B.Sc. Engg. CSE 7th Semester — 24 February 2020 (Morning)

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

MID SEMESTER EXAMINATION — **WINTER SEMESTER, 2019-2020**

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

CSE 4709: Machine Learning

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

There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

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1. a) Suppose you want to analyze the sentiment of a popular media content and classify that sentiment as positive or negative. Answer the following:
   i. Is the problem a machine learning problem? Explain your answer by comparing machine learning approach with traditional programming approach. 6
   ii. Write the machine learning steps for this problem in brief. 10

   b) What is reinforcement learning? Explain the basic elements of a reinforcement learning with a real-life example. 9

2. a) Consider a linear regression problem $y = \theta_1 x + \theta_0$, with a training set having m examples $(x_1, y_1), (x_2, y_2), \ldots, (x_m, y_m)$. Suppose that we wish to minimize the mean of *fourth* degree error (loss function) given by:

$$Loss = \frac{1}{m}\sum_{i=1}^{m}(y_i - \theta_1 x_i - \theta_0)^4$$

   i. Derive the equation to calculate the gradient with respect to the parameters θ_1 and θ_0. 6
   ii. Write the pseudo-code of the gradient descent algorithm for this problem. 6
   iii. Write the interpretations of empirical risk in the form of noise that incur in the loss function. 3

   b) What is feature engineering? Explain the following feature engineering tasks with example: 1+9
   i. One-Hot Encoding
   ii. Standardization
   iii. Data imputation

3. a) What are overfitting and underfitting problems in machine learning? Explain how the lasso and the ridge regularizations work to solve the overfitting problem with necessary equations. 6+8

   b) What is odds ratio? How does the logistic regression solve two-class problem using odds-ratio? Derive the cost function of logistic regression to maximize the likelihood of the training set. 11

4. a) Consider the set of training examples given in Table 1.

Table 1: Dataset for decision tree

SN	Major	Experience	Tie	Hired
1	CSE	Programming	Pretty	No
2	CSE	UI/UX	Pretty	No
3	SWE	Programming	Ugly	Yes
4	CSE	UI/HX	Ugly	Yes

Do the followings:
   i. Determine the entropy of **Hired.** 4
   ii. Which attribute should be selected as a root of the decision tree using ID3? 3
   iii. Construct the decision tree for this dataset based on information gain. 6

   b) How does the clustering technique help in solving machine learning problems? Consider the following sample points, $A\,(1,1), B\,(2,-2), C\,(3,4), D\,(4,5)$. Perform k-means clustering, show the calculation of distance matrix and group assignment matrix for two epochs only. [Assume k=2.] 2+10