Makkunda Sharma

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Google Scholar

Education

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

Work Experience

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

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

Publications

Conference Publications

* - equal contribution

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

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

A Pest Management Solution using Object Detection and Image Classification *June 2021 - Present*
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

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 *January 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 *August 2019 - January 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 - December 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 Course Projects

Processor for deep learning *Aug 2019 - November 2019*
Prof. SR Sarangi *COP 820 : Processor Design Lab - IIT Delhi*

- Built a CNN processor in Verilog
- Used systolic arrays for convolution to speed up computation

Scene Understanding using natural language cues *Feb 2018 - April 2018*
Prof. Mausam *COL 772 : Natural Language Processing - IIT Delhi*

- Built a system for generating a paragraph description of a given image using a sequence to sequence model
- Encoder built a scene graph of the input image and the decoder generated the paragraph using a Hierarchical LSTM network taking the scene graph as the input

3D Human Pose Estimation with a Single RGB Camera *Sep 2017 - Nov 2017*
Prof. S Banerjee *COL 780 : Computer Vision - IIT Delhi*

- Implemented the paper "VNect: Real-time 3D Human Pose Estimation with a Single RGB Camera" by Mehta et al. ,SIGGRAPH 2017
- The implementation included CNN pose regression followed by temporal filtering and kinematic skeleton fitting

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*
  - Took a weekly tutorial/recitation class for problem solving for 40 students
  - Graded quizzes and exams
- **COL 202** : Discrete Mathematics - *Prof. Ragesh Jaiswal* *Semester I 2018-19*
  - Took a weekly tutorial/recitation class for problem solving for 30 students
  - Graded quizzes and exams - wrote model solutions for the assigned questions
- **COL 772** : Natural Language Processing - *Prof. Mausam* *Semester II 2018-19*
  - Helped design an assignment, built evaluation mechanism, and evaluated the assignment
  - Was a deep learning assignment so wrote scripts for student assignments to be trained and evaluated under predefined constraints on university cluster with correct permissions
  - Graded exams - wrote model solutions for the assigned questions
- **COL 215** : Digital Hardware Design - *Prof. Anshul Kumar* *Semester I 2019-20*
  - Took a weekly lab session for 30 students, graded them on the labs and took student vivas
  - Graded quizzes and exams
- **COL 331** : Operating Systems - *Prof. Sorav Bansal* *Semester II 2019-20*
  - Evaluated and graded student assignments
  - Graded homeworks and exams - set up gradescope for one of the homeworks

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*