Hitesh Kandala

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Education

Bachelor of Technology | Indian Institute of Technology Bombay July'18-Present
Department of Electrical Engineering GPA (till 7th semester) : 8.86/10.0
Pursuing a **major** in **Electrical Engineering** and **double minor** in **Computer Science** and **Machine Learning**

Publications

Exploring Transformer and multi-label classification for remote sensing image captioning (under review)
Hitesh Kandala, Sudipan Saha, Biplab Banerjee, Xiao Xiang Zhu
IEEE Geoscience and Remote Sensing Letters (GRSL)

Multi-Stage Semantic Graph Embeddings for Compositional Zero-Shot Learning (under review)
Hitesh Kandala, Ruchika Chavan, Biplab Banerjee, Vinay P. Namboodiri

Internship Experiences

MODEL MISSPECIFICATION IN SIMULATION-BASED INFERENCE

Research Intern | Guide: Prof. Jacob Macke | Eberhard Karls Universität Tübingen, Germany May'21-Jul'21
https://github.com/hiteshK03/Model-Misspecification

- Investigated how model **misspecification** in inherent simulators affect recent simulation-based inference algorithms
- Corrected the **posterior inference** in mixed Gaussian toy example of two normals with misspecifed variance by adding **auxiliary variables** in order to make the assumed (misspecified) distribution overlap with the true distribution
- Sampled auxiliary variables from **Laplace** distribution to account for small variance misspecification with its tails

PNEUMONIA DETECTION

Deep Learning Researcher | Endimension Technology Pvt. Ltd. Jul'20 - Aug'20

- Implemented a **TensorFlow** model to detect the regions of pneumonia from the chest **X-rays** of patients in India
- Optimized and averaged bounding boxes from two **RetinaNet** models, with ResNet-50 and ResNet-101 as backbones
- Achieved **Sensitivity** and **Specificity** of more than **90%** on the test dataset, consisting of over 3000 X-ray images

Research Projects

COMPOSITIONAL ZERO SHOT LEARNING

B.Tech Thesis Project | Guide: Prof. Biplab Banerjee Sep'21 - Jan'22

- Implemented a novel **multi graph** based model in PyTorch for closed world **compositional** zero shot learning
- Constructed joint embedding space between image features from **vision-image transformer** and classes of composition from graph and introduced an **adaptive margin** based softmax formulation for the cross-entropy loss
- Surpassed previous **state-of-the-art** results comfortably on the datasets of MIT-States, C-GQA and UT-Zappos50K

CAPTIONING AND MULTI-LABEL CLASSIFICATION

R&D Project | Guide: Prof. Biplab Banerjee Dec'20 - May'21
https://github.com/hiteshK03/Remote-sensing-image-captioning-with-transformer-and-multilabel-classification

- Developed a **multi-task** learning model to improve **image captioning** with the help of an additional auxiliary task
- Built an architecture with common CNN stacked **transformer** encoder and two different decoders for the two tasks
- Surpassed state-of-the-art results by 3% on UC-Merced dataset using **multi-label** classification as the auxiliary task

MULTI-DOMAIN FEW SHOT LEARNING

R&D Project | Guide: Prof. Biplab Banerjee Jan'21 - Apr'21

- Experimented with series and parallel **residual adapters** to improve the results on the 10-domain Decathlon dataset
- Implemented an **incremental** learning approach using Elastic Weight Consolidation loss as an alternative to adapters
- Explored **unsupervised**-learning approaches such as instance discrimination, SimClr for **few shot** in multi-domain

MAHINDRA RISE DRIVERLESS CAR CHALLENGE

*One of the 11 finalists among 259 teams (prize money - **$ 1 million**) | UMIC, IIT Bombay* Apr'19 - Apr'20
https://github.com/Innovation-Cell

- Operated as a part of team SeDriCa, aiming to develop India's 1st **self-driving car** targeting the level 5 autonomy
- Trained Traffic Sign and Light classifier based on pretrained **Resnet50** and **Resnet152** using transfer learning
- Implemented submodules in **path planning** and **decision making** subsystems to avoid obstacles and optimize the path of vehicle accounting for the location and information from the *traffic signs, traffic signals and speed bumps*

