Makkunda Sharma

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Education

University of Oxford *2022 - 2023 (expected)*
MSc in Advanced Computer Science

Indian Institute of Technology Delhi *2015 - 2020*
Dual Degree (B.Tech + M.Tech) in Computer Science and Engineering

Work Experience

Wadhwani AI *August,2020 - September,2022*
Research Fellow / Associate ML Scientist
Advisors: Jigar Doshi , Jerome White & Makarand Tapaswi

Big Data Experience Lab, Adobe Research *May - July,2018*
Research Intern
Advisor: Vishwa Vinay

Publications

Conference/Workshop Publications

* - equal contribution

3. **A Case for Rejection in Low Resource ML Deployment**
   Jerome White, Pulkit Madaan, Nikhil Shenoy, Apoorv Agnihotri, **Makkunda Sharma** and Jigar Doshi
   *Challenges in deploying and monitoring ML systems workshop @ **NeurIPS**, 2022*

2. **Impact of Data-Splits on Generalization: Identifying COVID-19 from Cough and Context**
   Makkunda Sharma*,Nikhil Shenoy*, Jigar Doshi*, Piyush Bagad, Aman Dalmia et al.
   *AI for Public Health Workshop @ **ICLR**, 2021*
   *Workshop on Machine Learning for Preventing and Combating Pandemics @ **ICLR**, 2021*

1. **Using Image Captions and Multitask Learning for Recommending Query Reformulations**
   Gaurav Verma, Vishwa Vinay, Sahil Bansal*, Shashank Oberoi*,**Makkunda Sharma*** and Prakhar Gupta
   *European Conference on Information Retrieval (**ECIR**), 2020*

Preprints

* - equal contribution

2. **Using satellites and artificial intelligence to measure health and material-living standards in India**
   Adel Daoud, Felipe Jordan, **Makkunda Sharma**, Fredrik Johansson, Devdatt Dubhashi, Sourabh Paul and Subhashis Banerjee
   arXiv:2202.00109, 2021

1. **On monitoring development using high resolution satellite images**
   Potnuru Kishen Suraj,Ankesh Gupta*,**Makkunda Sharma***, Sourabh Bikash Paul and Subhashis Banerjee
   arXiv:1712.02282, 2018

Research Projects

Screening for Tubercolosis using Cough Sounds *Feb 2022 - Sep 2022*
Advisors: Jigar Doshi & Makarand Tapaswi, *Wadhwani AI*

- Built a model to screen for TB using cough sounds on a dataset of clinically labelled approximately 15000 patients
- Initial model used a CNN classifier on mel-spectrogram representation of 2 second windows from the audio recordings
- Improved the model to use attention over a sliding window sequence of mel spectrograms or 1d convolutions on the raw audio recording
- The best model, which was a transformer on a sequence of mel spectrograms of 2 second sliding windows over the audio recordings, gave an AUROC score of 0.773, and sensitivity of 73% at a specificity of 70%.
- A pilot study based on this work is in the process of being deployed by the central TB division of the government of India.

A Pest Management Solution using Object Detection and Image Classification *June 2021 - May 2022*
Advisors: Jigar Doshi & Jerome White, *Wadhwani AI*

- Trained the deep learning model deployed on an app used by 10,000 cotton farmers for early pest detection
- The model has 2 components - a classification component which classifies if input image is of pest trap, and a counting component which detects and counts pests in the image
- Trained a joint classification and detection model with common backbone which improved absolute count error relative to two independent models
- Deployed the model into the real world, where the project used by around 10,000 farmers. Analyzed challenges arising from deployment, and updating model based on new incoming data

Cough Against Covid: Identifying Covid from Cough and Context *Aug 2020 - May 2021*
Advisor: Jigar Doshi, *Wadhwani AI*

- We built a model to distinguish people with covid from non-covid using data available on a phone - recorded cough sounds and context (symptoms and meta-data such as age and gender)
- We used separate classifiers for the audio and the context and then ensembled their predictions for the final decision
- Our audio classifier was a CNN applied to the melspectrogram representation of the cough sound, and for the contextual data we used TabNet
- There were many works in covid classification from cough but we saw none of them reported performance across clinically relevant data splits
- To analyze expected deployment performance,we split the development and test sets across time and across sites,while the model generalized in both cases, performance significantly varied and both were worse than the random split seen in current literature

Temporal Census Prediction from Satellite Images *Jan 2020 - July 2020*
Advisors: Prof. Subhashis Banerjee & Prof. SB Paul, *IIT Delhi*

