ECE 387: Intro to Robotic Systems

Lsn	Topic	Reading	Due
1	Intro & Overview		
2	Linux Command Line	Matlof Ch 1.0-1.9	Install required software
3	Python Intro [download]		HW 1
4	Python Numpy, Sympy, Matplotlib [download]	Matlof Ch 3	HW 2
5	**Python Quiz** [download]		HW 3
6	Lab 1: linux and python		Lab1 EOC
7	Kinematics: Intro [download]	Craig Ch 3	
8	2D Forward-Inv Kinematics		**Quiz 1**
9	3D Inverse-Inv Kinematics		HW4
10	Robot Arm Control [download]	RC Servos	
11	OpenCV Introduction [download]		HW5
12	Lab 2: Robot Arm		Pre-Lab2
13	Lab 2: Robot Arm		Lab2 EOC
14	Filtering [download]	Edge Detection	HW6
15	Feature Detection [download]		**Quiz 2**
16	**GR 1**		
17	Cameras and Calibration [download]		
18	Face Detection [download]		
19	Marker Detection [download]	Wolf	
20	Color Detection [download]		
21	Change Detection [download]		
22	Tracking [download]		HW7
23	Image Stitching [download]		**Quiz 3**
24	Lab 3: Detection and Tracking		
25	Lab 3: Detection and Tracking		Lab3 EOC
26	Mobile Robotics [download]	Siegwart Ch 3	
27	Roomba Sensors [download]	Siegwart Ch 4-4.1.71	
28	Sensor Calibration [download]		
29	Controls [download]	Siegwart Ch 5	HW8
30	Lab 4: Roomba Control		
31	Lab 4: Roomba Control		Lab4 EOC
32	Path Planning [download]	Law	
33	Final Project		
34	Final Project		
35	Final Project		
36	Final Project		**Quiz 4**
37	**GR2**		
38	Final Project		
39	Final Project		Bonus I
40	Final Project		Bonus II

- Homeworks are at the beginning of class (BOC)
- Labs are due on the final day at the end of class (EOC)

Spring 2018 Syllabus

Instructor

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Course Goals and Objectives

Cadets shall:

- Apply common robotic skills using python and the linux command line
- Apply forward and inverse kinematic analysis manipulators and mobile robots
- Apply control methods to mobile robots so they can avoid obstacles and navigate
- Apply common techniques in modern image processing and computer vision

Prerequisite Course

- Familiarity with any programming language, such as Matlab or C/C++
- Understanding of high school trigonometry
- Understanding of simple matrix/vector operations

Course Materials and Resources

Course Text	None, various PDFs are provided for reading
Web Page	https://marsuniversity.github.io/ece387/
Software	Python 2.7
	OpenCV 3.4.x
	Jupyter notebooks
	GitBash

Grades

Grade	Grade
90 < A < 100	74 < C+ < 77
87 < A- < 90	70 < C < 74
84 < B+ < 87	67 < C- < 70
80 < B < 84	60 < D < 67
77 < B- < 80	0 < F < 60

	Prog %	Final %
HW	10	10

Robots are cool!

	Prog %	Final %
Quizzes	10	10
GRs	45	30
Labs	35	25
Final Project		25

Missing Class and the Late Policy

Inform your instructor of absences in advance via email. Please include the reason for the absence and any relevant SCA. Check the SCA to see if instructor permission is required and if it is, make the request prior to the absence. You will be given an Unexcused Absence in CAS if you fail to get permission.

If you plan to miss a class, you *must* take any quiz or GR prior to your departure.

Due to the limited time to conduct labs and the fact they are executed in groups, you can not miss both lab days unless you have a medical excuse due to unplanned illness. You can miss one lab day, but depending on situation (e.g., something you could have avoided), you may loose points for the lab.

If you are expecting to miss class on the day an assignment is due, you shall turn in your assignment prior to your departure. Your instructor may grant a no-penalty turn-in extension for absences resulting from illness or other legitimate extenuating circumstances. Cadets shall coordinate late submittals in advance. The late policy for the Department of Electrical and Computer Engineering is as follows:

How Late?	Max Penalty	Max Grade
< 1 day	25%	75%
2 day	50%	50%
3 day	75%	25%
> 3 day	100%	0%

Collaboration and Documentation Policy

You may receive help from any DFEC faculty member on the homework. Do not work with other students in the class or who have taken the class previously. Document all help received on work submitted for grading IAW DF policies, or document *none* if your work was completely individual effort.

Labs and Final Project

The labs are performed in groups of no more than 3 students. Each lab will build on the homework, in class lectures and readings. The purpose of the labs is to provide hands on experience with the topics discussed in the lectures. The final project will focus on the Roomba robot, controls, computer vision, and path planning.

All team members will receive the same grade unless it is identified that all members did not equally help out. The offending member(s) will receive a scaled grade equal to the team grade time 0.75. If this happens more than once, then the offending individual will become a team of one.

Homework/Lab Templates

- Jupyter Notebook
- Python

References

Readings

- Matlof, "Fast Lane to Python"
- Craig, "Introduction to Robotics"
- RC Servos
- Edge Detection, 2nd half of pdf
- Siegwart, "Introduction to Autonomous Mobile Robots"
- Wolf, "AN INTRODUCTION TO ERROR CORRECTING CODES"
- Faragher, "Understanding the Basis of the Kalman Filter"
- Law, "Quantitative Comparison of Flood Fill and Modified Flood Fill Algorithms"

Install/Setup Guides

- **Required Software:** Laptop software install for python, OpenCV, and MS Compiler
- Roomba Setup
- Interfacing Windoze and Linux file systems
- Connecting to the Roomba via wifi
- Pandoc setup for automating website/documentation generation

On-line Python and Command Line Class

- www.codeacademy.com

Lynxmotion Arm Guide

- SSC-32u Servo motor controller

Class Python Libraries

- ar_markers: detecting QR markers
- nxp_imu: driver for NXP inertial measurement unit
- pycreate2: driver for iRobot Create 2
- ins_nav: algorithms for inertial navigation
- opencvutils: OpenCV functions
- the-collector: saving live data for later
- pyhexdump: reads binary files

Standford Python Class: Introduction to Scientific Python, CME 193

- Intro
- Functions & Testing
- Data Structures
- Object Oriented Programming
- Numpy and Matplotlib
- File I/O and Strings
- Other Topics

OpenCV Documentation

- OpenCV 3 Overview pdf
- OpenCV Documentation, all languages
- OpenCV tutorials for python
- OpenCV source code on github, python examples

Cheat Sheets and References

- Linux command line reference
- Markdown
- LaTeX math symbols
- Python and matplotlib (long)
- Python (short)
- Python Crash Course
- Jupyter reference I
- Jupyter reference II
- iRobot Create 2 Open Interface Spec

Robots are cool!