Capstone: CNN Emotion Detection

RONG T. WONG, GA DSI 15

Rants, Ratings and Reviews 

If we wanted to know more about a business or product, we should ask around for recommendations. .. Right?

Welcome to year 2020. Turns out a majority of buyers seek out online reviews before purchase. These reviews have a big impact on how buyers react to products, services and business and have a direct impact on sales. Reviews take on weight when products are highly priced or supplied by an unknown business, when reviews are negative and when there is simply a lack of reviews.

70% - 90%

of shoppers read a review before making a decision or final purchase.

Why Do Reviews and Ratings Matter?

Consumers

- As good as word of mouth
- Affects buying decisions
- More likely to spend if reviews are good
- Helps build trust

Businesses

- Products are more likely to sell if reviews are good or excellent
- Consumers are more willing to spend on business with good reviews
- Solves issues and improve

When do we use it?

- Downloading a bus timing app on App Store
- Trying out a new restaurant on Chope
- Buying an item from a Carousell seller
- Getting a product from an overseas buyer in Shopee

So, how many users are we looking at?

An Estimate of 4.65M smartphone users in 2020
Apple's share of mobile devices to be at 33.6% of the market share.

1.6 MILLION

Apple smartphone users in Singapore

Source: https://www.statista.com/topics/5842/smartphones-in-singapore/

Problem:

While all data points to heavy usage of Apps in the App Store, we see only a fraction of user reviews coupled with very skewed ratings.

How do we solve this?

BUSINESS

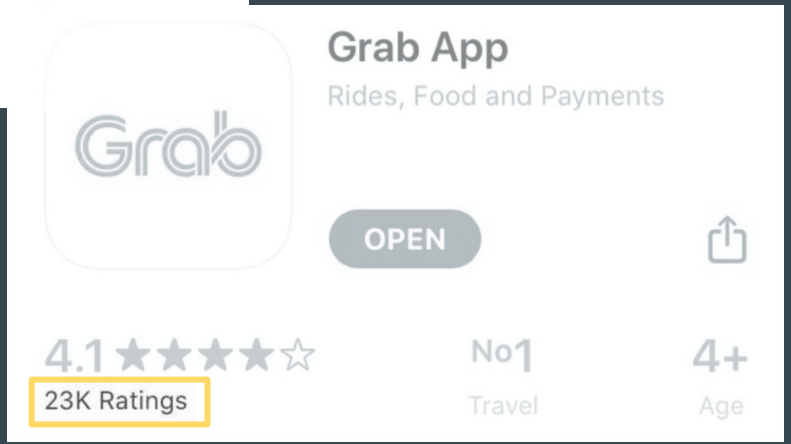
June 6, 2017

Grab Celebrates Fifth Anniversary and Significant User Milestones

- *3x growth in last year to 45 million downloads, and up to 2.5 million daily rides*
- *Has provided higher incomes for nearly 1 million drivers and reduced travel time in half across Southeast Asia since founding*
- *Adds GrabNow, New Service to Digitise Street Hailing*

2%

of estimated users leave ratings



Grab : 4.5 million Downloads in 2017.
(26.15% market share in 2017, approx 1.2M)
23K Ratings altogether. Gap of 1.15M users

Source: https://www.grab.com/sg/press/business/grab-celebrates-fifth-anniversary-significant-user-milestones/

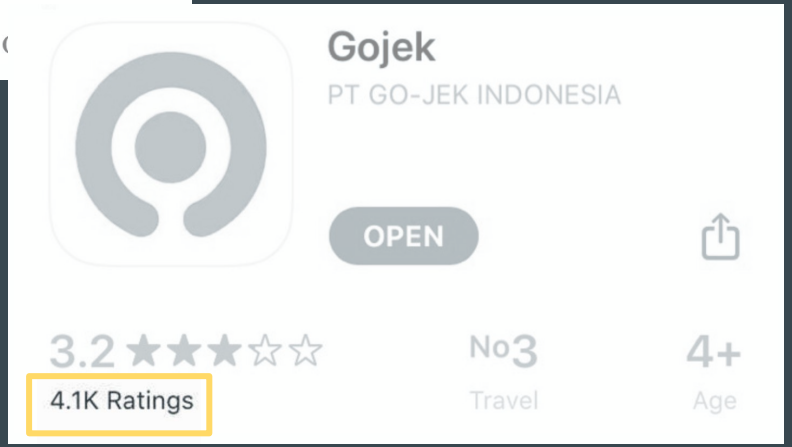
The number of rides fulfilled in the past six months was 20 million — double the figure during Gojek's first six months here.

