EE6310

Problem Set 5

Write the code for the following. Google if the problem introduces you a new function you have not learned. Make a random matrix with the size and dimension of your choice to solve the problem.

1. Array Creation and Manipulation:
   1. Create a NumPy array of zeros with shape (3, 4).
   2. Create a NumPy array of ones with shape (2, 5).
   3. Create a NumPy array of integers from 1 to 10.
2. Array Indexing and Slicing:
   1. Access and print the element in the second row and third column of a 2D array.
   2. Extract the second column from a 2D array.
3. Array Operations:
   1. Perform element-wise addition of two arrays of the same shape.
   2. Perform matrix multiplication between a 3x3 matrix and a 3x1 vector.
4. Array Reshaping and concatenation:
   1. Reshape a 1D array of size 12 into a 3x4 2D array.
   2. Concatenate two arrays vertically and horizontally.
5. Array Aggregation and Statistics:
   1. Compute the mean, median, and standard deviation of a 2D array with random values.
   2. Compute the mean, median, and standard deviation of a 2D array with random values along the axis 0.
6. Boolean Indexing and Filtering:
   1. Find elements greater than 0.5 in a random array.
   2. Replace all negative values in an array with zero.
7. Random Number Generation:
   1. Generate a random 3x3 array of integers between 0 and 10.
   2. Generate a random 1D array of 20 elements from a normal distribution with mean 0 and standard deviation 1.
8. Linear Algebra Operations:
   1. Compute the determinant of a given 2x2 matrix.
   2. Compute the inverse of a given 3x3 matrix.
9. Broadcasting:
   1. Add a constant value of 5 to each element in a given array.
   2. Multiply each row of a 3x3 matrix by a different value.
10. Advanced Indexing:
    1. Extract elements from a 2D array using a list of row indices.
    2. Use boolean indexing to select elements from an array based on a condition.
11. In the future, you will learn to make a neural network layer which involves a equation such as below:

where is the sigmoid function, ***x*** is the input (a 1D vector), ***w*** is the model parameter called weights (a 2D matrix), ***b*** is the model parameter called bias (a 1D vector), and ***z*** is the model output. indicates the matrix multiplication between and . Follow the following step.

* 1. Make a random matrix ***x*** of the shape (128).
  2. Make a random matrix ***w*** of the shape. In order for the operation to be valid, what does the size of each dimension need to be? Is the size of the dimension constrained or free?
  3. What does the dimension of the ***b*** need to be?
  4. Select a integer of your choice for the dimension of ***w*** and ***b*** that are free. Look up the sigmoid function on Google, and write out the equation for calculating ***z***.