

# Raja Kumar

✉ kumar.raja.iitb@gmail.com | 🏠 | 🌐

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*

CPI: 8.65/10

*Master's: AI in Healthcare Informatics*

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

## Publications

**Raja Kumar**, Raghav Singhal, Pranamyia 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 2024 - 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 2023 - 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 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

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### 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

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### 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

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### 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

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**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

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

## Technical Skills

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**Softwares** Python, MATLAB, C++, Spice, LaTeX

**Libraries** Pytorch, TensorFlow, Scikit-Learn, NumPy, Pandas, Matplotlib