The app now has 800,000 active users in Singapore. Although that makes it Gojek's smallest user base — it has 2.92 million users in Indonesia, 4.3 million in Vietnam and two million in Thailand — Singapore is the company's second largest transport market in terms of transaction volume.

What can Singapore users expect in 2020? A higher likelihood

1.5%

of estimated users leave ratings



Gojek : 800K active users in Singapore (2020)
(33.6% market share in 2020, approx 269K)
4.1K Ratings altogether. **Gap of 265K users**

Source: https://www.todayonline.com/singapore/singapore-users-complain-most-thats-good-thing-says-gojek

A joint study by Google and Temasek Holdings in 2018 also estimated the SEA's ecommerce industry to grow to US$240 billion by 2025. Moreover, it also said that 90% of Southeast Asians connect to the internet mainly through their mobile devices and this population of

350 MILLION

"mobile-first" users is expected to grow.

Source: https://www.thinkwithgoogle.com/intl/en-apac/tools-resources/research-studies/e-conomy-sea-2018-southeast-asias-internet-economy-hits-inflection-point/

Solution:

Create an automated rating system that uses real-time capture of emotions to rate the products.

What are Convolutional Neural Networks (CNN)?

A convolutional neural network is one of many a Deep Artificial Neural Network. CNNs particularly useful in the area of object recognition and image tagging.

In Image Classification, it is technique in computer vision to make the algorithm “see” the picture at a deeper level and capture the contents and patterns of the image.

Convolutional Neural Networks (CNN)

The Magic:

- Much less preprocessing
- Automatically detects the important features
- Very high accuracy with Image Classification

The Drawback:

- Needs A LOT of training data
- Still a Black Box
- Risk of Overfitting

My Process

Gather Datasets	• Searched for Labelled Datasets • Apply for Permission to use
Sorting, Image Processing	• Make Datasets uniform, combine, curate • Explore effects of Image processing techniques
Building our CNN	• Building a CNN from scratch • RandomizedSearchCV only takes you so far
Testing Datasets	• Finalise best Built • Run all Datasets through it
Final Train and Test, Apply	• Combine train and validation sets, for last fit • Cross your fingers and wait for the scores

