Department of Data Science
IIT Palakkad
DS5617 : Generative Artificial Intelligence

0800-0850 **Test 1 (13 Sep 2025)** **Marks : 15**

Instructions

1. Use Blue/ Black ink (red ink and pencils are not allowed). If your answer is not legible, you will not get any marks for that.
2. Be precise about notations, variables, parameters.

1. Describe the mechanism of sequential Bayesian learning considering linear regression. To be more precise, consider two sets of datasets $D_1 = \{X, Y\}$ and $D_2 = \{S, T\}$. $X = \{x_i\}_{i=1}^n$, and $x_i \in \mathbb{R}^d$. $Y = \{y_i\}_{i=1}^n$ and $y_i \in \mathbb{R}$. $S = \{s_i\}_{i=1}^m$, and $s_i \in \mathbb{R}^d$. $T = \{t_i\}_{i=1}^m$ and $t_i \in \mathbb{R}$. Moreover, y_i is prediction corresponding to x_i, similarly, t_i is prediction corresponding to s_i. (5)
   a. Describe a generative model for linear regression. [1]
   b. Extend the model to generate D_1 and D_2 sequentially. [1]
   c. State the learning problem associated to this sequential generation, precisely in terms of parameters and loss function. [1]
   d. Derive the sequential learning strategy. [2]
2. Consider a real data sample set $X = \{(x_{i1}, x_{i2}, x_{i3})\}_{i=1}^{100}$, where i is the index of the sample. Develop a normalizing flow model to generate artificial samples similar to the given real data samples. (10)
   a. Describe the flow model with the transitions functions. [2]
   b. Describe the training methodology. [2]
   c. Consider a simple neural network architecture with one hidden layer as part of the transition functions, and show the loss function with respect to the parameters to be learnt. You can consider one step transition function. [4]
   d. Describe the generation process after the training is done. [2]