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SML 2025, Winter, Quiz 3, Dur. 1 hr 10 mins. Marks 9.5

Note: Symbols have standard meaning.

Q1. We are given a simple dataset with three data points:

| x | y |
|---|---|
| 1 | 2 |
| 2 | 3 |
| 3 | 4 |

Build a gradient boosting regression model. Assume the loss to be $L(f(x)) = e^{|y-f(x)|}$. Initial model $F_0(x)$ predicts the mean of all y values. Learning rate is 0.1.

- Find $h_1(x)$. Evaluate at only two cuts: $x = 1.5$ and $x = 2.5$. [3]
- Suppose we stop the iteration at $h_1(x)$ itself. What will be the prediction of final model for $x = 2$? [.5]

Q2. Suppose we make a perceptron with following loss function $L(\beta, \beta_0) = e^{(y(\beta^T x + \beta_0))^2} + |\beta_0|$. $|\cdot|$ denotes absolute value. Derive the equations by which we can update the parameters. [3]

Q3. Consider the neural network in Figure 1. The input is 2d; $x = [x_1 \ x_2]^T$. The weights are $\beta = [\beta_1 \ \beta_3 \ \beta_4 \ \beta_5]^T$. There are no activations on hidden nodes. Output node has the following activation: suppose the value before activation at output node is z , then after activation, the output is z^2 . Recall that the activation in Rosenblatt's perceptron is sign function. \hat{y} denotes the network's prediction. Consider the following loss $L(\beta) = -y \log(\hat{y}) - (1-y) \log(1-\hat{y}) + \|\beta\|_2^2$. Find the update rule for β_1 . [3]

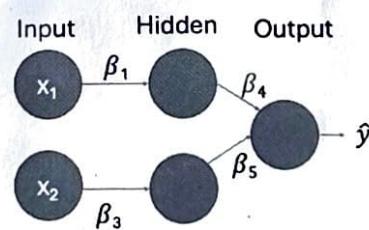


Figure 1: Neural network