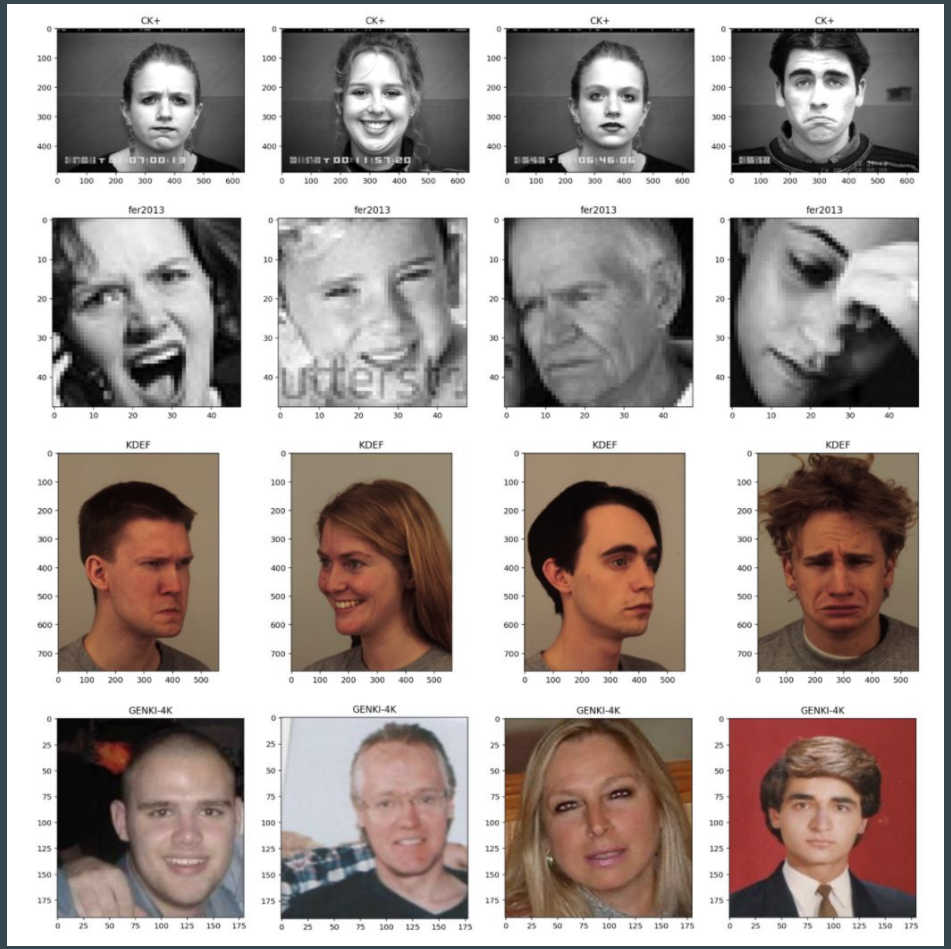
Datasets

CK+

FER-2013

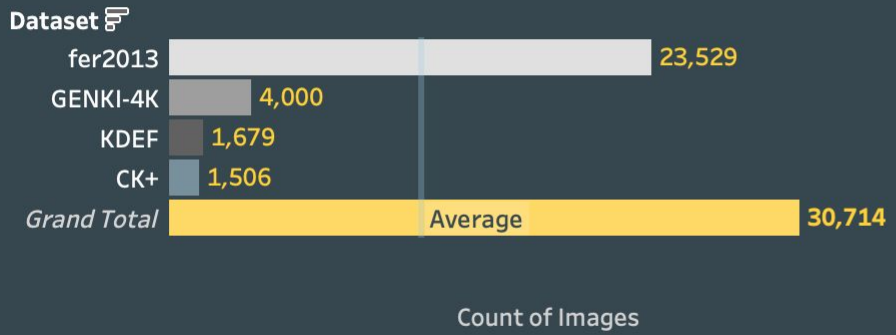
KDEF

GENKI-4K

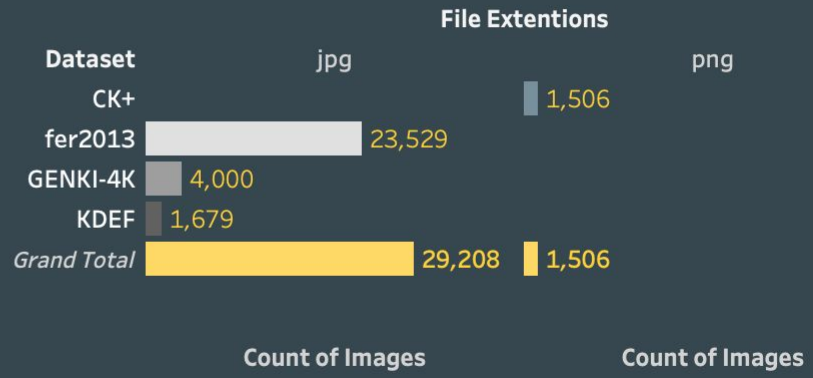


Multiple Datasets

Dataset



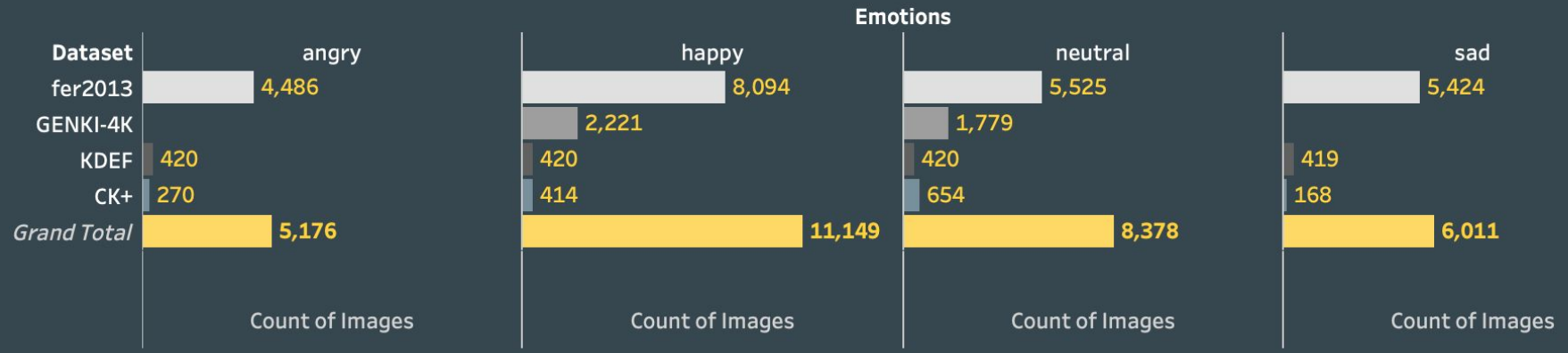
File Types



Majority of the images came from FER-2013 dataset. Although large, this dataset will prove to be very dirty but essential to our training.

