ECE 271A Quiz 1

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Abstract—The goal of this problem is to segment the "cheetah" image into its two components, cheetah (foreground) and grass (background).

I. PROBLEMS

A.

Using the training data in TrainingSamplesDCT 8.mat, what are reasonable estimates for the prior probabilities?

There are two matrices, TrainsampleDCT_BG and TrainsampleDCT_FG for foreground (cheetah) and background (grass) samples respectively.

The prior:

$$P_{Y=Cheetah} = \frac{n_{FG}}{n_{FG} + n_{BG}} = 0.8081350729086723 \quad (1)$$

$$P_{Y=grass} = \frac{n_{BG}}{n_{FG} + n_{BG}} = 0.1918649270913277 \quad (2)$$

B.

Using the training data in TrainingSamplesDCT 8.mat, compute and plot the index histograms $P_{X|Y}(x|cheetah)$ and $P_{X|Y}(x|grass)$.
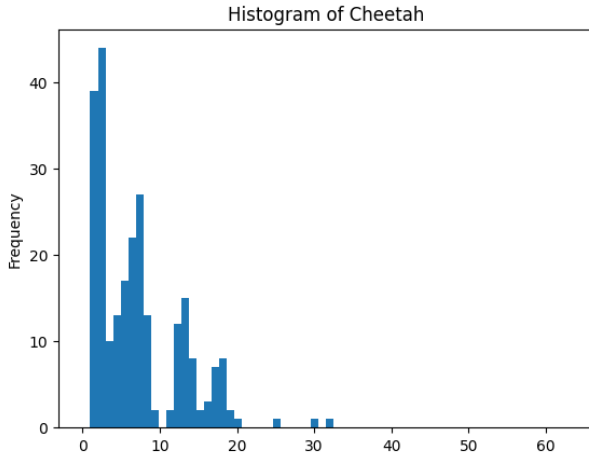

Fig. 1. *Histogram of $P_{X|Y}(x|cheetah)$*

C.

For each block in the image cheetah.bmp, compute the feature X (index of the DCT coefficient with 2nd greatest energy). Compute the state variable Y using the minimum probability of error rule based on the probabilities obtained in a) and b). Store the state in an array A. Using the commands imagesc and colormap(gray(255)) create a picture of that array.
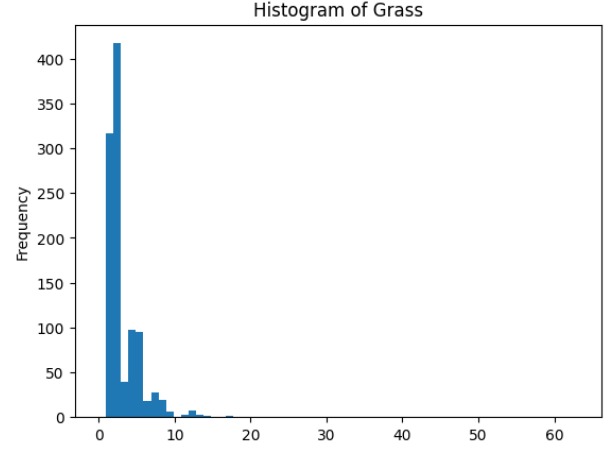

Fig. 2. *Histogram of $P_{X|Y}(x|grass)$*

Denote class "Cheetah" as FG and class "Grass" as BG. Using MAP rule,

$$Y = \begin{cases} 1(\text{Cheetah}) & \text{if } P_{X|Y}(x|FG)P_{FG} \geq P_{X|Y}(x|BG)P_{BG} \\ 0(\text{Grass}) & \text{Otherwise} \end{cases}$$
$$(3)$$

D.

The array A contains a mask that indicates which blocks contain grass and which contain the cheetah. Compare it with the ground truth provided in image cheetah mask.bmp and compute the probability of error of your algorithm.

Denote ground truth as T, we are going in to trim the ground truth image to have the same shape as A with height M and weight N. Since we are working with mask image, in each sample:

$$correct = \begin{cases} True & \text{if } T_{ij} - A_{ij} = 0 \ \forall i \in M \ \forall j \in N \\ False & \text{if } |T_{ij} - A_{ij}| = 1 \ \forall i \in M \ \forall j \in N \end{cases}$$
$$(4)$$

$$\text{The probability of error} = \frac{\text{Total number of wrong predictions}}{\text{Total number of samples}}$$
$$(5)$$

