

Homework 0: Prerequisites Check-in / Warm-up

CSCI 3302: Introduction to Robotics

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 (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.

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:

$$\begin{pmatrix} 1/3 & 2/3 & -2/3 \\ -2/3 & 2/3 & 1/3 \\ 2/3 & 1/3 & 2/3 \end{pmatrix}$$

- 2) **[5 pts]** Given two vectors $\mathbf{v} = \langle 3, 3, -1 \rangle$ and $\mathbf{w} = \langle 4, -3, 3 \rangle$, compute the angle between the 2 vectors.

Shortest Path in a grid (coding)

- 3) **[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), (2,1)
Solution = 4
```

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

- 4) **[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 = (0,1), (2,2)
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.
```