# Facial Attribute Classification

## Image Processing, CNN with Transfer Learning, and Evaluation Methods

Phoebe Jeske &
Lila Schisgal

# Data Processing

Initially:

- Loaded each image
- Standardized around training mean
- Reshaped to 1D array

Final model:

- Used three ImageDataGenerators for train, validation, and test
- Rescaled from 255 to 0-1
- These generated batches of images with specified attributes and labels

# Building the Model

**Model from Scratch**

- Conv2D, Flatten, Dense, and Dropout Layers
- Fully trained: test accuracy of 0.0257, weighted average precision of 0.40, recall of 0.34, and f-1 score of 0.36.

Pros: More customizable, predictions centered around a similar threshold for each attribute

**Transfer Learning**

- Transfer Learning using ResNet50
- Froze the ResNet50 layers and then fine-tuned
- Ran for five epochs, fine-tuned for five epochs
- test accuracy of 0.009, weighted average precision of 0.63, recall of 0.30, and f-1 score of 0.39 (however, not descriptive because of variety in thresholds)

Pros: Less training time, higher accuracy, less data necessary

# Evaluating the Model

Sklearn.classification_report

- We were able to see and compare the precision, f-1, and recall, as well as the difference between the weighted and unweighted averages
-

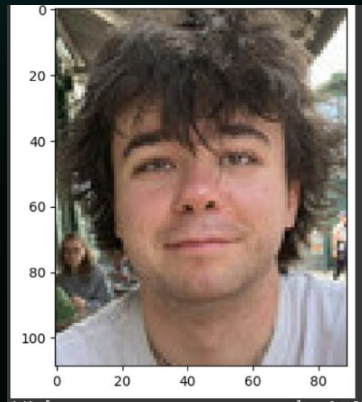
Confusion matrices

- We generated confusion matrices for each of the  40 attributes being looked at by our model. This allowed us to determine one of the issues with our accuracy was a tendency to predict all positive or all negative based on the attribute's threshold

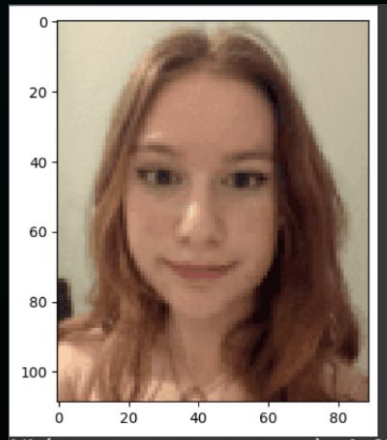
# Evaluating the Model (Part 2)

Custom Images:

By using custom images, we were able to get a better visual sense of how our model was performing, as well as the different thresholds. For example, aspects such as hair color always had low probability, whereas aspects like male always had high probability.



```
1/1 [==============================] - 0s 22ms/step
Probability of 5_o_Clock_Shadow: 0.1488
Probability of Arched_Eyebrows: 0.0209
Probability of Attractive: 0.1067
Probability of Bags_Under_Eyes: 0.1949
Probability of Bald: 0.0317
Probability of Bangs: 0.2567
Probability of Big_Lips: 0.1308
Probability of Big_Nose: 0.2999
Probability of Black_Hair: 0.0905
Probability of Blond_Hair: 0.0083
Probability of Blurry: 0.1874
Probability of Brown_Hair: 0.1113
Probability of Bushy_Eyebrows: 0.0716
Probability of Chubby: 0.1009
Probability of Double_Chin: 0.0845
Probability of Eyeglasses: 0.1330
Probability of Goatee: 0.2729
Probability of Gray_Hair: 0.0344
Probability of Heavy_Makeup: 0.0143
Probability of High_Cheekbones: 0.0742
Probability of Male: 0.7424
Probability of Mouth_Slightly_Open: 0.1935
Probability of Mustache: 0.1341
Probability of Narrow_Eyes: 0.1074
```



```
1/1 [==============================] - 0s 317ms/step
Probability of 5_o_Clock_Shadow: 0.1109
Probability of Arched_Eyebrows: 0.0796
Probability of Attractive: 0.2918
Probability of Bags_Under_Eyes: 0.1873
Probability of Bald: 0.0209
Probability of Bangs: 0.4066
Probability of Big_Lips: 0.2044
Probability of Big_Nose: 0.2176
Probability of Black_Hair: 0.1227
Probability of Blond_Hair: 0.0780
Probability of Blurry: 0.1584
Probability of Brown_Hair: 0.2199
Probability of Bushy_Eyebrows: 0.0914
Probability of Chubby: 0.0661
Probability of Double_Chin: 0.0447
Probability of Eyeglasses: 0.0575
Probability of Goatee: 0.0949
Probability of Gray_Hair: 0.0347
Probability of Heavy_Makeup: 0.1121
Probability of High_Cheekbones: 0.2026
Probability of Male: 0.4909
Probability of Mouth_Slightly_Open: 0.2261
Probability of Mustache: 0.0436
```

# Discussion

## If we had more time and resources:

We would run each of our models to full completion and potentially increase the number of layers.

We would try out other pretrained models to find one better suited to our data.