BIOE 210, Spring 2020

Homework 1

Due Wednesday, 2/19/2020 by 9:00am.
Upload a single PDF with your answers to Compass.

Part I (30 points)

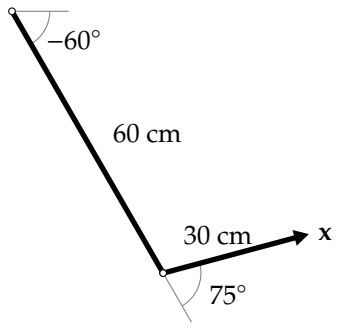
1. Show that the function $f(y) = 3y^2$ is not linear.
2. What values of θ make each of the following vectors unit vectors?

   (a) $\begin{pmatrix} 0 \\ 2\theta \\ \theta \end{pmatrix}$

   (b) $\begin{pmatrix} \cos\theta \\ 0 \\ 1 \end{pmatrix}$

   (c) $\begin{pmatrix} \cos\theta \\ 0 \\ \sin\theta \end{pmatrix}$

3. What is the angle between the vectors $\begin{pmatrix} 3 \\ 2 \\ -1 \end{pmatrix}$ and $\begin{pmatrix} 2 \\ -5 \\ 4 \end{pmatrix}$?
4. What value of a would make the vector $\begin{pmatrix} -3 \\ a \\ -1 \end{pmatrix}$ orthogonal to the vector $\begin{pmatrix} -1 \\ 5 \\ 2 \end{pmatrix}$?
5. Using rotation and translation matrices, find the position (**x**) of the end of the following multi-bar linkage arm.



Part II: Machine Problem (10 points)

Define the following matrix in MATLAB.

$$\mathbf{A} = \begin{pmatrix} 4 & 8 & -12 & 44 \\ 3 & 6 & -8 & 32 \\ -2 & -1 & 0 & -7 \end{pmatrix}$$

Apply the following elementary row operations to $\mathbf{A}$.

1. Multiply the 1st row by $1/4$
2. Subtract the 3 times the 1st row from the 2nd row
3. Add 2 times the 1st row to the 3rd row
4. Swap the 2nd and 3rd rows
5. Multiply the 2nd row by $1/3$
6. Subtract 2 times the 2nd row from the 1st row
7. Subtract the 3rd row from the 1st row
8. Add 2 times the 3rd row to the 2nd row

Hint: The following syntax can be used for indexing in matrices:

- $\mathbf{A}(i, :)$ refers to the ith row of $\mathbf{A}$.
- $\mathbf{A}(:, j)$ refers to the jth column of $\mathbf{A}$.
- In order to alter a row, set it equal to the desired quantity. For example, if you want to set the 1st row equal to the sum of the 2nd and 3rd rows, use:

$$\mathbf{A}(1, :) = \mathbf{A}(2, :) + \mathbf{A}(3, :)$$

For each operation (1-8), turn in the command you used and the resulting matrix.

Part III: Machine Problem (10 points)

Download the files `bioe210_test_suite.m` and `lasso_data.mat` from the course website. Both files need to be placed in the same directory, as `bioe210_test_suite.m` loads data from `lasso_data.mat`. Check the extensions on the files; some browsers change the names upon download (to .exe, for example). If so, try another browser or adjust your browser's MIME settings.

Run the file `bioe210_test_suite.m` and turn in the output.

For full credit, there should be no errors when you run the script. If the script completes without errors, you have installed all the Matlab toolboxes you will need for the course. (Note that there may be warnings that some functions "will be removed in a future release". This is not a problem. We are using the old names for functions to allow compatibility with previous Matlab releases.)