

TANUSHREE BANERJEE

🏠 tanushreebanerjee.github.io | 🔗 LinkedIn | 🎓 Google Scholar | ✉ Email

EDUCATION

Princeton University, Princeton, NJ

August 2020 - May 2024

Bachelor of Science in Engineering (BSE), Computer Science.

High Honors, Departmental GPA¹: 3.866 / 4.0

Received certificates in Statistics & Machine Learning, Optimization & Quantitative Decision Science.

RESEARCH EXPERIENCE

Princeton Computational Imaging Lab | Department of Computer Science, Princeton University

June 2024 - Present

Research Assistant (Full-Time): Inverse Generation for Explainable Computer Vision

Advisor: Prof. Felix Heide

Extending my undergraduate thesis work, my current project, “**OD-VAE²: Unlocking Analysis-by-Synthesis for Explainable 3D Object Detection**” by Tanushree Banerjee*, Julian Ost*, Maolin Mao, Mario Bijelic, and Felix Heide, proposes a novel method for tackling 3D object detection using an analysis-by-synthesis paradigm to leverage strong learned priors in a Variational Auto-Encoder (VAE). * denotes equal contribution.

1. I designed the novel VAE architecture to enable pose-conditioned generation for 3D object detection
2. I devised the optical flow-based inverse optimization step at the core of our method.

Princeton Computational Imaging Lab | Department of Computer Science, Princeton University

June 2023 - May 2024

Undergraduate Research Assistant: Inverse Generation for Explainable Computer Vision

Advisor: Prof. Felix Heide

My work resulted in the **co-first author arXiv preprint**, “**Inverse Neural Rendering for Explainable Multi-Object Tracking**” **[1]** under review at a peer-reviewed journal.

1. I devised inverse rendering and optimization steps
2. I demonstrated the explainability of our method via analysis of failure modes
3. I designed and ran main experiments to validate our method

Princeton NLP Group | Department of Computer Science, Princeton University

May 2022 - June 2023

Undergraduate Research Assistant: Human-in-the-Loop Machine Learning, LLM Self-Refinement Advisor: Prof. Karthik Narasimhan

I investigated human-in-the-loop methods and LLM self-correction to improve LLM lie detection abilities. My work resulted in the **first-author arXiv preprint**, “**LLMs are Superior Feedback Providers: Bootstrapping Reasoning for Lie Detection with Self-Generated Feedback**” **[2]**.

1. I designed a novel framework using LLM-generated feedback to enhance their reasoning for deception detection in **Diplomacy**
2. I compared the effectiveness of this LLM-generated feedback against expert human-generated feedback.

Princeton Visual AI Lab | Department of Computer Science, Princeton University

May 2021 - May 2023

Undergraduate Research Assistant: Bias in Computer Vision

Advisor: Prof. Olga Russakovsky

I conducted my junior and sophomore independent work in the lab, where I investigated **hallucination in vision-language models** **[4]** and **bias in unbalanced image classification datasets** **[5]**.

1. I designed several approaches to identify questions unrelated to an image to prevent object hallucination in VQA models
2. I analyzed the bias in a model against underrepresented skin tones in the training dataset for skin lesion classification.

PUBLICATIONS AND INDEPENDENT WORK

ArXiv Preprints

* denotes equal contribution.

1. Inverse Neural Rendering for Explainable Multi-Object Tracking

Julian Ost*, Tanushree Banerjee*, Mario Bijelic, Felix Heide

Under Review at a peer-reviewed journal

🔗 Project Page | Paper | arXiv:2404.12359

We recast 3D multi-object tracking from RGB cameras as an *Inverse Rendering* problem. Our method is not just an alternate take on tracking; it enables examining generated objects and reasoning about failure cases. A version of this paper titled “*Towards Generalizable and Interpretable Vision with Inverse Neural Rendering*” is under review at a peer-reviewed journal

2. LLMs are Superior Feedback Providers:

🔗 Paper | arXiv:2408.13915

Bootstrapping Reasoning for Lie Detection with Self-Generated Feedback

Tanushree Banerjee, Richard Zhu, Runzhe Yang, Karthik Narasimhan

We investigated a bootstrapping framework that leverages LLM-generated feedback to detect deception in diplomacy games. Our approach achieved a 39% improvement over the zero-shot baseline in lying F1 without any training.

