

Homework 0

16-311: Introduction to Robotics

Spring 2018

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1 Learning Objectives

1. Ensure basic C proficiency.
2. Ensure basic MATLAB proficiency.
3. Introduce basic website creation and hosting.
4. Introduce basic academic formatting.

2 Basic C Programming

This section is not meant to teach students C or proper coding style. It is meant to provide a refresher to concepts like pointers, header files and compiling. You will

not be graded on style.

Start from these files: <http://www.cs.cmu.edu/afs/cs.cmu.edu/academic/class/16311/www/current/hw/hw0/p1.c> and <http://www.cs.cmu.edu/afs/cs.cmu.edu/academic/class/16311/www/current/hw/hw0/p1.h>.

Write a program in C that can perform 1x3 vector and 3x3 matrix arithmetic including:

1. Assign vectors and matrices:

- For vectors, a lower case letter, then a space, followed by an = sign, and then followed by three numbers separated by spaces sets the value for the vector. Ex: `a = 1 2 3`
- For matrices, an upper case letter, then a space, followed by an = sign, and then followed by nine numbers (separated by spaces) sets the value for a matrix. Ex: `A = 1 1 1 1 1 1 1 1 1`

To make things easier, assume there could only be 26 vectors and 26 matrices. Hint: there is a nice relationship between chars and ints in C.

2. Print a formatted vector or matrix:

- A vector on a line by itself followed by return should print the vector in its appropriate forms. Ex: `a`
- A matrix on a line by itself followed by return should print the matrix in its appropriate forms. Ex: `A`

3. Addition:

- `c = a + b` stores the sum of vectors `a` and `b` to `c`.
- `C = A + B` stores the sum of matrices `A` and `B` to `C`.

4. Multiplication:

- `c = a . b` should compute the dot product of `a` and `b` and store in it in the first component of `c` (Set the other components of `c` to zero).
- `c = a * b` should store the cross product of `a` and `b` in `c`.
- `C = A * B` should perform matrix multiplication of `A` and `B`.

- `d = v * M` should perform the vector times matrix scalar multiplication.

You are only required to submit the single C file, but we recommend using a header file, as separate file for your main function and a makefile. Here are starter documents that you can use to test your implementation: <http://www.cs.cmu.edu/afs/cs.cmu.edu/academic/class/16311/www/current/hw/hw0/main.c> <http://www.cs.cmu.edu/afs/cs.cmu.edu/academic/class/16311/www/current/hw/hw0/makefile> (Careful! This makefile uses `gcc *.c`, so make sure you place it somewhere that it is ok to compile everything.).

Here are some example inputs and expected outcomes: http://www.cs.cmu.edu/afs/cs.cmu.edu/academic/class/16311/www/current/hw/hw0/hw0_clarifications.html

3 Basic MATLAB Programming

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.

Start from this file: <http://www.cs.cmu.edu/afs/cs.cmu.edu/academic/class/16311/www/current/hw/hw0/p2.m>.

Write a function that 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. Save this image as a variable of dimension $m \times n \times 3$ in MATLAB where m is the height and n is the width.
2. Display the colored image using MATLAB.
3. Display just the green channel of the image using MATLAB (greyscale is fine).
4. Change every other column of the fully colored image to be black.
5. Display this new image using MATLAB.

An example function call would be `p2('image7.png')` where `image7.png` is saved in the same directory as `p2`. The output from this call should be three separate images as described above.

4 Creating and Hosting a Website

Make and host a simple webpage with the following information:

1. An image of a real robot (in industry, one you made, etc.).
2. At least three headers: one for 'Sensing', one for 'Planning' and one for 'Acting'.
3. At least one sentence under each header explaining how the robot in the picture does each of these things.
4. A hyperlink to your favorite real robot video or article.

Ensure that your webpage is viewable for at least a week after submission to allow for grading. Students at CMU have free webspace. This is a tutorial made by CMU students for using that space: <http://www.cs.cmu.edu/afs/cs.cmu.edu/academic/class/16311/www/current/hw/hw0/publishingInstructions.pdf>.

5 Simple L^AT_EX Formatting

Use L^AT_EX to create a .pdf document with the following information:

1. Title
2. Your name
3. Your Andrew ID
4. The date this assignment is due
5. An image of you (one with your face visible) with a caption.
6. At least two sections, one titled "Academic Interests" and one titled "Extracurricular Interests".
7. At least one sentence under each section title that describes your academic and non-academic interests, respectively.
8. A reference to the picture in the text.
9. Any equation to demonstrate understanding of math notation in L^AT_EX.
10. The URL of the website you created for Section 4 (make sure it can be accessed from any computer using this web address).

6 What to submit

The following documents should be submitted on Autolab in their respective problems. Everyone on the roster (and waitlist, for now) will be added to Autolab no later than the end of the day on Thursday. There is no scoreboard or reward for early submissions.

1. A C file (named p1.c) that performs vector and matrix arithmetic (see Section 2).
2. A MATLAB function (named p2.m) that manipulates an image (see Section 3).
3. A .pdf file (named p4.pdf) that demonstrates basic \LaTeX abilities and links to the website you created (see Sections 4 and 5).