Raja Kumar

BTECH + MTECH · AI IN HEALTHCARE INFORMATICS

Indian Institute of Technology Bombay, India

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Education

Indian Institute of Technology Bombay   *Mumbai, India*

B.TECH IN MATERIALS SCIENCE + M.TECH IN AI IN HEALTHCARE INFORMATICS, CPI: 8.54/10   *Jul'2019 - Present*

- Secured **AA (highest)** grade in the first stage of **Master's Thesis**

Publications

Raja Kumar, Kishan Maharaj, Ashita Saxena, Pushpak Bhattacharyya. **Mental Disorder Classification via Temporal Representation of Text**, Under Review: **EMNLP 2024**

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 2023**

Raja Kumar, Raghav Singhal, Pranamya Kulkarni, Deval Mehta, Kshitij Jadhav. **M3CoL: Harnessing Implicit Relations via Multimodal Mixup Contrastive Learning for Multimodal Classification**, Under Review: **NeurIPS 2024**

Research Experience

Mental Disorder Identification through Linguistic Markers | Master's Thesis   *Jul'2023 - May'2024*

ADVISOR: PROF. PUSHPAK BHATTACHARYYA, IIT BOMBAY

- Proposed a novel idea of including temporal information for detecting mental disorders using time-series-based approaches
- Developed a novel framework for mental disorder identification via foundational deep learning models which surpasses the performance of BERT-based approaches by 4.67% in the F1 score on mental conditions: Depression, Self-harm, and Anorexia
- Conducted in-depth analysis on the common errors and investigated the potential for cross-domain mental health data usage

Cognitive-Driven Hallucination Detection in LLMs | Research Project   *Jul'2023 - May'2024*

ADVISOR: PROF. ABHIJIT MISHRA, UT AUSTIN & PROF. PUSHPAK BHATTACHARYYA, IIT BOMBAY

- Curated eye-tracking data with 500 instances for the task of hallucination detection and developed a BERT-based framework
- Proposed a novel attention bias framework inspired by human behavior and obtained a balanced accuracy of 87.1%
- Currently experimenting with prompt-based approaches for hallucination detection and mitigation in dialogue setting

Semi-Supervised Nuclei Classification in Whole Slide Images | R&D Project   *Jan'2023 - May'2023*

ADVISOR: PROF. KSHITIJ JADHAV, IIT BOMBAY

- Devised a method to classify lymphocytic nuclei in WSI patches using image segmentation followed by data programming
- Demonstrated the superior performance of the proposed pipeline compared to the ResNet18 model with limited training data

Depression Severity Prediction using Text Transcript | R&D Project   *Jan'2023 - May'2023*

ADVISOR: PROF. PUSHPAK BHATTACHARYYA, IIT BOMBAY

- Implemented depression severity prediction in interview transcripts using word embedding vectors: Glove, Word2Vec, BERT
- Evaluated model performance using cross-entropic test loss, with BERT-based model demonstrating an F1-score of 0.90
- Conducted live demo of the system to predict one out of five depression severity in texts using Hugging Face hub and gradio

Image-Text Multimodal Classification | Research Project   *Nov'2023 - May'2024*

ADVISOR: PROF. KSHITIJ JADHAV, IIT BOMBAY

- Implemented a multimodal contrastive learning objective for image-text classification using the extension of mixup strategy
- Experimented using unimodality supervision, cross-attention on diverse datasets (N24News, ROSMAP, BRCA, and Food-101)

Professional Experience

Computer Vision & AI Intern *May'2022 - Jul'2022*
ASSERT AI
- Developed a two-stage 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

Head Teaching Assistant *Autumn 2023*
INTRODUCTION TO PUBLIC HEALTH INFORMATICS, IIT BOMBAY
- 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, Cognitively Inspired NLP

References

Prof. Pushpak Bhattacharyya	**Prof. Abhijit Mishra**	**Prof. Kshitij Jadhav**
Computer Science and Engineering	School of Information	Koita Centre for Digital Health
IIT Bombay, India	The University of Texas at Austin	IIT Bombay, India