KAMALESH KUMAR K

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EDUCATION

Indian Institute of Technology (IIT), Madras, *Chennai, India* *July 2020 - May 2024*
Bachelor of Technology in Civil Engineering; CGPA: 8.12/10   *Minor: Artificial Intelligence and Machine Learning*

PUBLICATIONS AND WORKING PAPERS

- **Kamalesh Kumar**, P. P. Kendre, D. Manilal, R. Muthuganapathy. CleanupGAN: A generative network to enhance and correct query sketches for improving 3D CAD model retrieval system, submitted to **ACM SIGGRAPH, 2024**   [paper]

- P. P. Kendre, **Kamalesh Kumar**, S. S. K. Jayasree, S. Rajan, A. Jayan, and R. Muthuganapathy. SketchCADGAN: A generative approach for completing partially drawn query sketches of engineering shapes to enhance retrieval system performance, published in **Computer & Graphics - Elsevier, 2023**   [paper]

RESEARCH & PROFESSIONAL EXPERIENCE

Robust Reinforcement Learning | Paris AI Research Institute | Research Intern May '23 - present
Guide: Prof. Muni Sreenivas Pydi (MILES Lab, Université Paris-Dauphine - PSL)   *Paris, France*

- Investigating **adversarial models** in Markov Decision Processes (**MDPs**) by analyzing perturbations in state, action, reward, and transition kernel, established **theoretical equivalences** between adversaries in reinforcement learning (RL).
- **Proved** connections between **optimal transport distance, optimal couplings**, and adversarial risk in RL.

Improving Sketch Queries for Robustness in 3D CAD Model Retrieval Systems | IIT Madras Aug '22 - Dec '23
Guide: Prof. Ramanathan Muthuganapathy (Advanced Geometric Computing Lab)   *Chennai, India*

- Proposed a novel **three-branch factorization** based on **conditional WGAN** with a self-attention module to clean defective query sketches. Improvised a dataset of **58000** CAD sketches, submitted to **ACM SIGGRAPH'24**.
- Designed a **two-stage cascaded GAN** architecture to facilitate sketch completion in incomplete queries, published at Computer & Graphics, Elsevier 2023.

Foundational Challenges in Large Language Models | IIT Madras Sep '23 - present
Guide: Prof. Sutanu Chakraborti (Artificial Intelligence and Databases Lab (AIDB))   *Chennai, India*

- Continuing research beyond the course to investigate the challenges in LLMs from a **cognitive perspective**.
- Analysing the **symbolic behavior** in LLMs by investigating their formal & functional **linguistic competences**.

Deep Learning-Based Compression Techniques for Neuromorphic Vision Sensor Data | IIT Madras Jun '22 - Nov '22
Guide: Prof. Mansi Sharma   *Chennai, India*

- Worked on effectively compressing data from an **event camera**. Analyzed pitfalls of **low-rank** and sparse decomposition.
- Devised a pipeline based on **deep belief network** and **Huffman encoding** that achieved high PSNR & compression ratios.

Efficient Watermark Removal from Images | IceCream Labs | Machine Learning Intern Jun '22 - Aug '22
Guide: Madhu Konety   *Bangalore, India*

- Developed an end-to-end pipeline consisting of **calibrated localization**, image super-resolution, and object segmentation.
- Parallelized the training across 4 Nvidia T4 GPUs and the final pipeline was **deployed** to production.

RELEVANT COURSEWORK

- **Artificial Intelligence/Machine Learning:** Pattern Recognition & Machine Learning | Reinforcement Learning | Computational Models of Cognition* | Dynamic Game theory* | Nonlinear Optimisation

- **Mathematics:** Complex Networks* | Probability Foundations | Applied Linear Algebra | Functions of Several Variables | Series and Matrices

- **Other:** Machine Learning in Civil Engineering (CE) | Computer Methods in CE | Programming | Data Structures & Algorithms (audited)

(* ongoing)

