DeCal Course: Hardware Makers
Course Syllabus, Spring 2017
University of California, Berkeley Department of Electrical Engineering

I. General Information

Course Department: Electrical Engineering
Faculty Advisor: Prof. Chenming Hu
Course Number: EE 198
CCN: Come to First Class
Units: 2, P/NP
Prerequisites: None
When: TBD (DAY IS NOT CONFIRMED)
Where: TBD (125 Cory or 210 Jacobs Hall)
Slack: Email of student facilitator to be added to Slack group
Course Capacity: 20 students
Enroll: https://goo.gl/forms/hUvHChzcXmAcAxiA2
Invitation Video: https://youtu.be/JvDR_zcykTk

II. Student Facilitator

Juan Pablo Duarte (jpduarte@berkeley.edu) - Electrical Eng. and Computer Sciences

III. Course Description

The access to small and inexpensive computing hardware, sensors, actuators, and batteries has opened new and affordable opportunities for makers to create prototypes for their hardware ideas. This introductory course will expose students to the hardware knowledge necessary to make things; what things? Things that students may want to do with wifi/bluetooth connections of available boards, sensors/actuators, and additional electronics components. The topics of the course are as follow:

- **Hardware Boards:** Small and inexpensive computing hardware (ex: RedBear Duo ~$25, C.H.I.P ~$9) that have Wifi and Bluetooth capabilities. Students will learn how to load code into boards, read data from sensors, and control actuators with it.
- **Writing ideas into your hardware:** programming computing hardware. Basic programing for the board will be introduced; such as statements like , such as and not limited to, adding, such as and not limited to, adding, such as and not limited to, adding 'If-else', 'for', 'while', 'case', etc., interrupts, state machines, and create simple server/clients to establish wireless communications.
- **Measuring your hardware:** Oscilloscope, Function Generator and Multimeter. Fundamental skills in using these components will be presented. Students will be able to produce signals, measure sensor data, and do basic circuit debugging.

- **Talking and listening between hardware and humans:** Wifi and Bluetooth. Students will learn how to establish simple server/client communications.
- **Sensing the world:** accelerometers, gyros, microphones, GPS, ultrasonic distance sensor, etc. Working principle of several sensors, how to read and interpret data-sheet of components, and incorporate sensors into their computing boards.
- **Moving the world:** motors, speakers. Students will learn the working principle of some actuators like DC, servo and stepper motors, and how to control them using the computing boards.
- **Feeding hardware:** Batteries and Voltage Regulators. Popular batteries types will be introduced (A,AA,Li-Ion / LiPo,etc.), power capacity and capability metrics, and how to decide the adequate battery for given current/power budget requirements. In addition, AC adapters and voltages regulators will be introduced.
- **Hardware Startups:** what makers are creating and selling? Invited speakers will give talks about related topics to hardware.

Every class will present a topic in hardware (10 min), the working principle of the hardware (10 min), how people use it (10 min), and a hands-on experience to apply concepts (1hr). Students should be able to understand the basic principles of the hardware introduced during class, run an example, and modify it (30min). The last part of the course will be devoted to group projects. When a speaker gives a talk, the lecture assigned to that day will be moved to next week.

It must be pointed out that the ultimate purpose of the course is to have fun with hardware!

IV. Materials*

- RedBear Duo Board
- 140pcs Solderless Breadboard Jumper Cable Wire Kit
- 830 Tie Points Solderless PCB Breadboard MB102+65Pcs Jumper cable wires
- Metal Film Resistors
- 3 Axis gyroscope + accelerometer, Microphone Sensor
- TFT LCD Display

(*Items types, model, manufacture and price will be announced. Students are welcome/encourage to bring their own boards and hardware.)

These materials are to be used to teach students the hands-on knowledge behind hardware applications. The intention is to have students split into subgroups, each running examples and modifying them.

V. How to Enroll

Please fill up the form in: https://goo.gl/forms/hUvHChzcXmAcAxiA2

VI. Tele-Bears

A student must show up on the first day of class to confirm enrollment. If you cannot make it but still would like to join the class, please email us before the first class to ensure that you are still enrolled. If student interest exceeds room capacity, enrollment will be determined by application.

