TBMI26 – Computer Assignment Reports Boosting

Deadline – March 14 2021

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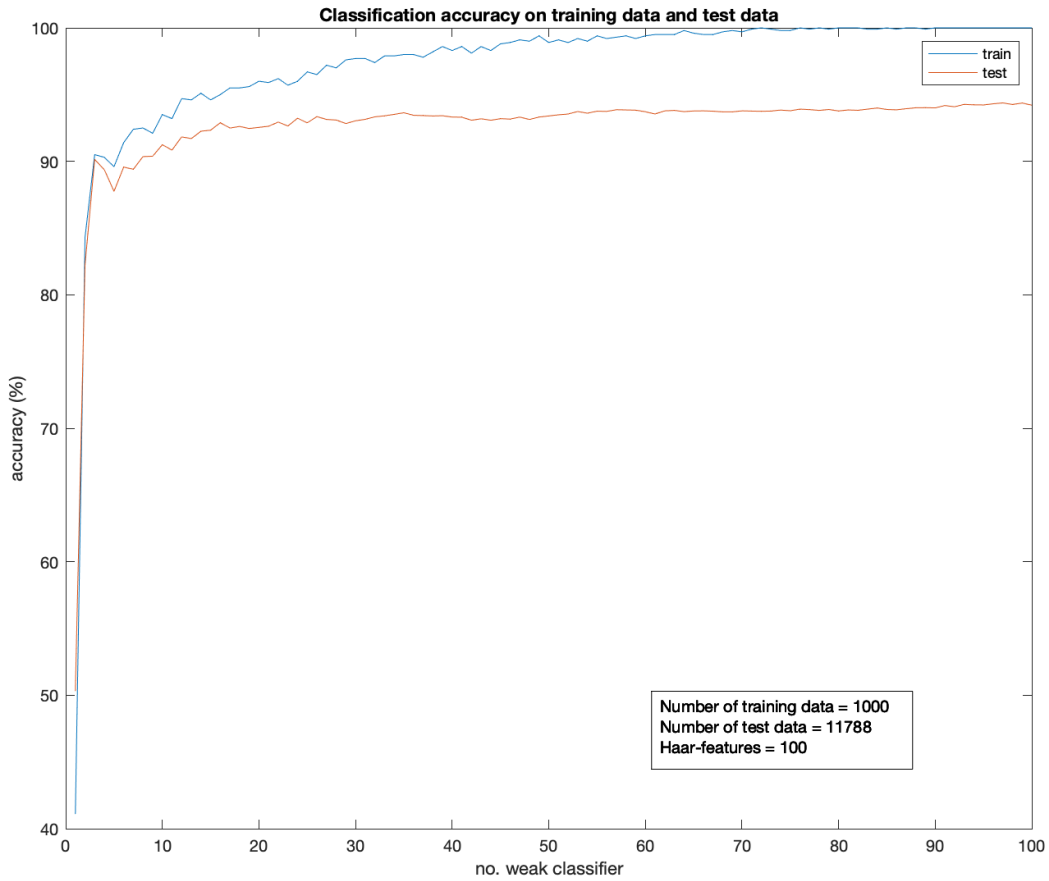
In order to pass the assignment you will need to answer the following questions and upload the document to LISAM. Please upload the document in PDF format. **You will also need to upload all code in .m-file format**. We will correct the reports continuously so feel free to send them as soon as possible. If you meet the deadline you will have the lab part of the course reported in LADOK together with the exam. If not, you'll get the lab part reported during the re-exam period.

1. **Plot how the classification accuracy on <u>training data and test data</u> depend on the number of weak classifiers (in the same plot). Be sure to include the number of training data (non-faces + faces), test-data (non-faces + faces), and the number of Haar-Features.**



2. **How many weak classifiers did you use when training? How many of them did you use for the final strong classifier? Motivate your choices.**

