

# Maya Gambhir

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## EDUCATION

### University of Pennsylvania

*BSE in Artificial Intelligence, GPA: 3.85, Rachleff Scholar*

Philadelphia, PA

*Aug. 2022 – May 2026*

## RESEARCH

### Conformal Prediction for LLM Reasoning

January 2024 – Present

*Rachleff Scholar Research under Professor Surbhi Goel*

*Philadelphia, PA*

- Improving LLM performance on reasoning tasks by designing updated qualitative metrics for evaluating segmented LLM outputs
- Iteratively developing a novel scoring mechanism that accounts for dependence between claims, optimizing outputs for correctness and coherence, and applying conformal prediction techniques to obtain correctness guarantees on model outputs
- Presented as a poster at the **2024 NeurIPS Statistics For LLMs workshop**, accepted to **ICLR 2025**

### Emotion Prediction for News Data

October 2023 – July 2024

*Penn Computational Social Science Lab*

*Philadelphia, PA*

- Applying the ChatGPT API and other machine learning models to do sentiment analysis on news data, iteratively adjusting api calls for effective quote extraction, calculating various error rates
- Providing weekly code updates to advisor, working collaboratively to debug and improve model performance
- Work presented at **2024 International Conference for Computational Social Science**

## KNOWLEDGE AREAS

### Machine Learning

*Advanced understanding of ML frameworks, focusing on calibration, multicalibration, and fairness in prediction systems*

- Training/fine-tuning of linear/logistic regression, decision trees, neural networks, CNNs, RNNs, and Transformers
- Conformal prediction algorithms for classification, graphics and LLM applications with proven guarantees
- Evaluation and correction techniques including calibration and multicalibration/group fairness
- Designing and analyzing algorithms for game theoretic formulations and online adversarial learning

### Mathematics and Theory

*Advanced mathematical foundations for ML, including learning theory and adversarial settings*

- Proving theorems in learning theory: PAC learning, analyzing VC dimension, boosting, and uniform convergence
- Applying probability and game theory concepts to analyze regret minimization and minimax optimization
- Deriving statistical and generalization bounds for algorithms in adversarial and stochastic settings
- Implementing and proving differential privacy guarantees for learning systems

## PROJECTS

### Quantifying Bias in Word Embeddings with Casual Inference

2025

- Proposed an algorithm to represent and quantify bias in word embeddings via existing causal inference methods in a formal write-up
- Conducted a comprehensive literature review on casual inference and constraint and score based algorithms (Peter-Clark, GES) and word embeddings and their potential bias

### Noise Level Guarantees in Monte Carlo Path Tracing via Conformal Prediction Methods

2024

- Proposed an algorithm to guarantee low noise levels in Monte Carlo Path Tracing simulations, optimizing sample efficiency to address computational constraints.
- Conducted a comprehensive literature review on Monte Carlo Path Tracing, the Rendering Equation, and conformal prediction techniques, synthesizing findings and proposed algorithm into a ten-page research paper

### Movie Review Sentiment Analysis

2023

- Data preprocessing using PCA, WordNetLemmatizer and TfidfVectorizer, Adaboost with logistic regression/decision trees
- Implemented standard neural network with pytorch, visualized outcomes for both with varied hyperparameters and layers