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 - Jul 2020
Bachelor of Technology, Computer Science and Engineering   Overall GPA: 9.03/10
                                                                   WES Converted GPA: 3.96/4

EMPLOYMENT

Research Volunteer @ University of Southern California   Los Angeles, California
USC CPS-VIDA (Cyber-Physical Systems - Verification, Intelligence, Design, and Analysis)   March 2024 - January 2025

- Supervisor: Prof. Jyotirmoy Vinay Deshmukh (Google Scholar: https://bit.ly/3UIaIxd)
- Co-authored a research paper on formal and sampling-based techniques for automatic generation of edge-case scenarios in safety-critical autonomous systems, with applications in autonomous driving and human-robot collaboration in industrial settings **(RV '24)**
- Familiarized myself with Scenic and variants of Rapidly-exploring Random Trees (RRT's)
- Broadly explored the application of generative models like, VQGAN, diffusion models for generating safety-critical scenarios for comprehensive self-driving car testing

Research Intern @ 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: https://bit.ly/3CsdIaH)
- Designed three separate architectures for detecting handwritten Bengali numerals - one mimicking the LeNet-5 network and the other two using Residual and Inception blocks
- 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 ($\sim 97.1\%$)

RESEARCH COLLABORATIONS (REMOTE)

Collaboration with UNC Chapel Hill CV Group   March 2024 - January 2025

- Collaborators: Prof. Roni Sengupta (Google Scholar: https://bit.ly/4ejIRdC) and Jun Myeong Choi (Google Scholar: http://bit.ly/44Ls6Hk)
- Occasionally collaborated on detecting student video lecture engagement with passive monitor illumination
- Implemented a personalized ViT backbone architecture which shows an improvement in performance (74.95%) when compared with the baseline architecture ($\sim 71\%$) in dark lighting conditions
- Experimented with diffusion models and SDS loss (per-image optimization) to improve the monitor image prediction quality
- Explored the application of self and cross attention based architectures in detecting video engagement with the ultimate goal of building a generalized model for the task

Collaboration with USC CPS-VIDA (Cyber-Physical Systems - Verification, Intelligence, Design, and Analysis)
                                                                May 2023 - August 2023

- Collaborators: Prof. Jyotirmoy Vinay Deshmukh (Google Scholar: https://bit.ly/3UIaIxd), Shuvam Ghosal (Google Scholar: https://bit.ly/4dBdcWE) and Anand Balakrishnan (Google Scholar: https://bit.ly/4364Gv5)
- Developed a safety monitoring framework for detecting the robustness of existing pedestrian detection models in low-light and adverse 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
- Found IA-YOLO to perform better as compared to vanilla YOLO in both foggy as well as night conditions
- Experiments indicated that IA-YOLO was able to detect pedestrians successfully in both foggy and night conditions whereas vanilla YOLO was able to detect pedestrians reasonably in night conditions but failed to satisfy the TQTL specifications in foggy weather conditions
- Proposed TQTL as a quality metric that will help in debugging or improving the existing pedestrian detection models

PUBLICATIONS

C2. Vidisha Kudalkar, Navid Hashemi, Shilpa Mukhopadhyay, **Swapnil Mallick**, Christof Budnik, Parinitha Nagaraja, and Jyotirmoy V. Deshmukh. Sampling-Based and Gradient-Based Efficient Scenario Generation. 24th International

Conference on Runtime Verification, pp. 70-88. Springer Nature Switzerland, 2024.
DOI: https://doi.org/10.1007/978-3-031-74234-7_5 || PDF Link: https://bit.ly/48Plesq

C1. **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.
DOI: https://doi.org/10.1007/978-3-031-44267-4_22 || PDF Link: https://par.nsf.gov/servlets/purl/10495152

ACADEMIC PROJECTS

Analysing Twitter Data on Rhino Conservation using Natural Language Processing
Project Report: 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 Report: 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 Code Repository: 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 Code Repository: 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 Multimodal Approach to Speech Emotion Recognition
Project Report: https://bit.ly/4gKNMqD | *Project Code Repository:* https://bit.ly/3BuQu3u   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 Code Repository: 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

Graduate Courses:

- **CSCI 513:** Autonomous Cyber-Physical Systems (**Scored 476.05 out of 440**)
  - ☐ **Link to Blackboard grade sheet:** https://bit.ly/3YR1v8l
  - ☐ **Link to Course Syllabus:** https://bit.ly/3YAvKyZ
- **CSCI 567:** Machine Learning
- **CSCI 544:** Applied NLP
- **CSCI 461:** AI for Sustainable Development
- **CSCI 561:** Foundations of AI
- **CSCI 566:** Deep Learning and its Applications
- **CSCI 572:** Information Retrieval and Web Search Engines
- **CSCI 585:** Database Systems
- **CSCI 570:** Analysis of Algorithms

Undergraduate Courses:

- **CS 402:** Formal Language and Automata Theory
- **CS 502:** Microprocessors and Microcontrollers
- **CS 504D:** Object Oriented Programming
- **CS 601:** Database Management System
- **CS 603:** Operating System
- **CS 605A:** Operations Research
- **CS 702:** Compiler Design
- **CS 801D:** Cryptography and Network Security
- **CS 403:** Computer Architecture
- **CS 503:** Discrete Mathematics
- **CS 591:** Design and Analysis of Algorithm
- **CS 602:** Computer Networks
- **CS 604A:** Information and Coding Theory
- **CS 701:** Software Engineering
- **CS 703C:** Artificial Intelligence

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: https://bit.ly/48EgkOS)
  - ☐ Neural Networks and Deep Learning (Link: https://bit.ly/3O1M5YN)
  - ☐ Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization (Link: https://bit.ly/48E1w2C)
  - ☐ Structuring Machine Learning Projects (Link: https://bit.ly/48Kg3tJ)
  - ☐ Convolutional Neural Networks (Link: https://bit.ly/4fgHYUJ)
  - ☐ Sequence Models (Link: https://bit.ly/40Bl0D4)
- Natural Language Processing Specialization (DeepLearning.AI) (Link: https://bit.ly/3AzIRsm)
  - ☐ Natural Language Processing with Classification and Vector Spaces (Link: https://bit.ly/3YDBAzB)
  - ☐ Natural Language Processing with Probabilistic Models (Link: https://bit.ly/3AxSkAj)
  - ☐ Natural Language Processing with Sequence Models (Link: https://bit.ly/3ULl6V1)
  - ☐ Natural Language Processing with Attention Models (Link: https://bit.ly/40CoFkj)
- MATLAB (Vanderbilt University) (Link: https://bit.ly/3YZZKGc)
- Bayesian Statistics (UC Santa Cruz) (Link: https://bit.ly/3Axq7cU)
- Introduction to Big Data (UC San Diego) (Link: https://bit.ly/48E5590)
- Big Data Integration and Processing (UC San Diego) (Link: https://bit.ly/3AyiDq8)
- Big Data Modeling and Management Systems (UC San Diego) (Link: https://bit.ly/3YHNGYw)
- Machine Learning with Big Data (UC San Diego) (Link: https://bit.ly/40DPFzN)
- Introduction to TensorFlow for Artificial Intelligence, Machine Learning, and Deep Learning (DeepLearning.AI) (Link: https://bit.ly/40CTV2p)
- Convolutional Neural Networks in TensorFlow (DeepLearning.AI) (Link: https://bit.ly/4fEZVMf)

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