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Piyush Arora

Professional Summary

Graduate student in MSc Computing (AI & ML) at Imperial College London, with a B.Tech in Computer Science and Engineering from IIT Jodhpur. Research focuses on multimodal learning, AI fairness, and robust representation learning. Former AI Research Engineer at MetaFusion, where I built and deployed large-scale VLM- and LLM-driven systems for surveillance, traffic automation, and scene-captioning across Indian cities. Published at top conferences including WACV and EMNLP, with ongoing work on optimal transport-based multimodal fusion and diffusion-based lip-sync personalization.

Education

- **Imperial College London** — United Kingdom
  MSc Computing (Artificial Intelligence and Machine Learning) — *Sep 2025 - Sep 2026*
- **Indian Institute of Technology Jodhpur** — India
  Bachelor of Technology in Computer Science and Engineering; CGPA: 8.88/10 — *Dec 2020 - May 2024*
  - *All India Rank **3316 (IIT-JEE 2020)** among 1.3 million applicants.*
  - *Secured 2nd position in Computer Vision Hackathon conducted by algo8.ai.*
  - *Selected for the prestigious **Mitacs Globalink Research Internship** and completed a funded summer research internship.*
  - *Capstone Project: Hybrid Sample Synthesis-Based Debiasing in Limited Data Settings published at **WACV 2024**.*
  - *Ranked among the top 5 students in the cohort.*
  - *Coursework: Deep Learning, Advanced Machine Learning, Natural Language Understanding, Data Structures and Algorithms, Operating Systems, Computer Networks, Probability, Statistics, Stochastic Processes, Linear Algebra.*

Publications

- **P. Arora***, N. Singh*, V. Diwan*, P. Mazumder, *BLADE: Bias-Linked Adaptive DEbiasing*: Under Review
- A. Subramanyam*, N. Singh* **P. Arora***, , and A. Mishra, *When Big Models Train Small Ones: Label-Free Model Parity Alignment for Efficient Visual Question Answering with Small VLMs*: **EMNLP 2025**
- **P. Arora***, and P. Mazumder*, *Hybrid Sample Synthesis-Based Debiasing Of Classifier In Limited Data Setting*: **WACV 2024**

* denotes equal contribution

Research Experience

- **Chain-of-Thought Faithfulness in Language Models** — Imperial College London
  Supervisor: Dr. Oana-Maria Camburu — *Oct 2024 – Present*
  - Investigating evaluation metrics for Chain-of-Thought faithfulness to quantify alignment between reasoning traces and model decision-making processes in large language models.
  - Developing reinforcement learning-based approaches to improve faithfulness by rewarding reasoning steps that demonstrate verifiable logical connections to final predictions.
- **Optimal Transport for Multimodal Fusion in Audio-Visual Language Models** — Imperial College London
  Supervisor: Dr. Umberto Cappellazzo (iBUG Lab) — *Nov 2024 – Present*
  - Optimizing transport algorithms to fuse audio and visual modalities in LLMs such as Llama.
  - Investigating robustness of transport-based fusion techniques in noisy acoustic environments; analyzing performance degradation patterns across varying signal-to-noise ratios.
- **Diffusion-Based Personalization for Audio-Driven Lip-Sync** — Imperial College London
  Supervisors: Dr. Antoni Bigata, Dr. Stavros Petridis (iBUG Lab) — *Oct 2024 – Present*
  - Investigating personalization techniques for the KeySync model to capture speaker-specific micro-expressions and articulation patterns with minimal reference samples.
  - Analyzing audio cross-attention layers to identify bottlenecks in capturing individual traits; applying layer-specific LoRA fine-tuning with targeted inpainting masks to prevent identity leakage.
  - Exploring cross-lingual transfer: training on one language and evaluating articulation pattern preservation when generating lip-sync for different languages and identities.
- **When Big Models Train Small Ones** — IIT Jodhpur
  Supervisor: Dr. Anand Mishra (VL2G Lab) | *Technical Report* — *Dec 2024 – Mar 2025*
  - Designed **Model Parity Alignment (MPA)** for Visual Question Answering to train small VLMs (SmolVLM-500M, TinyLLaVA-2B, InternVL2-2B/4B) from large VLMs (Qwen2VL-7B, InternVL2-8B, GPT-4o) using unlabeled data.
  - Developed disparity-aware training to mitigate hallucinations and close reasoning gaps between VLM and its larger counterpart via automated QA pair generation and filtering of disparity samples to guide fine-tuning across OCR, commonsense, and factual tasks.

