Practicum Computational Vision: Face Detection

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Contents

Abstract

In this session, we work with the concepts involved in the face detection method from Viola & Jones: Integral Images and Haar-like features. You can download from the Campus Virtual all the material you will need for this practicum.

Integral Images and Haar-like features

Exercise 1: Haar-like features and Classification

First folder "CV_Face_detection_1" contains a matlab function and two images. Open the file FD_ex1.m and follow the comments to complete the exercise.

Part 1: Compute and visualize Haar-like features

The code is devoted to compute the two firsts Haar-like features in six windows of the image "NASA1.bmp". We have chosen three windows containing faces and three windows without faces. These Windows are defined by the coordinates (x, y) of the top-left corner, are squared and the length of the sides is "L" pixels. The two Haar-like features to compute correspond to the rectangles described in the Figure 1. The area of these rectangles can be computed by means of the integral image S, computed from the original image I. You have to compute features F1 and F2 over the six windows with and without faces. The values of the features are stored in two matrices, and finally, the features of the considered windows are visualized in a figure. The points are displayed in two different colors to remark the difference, in the feature space, between windows with and without faces. Finally, you can display the windows over the original image in two different colors for windows with and without faces.
Answer the following questions:

- Explain the obtained 2-dimensional plot on the feature space.
- Given this 2-dimensional plot, can we infer the defined Haar-like features are appropriate for face/non-face discrimination?

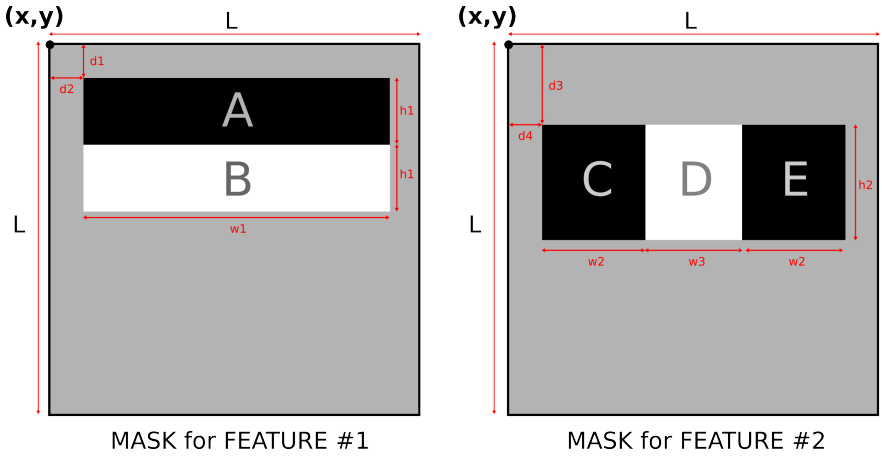

Figure 1: Two masks of Haar-like features.

Part 2: Classification in the feature space

The objective of this exercise is to train a k-Nearest Neighbor (NN) classifier using a set of features extracted from the image "NASA1.bmp" and evaluate the classifier in a new image "NASA2.bmp".
Consider the 11 windows from image "NASA1" as training set. Define the test set by 22 windows manually selected in the image "NASA2.bmp". You can use "ginput" matlab comand to manually capture the positions of these windows. Then concatenate all the faces coordinates in the same matrix and compute the rectangular features for all the windows. Consider the 2 Haar-like features corresponding to the rectangles described in the Figure 1.
In the feature space, 2-dimensional space, use k-NN classifier. For this purpose, the Matlab function "knnclassify" can be used. Display the results of the classification over the test image using two different colors of the rectangles for face / non-face.
Answer the following question:

- Is the result good enough? Explain your response.

Exercise 2: Haar-like features and Classification

Repeat the same classification problem as in Exercise 1, but considering the 6 Haar-like features corresponding to the rectangles described in the Figure 2. Create the file FD_ex2.m and write the code.
Answer the following question:

- Is the result better? Explain your response.