Multiple Datasets

Emotions



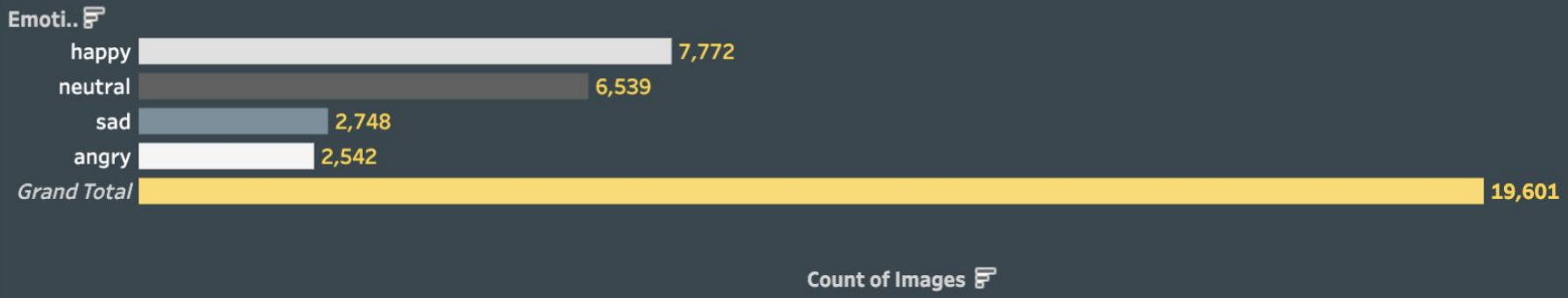
Classes are imbalanced.

