

*In The Name of Allah*  
*Pattern Recognition*  
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**Homework #1: Bayesian Decision Theory**

Due Date: 1402.12.18

**1- First of all, answer to the following questions.**

- a) Write down the Bayes decision rule which minimizes the Bayes risk.
- b) Determine in which condition it is reduced to 1) MAP and 2) ML decision rules.  
(Describe the value of the parameters of Bayes decision rule when we want to have MAP and ML decision rules.)

**2- Binary classification**

- Download “Haberman's Survival” dataset from [here](#)
- Using your above implementations, classify the dataset using Bayes (with cost matrix  $\begin{bmatrix} 0 & 2 \\ 1 & 0 \end{bmatrix}$ ), MAP and ML.

**Guide:** Use the dataset to estimate the prior and likelihood function of each class.

- a) Report the confusion matrix of each method
- b) For each method, report the accuracy of each class and the averaged accuracy.
- c) Compare and discuss about the results.

**3- Multi-class classification**

- Download dataset from [here](#)
- Using your above implementations, classify the dataset using MAP and ML.

**Guide:** Use the datasets to estimate the prior and likelihood function of each class.

- a) Report the confusion matrix of each method.
- b) For each method, report the accuracy of each class and the averaged accuracy.
- c) Compare and discuss about the results.

**4- Practical issues (regarding Section 2&3):**

- a) Check whether the covariance matrixes are singular?
- b) If the covariance matrixes are singular, what the problem is?
- c) Propose your solution(s) to resolve the problem mentioned in Section b.
- d) **[optional]** Implement one of your suggested solutions and evaluate the results.

**Note:**

- In all the following parts, you must **individually** implement all the codes **yourself** (including Bayes, MAP and ML methods, generating confusion matrix and calculating the classifier accuracy).
- You are **not allowed** to employ **any** available **codes from others, on the internet or in a library.**
- Prepare a report in PDF format including the figures, answer to the questions and discussions mentioned in the homework.
- Make a folder including your report and your codes (Note that your code is needed to be self-comment)
- Submit all things in a zipped folder named as “YourNameYourFamily - Practical”+ “Exercise Number”+”Student Number”.rar

**Good Luck**