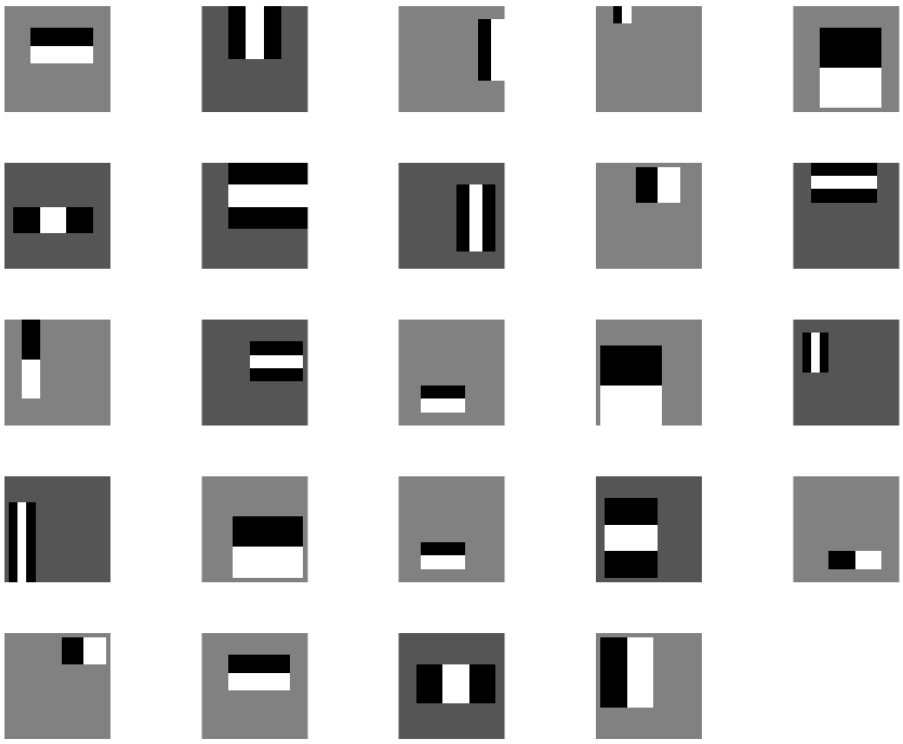
We were using 100 weak classifiers for training our model. This was a reasonable number considering training time and prediction accuracy. In the final strong classifier we were keeping the number of weak classifiers that were needed to reach at least 93% accuracy as asked in the assignment. The minimal number of reaching that accuracy given our seed (rng(1)) was found to be at 24 weak classifiers.

3. **What is the accuracy on the training data and test data after applying the optimized strong classifier? Discuss your choice of hyperparameters and how they influence the accuracies.**

After applying the optimized strong classifier we achieve an accuracy of 93.23% using 24 decision stumps. Increasing the number of weak classifiers will eventually lead to improvement of accuracy. Though, if we increase that number exceeding some threshold we also might see a decrease in accuracy given that our classifier will overfit the training data.

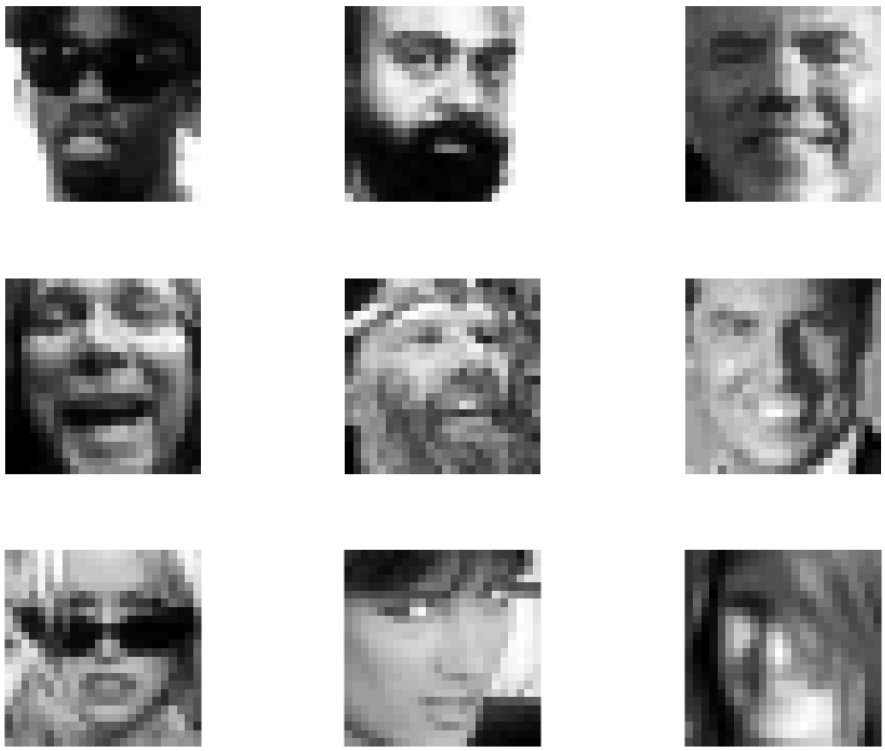
Another way of tuning our hyperparameters would be, instead of increasing the number of weak learners we could also increase the depth of our decision trees, which might also lead to better results.

