

# Homework 0

16-311: Introduction to Robotics

January 18, 2023

## Contents

<b>Learning Objectives</b>	<b>1</b>
<b>1 L<sup>A</sup>T<sub>E</sub>X</b>	<b>2</b>
<b>2 MATLAB</b>	<b>2</b>
<b>3 Python</b>	<b>3</b>
<b>4 Basic Linear Algebra</b>	<b>3</b>
4.1 Vectors . . . . .	4
4.2 Matrices . . . . .	4
<b>What To Submit</b>	<b>5</b>

## Learning Objectives

1. Ensure understanding of vectors and matrices
2. Ensure basic programming proficiency
3. Ensure basic Python and MATLAB proficiency
4. Introduce basic academic formatting

# 1 L<sup>A</sup>T<sub>E</sub>X

You can start from this file or create your own:

<http://www.cs.cmu.edu/16311/www/current/homework/hw0/p1.tex>

Use L<sup>A</sup>T<sub>E</sub>X to create a document called p1.pdf with the following information:

1. Title
2. Your name
3. Date
4. An image of you with a caption
5. A clickable reference to the picture in the text that would update if you were to add more images
6. Any equation to demonstrate understanding of math notation in L<sup>A</sup>T<sub>E</sub>X
7. The answers to the questions in Section 4 (Linear Algebra)

# 2 MATLAB

This section will be submitted on Autolab and graded by TAs using an autograder.

This section is not meant to teach students MATLAB or proper coding style. It is meant to provide insight for image manipulation skills that will be useful in the coming assignments.

You can start from this file or create your own, provided that it matches the specified format: <http://www.cs.cmu.edu/16311/www/current/homework/hw0/p2.m>

Write a function (not a script) called p2 takes in the file name of a colored.png image saved in the same directory that can manipulate an image in the following ways:

1. Take just the top left 5x5 pixels of the image. Save this as topleft.png.
2. Change every other column starting with the first column of the original image to be black. Save this image as stripes.png.

An example function call would be p2('image7.png') where image7.png is saved in the same directory as p2. The function would create topleft.png and stripes.png and save it in the same directory. Do not hard code an image. Your code should work with any image we call.

### 3 Python

This section is submitted on Autolab and graded by an autograder.

This section is meant to ensure that students have the ability to create and run Python files.

You can start from this file or create your own file, provided that it matches the specified format: <http://www.cs.cmu.edu/16311/www/current/homework/hw0/p3.py>.

Using any stable version of Python 3, create a function that takes in a number as an input and returns the Fibonacci number corresponding to that input. The 0th Fibonacci number is 0, the 1st is 1. From there, a Fibonacci number is found by adding the two previous Fibonacci numbers. For example, the 2nd Fibonacci number is 1 (or 0+1). You can find additional information about Fibonacci numbers here: [https://en.wikipedia.org/wiki/Fibonacci\\_number](https://en.wikipedia.org/wiki/Fibonacci_number).

Name your file p3.py. This function should be able to be run by entering p3(12), for example.

### 4 Basic Linear Algebra

This section will be submitted in the .pdf created in Section 1 (L<sup>A</sup>T<sub>E</sub>X).

This section is designed to make sure that students recall basic linear algebra skills and intuition.

## 4.1 Vectors

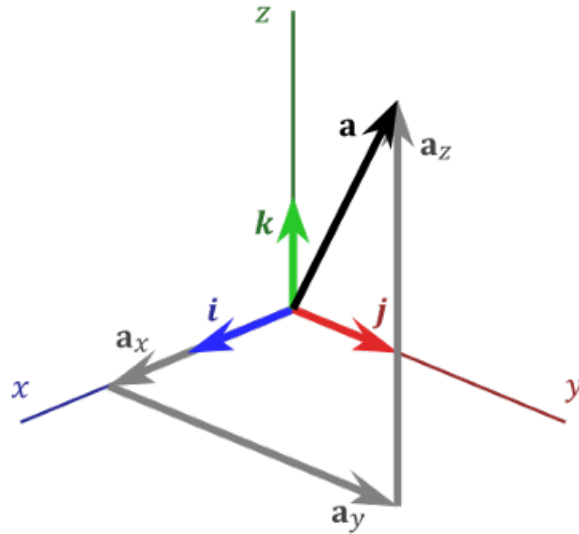


Figure 1: Coordinate system with representative vector  $\vec{a}$ .

1. What is the dot product of  $\vec{i}$  and  $\vec{j}$ ?
2. What is the cross product of  $\vec{i}$  and  $\vec{j}$ ?
3. Which of these is a vector? Speed, distance, or velocity?

## 4.2 Matrices

Perform the following by hand

1. 
$$\begin{bmatrix} 1 & 2 & 3 \\ 1 & 1 & 1 \\ 7 & 1 & 1 \end{bmatrix} + \begin{bmatrix} 8 & 0 & 1 \\ 8 & 3 & 4 \\ 7 & 2 & 3 \end{bmatrix}$$

2. 
$$\begin{bmatrix} 1 & 2 & 3 \\ 1 & 1 & 1 \\ 7 & 1 & 1 \end{bmatrix} \star \begin{bmatrix} 0 & 0 & 1 \\ 1 & 3 & 4 \\ 0 & 2 & 3 \end{bmatrix}$$

3. What is the determinant of 
$$\begin{bmatrix} 2 & 1 & 1 \\ 1 & 3 & 4 \\ 0 & 2 & 3 \end{bmatrix}$$

## What To Submit

Submissions are due on Autolab by the date specified in the Syllabus.

1. You will submit two files to Autolab, one each for sections 2 and 3.
2. You will submit one .pdf file to Gradescope for sections 1 and 4.
3. Please ensure all files are named as described.