Shiraz University

Pattern Recognition Course (Fall 2024)

Assignment #1: Bayesian classifier

Due date: 3th Aban 1403

In this project, we want to first segment the 'elephant_walking' image into 3 areas (sky, grass and elephant) and secondly, segment the image into 2 areas (background and elephant).

1. Use 'elephant_walking.bmp' as an input image (x = imread('elephant_walking.bmp')) and show it.
2. Use 's1.bmp', 's2.bmp' and 's3.bmp' to identify sample pixels for class 1 (sky). w1 = sky
3. Use 'g1.bmp', 'g2.bmp' and 'g3.bmp' to identify sample pixels for class 2 (grass). w2 = grass
4. Use 'e1.bmp', 'e2.bmp' and 'e3.bmp' to identify sample pixels for class 3 (elephant). (Hint: Delete white pixels and don't use these pixels as sample pixels for class 3.) w3 = elephant
5. Plot in a 3D space (Red-Green-Blue) preceding pixels. Do the classes seem separable for these characteristics (R, G and B)?
6. Estimate parameters of probabilities $p(x|wi)$ for a Gaussian model starting from these samples.
7. Use 'gt1.bmp' as a ground-truth image. (gt = imread('gt1.bmp'))
8. Estimate the prior probabilities $p(wi)$ in the following way:
    - Generate by chance the coordinates of (x, y) of 1000 pixels of the image. (Use h = fix(rand(1,2).*[size(x,1) size(x,2)]);)
    - Count the number of pixels belonging to each class by using ground-truth image and divide by 1000.
9. Use a Bayesian classifier to automatically segment the image in 3 areas (black, gray and white) corresponding to the classes.
10. What is the total error of classification for all pixels in the image? Using ground-truth image to check whether pixels are well classified or not.

11.(irrelevant to previous questions) Find the optimal decision based on bayes theory where we have two classes $\Omega = \{\omega_1, \omega_2\}$ and $P(\omega_1) = \frac{1}{4}$, $P(\omega_2) = \frac{3}{4}$ also likelihood functions are: $P(x|\omega_1)$ with normal distribution characterized by mean 1 and variance 2 , $P(x|\omega_2)$ with normal distribution characterized by mean -1 and variance 1. The loss function is:

$$\lambda = \begin{bmatrix} 0 & 4 \\ 2 & 0 \end{bmatrix}$$

❖ **Notes:**

- The goal of this project is your learning, so make sure to write the code yourself and understand what is being asked of you. This is important for the next stages of your studies.
- Prepare your full report in PDF format and include the figures and results.
- Feel free to use any programming languages.
- Feel free to use any predefined functions.
- If you can't submit by the specified deadline and send the project later, points will be deducted, but you won't receive a zero and your effort will be acknowledged.
- Email your files(include code & report) as a ZIP or RAR in this format (HW#_StudentNumber_Name.zip).

Email: patternbiomedical1403@gmail.com