Majority class - ‘Happy’ makes up 36.3% of the data before merging

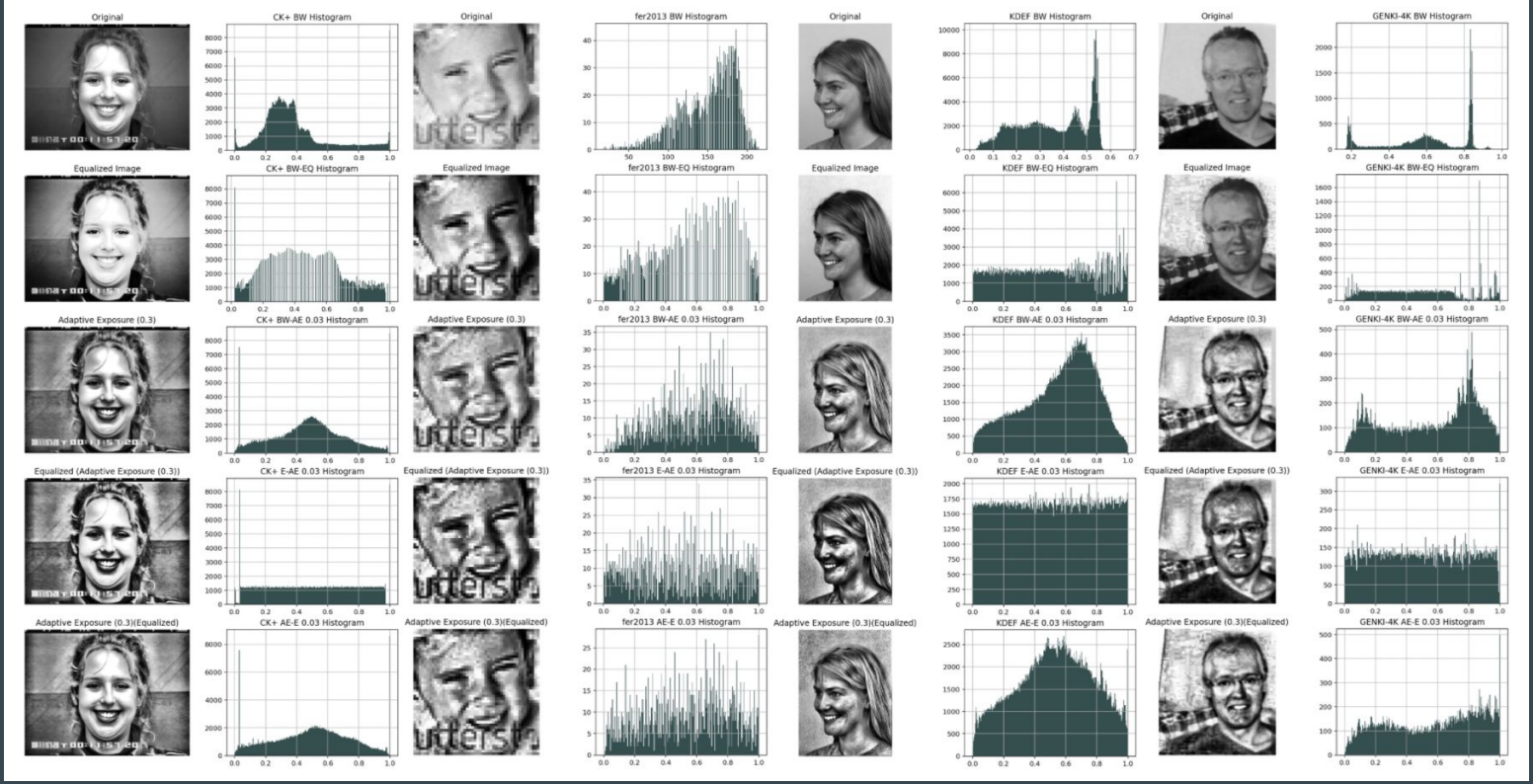
Merged Processed Data

FER-2013 was further curated before the merge, shrinking our dataset down further.

This shows a clearer picture of the data imbalance:



5 Sets of Merged Datasets



Adaptive Exposure + Equalization (AEE)

Images were put through Adaptive Exposure before going through Equalization.

Weighted-F1: 0.79

Equalization + Adaptive Exposure (EAE)

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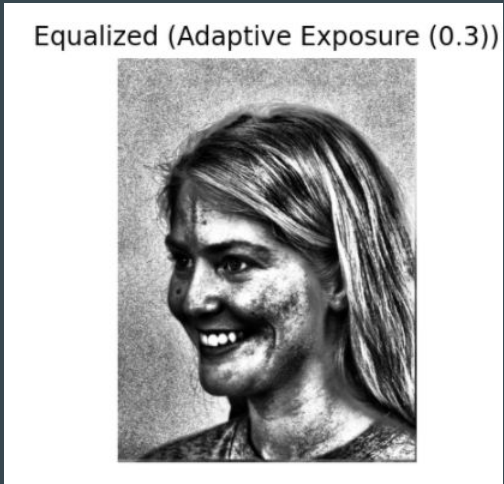
Weighted-F1: 0.79

