

Achint Soni

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Education

- **Research Masters (MMath Thesis), University of Waterloo** **Ontario, Canada**
Major: Computer Science *Sep'23 - Jun'25 (Expected)*
- **B.Tech, Indian Institute of Technology Kanpur** **Kanpur, India**
Major: Electrical Engineering | Minor: Machine Learning, Theory of Computing | GPA: 3.57/4 *Jul'19 - May'23*

Research Interests

Probabilistic ML (Generative models); Deep representation learning; Foundational models (text to multimedia generation); Time series forecasting

Research Experiences

- **Mobility data to address public health decision making post COVID-19** *Jun'22 – Dec'22*
Mentor: Sahar Saeed, Queen's University, Canada
 - Evaluated the viability of monitoring mobility data to specific points of interest in Canada in order to continue informing post-COVID-19 pandemic public health decision making.
 - Accessed the representativeness of SafeGraph mobility data in Canada by comparing the number of sampled devices with Census population counts at different geographic levels.
 - Described the temporal patterns of visits to healthcare institutions at several epochs and contrasted these patterns across provinces and Material Deprivation Indices by utilising a quasi-Poisson hierarchical generalised additive model.
 - Estimated the utilization patterns of each facility during the pandemic using geographic catchment analytical methods.
 - The ratio of expected and observed healthcare utilization over time for each census block group was used to construct an inequity map.
- **Fast and accurate bayesian polygenic risk modelling using variational inference** *May'22 – Jul'22*
McGill University, Canada
 - Implemented fast and efficient Bayesian polygenic risk score method that approximates posteriors for the effect sizes of genetic variants on the phenotype using variational inference techniques.
 - Conducted comprehensive set of experiments using simulated and real traits to assess the predictive ability of the model in comparison with some of the most popular Bayesian and non-bayesian methods.
 - Observed fast model convergence enabled by variational inference algorithm in contrast to stochastic MCMC approaches implemented by other methods.
- **Carbon footprint reduction using plastic bag price optimization** *Jan'22 – Apr'22*
WRIHW Lab, Durham University
 - Formulated a multi-objective optimization model to determine the Pareto-optimal pricing strategy for plastic bags, effectively balancing supermarket profitability and the quantifiable carbon footprint associated with plastic production and consumption.
 - Engineered an optimal reward policy, effectively curbing the carbon footprint of plastic bags while ensuring stable sales trajectories.
- **Forecasting COVID-19 Vaccination demand using Twitter** *Sep'21 – Jan'22*
LMS, University of Hull
 - Proposed a novel method to predict the demand information for COVID-19 vaccinations in a tweet by utilizing semi-supervised learning with recurrent neural networks (RNN).
 - Designed a mathematical model that calculates the likelihood of demand information of a tweet at a particular time.
 - A new data dictionary is derived with words that show the feeling of support and request, which increases the robustness of the model to temporal losses and long term dependencies.
 - The result is compared with other neural network based control to demonstrate the superiority of the proposed technique.
- **Student Research Associate** *Sep'21 – Nov'21*
Department of Biotechnology, Government of India
 - Deployed a classification model involving deep learning that can detect motor imagery brain signals using an open-source brain-computing interface electroencephalogram (OpenBCI-EEG) headset.
 - Implemented intelligent EEG artefacts removal such as eye and tongue movements, electrode and sweat artefacts by Autoregressive-Deep Variational Autoencoder model.

Undergraduate Research Associate- SURGE'21, IIT Kanpur

- *Intelligent Systems and Controls Lab, IIT Kanpur* *Jun'21 – Sep'21*
 - Built a lightweight keyword spotting system that can recognize multiple different short speech commands.
 - Calculated Mel-Frequency Cepstral Coefficients (MFCC) to extract spectral features and gain more perceptually-relevant representation of speech audio.
 - Deployed a classification model involving deep CNN that can detect speech commands based on their mel spectrograms.
 - Assembled the model on unmanned mine safety inspection vehicle and tested on English and Hindi language speakers.

Projects

Document Image Classification with Intra-Domain Transfer Learning

- *Mentor: Prof. Tushar Sandhan, IIT Kanpur* *Jan'23 – Mar'23*
 - Implemented a region-based DCNN framework for document structure learning on RVL-CDIP dataset.
 - Separated the image into four different regions and applied transfer learning using Vgg16 architecture trained on ImageNet.
 - Combined the predictions from individual base deep neural network using a stacking generalisation based ensembling.
 - Achieved a maximum mean F1-Score of 79.5% on test and 92% on train dataset and secured an All India Rank 21.

Acoustic Event Detection

- *Mentor: Prof. Vipul Arora, IIT Kanpur* *Apr'22 – May'22*
 - Identified onset, offset times, and labels of acoustic events in audio clips using mel-spectrogram features at millisecond precision.
 - Leveraged a diverse array of advanced models, including CNNs, RNNs, hybrid CRNNs, LSTM, and HMMs, attaining a noteworthy 0.91 F1 score for precise acoustic event detection.
 - Applied rigorous statistical techniques, including Gibbs sampling, Importance/Rejection sampling, Monte-Carlo sampling, and Normalizing Flows, enhancing the robustness of the analysis.
 - Constructed Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) from the ground up, employing neural networks to model Gaussian Mixture Models for a comprehensive exploration of acoustic event distributions.

Twitter Sentiment Analysis

- *Mentor: Prof. Faiz Hamid, IIT Kanpur* *Aug'21 – Oct'21*
 - Designed and implemented an information retrieval and classification system for sentiment analysis on Twitter.
 - Cleaned, parsed and segmented tweets content; counted most frequent words, ngrams and hashtags.
 - Used TF-IDF and GloVe pretrained Word Embeddings to obtain vector representations for words.
 - Modeled Support Vector Machine and Naive Bayes algorithm to determine sentiment polarity of data set.
 - Implemented a Bidirectional LSTM model using Tensorflow to classify the tweets into appropriate categories of sentiment.

Deep learning approaches for COVID-19 detection based on chest X-Ray images

- *Self project* *Jul'20 – Sep'20*
 - Designed a deep learning system to extract features and detect COVID-19 from chest X-ray images.
 - Automated the process of analyzing X-ray images with high accuracy using deep Convolutional Neural Networks (CNNs).
 - Three powerful networks, namely ResNet50, InceptionV3, and VGG16, were fine-tuned on an enhanced dataset.
 - Implemented transfer learning to train a ResNet50 model on the same data to achieve an accuracy of 96.32% on train data and 94.53% on validation data

Technical Skills

Programming Skills: C/C++, Python, L^AT_EX

Libraries: PyTorch, Tensorflow, HuggingFace, Keras, OpenCV, Sklearn

Tools & OS: Git, VS Code, MacOS, Linux(Ubuntu)

Achievements and Accolades

- Received MITACS Graduate Fellowship for aiding my graduate research
- Top 0.05% in JEE Advanced 2019, outperforming 230,000 candidates nationally in India
- Top 0.1% in JEE Mains (2019), among 1.6 million candidates nationally in India
- Among the top ten recipients of the INFORMS Scholarship,2022.
- Academic Excellence Award for exceptional performance in Mathematics and Science