B.Sc. Engg. 8th Semester (35) 19 November 2020

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

MID SEMESTER EXAMINATION **Summer SEMESTER, 2019-2020**

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

CSE 4835: Pattern Recognition

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

Answer all of the questions. Figures in the right margin indicate marks.

(Any unfair mean like copying from slides/internet source, sharing answer scripts etc. will result into severe punishment.)

1. a) Suppose a dataset contains 10000 RGB images belonging to n different classes. A linear classifier was used to correctly classify these samples. To achieve better accuracy, K-fold cross-validation was performed. Each of the K-folds $(fold_1, fold_2, \dots\dots, fold_k)$ contained an equal number of images. 15

   Firstly $fold_1$ was considered as the test set, $fold_2$ as the validation set and all other $(k-2)$ folds as training set which led to the accuracy: $'acc_1'$. In the next iteration, $fold_2$ was considered as the test set, $fold_3$ as the validation set and all other $(k-2)$ folds as training set leading to another accuracy: $'acc_2'$. In this way, the test-set and validation-set were changed k times leading to k accuracies $(acc_1, acc_2, \dots\dots, acc_k)$. The final accuracy was claimed to be 95% by averaging all these acc_i values.

   Explain the effectiveness of this experimental method. How much can this result be trusted? Write your remarks with possible comments on improving the methodology (if any).

   b) How much does *K Nearest Neighbour* algorithm care about the semantic information of an image? How does that affect the overall result? How to improve? 7

   c) Define $'Hyperparameter'$. What can the Hyperparameters be in the context of Image classification with the *KNN* algorithm? 3

2. a) What is *Pattern Recognition* (PR)? Write three applications of PR is any domain. Briefly explain the properties that an efficient feature should hold for better recognition rate. 1+3 +6

   b) Suppose you are trying to build a Linear Classifier for *'Bangla Handwritten Digit Recognition'* which is a 10-class classification problem. The Linear classifier will produce a score based on the following function: 6+6

$$f(x, W) = Wx + b$$

   Here, W represents the weights, x is the input pixels and b represents bias terms for individual classes. Let's say the dimension of the input image is $(ID + 5) \times (ID + 10) \times 3$. [$'ID'$ is representing the last two digits of your student-ID]

   With proper justification, mention the suitable dimensions of W & b for this experiment. Explain the analogy of '*bias trick*' for adopting the bias terms within W & x to avoid the addition operation.

   c) Briefly explain *Figure-1* in the context of *Multi-Class SVM classifier*. 3

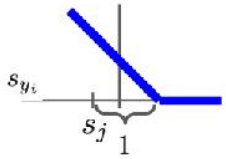

Figure 1: Hinge Loss

3. a) $Keywords$: $\{Score, Weight\ vector, Gradient\ Descent, Loss\ Function, Input\ data, Backpropagation, Regularization\}$ 15

Draw a proper flow-chart by arranging the *keywords* mentioned above according to their roles in solving a *classification problem*. Mention their roles & relation with each other properly in the chart.

b) 3+7

$$f(x,y) = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2}$$

Draw the *Computational Graph* representation of the above-mentioned function in the most granular fashion. Showing detailed calculations, find the gradients of the function f with respect to the variables (x_1, x_2, y_1, y_2) using the *Backpropagation algorithm*. Consider $(x_1, y_1) = (2,3)$ and $(x_2, y_2) = (1,7)$.