Raja Kumar

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I'm a NeuroAI PhD researcher at CNRS–ANITI (CerCo, Toulouse), exploring brain-inspired multimodal intelligence.

Education

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

Interdisciplinary Dual Degree: *Bachelor's: Materials Science*

Master's: 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**, ***TMLR'25***; version accepted at UniReps Workshop, ***NeurIPS'24*** [**Paper**] [**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*** [**Paper**] [**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

Brain-Inspired Multimodal Learning with Global Workspace Theory | CNRS–ANITI *Toulouse, France*

Guide: Prof. Rufin VanRullen *Oct 2024 - Present*

- Designing Global Workspace-inspired mechanisms for vision-language models (VLMs) to enable flexible cross-modal information exchange and integration within a shared latent space, aiming to improve model generalization and efficiency.
- Developing a transformer-based semi-supervised framework for multimodal learning, leveraging principles of the Global Workspace Theory (GWT) to coordinate information flow between specialized model modules.

Multimodal Mixup Contrastive Learning | Monash University & IIT Bombay *Mumbai, India*

Guide: Prof. Kshitij Jadhav & Dr. Deval Mehta *Dec 2023 - Sep 2024*

- 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

Mental Disorder Identification through Linguistic Markers | IIT Bombay *Mumbai, India*

Guide: Prof. Pushpak Bhattacharyya *Jul 2023 - May 2024*

- Proposed an 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 2023 - May 2024*

- 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 2022 - Jul 2022*

- Developed an 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

Conferences and Workshops | Peer Reviewer *2024 - Present*

- Reviewed for NeurIPS UniReps Workshop 2024, 2025
- Reviewer for ICLR 2025

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

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 2021 - Jul 2021*

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

Technical Skills

Softwares	Python, MATLAB, C++, Spice, LaTeX
Libraries	Pytorch, TensorFlow, Scikit-Learn, NumPy, Pandas, Matplotlib