LAHORE UNIVERSITY OF MANAGEMENT SCIENCES
Department of Electrical Engineering

EE514/CS535 Machine Learning
Quiz 04 Solutions

Name: _____

Campus ID: _____

Total Marks: 10
Time Duration: 12 minutes

Question 1 (3 marks)

Choose a correct answer.

(a) Consider a classifier for the initial screening of Cancer patients. True here refers to Cancer positive. Given ROC of the classifier, which point would you pick that reduces the chances of classifying Cancer positive patients as healthy?

(i) A point on the curve with higher sensitivity
(ii) A point on the curve with higher specificity.
(iii) A point on the curve that's further from the x-axis.
(iv) A point on the curve that's closer to the y-axis

Solution: A point on the curve that's further from the x-axis. OR A point on the curve with higher sensitivity.

(b) A high classification accuracy necessarily signifies a good classifier. T/F

Solution: F: Self-explanatory.

(c) Consider building a spam classifier (binary: spam vs non-spam) for your mailbox. If we assume spam to be a positive class, which of the following would be more important to optimize? Note that we do not want to classify genuine emails as spam emails.

(i) Precision
(ii) Recall
(iii) Both Precision and Recall
(iv) Accuracy

Solution: Precision

Question 2 (3 marks)

Evaluate the following limits and provide an interpretation of the answer you obtain: (a) $\lim_{\beta \to 0} F_\beta$ and (b) $\lim_{\beta \to \infty} F_\beta$, where

$$F_\beta = \frac{(1+\beta^2) \times \text{Precision} \times \text{Recall}}{(\beta^2 \times \text{Precision}) + \text{Recall}}.$$

Solution:

a)

$$\lim_{\beta \to 0} F_\beta = \frac{(1+0) \times \text{Precision} \times \text{Recall}}{(0 \times \text{Precision}) + \text{Recall}}$$

$$\lim_{\beta \to 0} F_\beta = \text{Precision}$$

b)

$$\lim_{\beta \to \infty} F_\beta = \frac{(1+\beta^2) \times \text{Precision} \times \text{Recall} \times \frac{1}{\beta^2}}{(\beta^2 \times \text{Precision}) + \text{Recall} \times \frac{1}{\beta^2}}$$

$$\lim_{\beta \to \infty} F_\beta = \frac{(\frac{1}{\beta^2}+1) \times \text{Precision} \times \text{Recall}}{\text{Precision} + \frac{\text{Recall}}{\beta^2}}.$$

$$\lim_{\beta \to \infty} F_\beta = \frac{(\frac{1}{\infty}+1) \times \text{Precision} \times \text{Recall}}{\text{Precision} + \frac{\text{Recall}}{\infty}}.$$

$$\lim_{\beta \to \infty} F_\beta = \text{Recall}$$

Rubric:

Question 3 (4 marks)

A classifier gives the following confusion matrix for a 3-class (k_1, k_2, k_3) classification problem. Calculate the micro-average Precision for this classifier.

$$\alpha = \begin{array}{c} \\ \hat{k_1} \\ \hat{k_2} \\ \hat{k_3} \end{array} \begin{array}{c} \begin{array}{ccc} k_1 & k_2 & k_3 \end{array} \\ \begin{pmatrix} 5 & 8 & 4 \\ 1 & 3 & 5 \\ 9 & 2 & 7 \end{pmatrix} \end{array}$$

$$MicroAvgPrecision = \frac{TP}{TP+FP} = \frac{15}{15+29} = \frac{15}{44}$$