COMPSYS 721 Machine Intelligence and Deep Learning

Project 1: Face Recognition (30% of Final Mark)

Due Date: Week 9 Monday, 12th May 11am

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Project Overview

Face recognition has been a significant area of research within computer vision and machine learning, with applications ranging from surveillance systems to biometric authentication and emotion recognition on social media. Over the past decade, the field of computer vision have been advanced by deep learning techniques, greatly enhancing face recognition capabilities.

This individual project (i.e. no group work) will engage you in studying, implementing, and analysing the strengths and weaknesses of well-known convolutional neural network models, using face recognition as a real-world example with a publicly available dataset.

Project Steps

Step 1: Literature Review and qualitative comparison

This part is a literature-based analysis (with at least 6 references). There is no need to run any experiment at this stage.

- Baseline Models: Conduct literature review on three popular models: ResNet, VGG, and Inception V4.
- Qualitative Comparison: Based on the literature review, perform a qualitative comparison of these models in terms of their performance, model size, and computational complexity.

Step 2: Dataset Analysis

- Primary Dataset: Study the LFW (Labeled Faces in the Wild) dataset. (https://vis-www.cs.umass.edu/lfw/). The dataset is provided on Canvas, and you must use this version.
- Additional Datasets: Research and find three other publicly available human face datasets. Perform a qualitative comparison of these datasets (with LFW), discussing their strengths and weaknesses with one another, in terms of the purpose of dataset, the diversity (e.g., number of classes and number of samples in each class), the robustness (e.g. variations in images and image qualities).

Step 3: Model Implementation and Evaluation

- Model Selection: Based on the result of step 1, select two of the models you analysed to implement. Note: your implementation must NOT use pre-trained weight or pre-trained model. [**Note: Tensorflow will not be supported in project 2 so we recommend using pytorch for implementation to avoid extra effort.**]
- Data Preparation: Use the top 8 classes (ranked in descending order of the number of images) from the LFW dataset for your experiments.
- Hyperparameter Tuning: Tune your model hyperparameters and select the ones that offer the best performance.

- Performance Evaluation: Design and run quantitative analyses to evaluate and compare the models in terms of their performance, model size, and computational complexity, using the selected 8 classes from the LFW dataset.

Deliverable

Report (30%) - Up to 8 pages (with the given template on Canvas), containing:

1. **Literature Review (8%):**
   - A literature review of at least 6 reputable papers and provide descriptions of individual models in terms of their architecture, strengths, and weaknesses.
   - Provide a qualitative comparison of the 3 baseline models. Please present your qualitative comparison in the form of a table, and elaborate by text.
2. **Dataset Review (6%):**
   - Review the LFW dataset and compare it with three other datasets. Please present your qualitative comparison in the form of a table, and elaborated by text.
3. **Methodology (6%):**
   - Descriptions on model implementation details for the two selected models, with justifications for the model selection.
   - Descriptions on hyperparameter tunning process and the final parameter values.
4. **Performance Comparison (9%):**
   - Descriptions on the experimental setup (train/validate/test processes) and how to evaluate (i.e. what metric(s)) the models' performances.
   - Present and discuss the quantitative performance results using the LFW dataset. Please present your quantitative comparison in the form of a table, and elaborate by text.
5. **Concluding remark (1%)**
   - What are your findings, do qualitative analyses match with quantitative analyses?