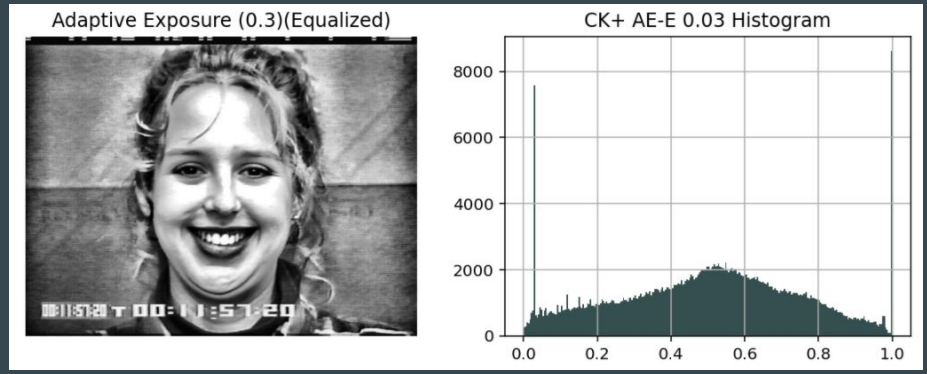


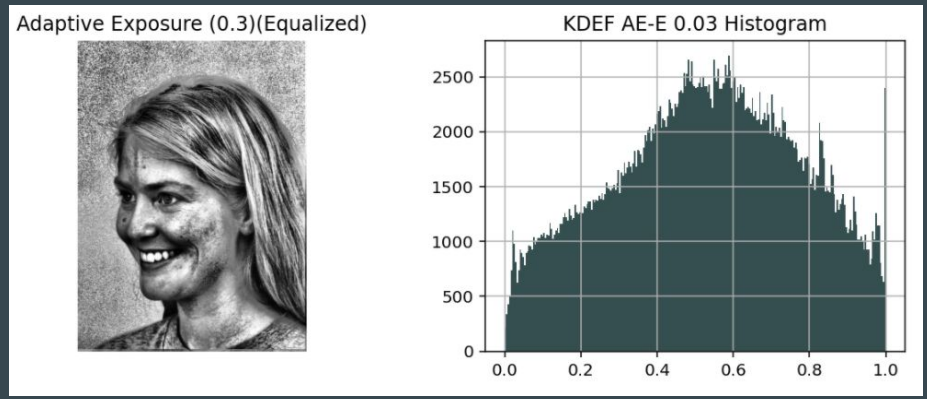
Adaptive Exposure + Equalization (AEE)

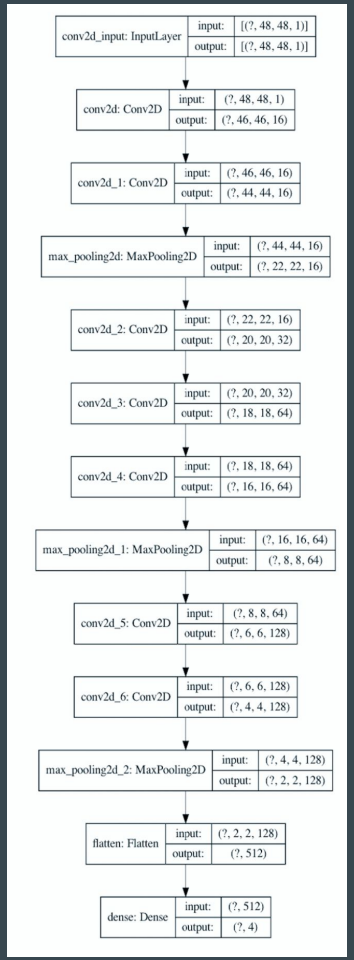
Despite having the same Weighted-F1, it had higher Precision and fewer Type II Errors for the Minority Classes

Characteristics

- Almost normally distributed Histogram







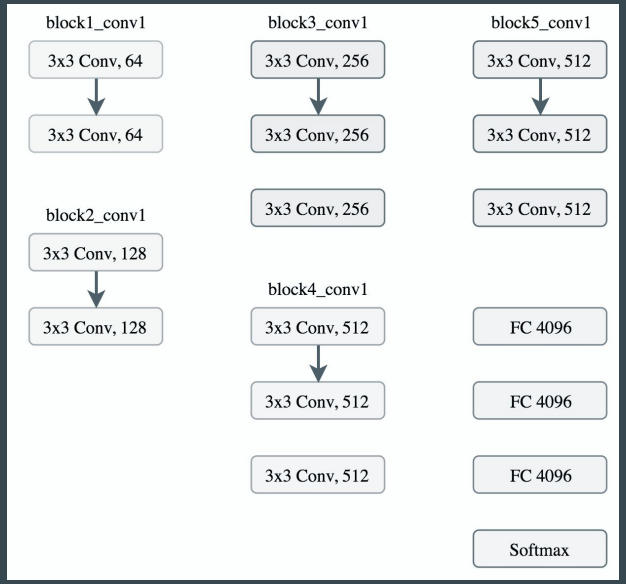
My CNN

The architecture was inspired by Oxford Visual Geometry Group, or VGG CNN Model. **Built from scratch.**

Tried and Tested:

- Batch Normalization
- Dropouts (various ratios)
- Max Pooling (various strides)
- Additional Convolution layers (various filters sizes)
- Different Batching combinations
- Different Learning rates
- Various Patience levels
- Elu activation
- Paddings
- Kernel Initializer (he_normal)
- Kernel Regularizer
- Activity Regularizer

