BIOE 210, Spring 2022

Homework 1

Due Monday, 1/24/2022 by 5:00pm.
You must upload your answers to Compass and tag each question.

1. Write out in words the following statements:
   (a) $r \in \mathbb{Q} \Leftrightarrow \exists\, p, q \in \mathbb{Z}$ s.t. $r = p/q$
   (b) $f(x) > g(x) \quad \forall x \in [0, 1]$
2. What is a common name for the set S defined below?

$$x \in S \Leftrightarrow x/2 \notin \mathbb{Z}$$

3. The function $g(x)$ is linear and $g(2) = 0.9$. What is $g(5)$ and $g(-1.5)$?
4. Given a function $L(\theta)$ where $L(0) = 1$, is L linear?
5. For the following vectors, find the 0-norm, 1-norm, 2-norm, and ∞-norm.
   (a) $\begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix}$
   (b) $\begin{pmatrix} 2 \\ a \\ 0 \end{pmatrix}$
   (c) $\begin{pmatrix} 1 \\ -1 \\ 1 \end{pmatrix}$
6. What values of θ make each of the following vectors unit vectors?
   (a) $\begin{pmatrix} 0 \\ 3\theta \\ \theta \end{pmatrix}$
   (b) $\begin{pmatrix} 2\cos\theta \\ 0 \\ 1 \end{pmatrix}$
   (c) $\begin{pmatrix} \cos\theta \\ 0 \\ \sin\theta \end{pmatrix}$
7. What is the angle between the vectors $\begin{pmatrix} 3 \\ -2 \\ 1 \end{pmatrix}$ and $\begin{pmatrix} 2 \\ -5 \\ 4 \end{pmatrix}$?

8. What value of a would make the vector $\begin{pmatrix} -3 \\ a \\ 1 \end{pmatrix}$ orthogonal to the vector $\begin{pmatrix} -1 \\ 5 \\ 2 \end{pmatrix}$?

9. The vector $\mathbf{a}$ is orthogonal to the vector $\mathbf{b}$. Is the vector $2\mathbf{a}$ orthogonal to the vector $-\mathbf{b}$? Prove it.

10. **Machine Problem**

    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.)