Course Control Numbers are given out at the end of class on the first day. There are no prerequisites for this course; we welcome all interested majors!

VII. Instruction

Class: Course will primarily consist of short lectures (30 min) followed by hardware hands-on experiences (1.5 hrs). Class schedule is TBD. Some scheduled lectures will be complemented by guest lectures from industry insiders, design engineers, start-ups, etc.

Optional Reading: Biweekly short readings will be posted in the course website which will generally focus on recent news to do with hardware, updates on technological developments in the field, or fun projects from makers.

Final Project: A prototype project designed by students and guided by facilitator will be developed during the last four weeks of classes.

The course website will be hosted on bCourses. If you are auditing the class, please notify the student facilitator via email so that you can be given access to the course's bCourses site.

VIII. Attendance

You are allowed to miss two days of classes. Absences may be excused if a credible reason is given and the student facilitator is informed via email before class. Attendance is taken at the end of class each day. If you need to leave early please talk to us, or you will not get credit for that day's participation.

IX. Grades

The grades will be determined by attendance, in-class hardware experiences, and final project:

20% Assistance (student must stay until of end of each lecture to obtain a point)
40% Hands-on hardware experiences (student must be able to finish during class the experience to obtain a point)
40% Final Project (student should present project idea, project update, and project presentation to obtain full score)

Since the course is on a P/NP basis, a passing grade is 70% or higher.

X. Faculty Advisor

Dr. Chenming Hu (hu@eecs.berkeley.edu) will be the faculty sponsor for this course. While the student facilitators have the primary responsibility of running the course, Dr. Hu has the final authority for inputting course grades. Also, if there are any complaints about the nature of the DeCal or how the course is run that cannot be addressed by the student facilitator, he is the person to contact.

Dr. Hu may supervise the student course facilitator through occasional communication and follow-ups at their discretion. He may also choose to visit lectures with no prior notice to the students or facilitator.

XI. Tentative Spring 2017 Schedule

Week:	**Lecture:**	**Experience:**
1	**Hardware Boards:** Students will learn how to upload code to a board, establish a serial communication with computer, and use computer to analyze the data from serial port.	**Electric Angklung:** Students will create an electric Angklung. We will play all together a song at the end of the class (http://bit.ly/2fzAcMh).
2	**Programing computing hardware:** Students will learn how to make a state machine inside the hardware board. Also they will run the same code in processing 3 language	**Life decision flow-diagram advice using hardware:** Students will create flow diagrams (http://bit.ly/2e68ipW) using state machines in hardware.
3	**Oscilloscope, Function Generator and Multimeter:** Basic operation of these components will be introduced. Digital to Analog signal conversion and PWM (pulse width modulation) concepts will be explained.	**Lighting up LEDs:** Digital versus analog signals. Students will learn how to light up LEDs using analog and digital signals.
4	**Wifi and Bluetooth:** Simple server/client communication will be explained.	**Chat with your classmates using hardware:** students will learn how ask/share multiple choice answers using hardware and the network.
5	**Sensors 1:** Different types of switches will be introduced, together with the code necessary to implement them in	**Fast reaction card game:** students will play multi-user card game, using switches like buttons or pressure

	hardware.	mats.
6	**Sensors 2:** Working principle of accelerometer and gyro sensors will be introduced.	**Game Controller:** students will construct a game controller using accelerometers.
7	**Actuators 1:** Students will learn the working principle of some actuators like DC, servo and stepper motors, and how to control them using the computing boards.	**Small Connected Robot:** Students will control speed of robot motors using wifi. We will race!
8	**Actuators 2:** basic control theory will be explained and how to implement with hardware.	**Stabilizer Arm:** An arm (a pole stick) will be stabilized using a simple control scheme and the data of an accelerometer.
9	**Batteries and Voltage Regulators:** Popular batteries types, AC adapters and voltages regulators will be introduced.	Students will construct the needed circuitry to feed their hardware and establish a wireless communication with a server.
10	Project Idea Brainstorm	
11	Project	
12	Project	
13	Project Update Presentation	
14	Project	
15	Project Presentation	