CSE 4309 Assignment 4

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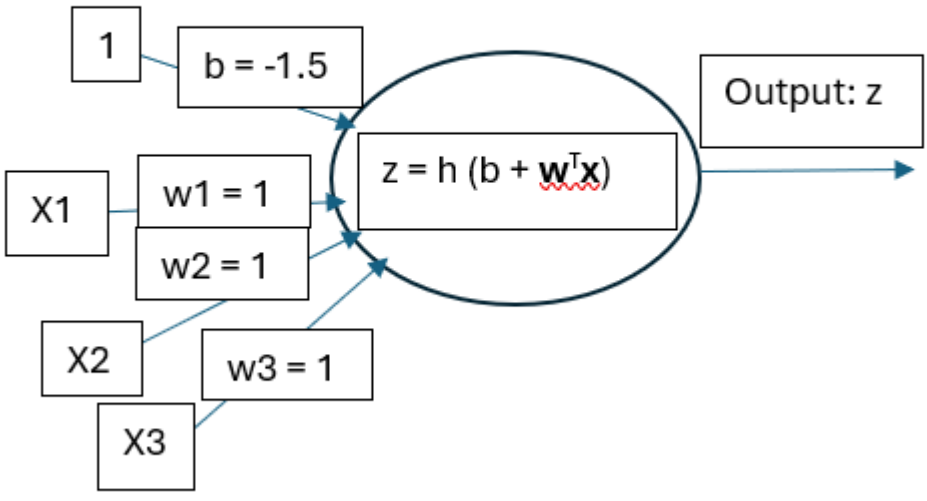
Due date: 10-October-2024

Task 1:

Output for Training and testing on pendigits dataset, with 2 layers, 10 training rounds:
classification accuracy=79.3596%
Output for Training and testing on pendigits dataset, with 4 layers, 40 units per hidden layer, 20 training rounds, sigmoid activation for the hidden layers:
classification accuracy=81.8182%

Task 2:



Working:

Case 1: All 3 inputs True

-1.5 + (1*1) + (1*1) + (1*1) = 1.5

h(1.5) = 1 (true)

Case 2: 2 inputs True

-1.5 + (1*1) + (1*1) + (1*0) = 0.5

h(0.5) = 1 (true)

Case 3: 1 input True

-1.5 + (1*1) + (1*0) + (1*0) = -0.5

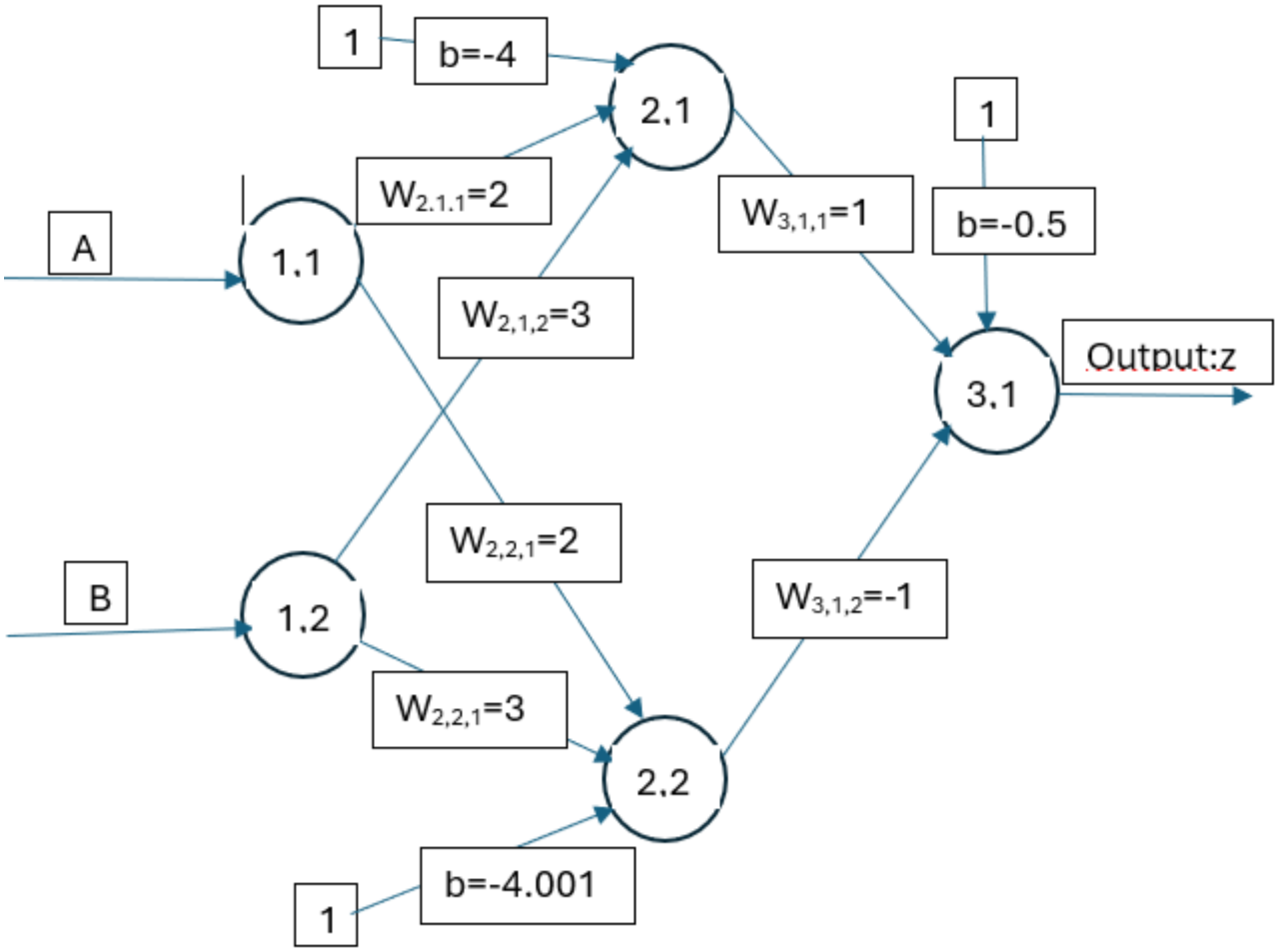
h(-0.5) = 0 (false)