Machine Learning Projects

HATE SPEECH DETECTION
Deep Learning for Natural Language Processing | Guide: Prof. Pushpak Bhattacharyya Apr'21 - May'21
- Performed classification of speech into toxic or non-toxic classes on the benchmark Hate Speech dataset, **HateXplain**
- Finetuned **BERT** model to generate additional attention layer and introduced an attention loss to deal with biases
- Built a GUI to classify the given text as hate, offensive or normal with an on-the-go explainability analysis on **LIME**

CASSAVA LEAF DISEASE CLASSIFICATION
Kaggle Competition | Achieved a bronze medal for being in top 10% Jan'21 - Feb'21
- Built an **ensemble** model of EfficientNet-B3 and ViT to detect the correct leaf disease out of 5 different labels
- Experimented with different loss functions such as **Label Smoothing** loss, **Focal** loss to counter dataset imbalamce
- Achieved categorization accuracy of **89.86%** in the private leaderboard to achieve a rank of 261 out of 3900 teams

AUTOMATIC WORD RECOGNITION
Speech Processing | Guide: Prof. Preeti Rao Nov'21 - Dec'21
- Developed a statistical model for the purpose of automatic word recognition from clean and noisy **speech** utterances
- Built the model using the popular **Hidden Markov Model** with output emissions modelled as Gaussian mixtures
- Trained the above model on the Google Speech Commands dataset to achieve accuracy of **65%** on the test dataset

REMOTE SENSING IMAGE CLASSIFICATION
Kaggle InClass Competition Sep'19 - Oct'19
- Developed an **image classifier** to classify remote sensor images captured by satellites into three different classes
- Trained models using transfer learning to maximise prediction accuracy while countering overfitting on small dataset
- Achieved test accuracy of **97.5%** using pretrained **VGG-19** network with Adam optimizer and cross-entropy loss

AUDIO SUPER RESOLUTION
Digital Signal Processing | Guide: Prof. VM Gadre Nov'20 - Dec'20
- Built a model for improving the resolution of audio samples by upsampling from the initial low-resolution versions
- Implemented the popular **AudioUNet** based on the U-Net architecture with a Subpixel shuffling layer in decoder-layer
- Used the single speaker data from the **Voice-Cloning Toolkit** dataset which contains 44 hours of recorded speeches

MULTITASK LEARNING
Machine Learning for Remote Sensing-II | Guide: Prof. Biplab Banerjee Oct'19 - Nov'19
- Developed a model for simultaneous **Image Segmentation** and **Depth Estimation** on the Cityscapes dataset
- Built attention-based **U-Net** architecture for implementing common encoder and multiple decoders of the network

INTRUSION DETECTION SYSTEM
Seasons of Code (SoC) | Web and Coding Club (WnCC) Mar'20 - Aug'20
- Coordinated in a team of **8**, to build a real-time system that monitors the network traffic for any malicious activity
- Applied Chi-square test and Pearson Correlation on **CICIDS2017** dataset to select the best 15 out of 81 features
- Deployed an **ExtraTrees** classifier model of **99.7%** accuracy with a raw network packet sniffer written in Python

Other Projects

STUDENT DESIGN CHALLENGE American Society of Mechanical Engineers
*Overall **winners** in Asia-Pacific Regionals out of 22 teams from all over Asia* Nov'18 - Feb'19
- Qualified for **World Finals** which was held at Utah, USA; by virtue of performance in regional level competition
- Coordinated in team of **11** to build a bot capable of picking, storing and placing balls of varying sizes for competition
- Integrated **Roboteq** with Arduino-UNO for controlling stepper, servo and Encoder Geared DC motors simultaneously

MORSE CODE TONE GENERATOR Course Project
Microprocessors Lab | Guide: Prof. Rajbabu Velmurugan Dec'20
- Generated Morse code audio **tones** for the characters typed on a keyboard connected to the PT-51 board via UART
- Programmed the **PT-51 board** in C language and also displayed the typed characters on LCD display for verification

IMAGE DEBLURRING USING REVERSE HEAT EQUATION Course Project
Digital Image Processing | Guide: Prof. Suyash Awate Dec'20
- Implemented an algorithm to solve the problem of **blurring** of image modeled in the form of heat equation
- Used **reverse heat** equation by stabilizing normal component of gradient, maintaining the overall form
- Added stopping criterion based on curvature of tangential component as reverse heat equation is divergent

LED INTENSITY CONTROL IN SOLAR-FUELED LIGHT
Electronic Design Lab | Guide: Prof. Joseph John Dec'20
- Designed an autonomous circuit to reduce charge consumption on low battery power by varying LED intensity
- Used mosfet-based switching circuit to vary the PWM duty cycle of 555 timer to light LED at full or half loads

