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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 robust multimodal representations, generative modeling, and AI fairness. 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 like WACV and EMNLP, with ongoing work on generative debiasing and lip-sync video personalization.

## Education

- **Imperial College London** — United Kingdom
  *MSc Computing (Artificial Intelligence and Machine Learning)* — *2025 - 2026*
- **Indian Institute of Technology Jodhpur** — India
  *Bachelor of Technology in Computer Science and Engineering; CGPA: 8.88/10* — *2020 - 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
- **P. Arora***, N. Singh*, A. Subramanyam*, 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

- **Diffusion-Based Personalization for Audio-Driven Lip-Sync** — Imperial College London
  *Supervisors: Dr. Antoni Bigata, Dr. Stavros Petridis (iBUG Lab)* — *Sep 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.
  - *Skills: Python, PyTorch, Diffusers*
- **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)** 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 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.
  - *Skills: PyTorch, HuggingFace, Docker, Git*
- **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.
  - *Skills: Python, PyTorch, Matplotlib, Plotly, ResNet, Docker, Git*

- **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.
  - *Skills: Python, PyTorch, Matplotlib, Plotly, ResNet, OpenCV, Docker, Kubernetes, Git*

## 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.
  - *Skills: Python, C++, PyTorch, RAG, HuggingFace Transformers, YOLO, Kubernetes*

## 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: Python, PyTorch, NumPy, Scikit-learn, OpenCV*
- **Unsupervised Learning for Bleed-Through Removal in Historical Documents** Remote
  *Supervisors: Florian Kordon, Dr.-Ing. Vincent Christlein (FAU)* *Jun 2022 – Sep 2022*
  - Designed an encoder–decoder to separate bleed-through artifacts from text in degraded documents using unsupervised learning.
  - Generated synthetic training data via image processing (thresholding, erosion, dilation) to replicate real-world degradation.
  - Demonstrated artifact removal without clean ground truth, enabling scalable archival restoration.
  - *Skills: Python, PyTorch, OpenCV*
- **Mitigating Spurious Correlations via Memory-Guided Triplet Loss** Remote
  *Supervisor: Dr. Roberto Capobianco (Sapienza University of Rome)* *May 2022 – Sep 2022*
  - Enhanced classifiers with a memory bank and cosine-similarity retrieval to detect shortcut learning.
  - Used nearest-neighbor retrieval to visualize bias-driven decisions and expose spurious correlations.
  - Applied memory-guided triplet loss to separate embeddings sharing bias features, improving generalization.
  - *Skills: Python, PyTorch, Git*

## 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.
- **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.