Syllabus

Course Information:

- UC Berkeley, Spring 2016
- Course Title: IEEE Micromouse
- Course Number:
    - Lower Division: EE98
    - Upper Division: EE198
- Unit Value: 1 unit
- Time / Location: 140 Cory Mon 8-10pm
- First class: 2/1/2016
- Instructors:
    - Chandler Chen (cgchen@berkeley.edu)
    - Christine Straub
    - Jeanie Jung

Prerequisites:

- If you've programmed or worked with circuits before you're good.
- Basic CS and EE familiarity lets you pursue the more complex topics.

Overview:

The purpose of this course is to teach students how to build an autonomous, maze-solving car, following the standards set in IEEE's Micromouse competition. Students form teams of 3-5 people to build the micromouse. Topics involve motor control, pathfinding, PID, and basic electrical engineering concepts, among others.

The course is aimed at students with a strong interest in EE, who want to pursue a hardware project but may not have the skills to do so on their own. By the end of the course, the student will be able to build an autonomous car with minimal assistance, and (hopefully!) be able to extend skills learned in this course to other projects.

Instruction:

Class is two hours a week in the lab. Each lab consists of a set of parts the students will use as well as some instructional material on how to interface with them. Several weeks into the course, the students will assemble a full mouse that they will then bring to future labs, where we will teach techniques on how to improve them. By the end of the course, the students should have a fully working mouse, and we will have an in-class competition on the last day.

Work outside of class involves research and development of the robot. In the first half of the semester, students will follow the links provided at the end of labs that provide deeper context for the current activity, and important background for the next class. In the following half

of the semester, students will spend time outside of class testing code for their robots, as the time in labs will not suffice.

Schedule:

- Notable Topics:
    - Diode to curb inductor spikes (protect against backcurrent)
    - Capacitors to smooth signals
    - Take the average of signals with circular arrays.
- Week 1 : What Is Micromouse?
    - Tournament video, rules
    - Team matching/signups
    - High-level overview of schematic
    - Research different robot designs, noting their disadvantages along with advantages

- Week 2 : Motors, equipment and controllers
    - Equipment tutorial:
        - Current controlled power supply
        - Multimeter
        - Function generator
        - Oscilloscope
    - Power motor with DC, varying current
    - Power motor with PWM, varying duty cycle with signal generator
    - Power motor with Microcontroller PWM
    - Research basic microcontroller programs, specifically ones that takes input from sensors

- Week 3 : Sensor, Microcontroller
    - Sensors:
        - Distance sensors
        - Print distance output
        - Convert distance to motor speed.
        - Control flow motor rotation
    - Research/Brainstorm a design for your chassis

- Week 4 : Build Mouse
    - Take out the parts bin, time to assemble your mouse.
    - Maybe lecture on parts
    - HW: Submit Chassis design for laser cutting

- Week 5 : Interrupt and performance programming
    - Encoders
        - Record encoder ticks first naively and then with interrupts.
    - Fast digital read / fast digital write

    - Bonus: Write to port registers directly
    - Research PID controlls, go through Udacity's AI for Robotics chapter on PID

- Week 6 : PID Controls
    - Proportional control
    - Integral control
    - Derivative control
    - Research: Finish the PID chapter

- Week 7 : PID Continued
    - Worksession to finish PID
    - Milestone 1 : Go down a 5 square corridor by the end of today
    - Research various maze solving algorithms.

- Week 8 : Maze Traversing (lecture)
    - Follow the right wall
    - Random turning
    - Localization: How to know your position in the maze
    - Dijkstra's algorithm
    - HW: program robot

- Week 9 :
    - Turning corners
    - HW: program robot

- Week 10 :
    - Milestone 2: Hardcode 90 degree turn
    - HW: program robot

- Week 11 :
    - Worksession
    - HW: program robot

- Week 12 :
    - Worksession
    - HW: program robot

- Week 13 :
    - **FINAL COMPETITION**
        - **you should have your stuff together by week 12**

Grading Procedures:

In order to receive a passing grade, the followings are required (although this list is subject to change):

- Only miss 1 lab unexcused or
- Complete all milestones or
- Send competition ready robot to end of semester competition

Cooperation Policy:

Cooperation is highly encouraged, with full disclosure of information. Since grades are not dependent on how well you do relative to other students, there is no reason to prohibit cooperation in any way. If you find out there's an anomaly with a microcontroller you're using, share it! It only benefits everyone.