HOMOMORPHIC ENCRYPTION

Computer and Network Security | Guide: Prof. G Sivakumar Dec'20

- Extended the Paillier CryptoSystem defined over integers to floating-point numbers for a wider use-case
- Performed image processing algorithms like Edge Detection and sharpening for secure client-server transmission

BINARY-CODED DECIMAL MULTIPLIER

Course Project

Introduction to Electronics | Guide: Prof. Mahesh Patil Mar'19-Apr'19

- Constructed a circuit which takes two numbers as input and returns their product as output in binary format
- Designed the circuit with Fast Carry Adders, D-Flip Flops, Synchronous 4-bit binary-up counters and logic gates

Workshops

- Attended the Amazon ML Summer School to learn machine learning techniques from scientists at **Amazon** ['21]
- Completed the 4-week bootcamp on the **Fundamentals of MLOps** organised by Career Cell, IIT Bombay ['21]
- Participated and completed the **Web Development Bootcamp** organised by Career Cell, IIT Bombay ['19]
- Participated in Two-Days Techno-Entrepreneurship workshop on **Ethical Hacking** at IIT Bombay ['18]

Positions Of Responsibilty

TEACHING ASSISTANT

Introduction to Machine Learning | Guide: Prof. Biplab Banerjee Jan'22 - Present

- Conducted weekly problem solving sessions for a batch of **100** students, focusing on academically weak students
- Evaluated the students' performance regularly and collaborated with the instructor for better teaching tactics

CO-ORDINATOR

Unmesh Mashruwala Innovation Cell (UMIC) Nov'18 - Apr'20

- Planned, organized and publicized **technical** events with a team under Unmesh Mashruwala Innovation Cell (UMIC)
- Presented an overview of all the subsytems of self-driving car to UG and PG freshmen as a part of publicity event
- Interviewed and recruited a total of **9** freshmen and **12** sophomores from pool of 300+ undergraduate applicants

MENTORSHIP

WnCC | MnP | UMIC | ERC Nov'19 - Apr'20

- (WnCC) Led a team of 8, to implement the machine learning part of intrusion detection system ['20]
- (MnP) Helped 2 students to understand the topics in Deep Learning as a part of Summer of Science ['20]
- (UMIC) Guided the new team members to help them understand team's work culture and balance ['20]
- (ERC) Guided a team of 4 freshmen to build a bluetooth controlled bot for the XLR8 competition ['19]

Academic Achievements

AIR 168	JEE Advanced (IIT-JEE)	['18]
AIR 37	JEE Mains	['18]
National Top 1%	NSEP & NSEC	['18]
National Top 300	INChO (Chemistry)	['18]
National Top 300	INAO (Astronomy)	['18,'17]
AIR 102 & AIR 517	KVPY Fellowship	['18,'17]
National Top 1000	NTSE Fellowship, Govt. Of India	['16]

Technical Skills

Programming Languages	C++, Python, ROS, OpenCV, Solidity, VHDL, SciPy, Git
Machine Learning	*Python:* PyTorch, Keras, scikit-learn, TensorFlow, PyCaret, DVC
Software/Platforms	GNU radio, Arduino IDE, MATLAB, NGSPICE, LaTeX, SolidWorks, Roboteq

Advanced Courses Undertaken

Electrical Engineering	Control Systems, Digital Communications, Digital Signal Processing, Microprocessors
Computer Science	Deep Learning for Natural Language Processing, Intelligent and Learning Agents, Speech Processing, Machine Learning for Remote Sensing, Digital Image Processing
Mathematics & Statistics	Linear Algebra, Calculus, Differential Equations, Data Analysis and Interpretation

Extra-Curricular

- Completed a year-long course in the **National Cadet Corps** in the Maharashtra Regiment at IIT Bombay ['19]
- Volunteered for Career Counselling Campaign conducted in BMC schools, in collaboration with NCC, IITB ['18]
- Awarded a merit certificate for winning the **football** tournament in the Annual Training Camp of NCC, IITB ['18]
- Volunteered in the Half Marathon conducted by AAVHAN, IIT Bombay with 4000+ participants ['18]
- Attended the **VIJYOSHI** - National Science Camp organized at IISc, Bangalore for KVPY fellows ['17]