Homework 1

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a) We are given the training data in TrainingSamplesDCT_8.mat and we are asked to provide the reasonable estimates for the prior probabilities. There are 1053 rows of background data and 250 rows of foreground data, so the estimates for the prior probabilities are:

$$P_Y(cheetah) = \frac{250}{250 + 1053} = 0.1919$$

$$P_Y(grass) = \frac{1053}{250 + 1053} = 0.8081$$

b) Using the training data in TrainingSamplesDCT_8.mat, we compute the index of the coefficient that has the 2nd largest energy value, and plot the index histograms $P_{X|Y}(x|cheetah)$ and $P_{X|Y}(x|grass)$ in Figure. 1 and Figure. 2.

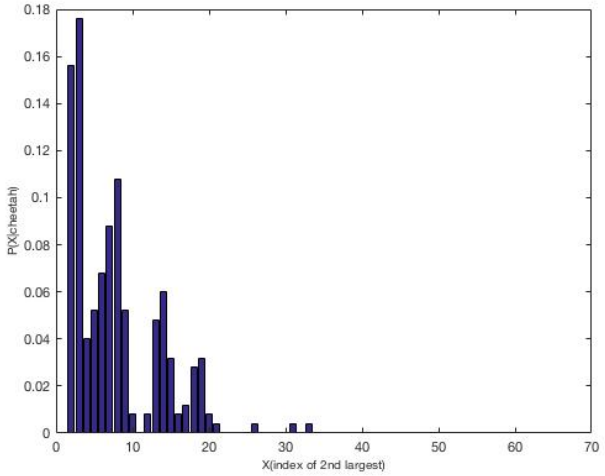

Figure. 1 Index histogram $P_{X|Y}(x|cheetah)$

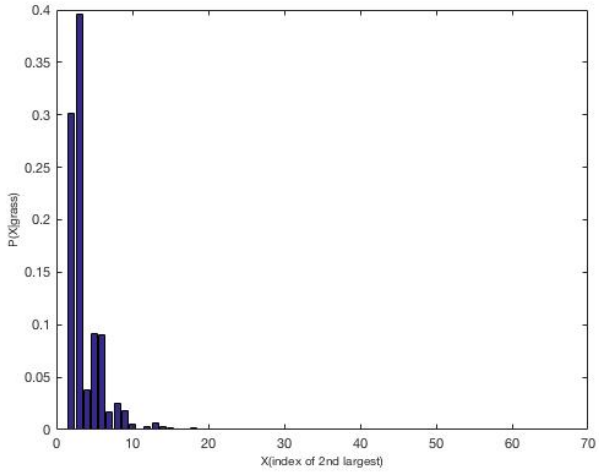

Figure. 2 Index histograms $P_{X|Y}(x|grass)$

c) The size of the image cheetah.bmp is 255 * 270, we segment the image into 248*263 blocks each with size 8 * 8, and each block stands for the pixel in its upper left.

For each block, we compute the feature X (index of the DCT coefficient with 2nd greatest energy), then we can use the minimum probability error to pick state of cheetah if:

$$\frac{P_{X|Y}(x|cheetah)}{P_{X|Y}(x|grass)} > \frac{P_Y(grass)}{P_Y(cheetah)}$$

The picture of the output array is shown is Figure. 3.

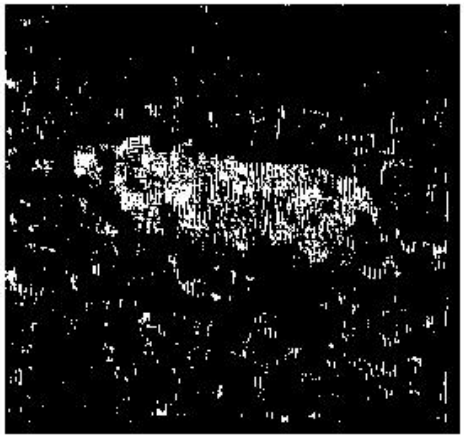

Figure. 3 Picture of the computed array A.

d) Compare the picture with the ground truth provided in image cheetah_mask.bmp, the probability of error of this algorithm is:

$$P_{error} = 0.1642$$