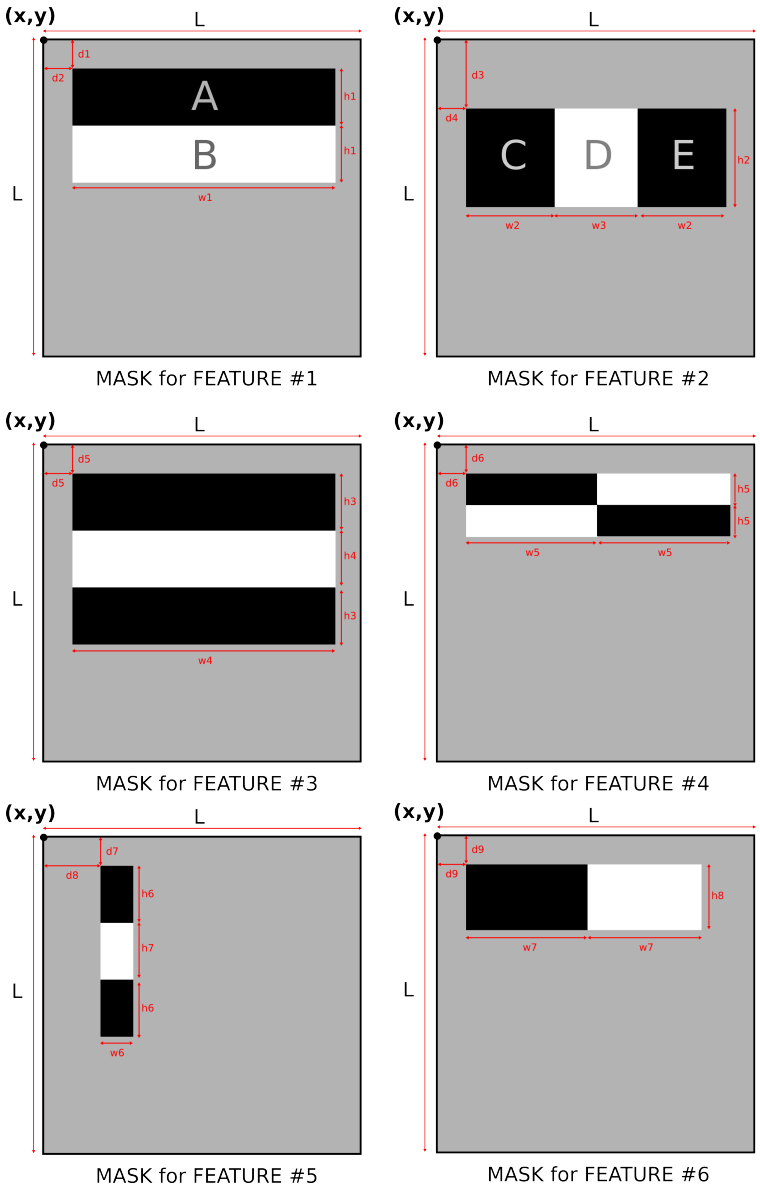

Figure 2: Six masks of Haar-like features.

Exercise 3: Apply and evaluate Viola & Jones method on a video

Folder "CV_Face_detection_2" contains matlab code and the video "Black_or_White_face_Morphing.mp4". The objective of this exercise is to apply Viola & Jones face detection method on the video. Use the matlab function CascadeObjectDetector from package vision to detect the face in the image. Write your code in the file FD_ex3.m to solve the exercise.
Answer the following questions:

- Is the Viola & Jones method detecting faces in the video frames?
- When is the Viola & Jones method not able to detect the faces? Explain your response.

Practicum submission

The evaluation of the exercises will be based on a students written report that must be submitted (via campusvirtual2.ub.edu).
The material to submit is a file "StudentName1+StudentName2_CV_LabFaceDetection.zip" containing: " A report entitled "Face Detection" including the results of the problems properly commented and all necessary images to fully understand your discussion. The report must provide answers for all questions highlighted in red. " The files FD_ex1.m, FD_ex2.m and FD_ex3.m of each exercise, where code should be completed.
Deadline: 11 of December, 23:55h by Campus Vitual.