Case 4: All 3 inputs False

-1.5 + (1*0) + (1*0) + (1*0) = -1.5

h(-1.5) = 0 (false)

Task 3:


1
b=-4
2,1
1
W2,1,1=2
W3,1,1=1
b=-0.5
A
1,1
W2,1,2=3
3,1
Output:z
W2,2,1=2
B
1,2
W3,1,2=-1
W2,2,1=3
2,2
1
b=-4.001

Working:

Case 1: When 2A+3B = 3

Using A = 0 and B = 1

Unit 2.1 = (2*0) + (3*1) - 4 = -1 so output = 0

Unit 2.2 = (2*0) + (3*1) - 4.001 = -1.001 so output = 0

Output Calculation: (0*1) + (0*-1) - 0.5 = -0.5 so output = 0

Case 2: When 2A+3B = 4

Using A = 2 and B = 0

Unit 2.1 = (2*2) + (3*0) - 4 = 0 so output = 1

Unit 2.2 = (2*2) + (3*0) - 4.001 = -0.001 so output = 0

Output Calculation: (1*1) + (0*-1) - 0.5 = 0.5 so output = 1

Case 3: When 2A+3B = 5

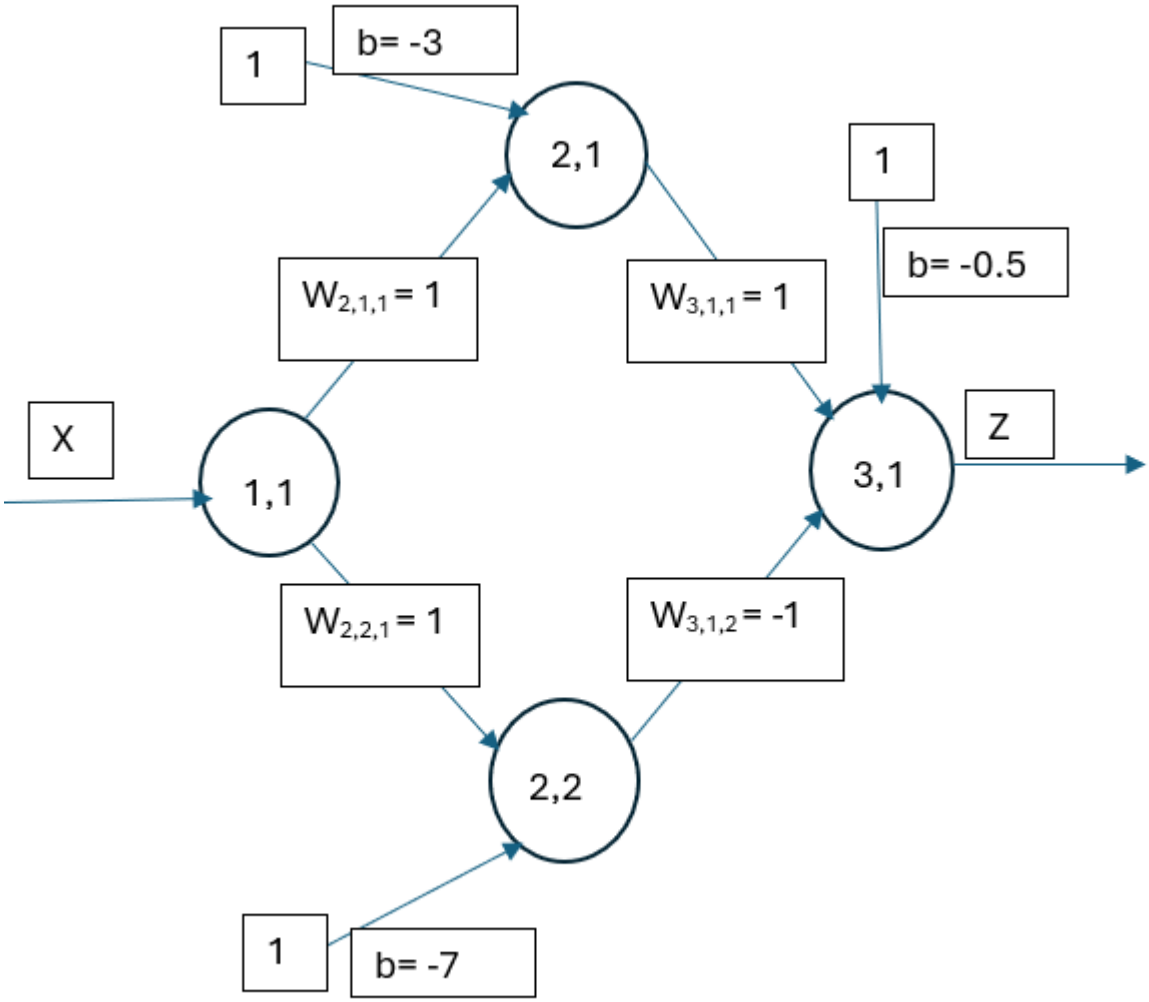
Using A = 1 and B = 1

Unit 2.1 = (2*1) + (3*1) - 4 = 1 so output = 1

Unit 2.2 = (2*1) + (3*1) - 4.001 = 0.999 so output = 1

Output Calculation: (1*1) + (1*-1) - 0.5 = -0.5 so output = 0

Task 4:



Working:
Case 1: (When X = 2 which is less than 3)
Unit 2,1: (2*1) -3 = -1 so output = 0
Unit 2,2: (2*1) -7 = -5 so output = 0
Output Layer Calculation: (0*1) + (0*-1) - 0.5 = -0.5 so output = 0
Case 2: (When X = 5 which is in the range of 3 and 7)
Unit 2,1: (5*1) -3 = 2 so output = 1
Unit 2,2: (5*1) -7 = -2 so output = 0
Output Layer Calculation: (1*1) + (0*-1) - 0.5 = 0.5 so output = 1
Case 3: (When X = 8 which is greater than 7)
Unit 2,1: (8*1) -3 = 5 so output = 1
Unit 2,2: (8*1) -7 = 1 so output = 1
Output Layer Calculation: (1*1) + (1*-1) - 0.5 = -0.5 so output = 0

Task 5:

Initializing all weights to zero in a perceptron training algorithm, where weights are typically set to small random values, can negatively affect classification accuracy. When weights start from zero, the perceptron cannot differentiate between inputs initially because the weighted sum (before applying the activation function) will always be zero, leading to no learning during the initial stages. This stunted learning phase can delay or prevent the model from correctly adjusting its weights to classify the input data effectively.

Consequently, classification accuracy can be expected to be lower or improve at a slower rate when compared to starting with random weights, which allow the model to immediately begin learning and differentiating inputs. Random initialization helps in breaking the symmetry in learning, allowing each neuron to learn different aspects of the input data from the outset, thereby enhancing the model's ability to classify data accurately and more efficiently.