Computational Design + Fabrication: Course Info

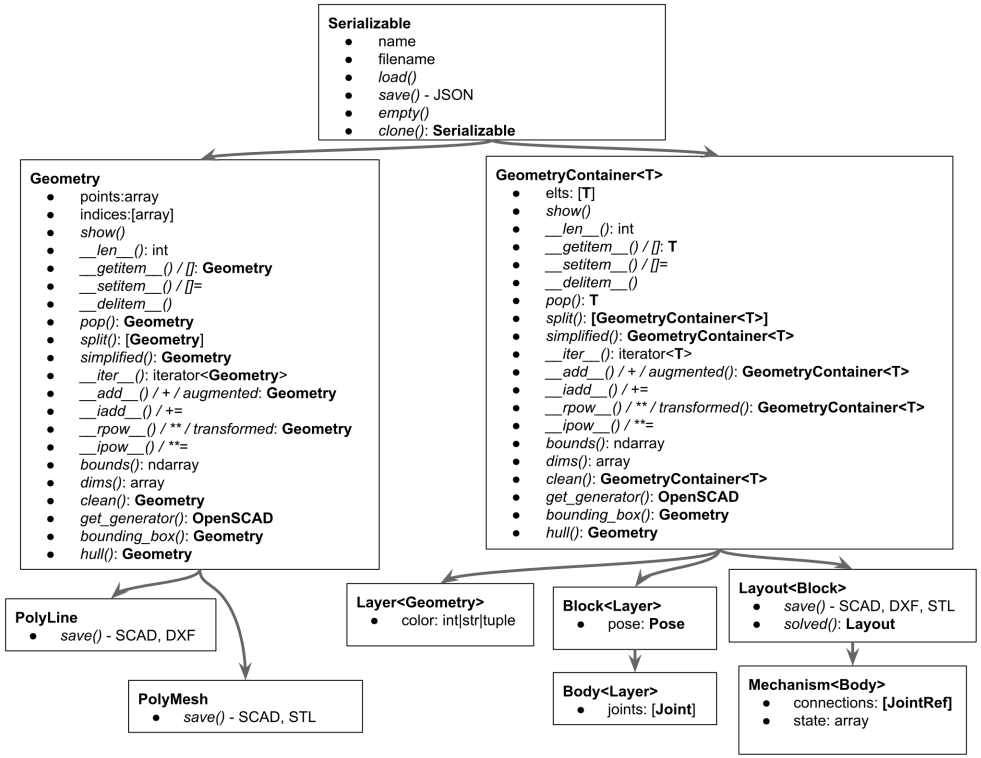
Jonathan Bachrach

EECS UC Berkeley

August 27, 2015

Course Style

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



Goals

- competent with basic 1-3d fabrication
- proficient in algorithmic design
- basic understanding of manufacturing constraints
- research directed – projects seed research ideas
- flush out examples for digifab toolkit
- raise level of design to be as productive as fab machines

Non Goals

- teach standard tools
- teach programming

Prerequisites

- cs61a
- cs61b
- cs164*
- cs184*

- python programming
- algorithms
- geometry
- computer graphics
- linear algebra

Who Am I?

- adjunct assistant professor in eecs
- algorithmic art for 35 years
- cofounded otherlab
- advise phd students and teach cs250
- lead chisel hardware design project

