Week_12_mlt_questions

2024 Apr 28 ET

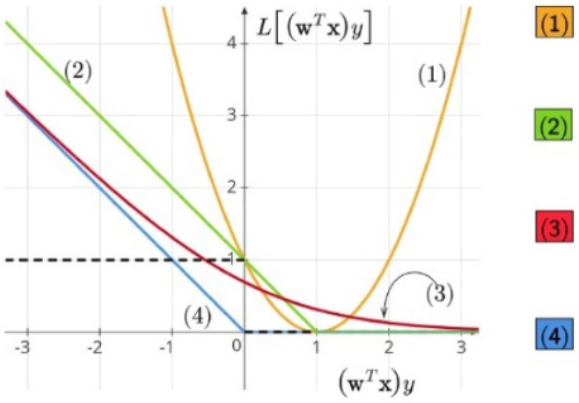
1. **(SA)** Consider a simple neural network with one hidden layer. The network has the following architecture: Input layer with 3 neurons. Hidden layer with 2 neurons, using the sigmoid activation function. Output layer with 1 neuron, using the linear activation function. The weights and biases for the network are as follows:

- **Hidden Layer:**
  - Neuron 1: Weights: $[0.5, -0.2, 0.8]$, Bias: 0.1
  - Neuron 2: Weights: $[0.4, 0, 0.2]$, Bias: -0.4
- **Output Layer:**
  - Neuron 1: Weights: $[0.2, 0.4]$, Bias: -0.3

Assume that the input values are $[0.6, 0.3, 0.8]$. Calculate output of Neuron 1 in hidden layer.
[Ans: 0.70 to 0.80]

2024 Sep 01 ET

2. **Comprehension:**
The convex surrogates for the 0-1 loss are displayed below:



Based on the above data, answer the given subquestions.

(i) (SA) Enter the number corresponding to the logistic loss.

[Ans: 3]

(ii) (SA) Enter the number corresponding to the (SVM) hinge loss.

[Ans: 2]

(iii) (SA) Enter the number corresponding to the perceptron loss.

[Ans: 4]

(iv) (SA) Enter the number corresponding to the squared loss.

[Ans: 1]

(v) (MCQ) Which of the following statements is true? $\ln = \log_e$.

(a) The logistic loss and the (SVM) hinge loss intersect when $(\mathbf{w}^T\mathbf{x})y = \ln(e-1)$.

(b) The logistic loss and the (SVM) hinge loss do not intersect.

(c) The logistic loss and the (SVM) hinge loss intersect when $(\mathbf{w}^T\mathbf{x})y = \ln(1-\frac{1}{e})$.

(d) The logistic loss and the (SVM) hinge loss intersect when $(\mathbf{w}^T\mathbf{x})y = \frac{1}{e}$.

[Ans: a]

3. **Comprehension:**
Consider the following architecture of a neural network for a binary classification problem:

Layer type	**Number of neurons**
Input	5
Hidden layer-1	10
Hidden layer-2	10
Output	1

Based on the above data, answer the given subquestions.

(i) (SA) How many learnable parameters does this network have? Ignore the biases in the computation.

[Ans: 160]

(ii) (MCQ) What is the most appropriate choice of activation function for the output layer if the binary cross-entropy loss is used?

(a) Sigmoid

(b) Linear

(c) ReLU

[Ans: a]

(iii) (MCQ) For a particular data-point, the activations after the first hidden layer in the forward pass is given to be

$$[0.2,\ 0.1,\ 1.5,\ 0.3,\ 0.1,\ 0,\ 0.8,\ 1.2,\ 1,\ 0]^T.$$

What is the activation function used in the first hidden layer?

