

Name: \_\_\_\_\_

Reg No: \_\_\_\_\_

1. Given the following confusion matrix for a binary classification problem, calculate the Accuracy, Precision, and Recall. **(3 Marks)**

	Predicted: NO	Predicted: YES
Actual: NO	50	10
Actual: YES	5	35

**Solution:**

- **Accuracy:**  $(TP + TN) / \text{Total} = (35 + 50) / (50 + 10 + 5 + 35) = 85 / 100 = \mathbf{0.85}$
  - **Precision:**  $TP / (TP + FP) = 35 / (35 + 10) = 35 / 45 \approx \mathbf{0.78}$
  - **Recall:**  $TP / (TP + FN) = 35 / (35 + 5) = 35 / 40 = \mathbf{0.875}$
2. A medical test for a rare disease has a very high Recall. What does this mean in the context of the test? What is the potential downside if its Precision is low? **(2 Marks)**

**Answer:** A high Recall means the test is very good at correctly identifying people who *actually have* the disease (it misses very few sick people). The downside of low Precision is that the test has a high rate of false positives—it will incorrectly flag many healthy people as having the disease, causing them unnecessary stress and further testing.

3. In a 3-class classification problem (Classes A, B, C), the raw scores (logits) from a Softmax Regression model for one instance are:  $[2.0, -1.0, 0.5]$ . Calculate the final probabilities assigned by the Softmax function. (*Show your steps*). **(5 Marks)**

*Hint:*  $\text{Softmax}(z)_i = \frac{e^{z_i}}{\sum_j e^{z_j}}$

**Calculations:**

- **Step 1:**
  - $e^{2.0} \approx \mathbf{7.389}$
  - $e^{-1.0} \approx \mathbf{0.368}$
  - $e^{0.5} \approx \mathbf{1.649}$
- **Step 2:**
  - $\text{Sum} = 7.389 + 0.368 + 1.649 = \mathbf{9.406}$
- **Step 3:**
  - $P(\text{Class A}) = 7.389 / 9.406 \approx \mathbf{0.785}$
  - $P(\text{Class B}) = 0.368 / 9.406 \approx \mathbf{0.039}$
  - $P(\text{Class C}) = 1.649 / 9.406 \approx \mathbf{0.175}$

(Check:  $0.785 + 0.039 + 0.175 \approx 1.000$ )