CS412 Machine Learning Homework 4 – Transfer Learning

Due: May 17th, 2023   **Late Accepted Until:** May 19th, 2023

Starter Notebook Link

https://colab.research.google.com/drive/1u7joStsUlNxfx-OQ6SLGsWquuHNjsSDW?usp=sharing

Goals

The goal of this homework is for you to have a hands-on experience with deep learning; specifically transfer learning with pre-trained models.

You will be given a subset of the *CelebA* Dataset, a large-scale face attributes dataset with more than 200,000 celebrity images. The task is to build a model to classify the gender of a person in an image, using **transfer learning**. To achieve this, you will start with the pretrained VGG-16 network, which is a widely used deep neural network for image recognition and modify this network to suit the new task and "retrain" (only) as needed. While CelebA has many annotated attributes about the photo, you will only use the gender column.

After changing the model architecture, you will need to decide on the learning rate and optimizer. For batch size, you can try using 8 or 16 images (in general larger batch sizes are more reliable but slows down training and also may not fit in memory depending on the size of the inputs) and run the algorithm for 10 epochs. You will then need to compare two models: i) one where you only train the output layer weights and ii) where you also fine-tune the weights of the last hidden layer.

Dataset

You are given a subset of *CelebA* dataset to work on. It consists of 30.000 RGB face images of different sizes together with the attribute information of the face images. You are going to use *Male* attribute to extract the gender label.

Task

Your task is to fill the starter notebook according to the instructions (you can also use your own code). In that way, you will implement a transfer learning setup, in which the VGG-16 architecture with a classification head (it is going to be set depending on the target class size) will be utilized.

The way you should load images, split dataset, create ImageDataGenerator objects, and freeze VGG-16 pretrained weights is already demonstrated on the starter notebook. You will choose the right classification head for your binary classification task, then experiment on different learning rates to make your model more accurate.

It is important to note that Google Colab provides a GPU, which can significantly accelerate your training phase. Therefore, we highly recommend switching your runtime to GPU by selecting "Runtime" from the menu bar, then choosing "Change runtime type" and selecting "GPU" under "Hardware accelerator".

Report

Your report should include:

- **Introduction**: where you briefly mention the problem description and how are you going to deal with it.

- **Dataset**: briefly explain the dataset and put at least 5 random images from it.

- **Methodology**: Explain that you used transfer learning and how you adapted it to your task.

- **Experiments**: Briefly mention the results of your experiments (may include learning rate trials even if for a few epochs; fine-tuning or not; ...). Include a table that summarizes your experiments (experiment and accuracy) and a figure for the training curve (train-val loss versus epoch).

- **Conclusion**: Summarize your findings in 5-10 lines.

Submission Guideline

Please submit your **PDF report** and **ipynb files** to SUCourse. For each deliverable mentioned, please include your name and student ID.