(a) ReLU

(b) Sigmoid

[Ans: a]

2025 Apr 13 ET

4. **(SA)** Consider a single-layer neural network comprising two neurons in the hidden layer. The parameters are given as below:

$$
\begin{aligned}
w_1^{(1)} &= \frac{1}{2}, \quad w_2^{(1)} = \frac{1}{2} \\
w_1^{(2)} &= 1, \quad w_2^{(2)} = -1 \\
w^{\text{out}} &= [2 \quad -2]^T,
\end{aligned}
$$

where $w_i^{(j)}$ represents the weight associated with the j^{th} neuron for the i^{th} input feature. Suppose we are solving the regression problem, then determine the output of the neural network using ReLU as the activation function for the input $x = [1 \quad 3]^T$.

[Ans: 4]

2025 Aug 31 ET

5. **(MCQ)** Suppose we are solving a binary classification task using a neural network with the following architecture:

- Input: $x = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$
- Hidden layer: 2 neurons (ReLU activation)
- Output layer: 1 neuron (sigmoid activation)

The weight parameters of the network are given as:

$$W^{(1)} = \begin{bmatrix} w_1^{(1)} & w_2^{(1)} \\ w_1^{(2)} & w_2^{(2)} \end{bmatrix} = \begin{bmatrix} 2 & -1 \\ 1 & 1 \end{bmatrix}, \quad W^{(\text{out})} = [w_1^{(\text{out})} \quad w_2^{(\text{out})}]^T = [1 \quad 2]^T,$$

where $w_i^{(j)}$ represents the weight associated with the j^{th} neuron for the i^{th} input feature. What are the predicted probabilities?

(a) $P(\text{class } 1) = 0.119, \quad P(\text{class } 0) = 0.881$

(b) $P(\text{class } 1) = 0.269, \quad P(\text{class } 0) = 0.731$

(c) $P(\text{class } 1) = 0.731, \quad P(\text{class } 0) = 0.269$

(d) $P(\text{class } 1) = 0.993, \quad P(\text{class } 0) = 0.007$

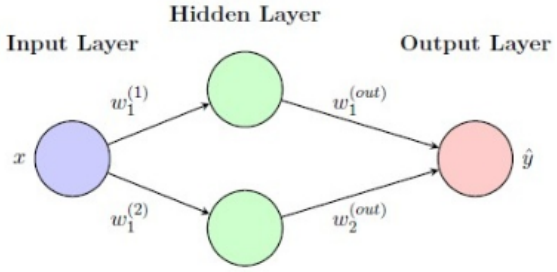
[Ans: d]

2025 Dec 18 ET

6. **Comprehension:**
Consider the following neural network, which takes a single real-valued input x, passes it through two hidden ReLU units, and produces a scalar regression output. ReLU and the sigmoid activation is given by:

$$\text{ReLU}(x) = \max(0, x)$$
$$\sigma(x) = \frac{1}{1 + e^{-x}}.$$

The network structure is shown below:



Assume the following weights:

$$w_1^{(1)} = 0.2, \quad w_1^{(2)} = -0.4, \quad w_1^{(\text{out})} = 1.0, \quad w_2^{(\text{out})} = -0.5.$$

Based on the above data, answer the given subquestions.

(i) (SA) For input $x = 0.5$, compute the regression output $\hat{y}$. Enter the answer correct to one decimal place.

[Ans: 0.1]

(ii) (SA) Suppose the target value for this input is $y = 1.2$. Compute the squared loss $L = (\hat{y} - y)^2$. Enter the answer correct to two decimal places.

[Ans: 1.19 to 1.23]

2026 May 06 ET

7. **(SA)** Consider a regression problem in which we use a neural network with the following architecture:

- Input layer has 5 neurons
- Three hidden layers, each with 10 neurons
- Output layer with one neuron

Find the total number of parameters in the network. Ignore the biases.

[Ans: 260]

2026 Sep 13 ET

8. **(SA)** You build a fully-connected feed-forward neural network for a classification task. The input is a 5-dimensional vector; the network has two hidden layers of 10 neurons each, followed by an output layer of 3 neurons. Every layer is densely (fully) connected to the next. Ignoring all bias terms, compute the total number of weight parameters in the network. (Enter -1 if it cannot be determined.)

[Ans: 180]