- The probability of error: **0.17544155525573413**
- The probability of error in foreground: **0.15150864712375814**
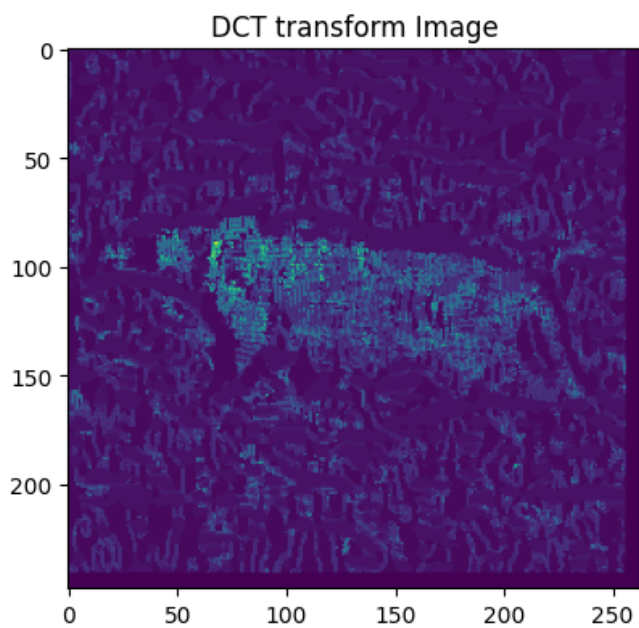- The probability of error in background: **0.02393290813197596**
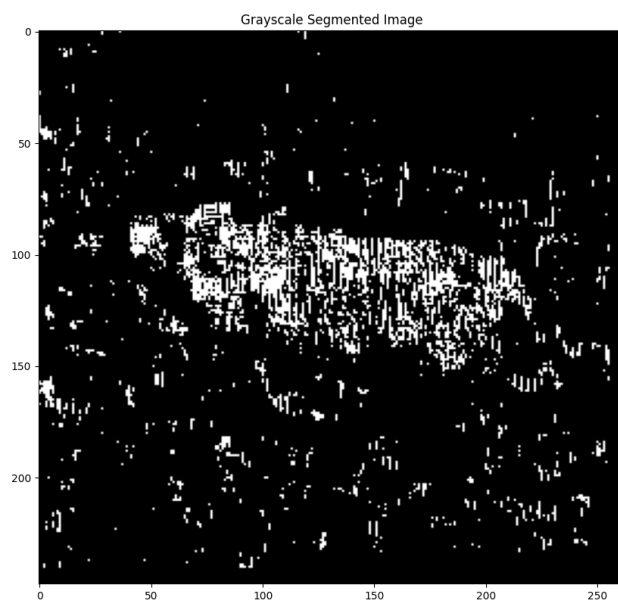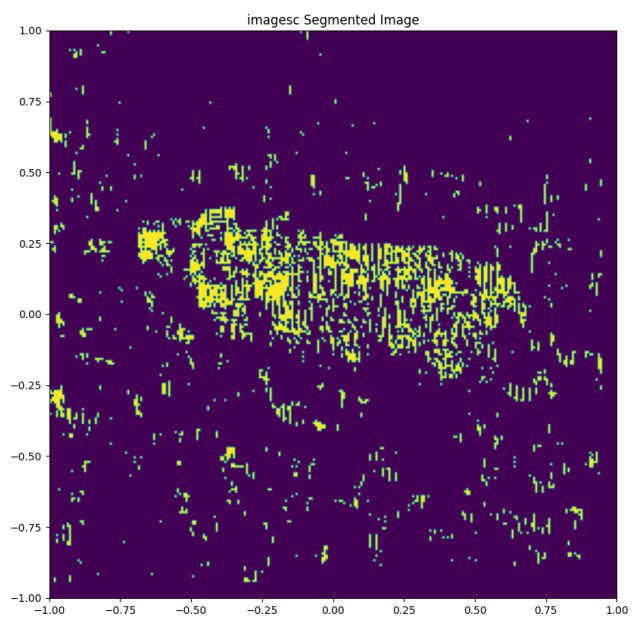
Fig. 3. *DCT Transformed Image*

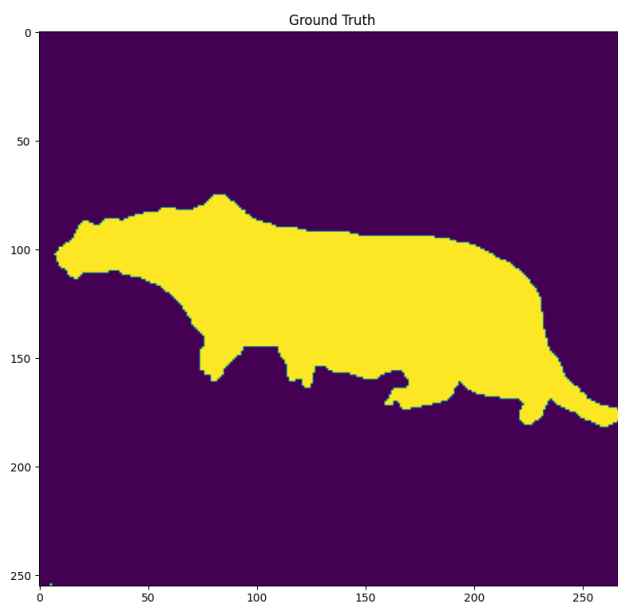

Fig. 5. *Gray-scale Segment*

Fig. 4. *Imagesc Segment*

Fig. 6. *Ground Truth*