**Homework 0: Prerequisites Check-in / Warm-up**

**CSCI 3302: Introduction to Robotics**

Report due 1/27/23 @ 11:59pm

Total points: 25

Pro tip: Use Piazza or Office Hours if you are stuck

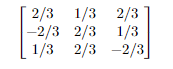
# Submission Instructions:

* Write your code for Q3-4 in the provided Python files (please do not change the python file names and the function signature).
* Create a PDF with detailed, step-by-step solutions to problems 1-2.
* Zip your 3 files (*shortest\_path\_without\_obstacles\_Q3.py, shortest\_path\_with\_obstacles\_Q4.py*, and *HW0.pdf*) and submit on Canvas. Your zip folder should be titled HW0\_lastname.zip. **If you don’t follow these naming conventions for the zip folder and .py + .pdf files, the grading script will most likely erroneously give you a zero, so please adhere to these requirements.**
* **You should complete these tasks on your own and without external help.** We will check for plagiarism.
* Please attend office hours if you need support. We are here to help!

# Algebra

**We need to see your steps and/or justifications for this section. Simply providing an answer won’t earn you full credit.**

1) **[5 pts]** Find the *inverse* of the following orthonormal matrix:



2) **[5 pts]** Given vector **v** = < 3, 3, -1 >, find vector **w** that is orthogonal to **v.**

# Shortest Path in a grid (coding)

1. **[5 pts]** **(Coding)** NASA’s Perseverance is on Mars and has mapped out an **obstacle free** square sector with grids. The free space is represented with 0s. Help It save precious energy by figuring out the shortest path from a given start position on this grid to a goal position. It cannot travel diagonally because of some issues. Assume that the grid is square and **the number of cells on the path is the length of the path including the start and the goal cells**. Complete the provided python function. Do not forget to add comments to your code. Here is an example -

**grid = [[0,0,0],**

**[0,0,0],**

**[0,0,0]**

**start, goal = (0,0), (2,2)**

**Solution = 5**

**Note:** Do not return the shortest path but just a single integer representing the length of the shortest path.

1. **[10 pts] (Coding)** Perseverance is able to perform some science thanks to you. It now spots a sector that has **obstacles represented by 1s.** Keeping the assumptions same as Q3, return the length of the shortest path avoiding obstacles. **Return -1 if no such path exists**.

Hints:

1. Don’t explore neighboring cells that don’t exist (are beyond the grid’s boundary)
2. Don’t explore neighboring cells that are obstacles.
3. Don’t revisit a cell.
4. Your search ends when there is nothing to explore.
5. You will have to propagate the information of the explored length so far.
6. CSCI 2270

Here are some examples.

**grid = [[0,0,0],**

**[1,1,0],**

**[1,1,0]]**

**start, goal = (1,2), (0,0)**

**Solution = 4**

**grid = [[0,1],**

**[1,0]]**

**start, goal = (0, 0), (1,1)**

**Solution = -1**  ---> Perseverance can’t travel diagonally and thus there doesn’t exist any feasible path.