Software Design of PCBs: Course Info

Jonathan Bachrach
EECS UC Berkeley
August 25, 2016
Software Defined Printed Circuit Boards
“Circuit Board Design for Programmers”

Prof Jonathan Bachrach with Richard Lin @ EECS

Do you want to

make this on this in code?

Have you ever wanted to design a circuit board but were intimidated?
Have you been frustrated by the tedium of circuit design apps?
Are you a programmer and want circuit board design to be like software design?
Do you want to design boards at the speed of rapid fabrication?

Well this class is for you...

CS194/294-126
upper div / grad / studio / project class

Fall 2016, TuTh 10-11:30a, Jacobs 220
4 Units: 3 hr lecture and 3+ hrs lab time / week.

http://www-inst.eecs.berkeley.edu/~cs194-126

“making the easy things easy and the hardware things software”
Course Style

- seminar
- cutting edge
- early stage and kind of rough
- workshop for fab toolkit
- lots of hands on and class discussion
$75 Jacobs MakerPass

> $100 material costs

can work with you if you have financial need
tools

- $75 Jacobs MakerPass and/or
- can use your own tools and/or lab space

parts

- > $100 material costs
- makerpass gives you access to stock parts
- makerpass gives you access to materials store
- otherwise buy from digikey + mouser + etc

can work with you if you have financial need
competent with milling + soldering boards
proficient in algorithmic design
basic circuit design
embedded debugging skills
basic understanding of manufacturing constraints
research directed – projects seed research ideas
flush out examples for jitpcb
push limits of what’s possible with pcb design
raise level of design to be as productive as fab machines
have fun!
Why This Class?

- Have you ever wanted to design a circuit board but were intimidated?
- Have you been frustrated by the tedium of circuit design apps?
- Are you a programmer and want circuit board design to be like software design?
- Do you want to design boards at the speed of rapid fabrication?

No but really Why This class?

- Want to dig deeper into circuit design specifically?
- Want to build a research platform for your projects?
- Want to learn how to quickly prototype boards?
- Want to participate in a new and powerful design paradigm?
Non Goals

- teach standard tools
- teach programming
- to be a hardcore mechatronics class
- to be a hardcore embedded systems class
Prerequisites

- cs61a
- cs61b
- cs61c
- ee16ab*

- python programming
- algorithms
- computing systems
- electronics
adjunct assistant professor in eecs
cofounded otherlab
advise phd students and taught cs250
teach cs194-028 on sw defined me
lead chisel hardware design project

http://www.jbot.org
jackbackrack
Who Are TA’S?

Richard “Ducky” Lin
Patrick Li
Austin Buchan

EE192 STANZA
PhD Students in EECS
Who Are You?

- CS
- EE
- ME
- Art
- other?

- power tools
- fabrication
- arduino?
- python programming
- electrical engineering?
“circuit boards for programmers”
- First chunk: lectures / readings / labs and
- Last 1/3 project

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<td>Lecture 07: Basic JITPCB</td>
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<td>Lecture 08: Basic Circuit Design Part I</td>
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<td>JITPCB Peripheral Design</td>
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<td>Lecture 16: Project Ideas</td>
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<td>Proposal Presentations</td>
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<td>Thu Nov 24</td>
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<td>Project 1-1s</td>
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<td>Thu Nov 31</td>
<td>Project 1-1s</td>
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<td>16</td>
<td>Tue Dec 06</td>
<td>Final Show</td>
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<td>17</td>
<td>Tue Dec 13</td>
<td>Final Project Writeups due</td>
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- start from stanza
- work through old skool ways
- build out sw defined hw defined sw approach
- tools
- stanza programming
- jitpcb toolkit
- lab questions
- monday 4-5p in jacobs 210
- series of tasks to learn fabrication and algorithmic design
- assigned at end of each Tuesday's class
- due by start of next Tuesday's class
- 5 late days total
Lab One – Stanza

- Overview
- Types
- Functions
- Standard Library
Lab Two – Breadboarding

- Breadboard simple Hello World with Nucleo
- Learn basic embedded programming
- Get console running
- Pipe cleaning your tools etc
- Get Otherplan software installed
- Get tooling
- Mill hello world board
Lab Four – Solder

- Solder hello world board
- Learn basic soldering techniques with milled boards
- Solder vias
- Bring up hello world board

adafruit soldering
- Write simple JITPCB design with couple peripherals
- Write PCB generator with parameters
- Mill, solder and bring up board
- Write geometry driven design
- Parameterize design
- Learn layout language
- Mill, solder and bring up board
Lab Seven – JITPCB Peripherals

- Write peripheral with package + circuit + driver
- Learn how to design a package
- Learn how to parameterize circuit design
- Write driver
- Write design with new peripherals
- Mill, solder and bring up board

pololu motor board
- eight week project
- JITPCB based projects
- quick pitches
- written project proposals
- live project proposals
- 1-1s
- critiques
- final show
sound – musical instruments
light – LED sculptures / displays
sensor – data acquisition and IoT
actuation – mobile, arm, flying robots
time – clocks
Project Goals

- parametric – reusable and scalable
- algorithmic – computational design
- declarative – optimize based on goals
- ones for lab one
- twos for remaining and sections
- try to get complementary skills
Grading

- from eecs grading guidelines
- 5% participation
- 45% labs
- 50% project

A (excellent); B (good); C (fair); D (barely passed); F (failure); P (passed at a minimum level of C- for undergraduate students); NP (not passed); S (satisfactory, passed at a minimum level of B- for graduate students); U (unsatisfactory); I (work incomplete due to circumstances beyond the student’s control, but of passing quality); and IP (work in progress, final grade to be assigned upon completion of entire course sequence).
- cs194-126
- sign up
- send message to instructors with
  - availability for wednesday
  - github username
  - teams
- questions posted and answered there
- cs194-126
- homework done here
- each student gets their own repo
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<th>windows</th>
<th>macos</th>
<th>linux</th>
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<td>JITPCB</td>
<td>yes</td>
<td>yes</td>
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http://inst.eecs.berkeley.edu/~cs194-126

Computer Science 194/294-126: Software Defined Printed Circuit Boards

Fall 2016

Prof. Jonathan Bachrach

Lectures: Tuesday and Thursday, 10:00-11:30AM, 220 Jacobs

Course Info and Poster

Course Calendar with Handouts

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Training

- get makerpass
- online training
- electronics training
- othermill training

http://jacobsinstitute.berkeley.edu/student-resources/
- Students can purchase materials through Jacobs.
- Visit https://store.jacobshall.org.
- Also buy through Digikey, Mouser, Sparkfun, Adafruit.
- Examples: nucleo, blank PCBs, sensors, actuators, ...