- Achieved consistent accuracy gains up to **6%** on VQA benchmarks like TextVQA, ST-VQA, OKVQA, MedicalVQA, and ChartQA.

- **BLADE: Bias-Linked Adaptive DEbiasing** — IIT Jodhpur
  Supervisor: Dr. Pratik Mazumder | Technical Report — *May 2024 – Mar 2025*
  - Proposed a generative debiasing framework using adapted StarGAN to create bias-translated image pairs, eliminating the need for conflicting supervision.
  - Trained ResNet classifiers with an instance-specific refinement strategy to align task-relevant features across domains.
  - Improved worst-group accuracy on corrupted CIFAR-10 by up to **15% absolute** over prior methods.

- **Hybrid Sample Synthesis-Based Debiasing in Limited Data Settings** — IIT Jodhpur
  Supervisor: Dr. Pratik Mazumder | Technical Report — *Dec 2022 – Mar 2023*
  - Designed a hybrid sample synthesis method for low-data regimes, enabling ResNet classifiers to generalize under unknown biases and promoting AI fairness.
  - Built a dual-model framework to create bias-conflicting samples without relying on explicit bias annotations.
  - Achieved up to **+10%** accuracy improvement over prior methods on benchmarks such as corrupted CIFAR-10, Colored MNIST, and BFFHQ.

Industry Research

- **MetaFusion** — Noida, India
  AI Research Engineer — *May 2024 - Aug 2025*
  - Developed agentic AI frameworks with VLMs and LLMs for surveillance captioning and fine-grained attribute prediction, training Microsoft Florence-2 and increasing F1 score from **84% to 91%**.
  - Built an intelligent traffic management system integrating multi-violation, vehicle detection, license plate recognition, OCR, and OpenAI CLIP-based vehicle attribute predictor.
  - Created interactive interfaces for the AI systems using Gradio for real-time monitoring and visualization.
  - Increased system throughput by over **50%** and deployed large-scale solutions across Gandhinagar, Vizag, and Maharashtra with cloud monitoring and automated logging.

Research Internships

- **Exploring Imbalanced Problems Through Data Transformation** — Ottawa, Canada
  Supervisor: Dr. Paula Branco (Mitacs GRI 2023, uOttawa) — *May 2023 – Aug 2023*
  - Evaluated SMOTE, reweighting, and feature engineering methods for their impact on boosting performance in imbalanced datasets.
  - Automated large-scale benchmarking on 30+ datasets with reproducible Python pipelines.
  - Identified insightful transformation patterns across continuous, discrete, and categorical features.

Skills Summary

- **Programming**: Python, C++, SQL, Bash
- **ML & AI Frameworks**: PyTorch, TensorFlow, Hugging Face, Transformers, Scikit-learn, OpenCV
- **Quantitative Skills**: Probability Theory, Statistics, Optimization, Stochastic Processes, Monte Carlo Simulation
- **Tools & Platforms**: Docker, Kubernetes, Git, Linux
- **Other**: Technical Writing, Public Speaking, Leadership, Project Management

Teaching, Co-Curricular and Academic Service

- **Reviewer — CVPR 2026**:
  - Serving as reviewer for the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) 2026.
- **Student Ambassador — AE Global Summit on Open Problems for AI**:
  - Represented students at a global forum featuring researchers from DeepMind, NVIDIA, and others.
- **Teaching Assistant — Dr. Angshuman Paul**:
  - Assisted in teaching "Principles of Computer Systems" (CPU design, memory hierarchy, MIPS).
  - Conducted labs, prepared assignments, and graded exams for 75+ students.
- **Teaching Assistant — Dr. Mayank Vatsa**:
  - Supported "Introduction to Computer Science" (C++, Python, DSA).
  - Designed tutorials and evaluated coursework for 200+ first-year students.
- **Exhibition Team Head — Prometeo 2023**:
  - Led a 10-member team to organize North-Western India's largest student-run tech exhibition.
  - Coordinated with 15+ companies/startups to showcase emerging technologies.