Daffodil International University

Department of Software Engineering
Faculty of Science & Information Technology
Midterm Examination, Fall 2023
Course Code: SE544; Course Title: Introduction to Machine Learning
Sections & Teachers: A (MHS)

Time: 1:30 Hours **Marks: 25**

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1.	You and your friends are sitting in the exam hall. Your teacher is on invigilation duty. Occasionally, staffs are coming with attendance sheets where students need to sign their names, IDs, room numbers, etc. In any case, be that students, teachers, or staffs, everyone has their respective duties in the exam hall, or, in other words, everyone is performing some specific tasks. Now look at the environment around you and find out any specific task that you can automate using Machine Learning. Obviously, you will not develop any model that will fill up the answer script on your behalf. After deciding on the task, **explain** the following components of your model: a. Task **T** of your model: what will your model accomplish? b. Experience **E** of your model: what kind of data your model expects and what are the features? c. Performance metric **P** of your model: the way you will evaluate your model. d. Type of the machine learning model you are developing. e. What are the challenges that you think you might face during the model development?	**[Marks-5× 1 = 5]**	**CO-1** ***Level-2***
2.	 **Height** | **Weight** | **BMI** 180 | 97 | 29.9 175 | 75 | 24.5 177 | 105 | 33.5 176 | 74 | 24.2 181 | 99 | 30.1 177 | 100 | 31.0 a. Generate a linear regression hypothesis function to predict BMI using Height and Weight and **Apply** 2 epochs of gradient	**[Marks-5+ 2.5+2.5 = 10]**	**CO-2** ***Level-3***

	descent to find the optimal values of the parameters. You are given the following information: i. $\partial L/\partial_{Height} = -2\times Height\times(Y-\hat{Y})$ ii. $\partial L/\partial_{Weight} = -2\times Weight\times(Y-\hat{Y})$ iii. $\partial L/\partial_{Intercept} = -2\times(Y-\hat{Y})$ b. **What** do you mean by generalization and **how** can you find out whether this model has generalized or not? c. Suppose your model is not generalizing, and you are thinking about using Lasso or Ridge regression. Would you increase the value of α (the term that is multiplied with l_1 or l_2 penalty terms), or decrease it? **Explain** your decision.		
3.	Suppose you are classifying tissue images to determine whether the tissue is tumorous or not, and you are developing a logistic regression model for this classification task. Now, you may encode Tumor with 1 and Normal with 0. a. If the images are grayscale and of 10×10 pixels, and you want to use the values of the pixels as features, **generate** a hypothesis function for this logistic regression. If there are too many terms, you may use "…" sign to omit some. b. However, the hypothesis function may generate any arbitrary value. **Formulate** a function that will keep the output of the hypothesis function between 0 and 1 and rewrite the hypothesis function so that it always outputs values between 0 and 1 inclusive. c. Even though we are representing classes as numbers like 0 and 1, they are still discreet entities. We cannot just use loss functions like mean squared error. **Formulate** a loss function for this classification task and **demonstrate** that it does what it is supposed to do. d. Suppose you are using gradient descent to optimize your parameters. **How** would you decide an optimal learning rate and how would you know when to stop the training? e. Few people have tumor compared to the whole population. Because of that, your dataset contains 10 images of tumor, and the rests are of normal types. **What** this situation is called in the context of machine learning? **What** are some problems that it might create, and **how** can you overcome them?	**[Marks-5× 2=10]**	**CO-3** ***Level-3***