Numericals (NNDL)_Chapter 1-4

1. Compute the output of a single neuron with input x=2.0, weight w=0.8, bias b=0.5 using the sigmoid activation $f(x) = \frac{1}{(1+e^{-x})}$.

2. A perceptron receives inputs x_1=1, x_2=0, weights w_1=0.7, w_2=0.3, bias=-0.5. Use a step activation (output=1 if z¿0 else 0). Draw the neural architecture and find the output.

3. Inputs: x1=2, x2=3. Hidden layer: 2 neurons, weights=1, bias=0, activation f(x)=$\frac{1}{(1+x)}$. Compute hidden layer outputs and also draw the neural architecture.

4. Input of network=[1,2], there is one hidden layer containing 2 neurons and Output (1 neuron). All weights=1, bias=0, activation $f(x) = \frac{1}{(1+x)}$. Find network output after forward propagation.

5. For input vector [5,4,2,7], all weights=1, bias=0, there exist two hidden layers (3 neurons each), activation $f(x) = \frac{1}{(1+x)}$. Draw the neural architecture and compute final output after one forward pass.

6. Compute derivative of sigmoid function $f(x) = \frac{1}{(1+e^{-x})}$ at x=0.

7. Find the output of a ReLU neuron ($f(x) = max(0, x)$) for z=-2.5, 0.0, 3.4.

8. A perceptron with $w_1 = 1$, $w_2 = 1$, bias=-1.5 implements which Boolean logic function? Verify by truth table.

9. A neuron output y=0.8, target t=1, learning rate η=0.1, input x=1, current weight=0.5. Update weight using $\Delta = \eta(t - y)x$.

10. Given two neurons with outputs 0.3 and 0.6 feeding a single neuron (weights=2 each, bias=-1, sigmoid activation). Compute final output and draw the neural architecture.

11. For a neuron with inputs [1,2,3], weights [0.5,-0.2,1.0], bias=0. Compute z and output using tanh activation.

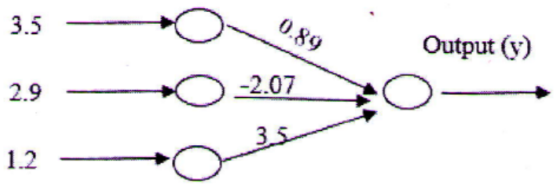
12. For the activation $f(x) = \frac{1}{(1+x^2)}$, compute output for x=2 and x=-1.

13. A perceptron for OR gate has w_1=1, w_2=1, bias=-0.5. Verify outputs for all combinations of (x1,x2).

14. If the loss function is $L = \frac{(t-y)^2}{2}$, compute $\frac{dl}{dy}$ when t=1, y=0.8.

15. Suppose you have a neuron with output y=$\sigma(z)$ where σ is sigmoid. Derive dy/dz in terms of y.

16. Compute output of the following neuron if activation function is:



(i) sigmoid function
(ii) Tanh tunction
(ii) RELU function (assume same bias 0.5 for each node).

17. Solve the following.

A 2 × 2 image is represented by the following pixel value matrix.

$$\begin{bmatrix} 5 & 4 \\ 2 & 7 \end{bmatrix}$$

This image is given to a 3-layer neural network, that is, two hidden layers and one output layer. Draw schematic diagram of the network.

Assuming all inter-connection weights having values 1, bias having value 0, the hidden layers having 3 neurons each, and a simple activation function of the form $\frac{1}{1+x}$ being used, compute output for one round of forward propagation.

18. Show that a single layer perceptron can be used to represent the Boolean AND, OR, NAND, and NOR functions. Can we represent XOR function using a single layer perceptron, if not specify the reasons.