HW9

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Q1 (8 points): Logistic function:

1a (3 pts): What's a logistic function? Write down the formula.
It is a function that generates an s shape curve where there is first an exponential growth, then linear, and then growth stops.

$$f(x) = \frac{L}{1 + e^{-kx - x_0}} \tag{1}$$

1b (2 pts): What is the standard logistic function? Write down the formula.

$$f(x) = \frac{1}{2} + tanh * \frac{x}{2} \tag{2}$$

1c (3 pts): What is the derivative of the standard logistic function f(x)? Write down the formula.

$$\frac{d}{dx} f(x) = \frac{e^x}{(1 + e^x)^2} \tag{3}$$

Q2 (8 points): Sigmoid function:

2a (4 pts): What is a sigmoid function? Write down the definition.
It is a function that is a bounded differentiable real function that is defined for all real values and has a non-negative derivative at each point.

2b (4 pts): What is the relation between sigmoid function and logistic function?
A sigmoid functuin is a subset of a logistic function where L=1, K = 1 and $x_0 = 1$

Q3 (8 points): Tanh function:

3a (4 pts): Write down the formula for the tanh function.

$$tanh(x) = \frac{1 - e^{-2x}}{1 + e^{-2x}} \tag{4}$$

3b (4 pts): What is the relation between sigmoid function and tanh function?
tanh is a type of sigmod function

Q4 (8 points): The softmax function:

4a (4 pts): What is the softmax function? Write down the formula.
Softmax is a generalization of the logistic function that is used to squish a vector so that all values are (0,1) and the sum of all values $= 1$.

$$softmax(z)_i = \frac{e^{z_i}}{\sum_{k=1} e^{z_k}} \tag{5}$$

4b (4 pts): If a vector x is [1, 2, 3], what is the value of softmax(x)?
0.09003057, 0.24472847, 0.66524096
Done with the following code in python
import numpy as np
softmax = lambda z:np.exp(z)/np.sum(np.exp(z))
softmax([1,2,3])

Q5 (18 points): Matrix:

5a (12 points): Let $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ and $B = \begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix}$

what is $A \times B$?
$\begin{bmatrix} 13 \\ 31 \\ 49 \end{bmatrix}$

what is $B \times A$?
Matrixes have incompatible dimensions

what is the transpose of A?
$\begin{bmatrix} 1 & 4 & 7 \\ 2 & 5 & 8 \\ 3 & 6 & 9 \end{bmatrix}$
what is the tranpose of B?
$\begin{bmatrix} 2 & 1 & 3 \end{bmatrix}$

what are the dimensions of B?
1 by 3

what are the dimensions of the transpose of B?
3 by 1

5b (6 points): Let $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 0 \\ 1 & 2 \end{bmatrix}$.
What is $A \times B$?
$\begin{bmatrix} 4 & 4 \\ 10 & 8 \end{bmatrix}$
what is $B \times A$?
$\begin{bmatrix} 2 & 4 \\ 7 & 10 \end{bmatrix}$

Is matrix multiplication communicative?
Not normally except for identity matrixes