ROB 101 - Computational Linear Algebra
HW #2

Profs Grizzle and Ghaffari

Due 9 PM = 21:00 ET on Thurs, Sept 16, 2021

This is the last week that we'll remind you that no late HW is accepted. In place of that, we simply drop your two lowest HW grades. It is perfectly fine to drop a zero as a HW grade. We are using Gradescope for turning in HW; see relevant information on the course Canvas site. Gradescope will always be set to accept HW solutions until 11:59 PM = 23:59 ET. See HW 01 for more discussion on this topic. **:-)**

There are six (6) HW problems plus a `jupyter notebook` to complete and turn in. **This week, the drill problems will not take much time to work, while the programming assignment will take more time than last week.**

1. Read Chapters 2 and 3 of our ROB 101 Booklet, `Notes for Computational Linear Algebra`. Based on your reading of the document, summarize in your own words:
   (a) Choose a chapter and summarize its purpose;
   (b) Two things you found the most challenging. If it was all straightforward for you, then summarize the two things you found the most interesting.

2. A system of linear equations with three unknowns

$$\begin{aligned} 4x_1 &= 8 \\ 2x_1 - 10x_2 &= -2 \\ x_1 + 2x_2 - x_3 &= 4 \end{aligned}$$

   (a) Solve the system of equations using forward substitution. Show all the steps when determining your solution.
   (b) Write the system in the form $Ax = b$, where you clearly identify A, x, and b

3. A system of linear equations with three unknowns

$$\begin{aligned} -2x_1 + x_2 &= 11 \\ x_2 - x_3 &= 5 \\ 2x_3 &= -10 \end{aligned}$$

   (a) Solve the system of equations using back substitution. Show all the steps when determining your solution.
   (b) Write the system in the form $Ax = b$, where you clearly identify A, x, and b

4. Determine the diagonal of each of the following matrices
   (a) $A_1 = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$
   (b) $A_2 = \begin{bmatrix} 1 & 2 & -4 \\ 3 & -2 & 14 \\ e & \sqrt{2} & \pi \end{bmatrix}$

(c) $A_3 = \begin{bmatrix} 1 & 2 & 2 & 1 \\ 11 & 12 & 14 & 13 \\ e & \sqrt{2} & \pi & \sqrt{\pi} \end{bmatrix}$

5. Compute the determinant for each of the following matrices. You can simply give the answer. Of course, showing your steps might help you when reviewing the material.

   (a) $A_1 = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

   (b) $A_2 = \begin{bmatrix} 2 & -4 \\ -1 & 2 \end{bmatrix}$

   (c) $A_3 = \begin{bmatrix} 4 & 2 & -4 \\ 0 & -1 & 2 \\ 0 & 0 & \frac{1}{2} \end{bmatrix}$

6. Julia programming skills:

   (a) Turn in a list of Julia commands that you have used or learned so far in ROB 101. **Your list does not need to be exhaustive**. Keeping an organized list of commands in a google doc will greatly help you to master the programming part of the course.

   (b) Are there any errors that you keep making over and over?

This is the end of the drill problems. The second part of the HW set is once again a `jupyter notebook`. **Please go to** the course Canvas Site and complete the assignment titled "juliahw2".

Hints

Hints: Prob. 4-(c) We have only defined the diagonal for square matrices. Hence, the expected answer would be "the diagonal is undefined because A_3 is not square." An alternative and equally fine answer would be for you to dig into the problem a bit further. For example, you might search the web for the "diagonal command" in Julia and see what it returns. If you do that, please give the command you used so that your work can be checked! You might also google "diagonal of a matrix". If you do that, please provide your source.

Hints: Prob. 5-(c) The third matrix is upper triangular. Computing the determinant of triangular matrices involves the diagonal of the matrix.