

Indian Institute of Technology Dharwad
Department of EE/CSE/ME
EE 405: Pattern Recognition and Machine Learning

Total Marks: 25

Quiz 2

Date: 05/12/2020

Instructions:

- Missing data or information if any, can be assumed appropriately. Mention your assumption clearly.
 - Any genuine queries regarding any question must be posted in moodle. Queries to any of the TAs through WhatsApp or email will not be entertained.
 - Copying in exam is strictly prohibited, if found both will be awarded zero mark.
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1. (9 Marks)

- (a) **(1 Marks)** What do you mean by discriminative and generative classifier, explain briefly. Out of GMM and SVM, comment on the type of classifier and justify.
- (b) **(2 Marks)** Mention the training procedure of SVM and GMM classifier, can GMM and SVM handle non-linearly separable data, justify your answer.
- (c) **(2 Marks)** Binary image data is given for classification. If you need to design a mixture model based classifier, from Gaussian and Bernoulli distribution, which kind of density you will prefer, justify.
- (d) **(2 Marks)** Write the update equations of the parameters of the preferred model using EM algorithm. Also mention the stopping criteria and likelihood equation (which you have to maximize through EM iterations).
- (e) **(2 Marks)** Consider a 2×2 binary image $X = [0, 1; 0, 1]$, and two Bernoulli mixture models for two different classes $\lambda_1 = \{0.3, 0.6, 0.6, 0.6\}$ and $\lambda_2 = \{0.1, 0.8, 0.6, 0.1\}$ respectively. Find $P(X|\lambda_1)$ and $P(X|\lambda_2)$, and also comment on the hypothesized class of the binary image X (assume equal prior probability of each class).

2. (6 Marks) Comment on the need for dimensionality reduction and mention its pros and cons.

Suppose you are building a face recognition model and you have a dataset which has 100 facial images with 10 images per person. Each image is of 64×64 pixels.

- (a) Write down each step to dimensionally reduce the image dimension using PCA and LDA. (Support your solution with mathematical equations where required).
- (b) State the criteria being optimized in each case and also the difference between LDA and PCA. Propose a measure to evaluate the performance of dimensionality reduction tasks on your dataset.

- (c) Once you have obtained the reduced dataset, is it possible to reverse the operation and get the original facial image? If yes how? If no, why?

3. (5 Marks)

- (a) Does a decision tree converge to global optima all the time? Yes/No, justify.
- (b) Construct a decision tree based classifier for the data in the table below. Use Entropy and Information Gain to find the attribute to split on. Also draw the final decision tree. Clearly write the equations in the beginning and show the calculations in each step.

Cough	Fever	Travel	Gender	Diseased
Absent	Absent	No	Female	No
Mild	Absent	Yes	Female	Yes
Absent	Absent	No	Male	No
Mild	Absent	No	Female	Yes
Severe	Mild	No	Female	Yes
Severe	Severe	Yes	Female	Yes
Severe	Severe	Yes	Male	No
Mild	Severe	Yes	Male	Yes
Severe	Mild	Yes	Female	Yes
Absent	Mild	No	Female	No
Absent	Severe	Yes	Female	Yes
Severe	Mild	No	Male	No
Absent	Mild	Yes	Male	Yes
Mild	Mild	No	Male	Yes

Table 1: Data for decision tree classifier

4. (5 Marks) Suppose a data set of M examples from multiple classes (i.e N) is given to you. But the label (i.e the examples belongs to which class) is not given. Propose a method to perform the classification task. Write the block diagram of your proposed method and describe its working. Clearly explain how do you perform training and testing.