Quiz 3 • Graded

Student

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Total Points

30 / 30 pts

Question 1

Q1 9 / 9 pts

→ + 9 pts Everything correct

- + 3 pts A is NOT selected (A incorrect), because more parameters are more likely to lead to overfitting
- + 3 pts B is selected (B correct), because that is how weights in MLP are updated by definition
- + 3 pts C is selected (C correct), because perceptrons need the threshold function (which is an activation function) to solve logical operations (e.g., AND, XOR)
- + 0 pts Unattempted/Incorrect

Question 2

Q2 11 / 11 pts

- - + 3 pts Step 1: Specify the correct objective function.
 - + 2 pts Step 2a: Specify the bias term to be updated
 - + 2 pts Step 2b: Specify the non-bias term to be updated
 - + 2 pts Step 3a: Use the correct update formula for the specific objective and parameter (bias term)
 - + 2 pts Step 3b: Use the correct update formula for the specific objective and parameter (non-bias term)
 - + 2 pts Partial credits for step 3: The update formula does not match the selected parameter/objective (grade for bias and non-bias term separately)
 - + 2 pts Partial credits for step 3: Incorrect update formula due to wrong derivation (e.g., incorrect calculation of derivatives, missing the summation notation) (grade for bias and non-bias term separately)
 - 1 pt Arithmetic error
 - + 0 pts Irrelevant answer/No attempt

Q3 10 / 10 pts

- - + 4 pts Correct examples of activation functions (ReLU, sigmoid, tanh, softmax, etc.)
 - + 1.5 pts Linearity correct for activation function I
 - + 1.5 pts Linearity correct for activation function II
 - + 3 pts Correct role of activation function in MLP. Expected answer should include one of: (1) introducing non-linearity to the function being modeled by the MLP (2) whether the neuron should fire an output/not (3) transforming original output values to 0-1 range or probability (normalize output).
 - + 1.5 pts Inaccurate role of activation function but put some related process related to it (e.g., (1) calculating posterior of input to belong to a certain class (this only applies to last layer's activation function (2) calculating real value of node's ouput)
 - + 0 pts Incorrect/no attempt

Question assigned to the following page: 1	

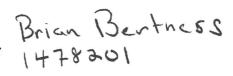
CSCI 5521: Machine Learning Fundamentals (Spring 2024)

Quiz 3 (Mar. 28, 2024)

Due on Gradescope by 2:00 pm, Mar. 29

Instructions:

- This quiz has 3 questions, 30 points, on 1 page.
- Please write your name & ID on this cover page.



1. (9 points) Select all the correct statement(s).

Adding more neurons to a single hidden layer of a Multilayer Perceptron always results in higher test accuracy. Should be False as this makes the model more complex and course over fitting.

(b) The weights in a Multilayer Perceptron are updated during the backpropagation phase based on an error function.

A Multi-layer Perceptron with no activation functions cannot solve the XOR problem if provided with the right weights and biases.

2. (11 points) Pick one bias term and one non-bias term in a (Multilayer) Perceptron without any activation functions, and write their update equations. Start with writing the objective function.

See Sheet

3. (10 points) Give two examples of activation functions in Multilayer Perceptron (You can write either the name or the mathematical representation of the function). Answer whether the activation functions that you wrote down are linear or non-linear. And briefly describe the roles of activation functions in a Multilayer Perceptron.

See Sheet

Question assigned to the following page: 2	

2. Ok, with no activation function such as sigmoid or tank we would simply have Zh= whx.

Thus, for a non-bias term with $E(W)U(X)=1/2 \sum_{t} (rt-yt)^2$ Choosing Wij as the non-bias term. $\Delta W_{1j} = -\eta \frac{\partial E}{\partial W_{1j}}$

= -U = DE DAT DET A

only part that is changing from in class derivations since DE and Dyte have not changed?

Now, 221 [wix] =X

From class we derived: $\frac{\partial E}{\partial y^t} = -(y^t - y^t)$ and $\frac{\partial y^t}{\partial z_i^t} = V_1$

Substituting 0,0,0 into equ * above we get

$$\Delta w_{ij} = -\eta \sum_{t} - (r^{t} - y^{t}) V_{1} X_{j}^{t}$$

$$= \eta \sum_{t} (r^{t} - y^{t}) V_{1} X_{j}^{t}$$

For bias term Δw_0 , we have the same except $\frac{\partial z_1^{\pm}}{\partial w_0} [w_0] = 1$ so $\Delta w_0 = -2 \frac{\partial E}{\partial w_0} = -2 \frac{\partial E}{\partial y^{\pm}} \frac{\partial y^{\pm}}{\partial z_0^{\pm}} \frac{\partial z_0^{\pm}}{\partial w_0} = \frac{\partial w_0}{\partial z_0^{\pm}} [w_0] = 1$

uestion assigned to the following page: 3	

3. Two examples of Activation Functions in TAR. Multi-Layer Perceptrons are the Sigmoid Function and the tanh function. Both of the functions are non-linear. An activation function (threshold function) does, as Dr. Zhuo states "If the input is bisser than a certain threshold then it returns a I otherwise its a zero." The activation function determines if the neuron (processing unit) is activated. LL -K STAR