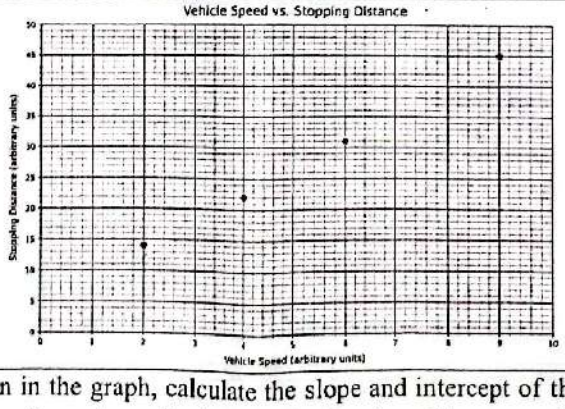
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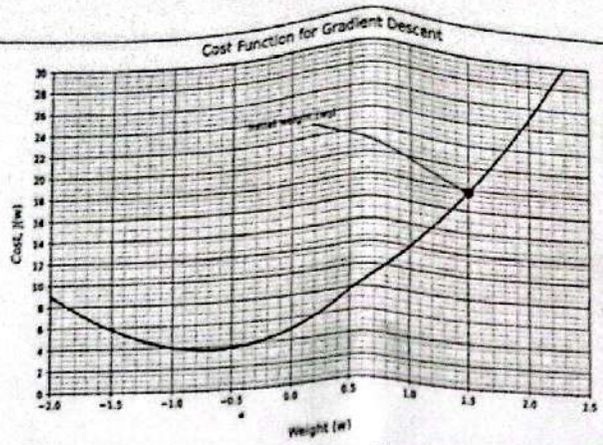
Daffodil International University
Faculty of Science & Information Technology
Department of Software Engineering
Midterm Examination, Fall 2026
Course Code: SE 544; Course Title: Introduction to Machine Learning
Sections & Teachers: (A)[ZH]; (B,D)[MSA]; (C,E)[MRN]; (F,G,I)[TBH]; (H)[BH]; (J)[SKS]
Time: 1:30 Hours Marks: 25

Answer ALL Questions

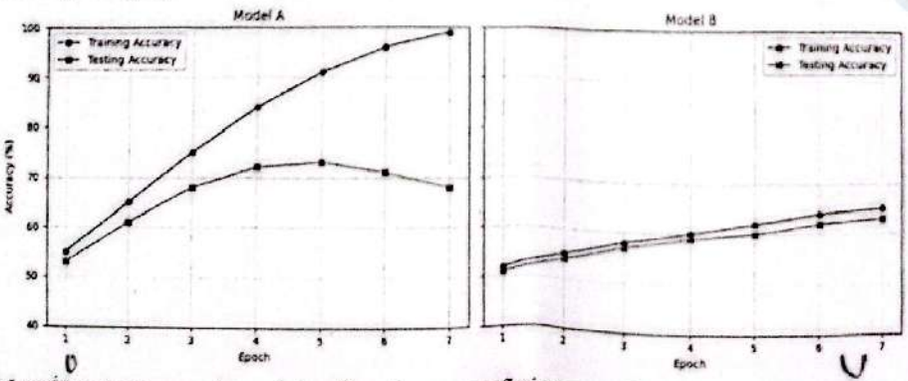
[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1.	A technology company aims to develop an autonomous vehicle capable of navigating city roads, recognizing traffic signs, and making safe driving decisions. Initially, engineers provided the system with thousands of unlabeled road images to discover hidden patterns and similarities among road scenes. However, the system fails to make reliable predictions about traffic signs and driving situations. The engineers then train the system using labeled road images containing traffic signs, pedestrian locations, and appropriate driving decisions. Finally, they test the vehicle in a simulated environment where it learns to make driving decisions through repeated interactions, receiving rewards for safe navigation and penalties for collisions and traffic violations. **Identify** the types of machine learning used in each of the three development phases. Justify your answers by explaining how the learning process differs across the phases and why the approaches used in the first two phases may produce different outcomes.	[Marks-5]	CO-1 *Level-2*
2.	The engineering team wants to predict the vehicle's stopping distance based on speed. The team collects data from four test runs, as shown in the graph.  a) Using the data points shown in the graph, calculate the slope and intercept of the simple linear regression line and construct the hypothesis function. Then, use the derived hypothesis function to **predict** the stopping distances for vehicle speeds of 2.8, 5.3, and 8.1, for which the actual stopping distances are 17, 28, and 40, respectively. Finally, calculate the coefficient of determination (R^2) by comparing the predicted stopping distances with the actual values.	[Marks-6 +4 = 10]	CO-2 *Level-3*

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b) Consider the cost function $C(w)=3w^2+4w+5$, as illustrated in the given graph. The initial weight (w_0) is indicated on the graph, and the learning rate is 0.01. Perform one iteration of Gradient Descent to **calculate** the gradient at the initial weight and determine the updated weight (w_1). Show all necessary calculations.

3.	An engineering team develops a machine learning model for an autonomous vehicle to detect pedestrians crossing the road. While testing 100 road images, the model correctly identifies 35 images containing pedestrians and 45 images without pedestrians. However, it fails to detect pedestrians in 8 images that actually contain pedestrians and incorrectly identifies pedestrians in 12 images that do not contain any pedestrians. Considering "*Pedestrian*" as the positive class, construct the confusion matrix, **compute** the model's precision and recall, and critically evaluate which type of error (false positive or false negative) is more critical in this scenario. **Justify** your answer.	[Marks-5]	CO-3 *Level-4*
4.	The autonomous vehicle manufacturer is comparing two machine learning models designed to recognize road signs and obstacles. During training, the engineers monitor each model's accuracy on the training and testing datasets across epochs, as illustrated in the given graph.  **Identify** whether each model suffers from overfitting or underfitting and **explain** how bias and variance relate to the observed performance. Recommend suitable strategies to address the identified issues and justify your recommendations.	[Marks-5]	CO-4 *Level-5*