TANUSHREE BANERJEE

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EDUCATION

Princeton University, Princeton, NJ *August 2020 - May 2024*
Bachelor of Science in Engineering (BSE), Computer Science. High Honors, Departmental GPA[1]: 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-VAE[2]: 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** *Under Review at a peer-reviewed journal*
   Julian Ost*, Tanushree Banerjee*, Mario Bijelic, Felix Heide* 🔗 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.

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[1]Departmental GPA, computed as the average of all nine senior departmental courses.
[2]Object Detection-Variational Auto-Encoder

Undergraduate Thesis

3. **Inverse Neural Rendering for Explainable 3D Perception** *Princeton University, 2024*
Tanushree Banerjee. *Advisor: Prof. Felix Heide* 🔗 [Thesis 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** *Princeton University, Spring 2023*
Tanushree Banerjee. *Advisor: Prof. Olga Russakovsky* 🔗 [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** *Princeton University, Spring 2022*
Tanushree Banerjee. *Advisor: Prof. Olga Russakovsky* 🔗 [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, PostgreSQL
Frameworks: PyTorch (Expert), PyTorch Lightning, PyTorch3D, TensorFlow, OpenCV, Open3D, Keras, Scikit-Learn, Git version control, GitHub, LaTeX, Slurm, Linux, NumPy, PIL, Bootstrap, `ssh` command line tools (e.g. `tmux`)
APIs: nuScenes devkit, OpenAI, HuggingFace, MMDetection, MMDetection3D, Waymo Open Dataset

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.