TANUSHREE BANERJEE

Research Assistant, Princeton Computational Imaging Lab
Department of Computer Science, Princeton University
Princeton, NJ, USA 08544

tanushreebanerjee1
tbanerjee [at] princeton [dot] edu
tanushreebanerjee.github.io
Google Scholar

RESEARCH STATEMENT

I work on developing **explainable 3D perception methods via inverse generation**. Some research questions that inspire my work:
1. Can we leverage priors learned in generative models to interpret 3D information from everyday 2D videos and photographs?
2. How can we reformulate visual perception as an inverse generation problem?

EDUCATION

Princeton University, Princeton, NJ *August 2020 - May 2024*
Bachelor of Science in Engineering (BSE), Computer Science.
Graduated *magna cum laude*. Received certificates in Statistics & Machine Learning, Optimization & Quantitative Decision Science.

RESEARCH EXPERIENCE

Heide Computational Imaging Lab, Princeton University *June 2023 - Present*
Research Assistant Advisor: Prof. Felix Heide
Princeton NLP Group, Princeton University *May 2022 - June 2023*
Research Assistant Advisor: Prof. Karthik Narasimhan
Russakovsky Visual AI Lab, Princeton University *May 2021 - August 2021*
Summer Lab Assistant Advisor: Prof. Olga Russakovsky

RESEARCH

ArXiv Preprints

** denotes equal contribution.*

2. **Inverse Neural Rendering for Explainable Multi-Object Tracking** Project Page
   Julian Ost,* Tanushree Banerjee**, Mario Bijelic, Felix Heide* *arXiv:2404.12359, 2024*

   We propose to 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 and resolving failure cases.

1. **LLMs are Superior Feedback Providers: Bootstrapping Reasoning for Lie Detection with Self-Generated Feedback**
   Tanushree Banerjee*, Richard Zhu, Runzhe Yang, Karthik Narasimhan* *arXiv:2408.13915, 2024*

   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.

Ongoing projects

1. **OD-VAE[1]: Inverting Generation for 3D Object Detection**
   Tanushree Banerjee**, Julian Ost*, Maolin Mao, Mario Bijelic, Felix Heide*

   We propose a novel method tackling 3D object detection using an analysis-by-synthesis paradigm to leverage the strong learned priors in a Variational Auto-Encoder (VAE).

Theses

1. **Inverse Neural Rendering for Explainable 3D Perception**
   Tanushree Banerjee*. Advisor: Prof. Felix Heide* *Undergraduate Senior Thesis, Princeton University, 2024*

   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.

Selected Independent Work Reports

2. **Reducing Object Hallucination in Visual Question Answering**
   Tanushree Banerjee*. Advisor: Prof. Olga Russakovsky* *Princeton University, Spring 2023*

   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.

1. **Bias in Skin Lesion Classification**
   Tanushree Banerjee*. Advisor: Prof. Olga Russakovsky* *Princeton University, Spring 2022*
   This paper analyzes the bias in a model against underrepresented skin tones in the training data set on skin lesion classification.

[1] Object Detection-Variational Auto-Encoder

Selected Awards and Honors

- **Outstanding Computer Science Senior Thesis Prize** for my senior thesis, *Inverse Neural Rendering for Explainable 3D Perception*, advised by Prof. Felix Heide. One of 6 in 216 in the graduating class of the CS Dept. to receive the award (2024).
- **FitzRandolph Gate Award** for presentation on *Inverse Neural Rendering for Explainable Multi-Object Tracking* at Princeton Research Day (2024).
- Nominated for the **CRA Outstanding Undergraduate Research Award** by the CS Department at Princeton for my research contributions to the paper *Bootstrapping Reasoning for Lie Detection with Self-Generated Feedback*, advised by Prof. Karthik Narasimhan (2023).

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 semester-long independent work projects.

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. Organized guest lectures given by Princeton faculty.

CSML Undergraduate Student Ambassador *Fall 2023 - Spring 2024*
Participated in CSML faculty recruitment interviews, helped organize CSML student social events.

Other Work Experience

Software Engineering Intern, Nautilus Software Technologies *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 progress in the project to other student interns. Advised by Prof. Chee Wei Tan.

Circulation Desk Assistant, Princeton University *September 2021 - November 2021*
Worked part-time ∼15 hours per week at the Engineering Library. Managed the main floor, maker space, and engineering stacks. In charge of books that were checked in or out.

References

1. **Prof. Felix Heide**, Assistant Professor, Princeton University fheide@princeton.edu
2. **Prof. Karthik Narasimhan**, Assistant Professor, Princeton University karthikn@princeton.edu
3. **Prof. Olga Russakovsky**, Associate Professor, Princeton University olgarus@princeton.edu