VGG-16



AEE Weighted-F1: 0.78 ⚖

Findings

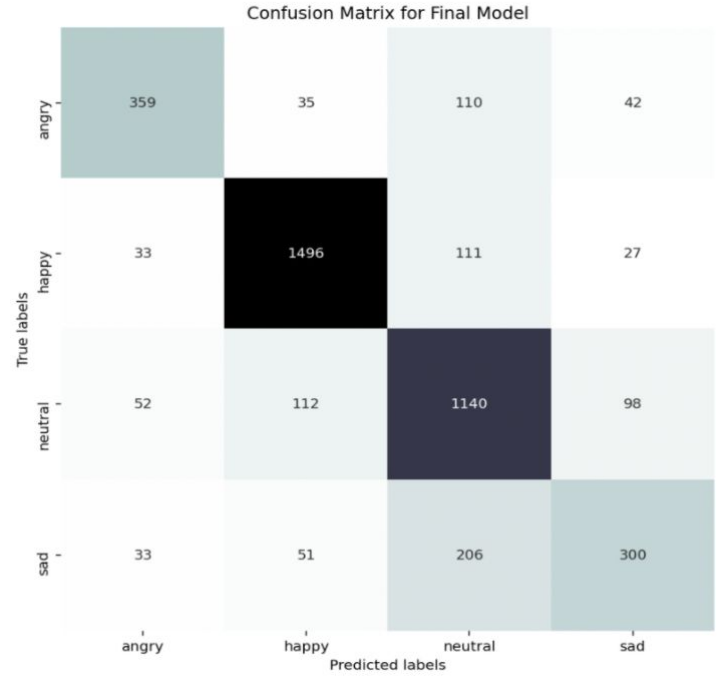
The Weighted-F1 for the final set dropped by 0.1 despite having slightly more data to train on.