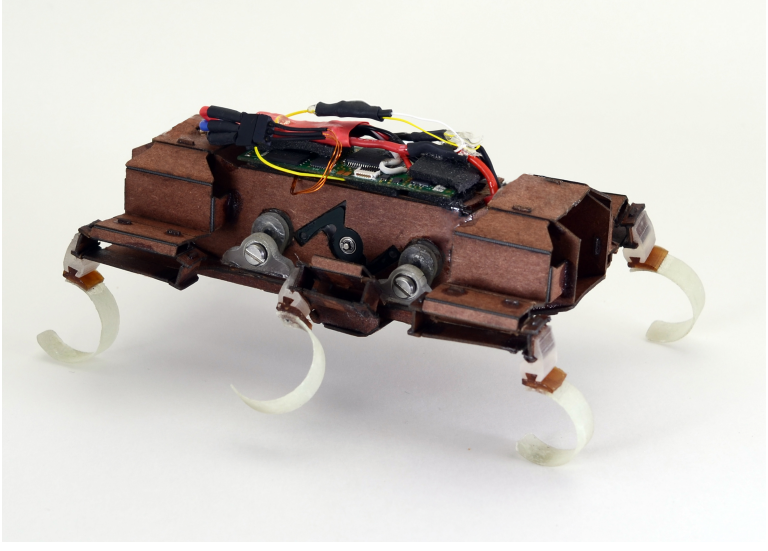
`http://www.jbot.org`

`jackbackrack`

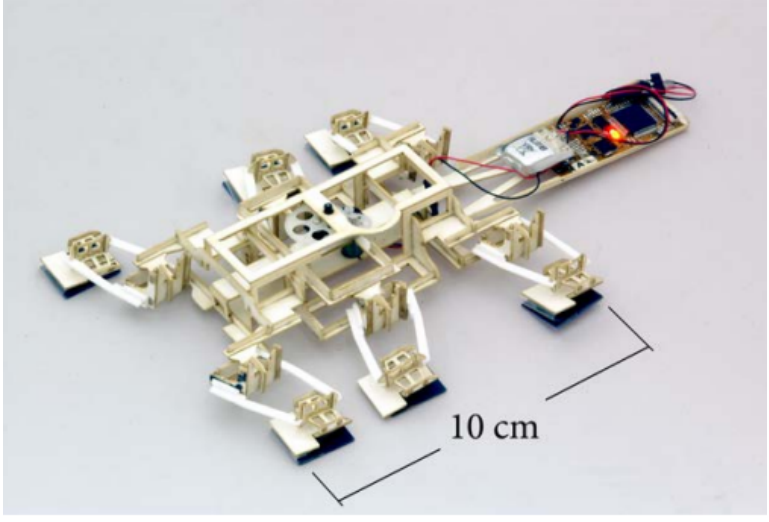
Who Are TA'S?

Austin Buchan / EECS

Duncan Haldane / MechE



PhD Students



in Robotics

Who Are You?

- CS
- EE
- ME
- Art
- other?

- power tools
- fabrication
- arduino?
- python programming
- computer graphics

Curriculum

- first chunk lectures / readings / labs and
- last 1/3 project

Week	Date	Subject	Assignments
01	Thu Aug 27	Lecture 01: *D Intro + Compiler + Organization	
02 *D	Tue Sep 01	Lecture 02: *D Solid Geometry	Reading 0
	Thu Sep 03	Lecture 03: *D CNC	
03 1D	Tue Sep 08	Lecture 04: 1D CNC / Geometry / Design	Reading 1
	Thu Sep 10	Lecture 05: 1D Joinery / Assembly	Lab 0
04 2D	Tue Sep 15	Lecture 06: 2D CNC / Geometry / Design	Reading 2
	Thu Sep 17	Lecture 07: 2D Rationalization / Joinery / Layout	Lab 1
05 3D	Tue Sep 22	Lecture 08: 3D CNC / Geometry / Design	Reading 3
	Thu Sep 24	Lecture 09: 3D Rationalization / Joinery / Validation	Lab 2
06 4D	Tue Sep 29	Lecture 10: 4D Geometry / Kinematics	Reading 4
	Thu Oct 01	Lecture 11: 4D Joints / Constraints	Lab 3
07 4.5D	Tue Oct 06	Lecture 12: 4D Digifab	Reading 5
	Thu Oct 08	Lecture 13: 4D Mechanisms + Project Ideas	Lab 4
08 5D	Tue Oct 13	Lecture 14: 5D Declarative Design + Exploration	Reading 6
	Thu Oct 15	Lecture 15: 5D Optimization / Analysis	Lab 5
09 6D	Tue Oct 20	Lecture 16: Advanced Topics	Reading 7
	Thu Oct 22	Lecture 17: Advanced Topics	Lab 6
10 props	Tue Oct 27	Proposal Presentations	
	Thu Oct 29	Proposal Presentations	
11 meets	Tue Nov 03	Project 1-1s	
	Thu Nov 05	Project 1-1s	
12 crits	Tue Nov 10	Project Critiquess.	
	Thu Nov 12	Project Critiquess.	
13 meets	Tue Nov 17	Project 1-1s	
	Thu Nov 19	Project 1-1s	
14 crits	Tue Nov 24	Project Critiques	
	Thu Nov 26	Thanksgiving	
15 meets	Tue Dec 01	Project 1-1s.	
	Thu Dec 03	Project 1-1s.	
16 R+R	Tue Dec 08	Project Work	
	Thu Dec 10	Project Work	
17 Finals	Tue Dec 15	Final Project Presentations	

