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 training data and test data depends 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.**

# of training data = 500

# of test data = 12288

# of Haar-Features = 300

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

For training 300 weak classifiers where used, for final strong classifier 84 weak classifiers were used because it has minimum test error = 0.0549

1. **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.**

When trying the optimized strong classifier with 300 weak classifiers, 300 Haar features and 500 Train images, we got -> train error: 0, test error: 0.0520

The following table presents training and testing errors the algorithm performed when tweaking parameters. # of Haar = 25, # of weak classifiers = 30, # of train data = 500 are base parameters and the ensuing cells represent the execution of varying one parameter and keeping the others.

|  |  |  |
| --- | --- | --- |
| parameters | Train error | Test error |
| # of Haar = 25  # of weak classifiers = 30  # of train data = 500 | 0.0360 | 0.1208 |
| Train data = 5000 | 0.0968 | 0.1154 |
| Haar features = 100 | 0.0020 | 0.0801 |
| Weak classifiers = 100 | 0 | 0.0919 |

As we can see higher number of haar features improve classifier better than # of train data and # of weak classifiers, however higher number # of weak classifiers also improve final classifier strongly. This is the reason why in final classifier number of Haar features and weak classifiers are increased.

1. **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?**

The following image shows the selected best features for the 30 first weak classifiers.

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The rectangular shapes used in these masks act as window detectors to capture facial structures. For instance, eyes that are darker than the face areas that surround them and therefore make themselves more prone to have a higher response towards a Haar-like feature with a rectangle located in that area. This approach is computationally less expensive than working with, say, image intensities.

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

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Some misclassified non faces looks like some human features and are in a similar place as face pictures. Some faces were misclassified because they have non usual expressions, items on them, are in different angels, or have shadows on faces.

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

Accuracy is 94.51% so it’s reasonable, results could be improved by increasing number of Haar features and weak classifiers. Also, there might be outliers so alternative update schemes could be used.

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

Attaining perfect results can be achieved as the strong classifier made out of weak classifiers can generalize perfectly for a concrete testing set. However, bad quality or misleading images of testing instances can induce to some errors as proved in 5, where structures that activate highly the Haar features can be present in non-face images.