

# Midterm Make-up Exam

## Explanation:

Each question is worth 5 points, and the total of 15 points will be added to your midterm exam score. Since the midterm exam accounts for 20% of the final grade, earning a full score of 15 points will increase your overall course grade by 3 points.

**Question 1: We are predicting whether a customer renews a subscription (Renew = Yes/No) using the attribute Payment Method. (5%)**

Payment Method	Renew=Yes	Renew=No
Credit Card	30	10
Bank Transfer	10	10
PayPal	20	30

Compute the Gini index after splitting by Payment Method.

$$Gini(D) = 1 - \sum_{i=1}^n \left( \frac{D_i}{D} \right)^2$$
$$Gini(D | A) = \sum_{i=1}^n \left( \frac{D_i}{D} \right) Gini(D_i)$$

**Question 2:** A Naive Bayes classifier is being used to classify emails as either Spam or Not Spam based on the presence of certain words. We observe that an email contains the words "Free" and "Win". The classifier has the following information:

- **Prior Probabilities:**

- $P(\text{Spam})=0.4$  ,  $P(\text{Not Spam})=0.6$

- **Likelihoods:**

- $P(\text{Free}|\text{Spam})=0.5$ ,  $P(\text{Free}|\text{Not Spam})=0.2$
- $P(\text{Win}|\text{Spam})=0.6$ ,  $P(\text{Win}|\text{Not Spam})=0.1$

Based on this information, calculate the posterior probability  $P(\text{Spam}|\text{Free and Win})$  for the email. Should the classifier label this email as Spam or Not Spam? (5%)

**Question 3:** Given the following confusion matrix and answer the following questions. You can express the answer in fractions. Please write down the calculation process.

		Predicted		
		Dog	Cat	Elephant
Actual	Dog	12	4	2
	Cat	3	8	4
	Elephant	2	3	9

**A. Calculate F2-score of class "cat." (Rounded to two decimal places) (1%)**

**B. Calculate the micro-average recall. (Rounded to two decimal places) (2%)**

**C. Calculate the weighted-average precision. (Rounded to two decimal places) (2%)**