- start from simple geometry and fabrication machines
- work through complexity
- build to articulated mechanisms and
- ultimately design space exploration and optimization

- tools
- programming
- digifab toolkit
- lab questions
- wednesday sometime

Readings

- series of readings to learn about fabrication and algorithmic design
- assigned at end of each tuesday's class
- question due by start of next tuesday's class
- will randomly call on a couple people each tuesday
- only accessible from berkeley
- first one up already

Computational Design of Mechanical Characters

Stelian Coros*[1] Bernhard Thomaszewski*[1] Gioacchino Noris[1] Shinjiro Sueda[2] Moira Forberg[2]
Robert W. Sumner[1] Wojciech Matusik[3] Bernd Bickel[1]

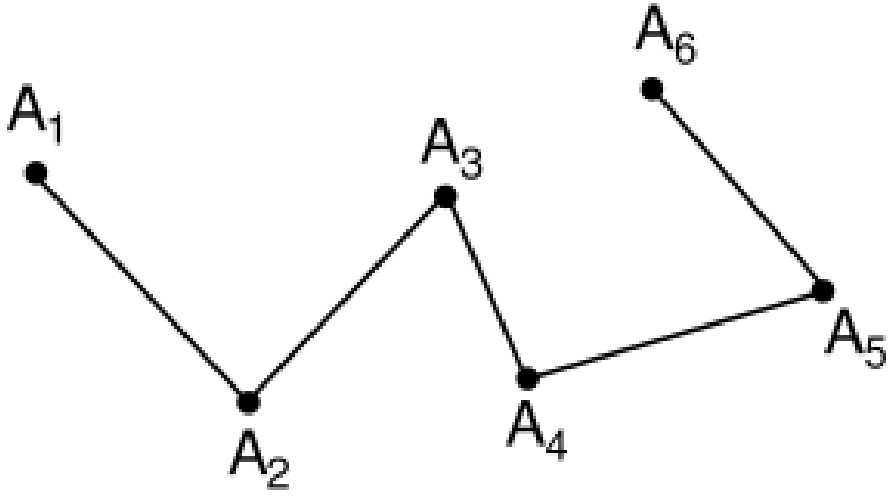
[1]Disney Research Zurich [2]Disney Research Boston [3]MIT CSAIL

Figure 1: *The interactive design system we introduce allows non-expert users to create complex, animated mechanical characters.*

Labs

- series of tasks to learn fabrication and algorithmic design
- assigned at end of each thursday's class (except today)
- due by start of next thursday's class
- 5 late days total

- python
- github
- geometry
- solidpython
- digifab
- openscad
- algorithmic design

