

## Instructions

1. This HW is based on lectures 1-8.
2. You are encouraged to work in pairs on this assignment.
3. Please show your work in the boxes.
4. Please post any questions you have in Piazza.
5. After completing your assignment, save your work as a zip file and name it LinearAlgebra-HW1-YOURNAME.zip. The zip file should contain a writeup.pdf file. Then, submit your assignment here:  
<http://bit.ly/LAHW1>

This HW is due July 1, 2016. Good Luck!

## 1 Part 1 - Written Work

## Questions:

1. (7 points) Please convert the following system of equations into  $Ax = b$  format where  $A$ ,  $x$ , and  $b$  are matrices, and then solve the system of equations.

$$\begin{aligned}x + y + 2z &= 8 \\ -2y + 3z &= 1 \\ 3x + 4z &= 10\end{aligned}$$

2. (5 points) Let  $A = \begin{bmatrix} 3 & 5 & -1 \\ 2 & 5 & 1 \\ 6 & 1 & 0 \end{bmatrix}$  Find  $A^{-1}$  if it exists, and if  $A^{-1}$  does not exist, prove why not.

3. (5 points) If  $A = \begin{bmatrix} 3 & 5 & -1 \\ 2 & 5 & 1 \\ 6 & 1 & 0 \end{bmatrix}$

What is the identity matrix of  $A$  and what is  $A^T$ ?

4. (10 points) Simplify  $(R^T R)^T$  where  $R$  is a matrix?

5. (10 points) Find the null space of matrix  $A = \begin{bmatrix} 5 & -1 & 1 \\ 1 & -2 & 2 \\ 6 & 1 & 3 \\ 9 & 1 & 5 \end{bmatrix}$

6. (10 points) Find all the solutions to the nullspace of matrix  $A = \begin{bmatrix} 5 & -1 & 1 & 3 \\ 6 & 1 & 3 & 4 \\ 9 & 1 & 5 & 2 \end{bmatrix}$  and how many free variables and how many pivot columns are there? What is the rank of Matrix  $A$ ?
7. (8 points) What do you know about the size of the solution set  $x$  for  $Ax = b$  when the rank of matrix  $A$  ( $m \times n$ ) is full? when the rank,  $r < m$ ? when  $r < m, n$ ? Please show how you know this.

## 2 The following section should be implemented in Python.

### Instructions

1. If you have not used git, please set up an account on github so that you can collaborate with your homework partner and push your code to your repository. Here is a link to a simple tutorial to learn about github. <https://try.github.io>. Git is a version control software.
2. Please setup a new repository and open the repository on your desktop.
3. Next, open Jupyter (iPython notebook) with the command "ipython notebook". If you have not yet installed Jupyter, please see the course website for instructions on installation.
4. Please create the following simple scripts in python and then push the code to Github.

Note: For more experienced programmers these tasks should be quite simple. The objective of this assignment is to allow less experienced programmers the opportunity to become acquainted with git, python, and Jupyter.

Here are some helpful inks:

1. <http://docs.scipy.org/doc/numpy-1.10.1/reference/routines.linalg.html>
2. <http://docs.sympy.org/0.7.5/tutorial/matrices.html>

8. (5 points) Compute  $A^3$  where  $A = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 1 & 2 & 3 & 4 & 5 \\ 1 & 2 & 3 & 4 & 5 \\ 1 & 2 & 3 & 4 & 5 \\ 1 & 2 & 3 & 4 & 5 \end{bmatrix}$
9. (5 points) Compute  $(AB)^T$  where  $A = \begin{bmatrix} 2 & 4 & 5 \\ 2 & 6 & 1 \\ -2 & 9 & 15 \\ 12 & 0 & 15 \\ 3 & 34 & -52 \end{bmatrix}$  and  $B = \begin{bmatrix} 2 & 4 & 5 & 4 \\ 2 & 6 & 1 & 4 \\ -2 & 9 & 15 & 4 \end{bmatrix}$

10. (5 points) Compute the rank of  $M$  where  $M = \begin{bmatrix} 2 & 4 & 5 \\ 2 & 6 & 1 \\ -2 & 9 & 15 \\ 12 & 0 & 15 \\ 3 & 34 & -52 \end{bmatrix}$

11. (5 points) Compute the row echolon form of  $M$  where  $M = \begin{bmatrix} 1 & 0 & 1 & 3 \\ 2 & 3 & 4 & 7 \\ -1 & -3 & -3 & -4 \end{bmatrix}$