AWARDS & ACHIEVEMENTS

- Awarded the **Charpak Scholarship** (1/30 recipients all over India) to pursue a research internship in Paris, France. *2023*
- Represented IIT Madras at the **Inter IIT Tech Meet** and won **gold** medal in the **computer vision** event. *2022*
- Secured a rank within the **top 2.9%** out of **150,000+** candidates in JEE-Advanced, the entrance exam to the IITs. *2020*
- Achieved a rank within the **top 0.09%** out of **1 million+** candidates in JEE-Mains, the screening test for JEE-Advanced *2020*
- Recipient of the **KVPY fellowship** from the Indian Institute of Science (in **top 0.7%** out of 100,000+ candidates). *2019*

KEY TECHNICAL PROJECTS

Image Restoration by Matrix Completion Using Schatten Capped p-Norm | *EE5120 Course Project [video, code]*   Spring '22
- Examined different facets of the **rank minimization** formulation used in **matrix completion** to recover a low-rank matrix.
- Replicated a paper on the Schatten capped p-norm and obtained PSNR of 24.93 for random masked image recovery.

Retrieving Age & Gender From Low-Resolution Surveillance Video | *InterIIT Tech Meet [code]*   Feb '22 - Mar '22
- Adapted algorithms Zero-DCE for **low-light enhancement**, DSFD for face detection & GFP-GAN for face super-resolution.
- Integrated **deep layer aggregation-34** architecture for age regression & fine-tuned **EfficientNetV2** for gender detection.
- The final pipeline obtained an **accuracy** of **94.38%** for gender detection and a **RMSE** of **7.21** for age regression.

A Hybrid Approach to Solve the Cold Start Problem of Recommender Systems | *Analytics Club [code]*   May '21 - Aug '21
- Curated a **hybrid matrix factorization** scheme by including the user-item explicit features to aid **content-based filtering**.
- Inspected other techniques that tackle sparse observations like **SVD** & **Slope-One**, and tested on *MovieLens* 100K dataset.

Algorithms for Solving Environments in OpenAI Gym | *CS6700 Course Project [code]*   Spring '23
- Implemented **SARSA**, Q-Learning to solve a 10x10 grid world and DQN, **Actor-Critic** for solving the *Acrobot-v1*, *Cartpole-v1* and *MountainCar-v0* environments in OpenAI Gym.
- Coded 1-step **SMDP Q-Learning** and **intra-option Q-Learning** in *Taxi-v3* and configured the best set of hyperparameters.

Spam or Ham Classification | *CS5691 Course Project [code]*   Spring '23
- Built an email spam classifier using the **Naïve Bayes algorithm** from a dataset of 367 ham emails and 1500 spam emails.
- Obtained a test accuracy of 94% for the spam category and 94.9% for the ham category

Classification of Constructional Debris and Rebars | *CE6051 Course Project [report]*   Spring '23
- Ideated an **ensemble-based** network using **Yolo-v5** and **XGBoost** for classifying construction debris vs rebars.
- Achieved a test accuracy of **98.2%** and compared results with techniques such as **SVM**, VGG-16 and **Random forests**.

SKILLS

- **Languages**: Python, C++, MATLAB, LaTeX, C, SQL
- **Libraries**: PyTorch, TensorFlow, OpenCV, Numpy, Pandas, Matplotlib/Seaborn
- **Softwares**: Git, Docker, AutoCAD

LEADERSHIP EXPERIENCE

Strategist, Analytics Club | *Center for Innovation, IIT Madras [website]*   Apr '22 - Mar '23
- **Led** a group of **5** undergraduates for a reinforcement learning (RL) bot-based project through regular **progress meetings**.
- Conducted technical sessions on RL to **500+** students of IIT Madras. Actively **educated** the student body in AI & ML.

COMMUNITY SERVICE & EXTRA CURRICULARS

- Taught high school physics, chemistry, maths to **4** students from **low-income groups**, as part of the **National Service Scheme**.
- Mentored **5 freshmen** undergraduates for their academic & **mental wellbeing** as part of the **Saathi mentorship Program**.
- Actively played badminton as an undergraduate and participated in inter-hostel competitions at IIT Madras.