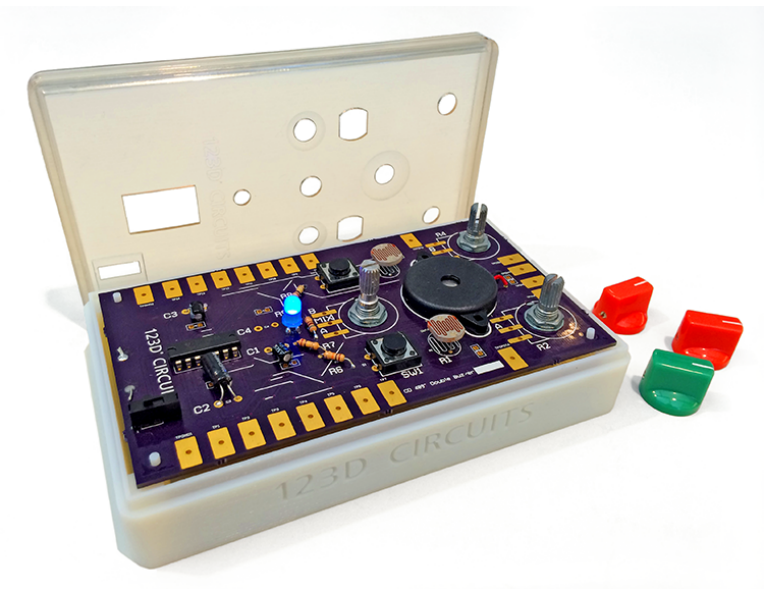


- DIWire
- Algorithmic Design
- Validation

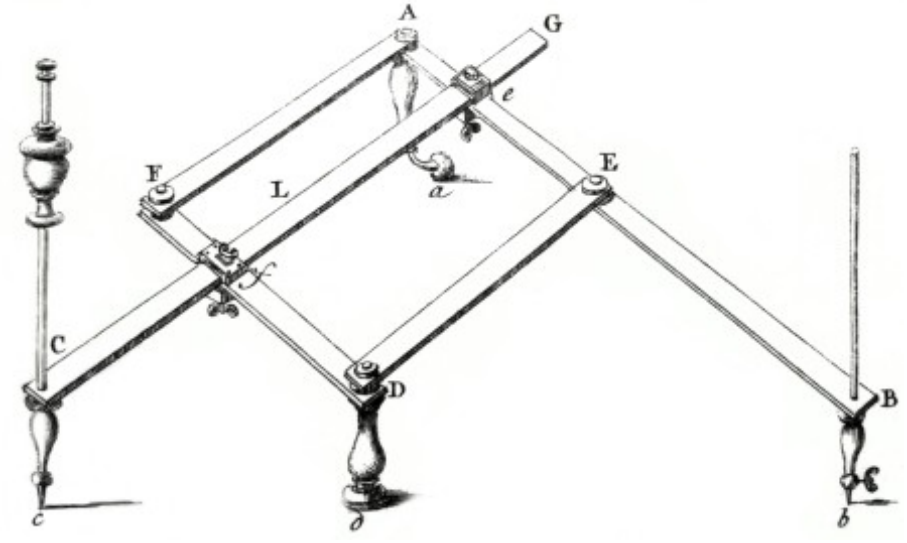
- Laser Cutter
- Layouts
- 2D Joinery

Lab Three

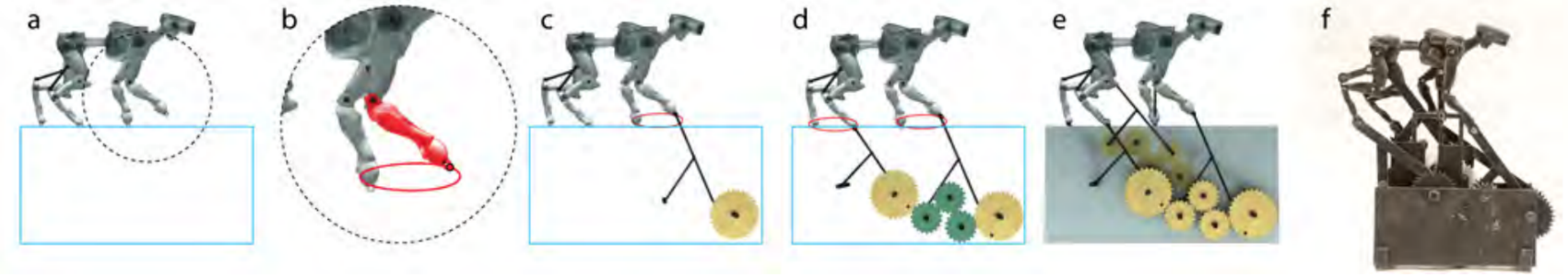
- 3D Printer
- 3D Joinery



- Kinematics
- Basic Mechanisms
- Construction from Solid Geometry
- Pantogram

