

**ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)**  
**ORGANISATION OF ISLAMIC COOPERATION (OIC)**

**Department of Computer Science and Engineering (CSE)**

**MID SEMESTER EXAMINATION**

**SUMMER SEMESTER, 2020-2021**

**DURATION: 1 HOUR 30 MINUTES**

**FULL MARKS: 75**

**CSE 4835: Pattern Recognition**

Answer **all 3 (three)** questions. Marks of each question and corresponding CO and PO are written in the right margin with brackets. Rename the file as '**ID\_CSE 4835\_mid.pdf**'.

1. a) Define Pattern Recognition (PR). Mention three applications of PR in any domain. Discuss the challenges involved in building an efficient PR system. 1+3+7  
(CO2)  
(PO4)
  - b) Discuss the role of 'Activation functions' in a Neural Network. Explain how this concept can introduce 'Space Warping' in the feature space. 4+6  
(CO2)  
(PO4)
  - c) Although K-Nearest Neighbor (KNN) is known as a learning algorithm, it hardly learns anything from the data and fails miserably if the data poses a high amount of variety. Despite this drawback, KNN is found really useful in certain scenarios. Mention a few of them. 4  
(CO1)  
(PO1)
2. a) A group of researchers is designing a PR system to identify diseases from leaf images. The dataset contains 1,000 images belonging to four classes (Healthy, Disease-1, Disease-2, and Disease-3). They have decided to use a Machine learning model for classification. To evaluate the classifier's performance, they have developed two policies to train the model and are yet to finalize a particular one. Discuss on the merit of both of the policies mentioned below and choose the appropriate one. 10  
(CO3)  
(PO2)  
(PO12)
  - **Policy-1:** Divide the dataset into two splits, 'split-1 & split-2' with a ratio of 80:20. Training will happen utilizing both of the splits until the model converges, and the performance on the 'split-2' set will be reported.
  - **Policy-2:** Dataset will be divided into three splits, 'split-1, split-2 & split-3' with a ratio of 80:10:10. Training shall continue using the 'split-1 & split-3' sets until the model converges. Finally, it will be evaluated on the 'split-2' set, and that performance will be reported as the final result.
- b) In continuation of the scenario mentioned in 2(a), the model has been tested with three unseen images and has produced the score for each of the four classes. The following table contains the scores of different classes for the images. 6+6+3  
(CO1)  
(PO1)

	Image-1: True class: Disease-2	Image-2: True class: Disease-1	Image-3: True class: Healthy
Healthy	5.3	-1.1	3.3
Disease-1	-1.1	6.2	3.1
Disease-2	2.7	2.45	-0.35
Disease-3	1.79	3.7	-1.0

Based on the information mentioned above, answer the following:

  - i. Calculate the overall loss of the model using the Multiclass SVM Loss function.
  - ii. Calculate the overall loss of the model using the Softmax Loss function.
  - iii. Compare the characteristics of these two ways of calculating Loss value.
3. a) In a Neural Network, each of the nodes in the hidden layer learns different representations of the data, combining which the model produces an appropriate prediction. Despite having no prior direction on what feature to look for, how does the network end up learning the relevant features? How does it know which node(s) should be triggered by what amount while predicting certain classes? 10  
(CO2)  
(PO4)
  - b) How does ADAM optimizer solve the drawbacks of the Stochastic Gradient Descent (SGD) algorithm? Why is it necessary to introduce 'bias correction' in ADAM optimizer? 10+3  
(CO2)  
(PO4)
  - c) How does 'Learning rate' affect an optimization algorithm? 2  
(CO1)  
(PO1)