Machine Learning Engineer Nanodegree

Capstone Proposal

Gender Classification

Domain Background

Gender classification is to determine a person's gender, e.g., male or female, based on his or her biometric cues. Usually facial images are used to extract features and then a classifier is applied to the extracted features to learn a gender recognizer. It is an active research topic in Computer Vision and Biometrics fields. The gender classification result is often a binary value, e.g., 1 or 0, representing either male or female. Gender recognition is essentially a two-class classification problem. Although other biometric traits could also be used for gender classification, such as gait, face-based approaches are still the most popular for gender discrimination [ref].

Problem Statement

The goal is to create a gender classification based on person face image so it's a binary classification problem; the tasks involved are the following:

1. Download and preprocess the Adience Benchmark dataset
2. Explore the dataset distribution and make sure the data is balanced
3. Use a pre-trained CNN model to extract features from the images
4. Build a neural network to classify gender given image features
5. Train the network and try different network architecture and configuration
6. Evaluate each network and choose the best one

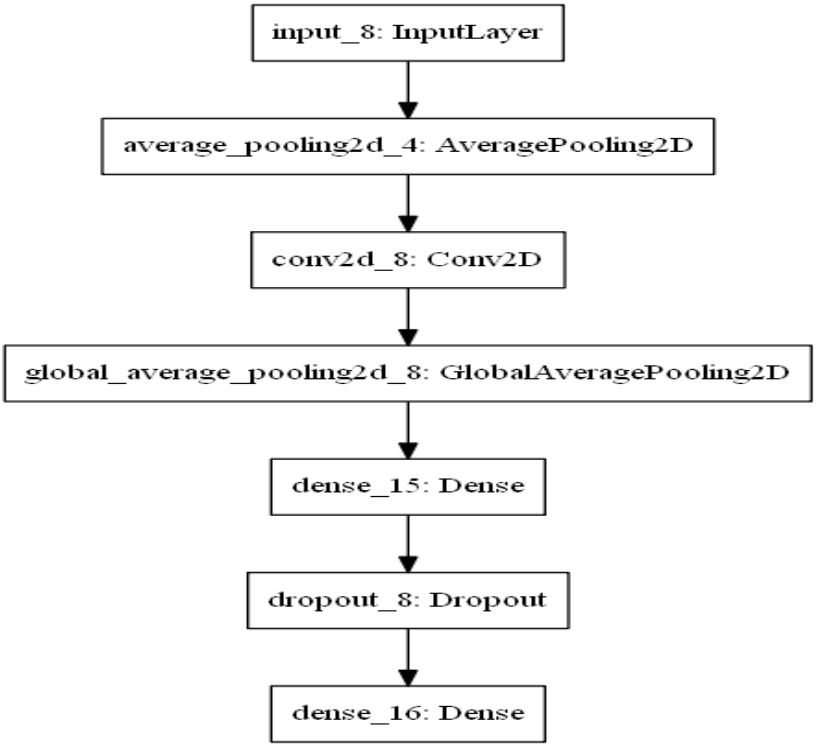
Datasets and Inputs

The dataset used for training and testing for this project is the Adience Benchmark - collection of unfiltered face images. It contains total 26,580 images of 2,284 unique subjects that are collected from Flickr. There are 2 possible gender labels: M, F and 8 possible age ranges: 0-2, 4-6, 8-13, 15-20, 25-32, 38-43, 48-53, 60+. Each image is labelled with the person's gender and age-range (out of 8 possible ranges mentioned above).
I'm only interested in gender labels, there are 9372 images with label f and 8120 with label m.
The images are Face images, cropped and aligned, and are of different sizes so I handle size when loading images to models.
I'm only going to work on a subset of this data, since it's a binary classification problem and I'm using a pre-trained model, I will use 6000 images for training, 2000 for validation and 2000 for testing, where I will sample each subset such that half of it with label f and the other half with label m.

Solution Statement

As this problem works with people face images I'm going to use a pre-trained model for image classification (InceptionV3) trained on imagenet dataset to extract useful features from images and then build a neural network that given the image features extracted from InceptionV3 can classify whether the person in this image is male or female.

Benchmark Model



I used a simple CNN model with input (224,224,3) then decreasing size by using average pooling layer then using a convolution layer with 64 filters then a global average pooling layer then a dense layer with 32 neurons and a dropout layer then a dense layer with sigmoid activation.

I got accuracy 0.54 and val_acc 0.57 after 16 epoch when training on 5984 image and validation on 1984 with batch size 32

Evaluation Metrics

I'm going to work with the accuracy metric provided by keras for binary classification problems, it's a good metric as I'm ensuring my data is balanced.

Project Design

My workflow for this problem:

1. Load the dataset and explore it, remove outliers, make sure it's balanced
2. Load the image and preprocess them for keras pre-trained models for image classifications problems and try different models
3. Build a neural network that given the images features extracted by the pretrained model can classify whether it's a male or female
4. Try different architecture for the neural network and different configuration and evaluate them on the validation set and choose the best model
5. Evaluate final model performance on the test set data
6. Use openCV to detect faces in new images and align them before processing them in the model