilities:** Delivered instructional content and moderated discussions, focusing on advanced Machine Learning concepts.

## Summer School Programs

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HIGH SCHOOL TEACHER

India

Summer 2015, 2016, 2017

- **Subjects:** Mathematics (2015), Computer Science and Mathematics (2016, 2017)
- **Responsibilities:** Taught 80 to 100 students with varying familiarity levels, simplified complex concepts, utilized interactive discussions and hands-on examples, and created an inclusive learning environment.

## CERTIFICATES

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#### **Center for Teaching and Learning, The University of Texas at Dallas**

GRADUATE TEACHING CERTIFICATE RECIPIENT

Richardson, TX

2025

- Completed formal training in instructional pedagogy through the UTD Center for Teaching and Learning.

- Fulfilled four core components: Epigeum coursework, faculty teaching observation, reflective essays, and semester-long teaching experience.
- Certificate awarded upon demonstrating teaching effectiveness and commitment to professional development in higher education.

## Professional Service

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I regularly review papers for the following venues:

### JOURNAL REVIEWER

Artificial Intelligence (AIJ)

Transactions on Machine Learning Research (TMLR)

IEEE Robotics and Automation Letters (RA-L)

### CONFERENCE REVIEWER

Neural Information Processing Systems (NeurIPS: Recognized as a Top Reviewer in 2024)

International Conference on Machine Learning (ICML)

International Conference on Learning Representations (ICLR)

Conference on Uncertainty in Artificial Intelligence (UAI)

International Conference on Artificial Intelligence and Statistics (AISTATS)

## Work Experience

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TechnoUniverse

Indore, India

ANDROID DEVELOPMENT INTERN

May 2017 to July 2017

- Developed a full-featured Android application for InvestoCafe, a financial services firm, ensuring seamless design alignment with their existing website.

## Technical Skills

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**Programming Languages:** Python, R, SQL, Java, C, Cython

**Machine Learning Tools:** TensorFlow, PyTorch, scikit-learn, Keras

**Data Analysis:** Pandas, NumPy, SciPy, Matplotlib, Seaborn

**Cloud Platforms:** AWS, Google Cloud Platform, Azure

**Version Control:** Git, GitHub

**Productivity Suite:** MS Office, LaTeX, Libre Office, Movie Maker

**Other:** Docker, Kubernetes

## Academic Projects

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COMPLETED AT THE UNIVERSITY OF TEXAS AT DALLAS

- **Parameter and Structure Learning Algorithms for Bayesian Networks**    **Statistical Methods in AI and ML**, Spring 2020  
Implemented several structure learning algorithms for Bayesian Networks, including FOD-Learn (fully observed data, known structure), POD-Learn (partially observed data, known structure), and Mixture-Random-Bayes (fully observed data, unknown structure). Conducted a comparative analysis of these algorithms based on different data and structure conditions.
- **Sampling-based Variable Elimination and Conditioning**    **Statistical Methods in AI and ML**, Spring 2020  
Implemented Sampling-based Variable Elimination and Conditioning algorithm for performing inference on probabilistic graphical models.
- **Learning Algorithms for Bayesian Networks**    **Machine Learning**, Fall 2019  
Implemented four algorithms: Independent Bayesian Networks, Tree Bayesian Networks (using Chow-Liu), Mixtures of Tree Bayesian Networks using EM, and Mixtures of Tree Bayesian Networks using Random Forests.
- **Non-Iterative Neural Networks**    **Machine Learning**, Fall 2019  
Implemented two non-iterative neural network models for classification and regression tasks across multiple datasets.
- **Collaborative-Filtering**    **Machine Learning**, Fall 2019  
Implemented collaborative filtering algorithms using a subset of the Netflix Prize movie ratings data. Evaluated model performance using Mean Absolute Error and Root Mean Squared Error metrics.
- **DART Database System**    **Database Design**, Fall 2019  
Designed and implemented the DART system's complete database, from EER diagram creation to relational schema design, SQL-based database construction, and query/view generation.

## Completed at Indian Institute of Information Technology Vadodara, India

- **Compressed Sensing** Computer Vision, Fall 2018  
Developed and evaluated an algorithm for multi-view tracking and 3D voxel reconstruction using 2D images.
- **Kakuro Puzzle Solver** Artificial Intelligence, Spring 2018  
Designed and implemented a bot to solve Kakuro puzzles by applying derived rules to handle diverse puzzle instances.
- **Autoencoder for Anomaly Detection** Deep Learning, Spring 2018  
Developed an autoencoder-based anomaly detection method, successfully tested on a credit card fraud dataset.
- **LEARN: A Programming Language** Compiler Design, Spring 2018  
Designed and implemented a beginner-friendly programming language LEARN using yacc and lex, aiming to ease the learning curve for new programmers.
- **Fatal Disease Detector Using Twitter Data** IIITV Hackathon, Fall 2018  
Implemented a k-means clustering algorithm to detect disease spread patterns using Twitter data.
- **SoT (Security of Things)** Cryptography, Fall 2017  
Developed an Android application to monitor real-time environmental temperature changes with AES encryption for secure data transmission.
- **Hatsphere: E-commerce Platform** Software Development, Fall 2017  
Developed a platform to enable traditional craftsmen to sell their products online and reach a broader market.
- **Cocktail Party Effect Algorithm** Speech Science and Technology, Fall 2017  
Implemented an algorithm to separate human voice from noise in audio recordings.
- **Movie Recommendation System** Database Design, Spring 2016  
Developed a user interface and managed a database system for a movie recommendation engine, utilizing PostgreSQL and C for backend management.

## Organizational Responsibilities

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### COMPLETED AT THE UNIVERSITY OF TEXAS AT DALLAS

Associate Officer **Research Club**  
Internal Projects

### COMPLETED AT INDIAN INSTITUTE OF INFORMATION TECHNOLOGY VADODARA, INDIA

Head	<b>Sports Committee</b>
Core Member	<b>Organizing Team – Krieva 2016, Ventura 2016, Krieva 2017, Cerebro 2018, Ventura 2018</b>
Core Member	<b>Pensive (Literary Society)</b>
Member	<b>Hostel Executive Committee</b>
Class Representative	<b>Vidya Sagar School</b>

## Certifications

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### COURSERA COURSE CERTIFICATES

- Mathematics for Machine Learning: Linear Algebra - *Present License* E5PBMECK8B4M Apr 2019
- What is Data Science? - *Present License* 5WS64BF2G2SY Feb 2019
- Introduction to Programming with MATLAB - *Present License* VGPWCM8WH73K Feb 2019
- Deep Learning Specialization - *Present License* J9V32CC6VTB5 Nov 2018
- Sequence Models - *Present License* 5E9VFH59THG4 Nov 2018
- Convolutional Neural Networks - *Present License* G888N3WXPXLN Sep 2018
- Python Programming Essentials - *Present License* TZXYXTF796L Jun 2018
- Structuring Machine Learning Projects - *Present License* JJNYAQTVFUPR May 2018
- Neural Networks and Deep Learning - *Present License* JSAR6KKVC5Y7 Apr 2018
- Improving Deep Neural Networks - *Present License* MRVNDFNWUHPQ Apr 2018
- Machine Learning - *Present License* FPWNJ39A5LWQ Mar 2018
- Python Data Structures - *Present License* DS5N3NM69PQ6 Mar 2018
- Programming for Everybody - *Present License* XS6H2XUBJ66U Jan 2018

## UDEMY COURSE CERTIFICATES

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- The Top 5 Machine Learning Libraries in Python
- MATLAB for scientists: a beginner's course

Jan 2019

Jan 2019