250

Ph.D. / M.Sc. Engg. CSE (20) 05 March 2019 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION **WINTER SEMESTER, 2018-2019**

TIME: 1 Hour 30 Minutes **FULL MARKS: 75**

CSE 6257: Advanced Pattern Recognition

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **4 (four)** questions. Answer any **3 (three)** of them including **Question no. 4**.

Figures in the right margin indicate marks.

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1. a) What is Pattern Recognition? Describe the general components of a pattern recognition system which should be able to classify the different characters of English Alphabet from a scanned document. 1+14

   b) Define the generalized discriminant function for a two-class problem. How can you use the discriminant functions for a multi-class problem? Briefly describe each of those designs. 1+6

   c) Can you convert a nonlinear classification problem into a linear one? Explain how. 3

2. a) Consider the hyperplane used for discriminant functions.

      i. Show that the projection of x_a onto the hyperplane is given by 5

      $$x_p = x_a - \frac{g(x_a)}{\|w\|^2} w$$

      ii. Show that the distance from the hyperplane $g(x) = w^t x + w_0 = 0$ to the point x_a is $|g(x_a)| / \|w\|$ 15

      by minimizing $\|x - x_a\|^2$ subject to the constraint $g(x) = 0$.

   b) Can you define the criterion function J as the number of misclassified samples while using it in the Gradient Descent technique? Justify your choice. 5

3. a) Consider a Support Vector Machine and the following training data from two categories given in Table 1:

Table 1

category	x_1	x_2
ω_1	1	1
ω_1	2	2
ω_1	2	0
ω_2	0	0
ω_2	1	0
ω_2	0	1

   i. Plot these six training points (use graph paper), and construct the weight vector for the optimal hyperplane, and the optimal margin. 15

   ii. What are the support vectors? 5

   [Note: You do not need to calculate the solutions by solving, rather from inspection with graph.]

   b) What is Lagrange Multipliers and Lagrangian? 5

[Mandatory]

4. a) What are the KKT conditions in SVM classifier? 5

   b) Explain the working principle of SVM classifier and postulate the dual form from the primary problem. Provide all detailed calculations. 15

   c) Why do we need the Kernel trick in SVM? Give some examples of SVM kernels. 5