SWAPNIL MALLICK

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EDUCATION

University of Southern California, Los Angeles   Aug 2021 - Dec 2023
Master of Science, Computer Science   Overall GPA: 3.56/4

Maulana Abul Kalam Azad University Of Technology (WBUT), India   Jun 2016 - Jun 2020
Bachelor of Technology, Computer Science and Engineering   Overall GPA: 9.03/10

RESEARCH EXPERIENCE

University of North Carolina at Chapel Hill   Remote
UNC CV Group   March 2024 - Present

- Supervisor: Prof. Roni Sengupta (Google Scholar)
- Currently collaborating on detecting student video lecture engagement and live deep fakes with passive monitor illumination
- Implemented a personalized ViT backbone architecture which shows a significant improvement in performance (74.95%) when compared with the previous architecture (62.05%) in dark lighting conditions
- Experimenting with diffusion models and SDS loss (per-image optimization) to improve the monitor image prediction quality
- Exploring the application of self and cross attention based architectures in detecting video engagement and live deep fakes with the ultimate goal of building a generalized model for the task

University of Southern California   Los Angeles, California
USC CPS-VIDA (Cyber-Physical Systems - Verification, Intelligence, Design, and Analysis)   March 2024 - Present

- Supervisor: Prof. Jyotirmoy Vinay Deshmukh (Google Scholar)
- Currently working on a project on generating safety-critical scenarios for autonomous vehicle testing **(RV '24)**
- Explored Scenic to generate safety-critical scenarios
- Broadly exploring the application of generative models like, VQGAN, diffusion models for generating safety-critical scenarios for comprehensive self-driving car testing

University of Southern California   Los Angeles, California
USC CPS-VIDA (Cyber-Physical Systems - Verification, Intelligence, Design, and Analysis)   May 2023 - August 2023

- Supervisor: Prof. Jyotirmoy Vinay Deshmukh (Google Scholar)
- Developed a safety monitoring framework for detecting the robustness of existing pedestrian detection models in low-light weather conditions using Timed Quality Temporal Logic (TQTL) **(RV '23)**
- Compared the robustness of vanilla YOLO and IA-YOLO in both foggy as well as night conditions
- Proposed TQTL as a quality metric that will help in debugging or improving the existing pedestrian detection models

Indian Statistical Institute   Kolkata, India
Computer Vision And Pattern Recognition (CVPR) Unit   July 2019 - May 2020
Certificate Link: https://bit.ly/3SOwxYo

- Supervisor: Prof. Ujjwal Bhattacharya (Google Scholar)
- Designed three separate architectures for detecting handwritten Bengali numerals using Residual blocks, Inception blocks and LeNet-5 architecture
- Employed DCGAN to create additional samples to deal with the initial scarcity of training data
- Found that the simpler LeNet-5 architecture achieved a higher accuracy of $\sim$ 98.2% on test data as compared to the architectures that used Inception block ($\sim$ 97.4%) and Residual block ($\sim$ 97.1%)

PUBLICATIONS

2. Vidisha Kudalkar, Navid Hashemi, Shilpa Mukhopadhyay, **Swapnil Mallick**, Christof Budnik, Parinitha Nagaraja, Jyotirmoy V. Deshmukh. Sampling-based and Gradient-based Efficient Scenario Generation. **(Accepted at the 24th International Conference on Runtime Verification, 2024)** (Abstract), (Pre-print version)

1. **Swapnil Mallick***, Shuvam Ghosal*, Anand Balakrishnan, Jyotirmoy Deshmukh. Safety monitoring for pedestrian detection in adverse conditions. 23rd International Conference on Runtime Verification, pp. 389-399. Springer Nature Switzerland, 2023. (Paper)

ACADEMIC PROJECTS

Analysing Twitter Data on Rhino Conservation using Natural Language Processing
Project Link: https://bit.ly/4eJ5mcX   November 2023

- This study, conducted as group project for CSCI 461 at USC, was designed to demonstrate the utility of social media data in monitoring public opinion regarding illegal rhino poaching and trade
- Various toolkits, including Pattern, TextBlob, VADER, and Twitter-roBERTa-base, were utilized to gauge the sentiment expressed in the tweets; used SHAP values to interpret the behavior of the models/toolkits
- In parallel, topic modeling techniques such as LDA and BTM were applied to gain deeper insights into the prevalent discussion topics and identify the user categories participating in these conversations
- The exploratory data analysis conducted on rhino-related tweets revealed that the volume of such tweets exhibited a comparative increase from 2014 to 2019, reaching a peak in 2018
- For assessing the sentiment of tweets in conservation-related discussions, the results obtained did not provide a clear indication of the effectiveness of relying on pretrained NLP tools
- The topic modeling analysis revealed a dual nature of discussions on rhinos, encompassing both general themes such as 'Poaching' and 'Horn/Ivory Trade', as well as event-specific topics like the 'Last White Male Northern Rhino Extinction' and 'Horn Stealing/Veterinarian'

