02458 Cognitive modelling F22
2nd Assignment

Hadil Houssin (s203388)
Mohammad Ali Abbas (s203383)

Questions: What is the feature of interest? Describe in detail how you selected the images based on the feature of interest and on features of no interest.

Before choosing any features, we did some research to identify how dermatologist describe smile features. Here we found that the human smile consists of five smile features: smile lines also called nasolabial folds, vertical lip lines also called peritoneal folds, oral commissures, marionette lines and chin wrinkles. We have illustrated these features on figure 1.

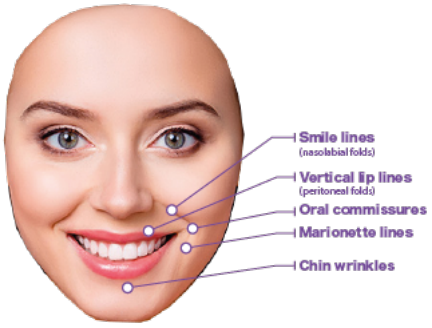


Figure 1: smile features according to dermatology

Then we looked at the images from the ARimages dataset and tried to identify the latter features. Since the images in the dataset didn't have high quality resolution, we couldn't identify all five features. We could however identify two features: nasolabial folds and oral commissures which could tell us something about the mouth curvature.

Figure 2: The figure shows the difference in the distance between the oral commissures

In the images on figure 2 we have highlighted the oral commissures feature. The visibility of the nasolabial folds is significantly different in the images and the distance between the oral commissures in the smiling face is larger than the face that is not. The more visible the folds and longer distance between the commissures, the surer we can be that the person is smiling.

We have decided to disregard images where glasses reflect too much light, since we have identified that this feature significantly decrease the accuracy of the models used. Images with facial hair also decrease the accuracy since the hair covers the selected features.

Question: Explain every step of the conversion of the raw data to the normalized pooled data. Verify that normalization worked by plotting histograms of ratings for each test person.

By using a MATLAB script, we could create a ratings dataset, that gives us the reaction time for each participant and the score per image from a scale from 1 (no smile) to 7 (smile). This dataset was loaded into python where the rest of the preprocessing took place.

We then used the following normalization equation to normalize the ratings:

$$x_{norm} = \frac{x - x_{min}}{x_{max} - x_{min}}$$

Figure 3: Normalization equation

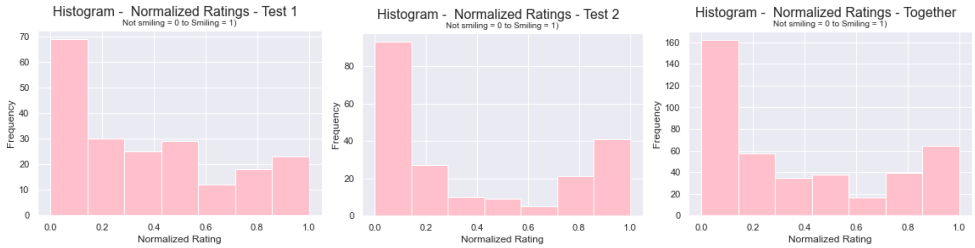
As we can see, each entry is reduced by the smallest value, and the result is divided by the range. where range is the discrepancy between the highest and lowest number.

This process was done in python as follows:

Step 1: Import the processing library from sklearn

Step 2: Use the normalize() method on the array (ratings)

Step 3: We then plotted histograms of ratings for each test person.



As we can see, the histograms show the normalized data. It ranges from 0 to 1 and the distribution for both participants show that they are biased towards answering no-smile.

Question: Provide a figure of the scaled PCs added to the mean. What do the PCs represent? How much variance do they encode?

On the images bellow we can see the scaled PCs. The "eigenfaces" are arranged from top-left to bottom-right in order of importance. We can observe that the first few elements appear to largely address lighting issues, while the following elements highlight distinguishing traits like the nose, eyes, eyebrows, etc.

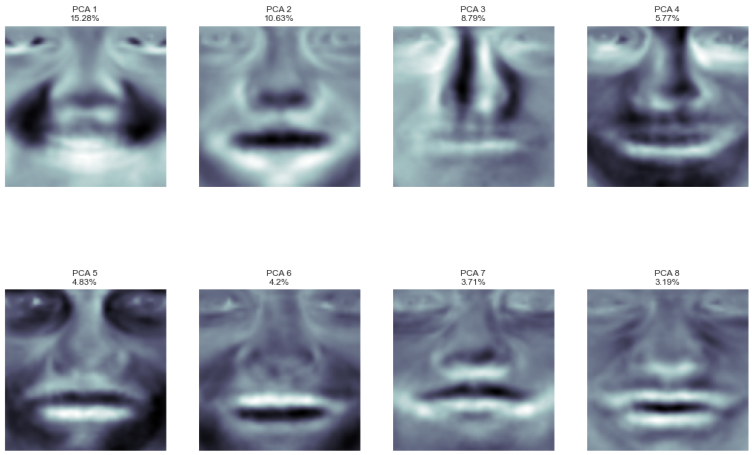


Figure 4: Scaled principal components added to the mean

The proportion of the variability of the predictions made by a machine learning model is measured using the explained variance. It is simply the discrepancy between the predicted value and the expected value. In our case the number of components explaining 90% variance is 48 (figure 5).

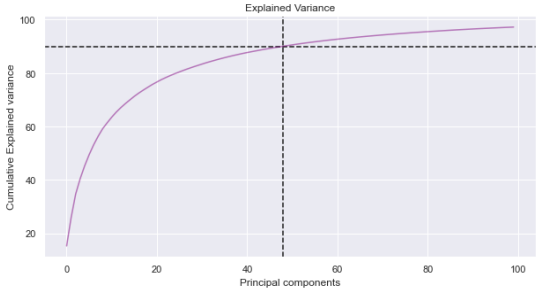


Figure 5: Explained variance

Question: Explain how your feature selection method works (your own or a routine from a toolbox).

Question: Explain in detail how you fit the model and how you use it to generate synthetic faces. Show the continuum as images.

Question: Explain in detail how you created these continua and show them.

Question: Analyse your results using ROC curves: Choose a baseline stimulus and fit/plot ROC curves for all the other stimuli with respect to the baseline stimulus. Do the ROC curves appear like you would expect? Explain your reasoning. Analyse your results using psychometric functions: fit/plot psychometric functions for each response criterion. Do the psychometric functions appear like you would expect? Explain your reasoning.