¹Departmental GPA, computed as the average of all nine senior departmental courses.

²Object Detection-Variational Auto-Encoder

Undergraduate Thesis

3. Inverse Neural Rendering for Explainable 3D Perception

Tanushree Banerjee. Advisor: Prof. Felix Heide

Princeton University, 2024

[Report](#) | [Abstract](#)

This thesis explores unlocking explainable 3D perception via Inverse Neural Rendering. *Part I* proposes and evaluates a novel take on 3D multi-object tracking, while *Part II* proposes recasting 3D object detection as an inverse generation problem.

Independent Work Reports

4. Reducing Object Hallucination in Visual Question Answering

Tanushree Banerjee. Advisor: Prof. Olga Russakovsky

Princeton University, Spring 2023

[Report](#)

This paper proposes several approaches to identify questions not related to an image to prevent object hallucination in VQA models. The best approach achieved an improvement of 40% over the random baseline.

5. Bias in Skin Lesion Classification

Tanushree Banerjee. Advisor: Prof. Olga Russakovsky

Princeton University, Spring 2022

[Report](#)

This paper analyzes the bias in a model against underrepresented skin tones in the training data set on skin lesion classification.

SELECTED AWARDS AND ACHIEVEMENTS

- **Outstanding Computer Science Senior Thesis Prize** for my senior thesis work on *Inverse Neural Rendering for Explainable 3D Perception* [3] under **Prof. Felix Heide**. One of only 6 students among 216 in the CS Department graduating class to earn the award. (2024)
- **FitzRandolph Gate Award** for *Inverse Neural Rendering for Explainable Tracking* [1] at **Princeton Research Day** (2024).
- **Computing Research Association (CRA) Outstanding Undergraduate Research Award Nomination** by the CS Department at Princeton for my research contributions to the paper *Bootstrapping Reasoning for Lie Detection with Self-Generated Feedback* [2], advised by **Prof. Karthik Narasimhan** (2023).

TEACHING AND ACADEMIC SERVICE

Undergraduate Course Assistant: Independent Work Seminar

Spring 2024

I held office hours for students in the seminar on *AI for Engineering and Physics* taught by Prof. Ryan Adams, helping them debug their code and advising them on their independent work projects for the semester.

Princeton AI4ALL Research Instructor

Summer 2022

Taught AI technology and policy to 11th-grade students from underrepresented groups. Led NLP workshops and developed coding tutorials and lectures in preparation for an NLP-based capstone project. I also organized guest lectures given by Princeton faculty.

CSML Undergraduate Student Ambassador

Fall 2023 - Spring 2024

Participated in CSML faculty recruitment interviews and helped organize CSML student social events.

SELECTED COURSE PROJECTS

[Re] METRA: Scalable Unsupervised RL with Metric-Aware Abstraction

Reinforcement Learning, Spring 2024

Tanushree Banerjee*, Tao Zhong*, Tyler Benson*. Advisors: Prof. Benjamin Eysenbach, Prof. Mengdi Wang

[Report](#)

In this reproduction study, we validate the claims of Park et al., 2024, who propose a novel unsupervised RL objective that learns diverse, useful behaviors and a compact latent space that can zero-shot solve various downstream tasks.

Towards Efficient Frame Sampling Strategies for Video Action Recognition

Computer Vision, Spring 2023

Tanushree Banerjee*, Ameya Vaidya*, Brian Lou*. Advisor: Prof. Olga Russakovsky

[Report](#)

We propose and evaluate two dataset and model-agnostic frame sampling strategies for computationally efficient video action recognition: one based on the norm of the optical flow of frames and the other based on the number of objects in frames.

TECHNICAL SKILLS

Languages: Python (Expert), Java, C, JavaScript, Go, HTML, CSS, R, MATLAB, SQL

Frameworks: PyTorch (Expert), PyTorch Lightning, PyTorch3D, Tensorflow, OpenCV, Open3D, Git, L^AT_EX, Slurm, Linux, NumPy, PIL

OTHER WORK EXPERIENCE

Nautilus Software Technologies | Software Engineering Intern

December 2020 - January 2021

Recreated the classic code-breaking game *Mastermind* in chat-bot format on Facebook Messenger using JavaScript. Collaborated in a team to present the project's progress to other student interns. Advised by Prof. Chee Wei Tan.