Assigment 2

For this we should do Gaussian elimination by hand and check it with the already built-in NumPy function to verify it. I tried to implement algorithms that are best for convenience and stability. Since NumPy gives very precise answers and we are using np.linalg.norm to check the difference between implementations, precision is important. I tried to explain the steps I took as much as I can in the comments, so I will summarize them here.

First, we are given a matrix of weights and the b vector that is the solution of this equation. Before proceeding with Gaussian elimination, I transformed the matrix into an augmented matrix for the next steps (this is important because the b vector should also change along with the operations we are doing).

For this function, I tried to break it into small and manageable pieces for convenience for both the reader and for me. I have written a swap rows function. After this, I have written partial pivoting. After searching it up, I found that it is quite a good way both for convenience and for numerical stability. It basically swaps the first row first element with the maximum absolute value from the first element of all rows below.

Then using forward elimination, I transformed the matrix into REF (row echelon form). I have also written a method named check consistency. It is used to be able to separate if the matrix has either no solution, a unique solution, or infinite solutions. Normally in NumPy, if a system has either no solution or infinite solutions, it will return "singular matrix" (because only invertible matrices can have a unique solution). I have separated them, so it's basically the same thing.

Then using back substitution, I find the value of the variable from the bottom row and put the value into the equations above to find every solution. Lastly, I implemented NumPy and

checked it with my solution. I tried multiple matrices and the precision is very accurate (the lowest difference I saw was e-12 and the highest was e-17, basically the same).

I used AI for learning purposes and feel like I learned so many things and deepened my understanding of Gaussian elimination and Python itself.