

Exam for ISA5230: Algorithms for Image Analysis

Due by 11:30 am of May 14, 2019 by an electronic submission

1. The pattern matrix **data3d.xlsx** is composed of 50 3-dimensional data points randomly generated from two multivariate normal distributions; the first 25 points are generated with mean vector $[1, 1, 1]^t$ and covariance matrix I_3 , the last 25 points are generated with mean vector $[-1, -1, -1]^t$ and covariance matrix I_3 . Please answer the following questions.
 - (a) Show that the Bayes error rate is $\Phi(-\sqrt{3}) = \int_{-\infty}^{-\sqrt{3}} \frac{1}{\sqrt{2\pi}} e^{-x^2/2} dx$.
 - (b) Compute the mean vector \mathbf{u}_1 and covariance matrix C_1 for the first 25 3-d points by Maximum Likelihood Estimation (MLE).
 - (c) Compute the mean vector \mathbf{u}_2 and covariance matrix C_2 for the last 25 3-d points by MLE.
 - (d) Compute the pooled mean vector and covariance matrix for all of the 50 3-d points by MLE.
 - (e) Plot a 2-d projection of the 50 points according to the first two principal components of PCA with the first 25 points labelled as 'X' and the last 25 points labelled as 'O'.
 - (f) Plot a 2-d projection of the 50 points according to the first two discriminative directions of LDA with the first 25 points labelled as 'X' and the last 25 points labelled as 'O'.
 - (g) Show your dendrograms of the 50 points using all of the 3-d features with *Euclidean distance* by using *average method* and *ward method*, respectively.
2. Print 2448×3264 *Nijubashi.jpg* and *Kamakura Daibutsu.jpg*; and 800×736 *Pumpkin.jpg*, 438×780 *carriers.jpg* color images and draw their R,G,B histograms by using Matlab tool or other software, where the images are located in the following website. Discuss your observation?
3. Show the silhousette by using Sobel operations as taught in class on the 512×512 images *lenna.raw*, *peppers.raw*, *mandrill.raw*, *koala512.raw*, respectively. Briefly describe your procedures including the *threshold selection* from the magnitude of gradients to get the silhousette for each image.

◇ All of the images mentioned in the problems are available in the following website.

<http://www.cs.nthu.edu.tw/~cchen/ISA5230/Examdata>

◇ You can use the existing programs to do your work but you should mention where the source codes come from.