4. **Plot the Haar-features selected by your classifier (one for each weak classifier). If you have many weak classifiers, select some representative subset. Can you think of why they would be useful for classifying faces?**

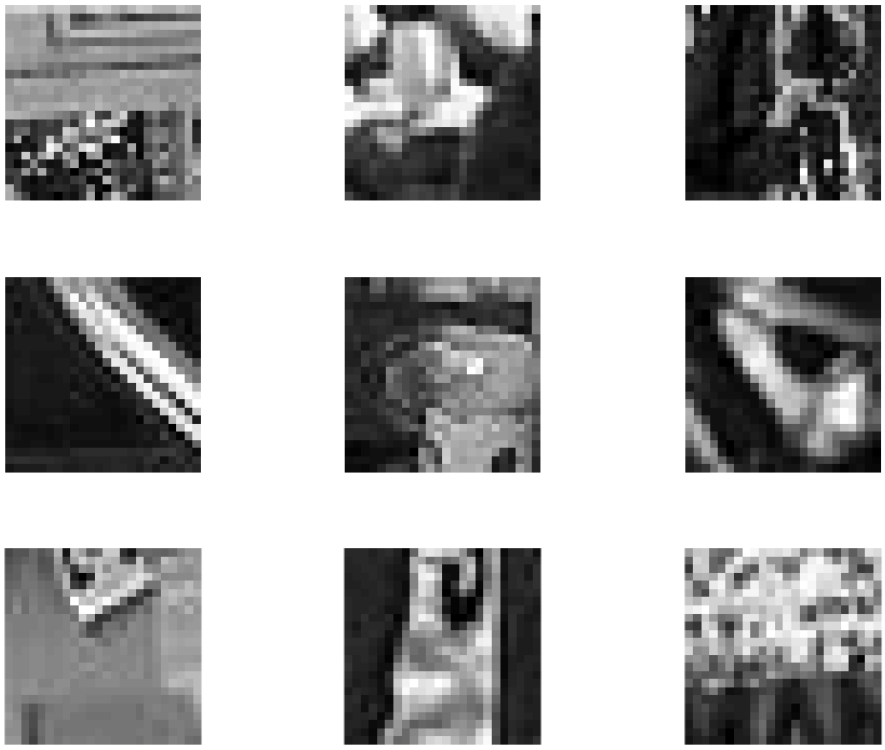


When we look at a photograph of a person's face we will see that for example the region where we find the bridge of the nose is usually brighter than the sides of the nose. We can use these specific properties to determine wether a photograph contains a face or not. Using Haar-features we can check if a region in a gray-scaled photograph is likely to be a face property by comparing the average white and black values in that specific region.

5. **Plot some of the misclassified faces and non-faces that seem hard to classify correctly. Why do you think they are difficult to classify?**



Reasons why these photographs are misclassified might be properties like beards, sunglasses, hair covering the face or the fact that the face is cut off at some points.



Reasons why these photographs are misclassified as faces might be that regions in these pictures somehow fit the Haar-features white and black values and thus fit the properties of a human face.
Especially the last picture in the second row has some obvious human traits that even makes us think that this photograph might be the face of a human wearing sunglasses.

6. **Are your results reasonable? Can you think of any way to improve the results?**

   Since our strong classifier results in an accuracy of over 93% given that we only used 24 features, we find our results to be reasonable. To improve the performance of our classifier we can think of using more weak classifiers in our ensemble or even deepen the our weak classifiers to be decision trees instead of stumps. Also, we could increase the amount of training data using more photographs of faces with properties that often were misclassified (people with sunglasses, beards,…).

7. **Can we expect perfect results? Motivate your answer.**

   We don’t expect perfect results, since we can’t be sure that new test data doesn’t contain faces in angles we have never seen before, or properties of faces that are different from all photographs we have trained our model on. Likewise it is also very unlikely that unseen test data is never misclassified as a face since non-face photographs might have the same properties as faces. Even though humans all have similar traits we are all different in some ways which makes it almost impossible to create a model that always classifies correctly.