- We extended our previous model to do census prediction across time
- Using a model trained on 2001 images and 2001 census , we predict the 2011 census on 2011 images
- To improve predection accuracy, we learnt a transfer function from 2001 census to 2011 census and applied on top of previous predictions
- We also extend our transfer learning experiments over time,where the transfer learning model trained for NFHS-4 is applied on images from 2019 to predict NFHS-5

Household Economic Status From Photos *Aug 2019 - Jan 2020*
Advisors:Prof. Chetan Arora & Prof. Nandana Sengupta, *IIT Delhi*

- We predicted the household income and assets present using 7 representative images per household
- We built a CNN based architecture that combined information from all images and did regression

Open IE-Based Science question answering *Aug 2018 - May 2019*
Advisor: Prof. Mausam, *IIT Delhi*

- The task is to answer multiple choice science questions taking into account external knowledge.
- Built a memory network based architecture to answer multiple choice science questions using external knowledge
- The reasoning module first used LSTMs for sentence representation and in the memory network
- Later we used BERT for generating the representations which were used to score the choices

Query Reformulations for Image Search using Session Context *May 2018 - July 2018*
Advisor: Vishwa Vinay, *Big Data Experience Lab, Adobe Research*

- We built a model to enhance the query recommendation experience for a commercial image search engine
- We used a sequence-to-sequence model that capture session context, and a multitask architecture that simultaneously optimizes the ranking of results
- The learning for reformulation was done using captions of clicked images as the target and a pairwise loss for the secondary ranking task

Monitoring development using high resolution satellite images *March 2017 - May 2018*
Advisors: Prof. Subhashis Banerjee & Prof. SB Paul, *IIT Delhi*

- Developed a machine learning tool for prediction of development and socio economic indicators from high resolution day time satellite imagery using data from the 2011 census and NFHS-4
- We used a deep convolutional neural network to build a model for regression of asset indicators from satellite images
- We also used the asset prediction model for accurate transfer learning of other socio-economic and health indicators which are not intuitively related to observable features in satellite images

Studying biological evolution using digital signal processing *April 2016 - Dec 2016*
Advisor: Prof. Kushal Shah, *IIT Delhi*

- Studied & analyzed genomes based on 3 base periodicity in the fourier transform of the genome sequence.
- Studied various changes in the fourier transform after making perturbations to the genome

- Used Genetic Algorithms to generate sequences with similar properties as known genomes
- Major challenges included taking a fast fourier transform of a very large signal and controlling the probabilistic factors during the perturbations
- This project got the **Design & Innovation Summer Award** from IIT Delhi

Selected Awards and Honors

- Secured **21st position** at **ACM-ICPC Asia Regional** at IIT Kharagpur *2020*
- Secured **20th position** at **ACM-ICPC Asia Regional** at IIT Kharagpur *2018*
- Won **IITD Semester Merit Award** in **5 semesters** given to **top 7%** of all the students *2015,2016,2017*
- Awarded the **Design & Innovation Summer Award(DISA)** by IIT Delhi *2016*
- Got a **department change** to computer science after end of first year, given to **8 in batch of 800** *2016*
- **All India Rank 309** in JEE Advanced (IIT-JEE) 2015 among 150,000 candidates *2015*
- **All India Rank 260** in JEE Mains (IIT-JEE) 2015 among 1.4 million candidates *2015*
- **National Top 300** in Indian National Physics Olympiad(**InPhO**) *2015*
- **National Top 200** in Indian National Olympiad in Informatics(**INOI**) *2014*
- Awarded **KVPY Fellowship** from Government of India *2014*
- **Rank 8** in Regional mathematics olympiad (**RMO**) in Delhi *2013*
- Awarded **NTSE Scholarship** from Government of India. **Rank 1** in Delhi *2013*

Teaching Experience

Teaching assistant at IIT Delhi in the following courses :

- **MTL 100** : Multivariable Calculus - *Prof. K. Sreenadh* *Semester II 2017-18*
- **COL 202** : Discrete Mathematics - *Prof. Ragesh Jaiswal* *Semester I 2018-19*
- **COL 772** : Natural Language Processing - *Prof. Mausam* *Semester II 2018-19*
- **COL 215** : Digital Hardware Design - *Prof. Anshul Kumar* *Semester I 2019-20*
- **COL 331** : Operating Systems - *Prof. Sorav Bansal* *Semester II 2019-20*

Mentorship

- **Research, Wadhwani AI**
  - Sachin Denisetty(IIIT Hyderabad) - Summer Research Intern (w\ Jigar Doshi & Jerome White) *2021*
  - Chirag Mohapatra(IIT Delhi) - Summer Research Intern (w\ Jigar Doshi & Jerome White) *2021*
- **Student Mentorship Program, IIT Delhi** : Guided 6 freshmen to ensure smooth transition into college life and was the first point of contact for any of their academic or social issues *2017-19*