Machine Learning

Quiz 2

Student Name: ____________________

1. Consider a set of observations $\mathbf{X} = \{\mathbf{x}_1, \ldots, \mathbf{x}_N\}^T$, $\mathbf{x}_n \in \mathbb{R}^D$, drawn independently from a multivariate Gaussian distribution with known covariance matrix Σ, $\mathcal{N}(\mathbf{x}_n \mid \mu, \Sigma)$.

   (a) (2 points) State the *Maximum Likelihood* problem of finding the best estimate for the Gaussian mean, μ_{ML}, given the observed data $\mathbf{X}$ (*Hint:* Your answer should include $\mathcal{N}(\mathbf{x}_n \mid \mu, \Sigma)$):

   $$\mu_{\text{ML}} = \arg\max_{\mu}$$

   (b) (1 point) What is the Maximum Likelihood estimate of the mean (actual solution to (a))?

   $$\mu_{\text{ML}} =$$

2. (1 point) In *Bayesian inference*, we maximize the *posterior probability* $p(\mu \mid \mathbf{X}) \propto p(\mathbf{X} \mid \mu, \Sigma) p(\mu)$, instead. Considering the prior $p(\mu) = \mathcal{N}(\mu \mid 0, \Sigma_0)$, **how will the inferred μ_{MAP} differ from μ_{ML}?** (math expression or word answer is ok)