REETU HOODA

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SUMMARY

- Three years of academic research experience in Image Compression using Optimization and Deep Learning techniques.
- I am seeking to be a part of organization that focuses on research related to Data Compression, Image Processing, Computer Vision, Machine Learning, Deep Neural Networks and Data Science.

EDUCATION

Ph.D. | Concentration: Image Processing GPA: 3.78
The University of Alabama in Huntsville (Expected May 2022)

M.S. | Electrical and Electronics Engineering GPA: 3.66
The University of Alabama in Huntsville (Aug 2016 – May 2018)

B.Tech. | Electronics and Communication Engineering GPA: 3.75
Visvesvaraya Technological University, Bangalore India (Sep 2012 – June 2016)

RELEVANT COURSEWORK

Major: Digital Image Processing, Data Compression, Digital Signal Processing, Intro to Parallel Programming
Minor I (Math): Analytical and Computational Methods I & II, Matrix Theory, Numerical Methods II
Minor II (CS): Deep Learning, Machine Learning, Data Mining, Big Data Analytics

TECHNICAL SKILLS

Programming Languages: Python, C, C++, MATLAB
Frameworks: Numpy, Pandas, Matplotlib, TensorFlow, Keras, Scikit-learn, PyTorch

PROFESSIONAL EXPERIENCE

Applied Research Intern, Sony Corporation of America May 2020 – Aug 2020

- Responsibilities involved improving the codec for compression of 3D point clouds.
- Conducting experiments and helping deliver input documents to the MPEG call for proposal for the new 3D video format.
- Follow-up activities regarding the definition of the standard.
- Developed a new scheme to switch between RAHT and Dyadic RAHT using 3D edge detection for improvements in point cloud attribute compression.
- Prepared a document for a survey on point cloud compression using deep learning approaches.

Graduate Teaching Assistant, The University of Alabama in Huntsville Aug 2016 – Present

- Courses: EE 203 (Digital Logic Design Lab), EE 384 (Digital Signal Processing Lab)

MASTERS RESEARCH

Search and Optimization Algorithms for Binary Image Compression: This work focused on improving efficiency of lossless compression (complete reconstruction) of binary images. To this end, I proposed to use Binary Particle Swarm Optimization (BPSO) and Tree-Based Search Algorithm which offers better compression. Extensive simulations on various datasets (Video sequences of 300 frames and Hyperspectral datasets) demonstrated that we can achieve significantly higher compression on average than other international standards such as the JPEG 2000 and JBIG 2.

CURRENT RESEARCH

Predictive Coding for Image Compression using Neural Networks: I am continuing my graduate research work of coding binary images under the guidance of my advisor Dr. David Pan. The research work aims at identifying potential improvements to compression performance using neural networks by predicting the pixels from its neighboring pixels that have similar correlations.

PUBLICATIONS

R. Hooda, and W. D. Pan, "Tree Based Search Algorithm for Binary Image Compression," in *Proc. of IEEE SoutheastCon,* Huntsville, AL, April 2019.

R. Hooda, and W. D. Pan, "Lossless Compression of Ground Truth Labels of Hyperspectral Images Using Optimization Algorithms", *in preparation*.

PROJECTS

- **Early Termination of dyadic RAHT (Region Adaptive Hierarchical Transform) for Efficient Attribute Compression**
  - Improvements were reported shifting from RAHT to Dyadic RAHT on average for attribute encoding.
  - Investigation of early stop experiments were made to observe the change in the BD-rate performance.
  - The idea was to use Dyadic RAHT for denser or non-uniform areas in the 3D point cloud and RAHT otherwise.
  - Early stop was made adaptive based on 3D edge detection on the block to be transformed.

- **Shallow Neural Network for Classification**
  - Developed an API-like python class of a fully connected shallow neural network for binary/multi-class classification from scratch using Numpy.
  - The implementation was tested on two datasets: MNIST and Madison County (non-image).
  - Reasonably high accuracy (MNIST: 97.37%, Madison County: 87.87%) was achieved using the methodology.
- **Classification of CIFAR 10 using Convolutional Neural Networks (CNN)**
  - Designed a CNN architecture for classifying images in CIFAR 10 dataset.
  - The proposed model achieves appreciable training (93.7%), validation (86.84%) and testing (95.03%) accuracy.
  - Overfitting was addressed using dropout and batch normalization.
- **Emotion Detection Through Facial Feature Recognition**
  - *Milestone1 (Face Detection and PCA to Generate Eigenfaces)*: An image processing methodology for face detection and PCA on detected images is implemented in this project. The complete training implementation uses Viola-Jone's Haar-like feature cascade detector to detect faces as well as eyes and mouth then PCA is performed to obtain eigenfaces.
  - *Milestone 2 (Face Recognition using LDA for Emotion Classification):* For each emotion that we wished to train a predictor for, we performed Fisher LDA in reduced dimensionality, in which the goal was to optimize the objective function that minimizes within class variance to gain clear separation between the class of interest and the other classes.
  - *Milestone 3 (Emotion Detection using Facial Feature Recognition):* Humans share 7 set of fundamental emotions which are exhibited through facial expression. The project involved development of multi-class predictor for classification of emotions. The hybrid approach involved computationally slower HOG feature extraction and a class prediction is made with a trained SVM. Reasonable accuracy of 81% is achieved on the testing set and test emotions.

- **Deep Convolution Generative Adversarial Networks (DCGAN) for CIFAR 10**
    - Generation of CIFAR 10 images using CNN based GAN architecture.
    - The model was successful in picking up the patterns that resembles the original training images.

- **A Survey on Point Cloud Compression Using Deep Learning Approaches**
    - The project covers the on-going research on 3D point cloud compression (PCC) using deep learning approaches.
    - The benchmark datasets with performance metrics are also included.
    - The results of the methods included shows performance comparable to conventional coding paradigm thus offering promising improvements in the future.

AWARDS AND RECOGNITION

1st prize in 3MT (Three-minute thesis and dissertation competition) at the University of Alabama in Huntsville, 2020

CERTIFICATIONS

- **Coursera | Machine Learning** (Stanford University)
- **Coursera | Deep Learning Specialization** (deeplearning.ai)
    1. Neural Networks and Deep Learning
    2. Structuring Machine Learning Projects
    3. Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization
    4. Convolutional Neural Networks
    5. Sequence Models