**BME 6310**

**Fall 2021**

**Homework #2**

**Due 11am, Wednesday, Sep. 15**

**Remember to show all your work. Submit all relevant code and one pdf with answers to all problems, pictures of your code and of your code working.**

1. ~~Write a function that implements Gaussian elimination to solve a system of equations by performing a forward sweep and a back substitution. Input will be~~ **~~A~~** ~~and~~ **~~b~~**~~, where~~ **~~A~~** ~~is an~~ *~~n~~* ~~x~~ *~~n~~* ~~matrix and~~ **~~b~~** ~~is a solution vector such that~~ **~~Ax=b~~**~~. The output will be the solution vector~~ **~~x~~**~~. Make sure you check for the possibility of a zero in the pivot element and subsequently make the appropriate change to your system so that the problem can still be solved. Assume that~~ **~~A~~** ~~has full rank and you only have one solution to~~ **~~Ax=b~~**~~. Be sure to demonstrate that your function works for an example (theoretical) problem.~~
2. ~~Find a biomedical engineering problem of interest that involves solving a system of equations. Demonstrate that your function from problem 1 can be used to solve this system.~~
3. ~~What is the relationship between the rank of a matrix and the solution of the corresponding system of equations?~~
4. ~~Given the following SVD of a matrix A:~~

~~A =  ~~

~~What is the rank of A?~~

~~Use this decomposition of A, with no calculations, to write a basis for Nul A and Nul A~~~~T~~~~. Write out an interpretation for each of these subspaces. What can they tell you about a given system?~~

~~Calculate A and illustrate how the bases for Nul A and Nul A~~~~T~~ ~~provide valid solutions to the respective problems.~~

1. Find an SVD of the following matrix using built-in functions of python/Matlab. Illustrate how the basis vectors for the four fundamental spaces describe the associated properties of the matrix.



1. ~~Watch~~ [~~https://www.youtube.com/watch?v=FgakZw6K1QQ~~](https://www.youtube.com/watch?v=FgakZw6K1QQ)~~.~~
2. ~~Find a data set in your own field of interest. Perform PCA with a built-in function in python/matlab. Plot your data on a 2-D plot with the first two principal components. What fraction of variation is captured in your first two components?~~ ~~Which variable has the highest weight in your first component?~~ ~~Offer an interpretation of why it makes sense for that variable to have the highest weight on your first component.~~