CHIP: Contrastive Hierarchical Image Pretraining
Project Link: https://bit.ly/4en84EA   May 2023

- This study, conducted in group of four students as the course project of CSCI 566 at USC, proposed a few-shot three-level hierarchical contrastive loss-based classification model that can classify an object of any unseen animal class into a relatively general category in a hierarchically based classification
- The proposed model was trained on a subset of the ImageNet (ILSVRC-12) dataset containing only the animal classes (366 classes in total) with 1300 images in each class
- The trained model was evaluated on a dataset created by us that contained 20 unseen animal classes not present in the ImageNet dataset
- The trained model, evaluated on 20 unseen animal classes, could classify 14 of them to their correct parent and super parent class

Adaptive Cruise Control System of Self-driving Car
Project Link: https://bit.ly/48UcXTI   December 2022

- Designed an adaptive cruise control system of a self-driving car using YOLOv5 model for object detection and Monodepth2 for distance estimation
- The Monodepth2 model was used to output a disparity map of the bounding box region of the detected lead car from which the value at the centroid position of the bounding box was taken to get the estimated distance
- This was then fed to the PID controller of the ego car, which has to maintain a safe distance to the lead car
- The system was tested in CARLA simulator Town 6 and the ego car was found to always maintain a safe distance to the lead car

Stock Price Prediction of a Company using LSTM
Project Link: https://bit.ly/3MOREpN   June 2022

- Leveraged an LSTM architecture to predict the stock price of a company
- Measured the performance of the model using RSME score
- Received highest RMSE score of 7.25 on unknown test data after running five times

A Multi-modal Approach to Speech Emotion Recognition
Project Link: https://bit.ly/47Z9T7T   May 2022

- This study, conducted as the course project of CSCI 544 at USC, uses audio and text as modalities from the IEMOCAP dataset for human emotion recognition
- A VGG frame architecture was trained from scratch to detect emotions from audio and a pretrained BERT was finetuned to predict the emotions from text transcriptions
- The text-only and audio-only architectures were combined to design a multimodal architecture for emotion recognition
- The multimodal architecture achieved a considerably higher accuracy of 76.9% as compared to the models that used either text (72.4%) or audio (47.8%) as the modality

Cipher Text Prediction using BiLSTM
Project Link: https://bit.ly/3QiJ5Jw   March 2022

- Designed a binary classifier that can classify whether a piece of text is encoded or not
- Converted text into word embeddings and employed BiLSTM for classification task
- The classifier achieved $\sim$ 87.5% accuracy on training data and $\sim$ 85% accuracy on test data

COURSEWORK

- Machine Learning
- Applied NLP
- Database Systems
- Operations Research
- Operating Systems

- Deep Learning
- Information Retrieval and Web Search Engines
- Foundations of AI
- Computer Networks
- Information and Coding Theory

- Autonomous Cyber-Physical Systems
- AI for Sustainable Development
- Algorithms
- Automata Theory
- Numerical Methods

SKILLS

- **Programming:** Python, C, C++
- **ML Frameworks:** Keras, TensorFlow, PyTorch, scikit-learn
- **Data Visualization:** Matplotlib, seaborn
- **Database:** MySQL, PostgreSQL, MongoDB
- **Software Tools:** Anaconda, Jupyter Notebook, LaTeX, CARLA Simulator, KNIME, WEKA, RapidMiner, Tableau, Gurobi Optimization

CERTIFICATIONS

- Deep Learning Specialization (DeepLearning.AI) (Link)
    - ☐ Neural Networks and Deep Learning (Link)
    - ☐ Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization (Link)
    - ☐ Structuring Machine Learning Projects (Link)
    - ☐ Convolutional Neural Networks (Link)
    - ☐ Sequence Models (Link)
- Natural Language Processing Specialization (DeepLearning.AI) (Link)
    - ☐ Natural Language Processing with Classification and Vector Spaces (Link)
    - ☐ Natural Language Processing with Probabilistic Models (Link)
    - ☐ Natural Language Processing with Sequence Models (Link)
    - ☐ Natural Language Processing with Attention Models (Link)
- MATLAB (Vanderbilt University) (Link)
- Bayesian Statistics (UC Santa Cruz) (Link)
- Introduction to Big Data (UC San Diego) (Link)
- Big Data Integration and Processing (UC San Diego) (Link)
- Big Data Modeling and Management Systems (UC San Diego) (Link)
- Machine Learning with Big Data (UC San Diego) (Link)
- Introduction to TensorFlow for Artificial Intelligence, Machine Learning, and Deep Learning (DeepLearning.AI) (Link)
- Convolutional Neural Networks in TensorFlow (DeepLearning.AI) (Link)

BLOG POSTS

- A Survey On Data Driven Approaches To Scenario Generation For Autonomous Vehicle Testing
  Link: https://swapnilmallick.github.io/blogs/scenario_generation.html
- A Guide To Generative Adversarial Network
  Link: https://swapnilmallick.github.io/blogs/gan.html