February 2016, 2nd Exam – Feel free to add to this

Q1: various definition true/false

… Is Gaussian mixture discriminant?

…Is it possible to determine generalization error with training data?

Can you perform ___ with unlabelled data?

Q2: Bayesian Decision Theory & Parametric Methods

Blah blah classifiers, 100 samples of binary data, sorted so that first 50% is 0, second 1. Data is in bins/groups of 25.. something something…

a) What is the version space of the above classifiers?

<Something about posterior, prior, maximum a posteriori>

<Maximum likelihood given σ^2?>

Q3: Combining Classifiers

<Description here>… something about 3 classifiers K

a) Explain the advantages of using multiple classifiers and how to combine them.

b) List 4 methods to make classifiers diverse.

c) The advantages and disadvantages of majority voting rather than best base as the final classification.

d) Calculate the error for each classifier K below

e) Calculate the combined error of all K assuming they are statistically independent

f) Based on the probabilities below, do you think it is feasible that they are statistically independent?

Value	$P(K_1 = 0\|C)$	$P(K_1 = 1\|C)$	$P(K_2 = 0\|C)$	$P(K_2 = 1\|C)$	$P(K_3 = 0\|C)$	$P(K_3 = 1\|C)$
C=1	0.12	0.88	0.20	0.80	0.16	0.84
C=0	0.86	0.14	0.82	0.18	0.90	0.10

Q4: PCA

Consider principle component analysis (PCA) for the 2-dimensional data below.

a) Do The PCA learning using the 2-dimentional data set in the table below. Describe the steps of your solution.

b) Sketch the data points and direction of maximal variance

c) Compute the proportion of variance (PoV) explained by the first principal component.

d) Find the reconstruction $\hat{x}$ of point $\mathbf{x}=[4.0,7.0]^T$ with the first principle component.

t	x_1^t	x_2^t
1	2.0	2.0
2	3.0	4.0
3	5.0	6.0

Q5: K-Means Clustering

Do three iterations for K-means clustering on the 2-dimensional data below. Use $K = 2$ clusters and the initial prototype vectors (=mean vectors) $\mathbf{m}_1$=(0.0, 2.0) and $\mathbf{m}_2$=(2.0,0.0). Write down calculation procedure and the cluster memberships as well as mean vectors after each iteration. Draw the data points, cluster means and cluster boundary after each iteration.

t	x^t
1	(0.0, 1.0)
2	(1.0, 2.0)
3	(4.0, 5.0)