Vs Baseline Score of 0.47

- 2 Layer Model
- Improved by 0.31

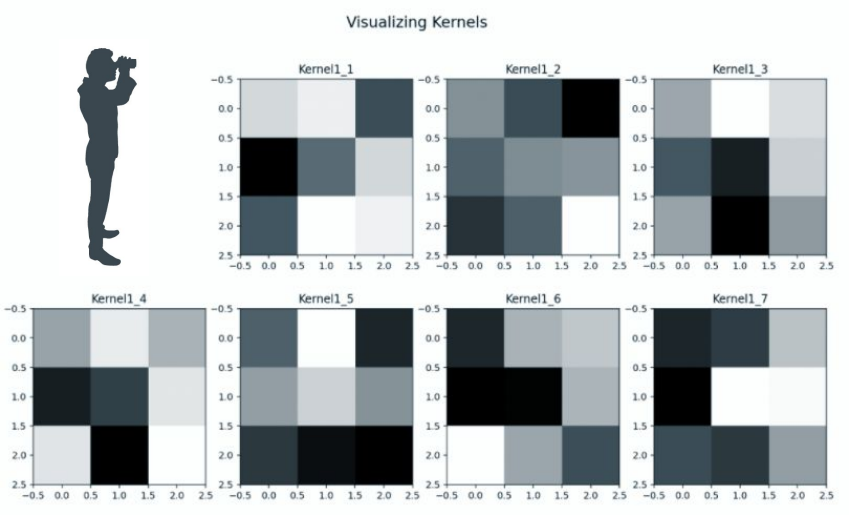
Classification Report for Final Model

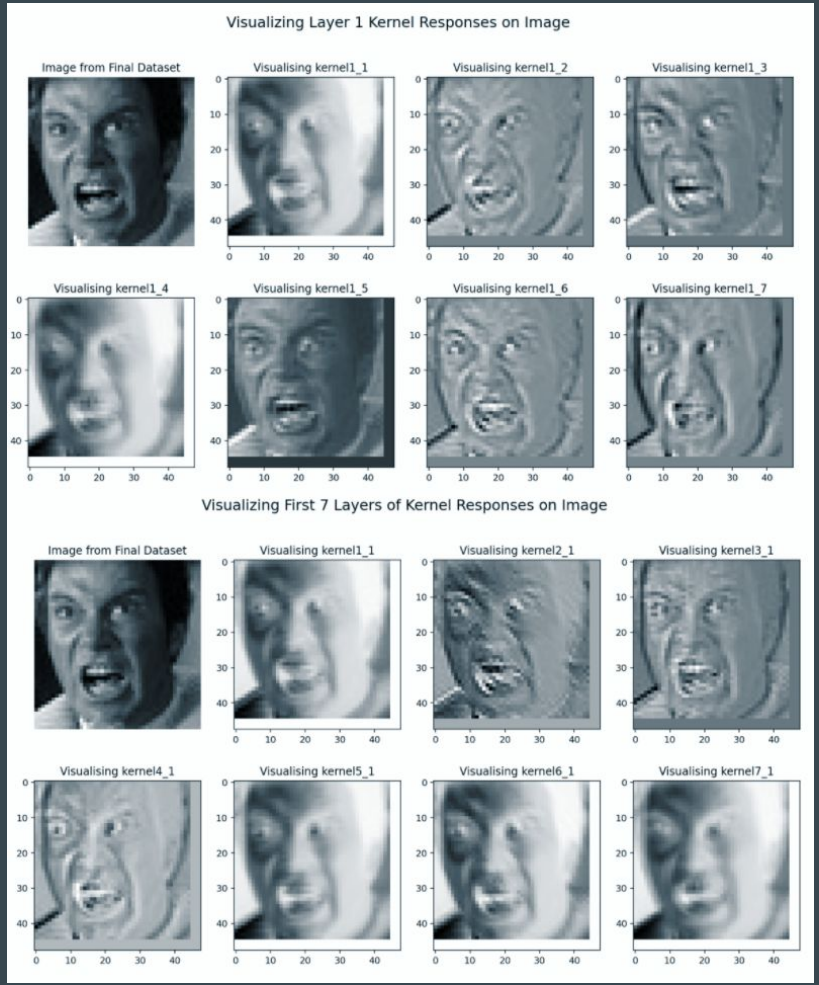
	precision	recall	f1-score	support
angry	0.75	0.66	0.70	546
happy	0.88	0.90	0.89	1667
neutral	0.73	0.81	0.77	1402
sad	0.64	0.51	0.57	590
accuracy			0.78	4205
macro avg	0.75	0.72	0.73	4205
weighted avg	0.78	0.78	0.78	4205



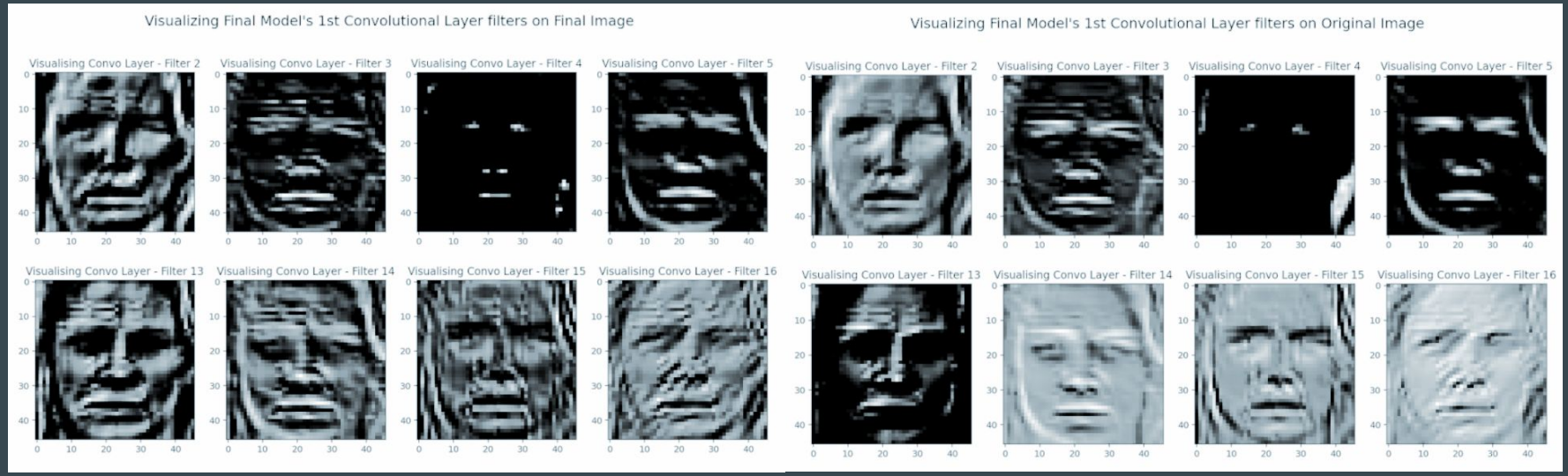
To better understand our CNN ..

Visualizing Kernel Responses ..





A Glimpse into Convolutional Masks 🔎



The Rating System

Emotion to Rating

Recommendation

Recommendations to improve the score requires higher quality and quantity of data being fed into the model for further training and generalisation.

This project also has the future option to add on recommender system to recommend popular words to add to the review. If successful, the tool will accurately predict emotions of faces. With sufficient data, it can also be expanded to learn more emotions to broaden the detection spectrum.

Questions?