Raja Kumar

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I am a research engineer at CNRS, based at CerCo in Toulouse, France, actively seeking a PhD position in NeuroAI.

Education

Indian Institute of Technology Bombay *Aug 2019 - Jun 2024*

Interdisciplinary Dual Degree: *Bachelor's: Materials Science*
Masters: AI in Healthcare Informatics
CPI: 8.65/10

- Secured **AA (highest)** grade in both stages of the **Master's Thesis** on Natural Language Processing for Mental Health

Publications

Raja Kumar, Raghav Singhal, Pranamya Kulkarni, Deval Mehta, Kshitij Jadhav; **M3CoL: Harnessing Shared Relations via Multimodal Mixup Contrastive Learning for Multimodal Classification**; *Under Review,* ***ICLR'25***, Version accepted at UniReps Workshop, ***NeurIPS'24*** [Arxiv] [Code] [Project Page]

Raja Kumar, Kishan Maharaj, Ashita Saxena, Pushpak Bhattacharyya. **Mental Disorder Classification via Temporal Representation of Text**; *In Findings of Association for Computational Linguistics* ***EMNLP'24*** [Arxiv] [Code]

Kishan Maharaj, Ashita Saxena, **Raja Kumar**, Abhijit Mishra, Pushpak Bhattacharyya. **Eyes Show the Way: Modelling Gaze Behaviour for Hallucination Detection**; *In Findings of Association for Computational Linguistics* ***EMNLP'23*** [Paper] [Code]

Research Experience

Deep-learning Implementations of the Global Workspace Theory | CerCo-CNRS *Toulouse, France*
Guide: Prof. Rufin VanRullen *Oct '24 - Present*

- Working on a transformer-based semi-supervised approach for multimodal learning through Global Workspace Theory
- Exploring efficient fine-tuning methods for multimodal large language models (MLLMs) to integrate Global Workspace

Multimodal Mixup Contrastive Learning | Monash University & IIT Bombay *Mumbai, India*
Guide: Prof. Kshitij Jadhav & Dr. Deval Mehta *Dec '23 - Present*

- Developed a novel multimodal contrastive loss incorporating mixup training to improve representation learning for complex real-world multimodal data relations, beating SOTA on four diverse public multimodal classification benchmarks
- Designed and implemented a multimodal learning framework incorporating unimodal prediction modules, a fusion module, and a new Mixup-based contrastive loss for continuous representation updating
- Currently exploring LoRA-based efficient fine-tuning techniques for Multimodal large language models (MLLMs)

Mental Disorder Identification through Linguistic Markers | IIT Bombay *Mumbai, India*
Guide: Prof. Pushpak Bhattacharyya *Jul'23 - May'24*

- Proposed a idea of including temporal information for detecting mental disorders using time-series-based approaches
- Developed a framework for mental disorder identification via foundational deep learning models which surpasses the performance of BERT-based approaches by 5% in the F1 score on mental conditions: Depression, Self-harm, and Anorexia
- Conducted in-depth analysis on the errors and investigated the potential for cross-domain mental health data usage

Cognitive-Driven Hallucination Detection in LLMs | UT Austin & IIT Bombay *Mumbai, India*
Guide: Prof. Abhijit Mishra & Prof. Pushpak Bhattacharyya *Jul'23 - May'24*

- Identified global and local attention biases in hallucination detection, inspiring a gaze-based detection framework
- Curated eye-tracking data with 500 instances for hallucination detection task and developed a BERT-based framework
- Proposed a novel attention bias framework inspired by human behavior and obtained a balanced accuracy of 87.1%

Professional Experience

Assert AI | **Computer Vision & AI Intern** *May '22 - Jul '22*

- Developed a approach for food grain quality assessment: contour detection for separation, SVM for 89% accuracy
- Deployed customized YOLOv4 models for object detection tasks in surveillance leveraging the Nvidia Jetson series GPUs
- Generated tailored datasets and trained YOLOv4 models for diverse object detection and classification scenarios

Academic Services

DH 302: Introduction to Public Health Informatics | **Head Teaching Assistant** *Autumn 2023*

- Responsible for managing logistics and assisting the professor in ensuring the smooth functioning of the course
- Assisting in evaluation of answer scripts, designing projects, and conducting tutorials for a batch of 210+ students

Conferences and Workshops | **Peer Reviewer** *2024 - Present*

- Reviewed for NeurIPS 2024 UniReps Workshop
- Serving as reviewer for ICLR 2025

Key Technical Projects

Leveraging large language models for multiple-choice question answering *Autumn 2022*

Instructor : Prof. Pushpak Bhattacharyya | CS772: Deep Learning for NLP

- Incorporated the ALBERT model for solving riddles accompanied by a set of five available choices
- Conducted experiments on the RiddleSense dataset and achieved an accuracy of 61%

Deep Learning and Image Processing Method for Shadow Removal *Autumn 2021*

Instructor : Prof. Amit Sethi | EE610: Image Processing

- Implemented Stacked Conditional Generative Adversarial Networks for jointly detecting and removing shadows
- Applied k-means clustering to equalize global and local shadow background, eliminating shadows from documents

Image Quilting for Texture Synthesis and Transfer *Autumn 2021*

Instructor : Prof. Ajit Rajwade | CS663: Fundamentals of Image Processing

- Thoroughly analyzed the algorithm discussed in the paper - Image Quilting for Texture Synthesis and Transfer
- Obtained convincing results by implementing the algorithm and evaluated my model on the final output images

Using ML to Predict Stock Price Movements *Jun'21 - Jul'21*

FINSEARCH Competition | Finance Club, IIT Bombay

- Collaborated in a team of 4 to study time series forecasting, its components, and other technical terms related to it
- Deliberated upon the theory and implementation of AR, ARIMA, and LSTM models used for time series forecasting

Key Courses Undertaken

Computer Science	Deep Learning for NLP, Speech & NLP, Machine Learning, Image Processing, Speech Processing
Maths	Probability and Statistics, Optimization in ML, Applied Linear Algebra, Data Structures
MOOCs	Quantum Computing: Qubit, Specialization in DL: deeplearning.ai, Python Specialization

Research Interests

AI/ML	NeuroAI, Multimodal Representation Learning, Psycholinguistics, Computational Neuroscience