CS60073: Advanced Machine Learning

Class Test II

Time: 1 hrs, Marks: 20 (10+10)

Solve the problem neatly on paper. Write your Name and Roll number clearly on top of the paper. Take photograph of the paper(s) and convert to a SINGLE pdf file. Upload the file in MS Teams.

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1. In a course the probability that a student gets a grade "A" is P(A) = ½, a "B" grade is P(B) = μ, a grade "C" is P(C) = 2μ, and a grade "D" is P(D) = ½ -3μ. We are told that c students get "C" and d students get "D". We do not know how many students got exactly an "A" or exactly a "B". But we do know that h students got either "A" or "B", i.e., $a + b = h$. Our goal is to use the Expectation Maximization algorithm to obtain an estimate of μ. Derive the E-Step and the M-Step. Show your work.

2. Suppose that $p(\boldsymbol{x})$ is some fixed distribution and that we wish to approximate it using a Gaussian distribution $q(\mathbf{x}) = \mathcal{N}(\mathbf{x}|\boldsymbol{\mu}, \boldsymbol{\Sigma})$. By writing down the form of the KL divergence KL(p || q), show that minimization of the KL divergence with respect to $\boldsymbol{\mu}$ and $\boldsymbol{\Sigma}$ leads to the result that $\boldsymbol{\mu}$ is given by the expectation of $\mathbf{x}$ under $p(\boldsymbol{x})$ and that $\boldsymbol{\Sigma}$ is given by its covariance.