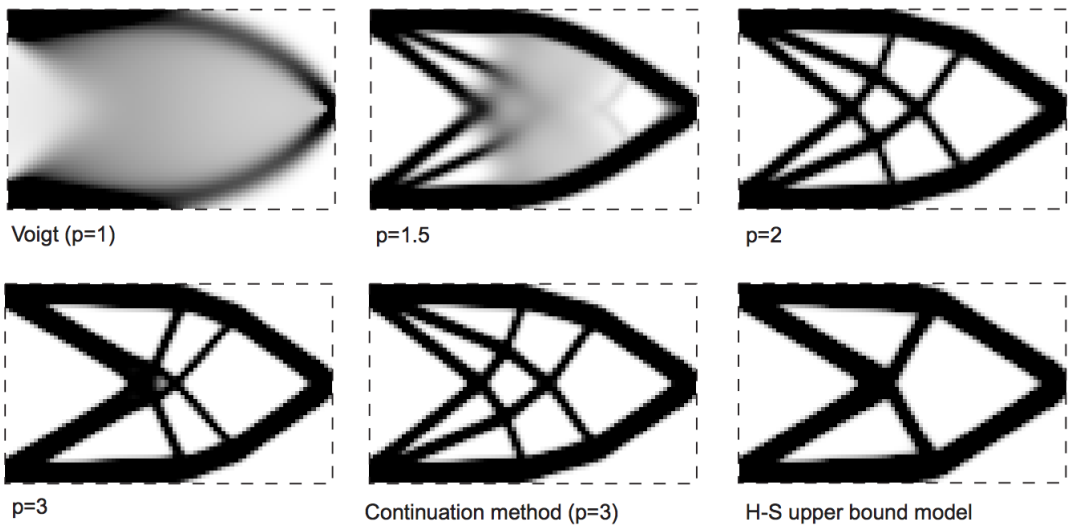


- Advanced Mechanisms
- Desired Kinematic Output and How to Achieve It
- Analysis to Determine Actuator Sizing



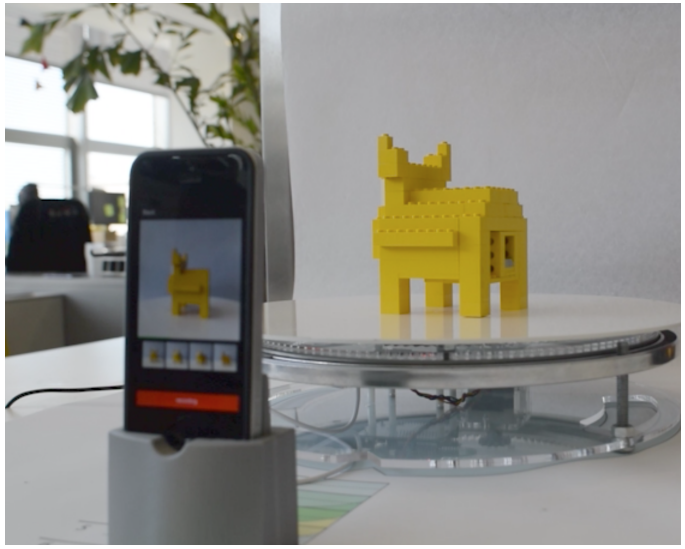
Computational Design of Mechanical Characters – Disney Research

- Design Space Exploration
- Optimization
- Topology Optimization

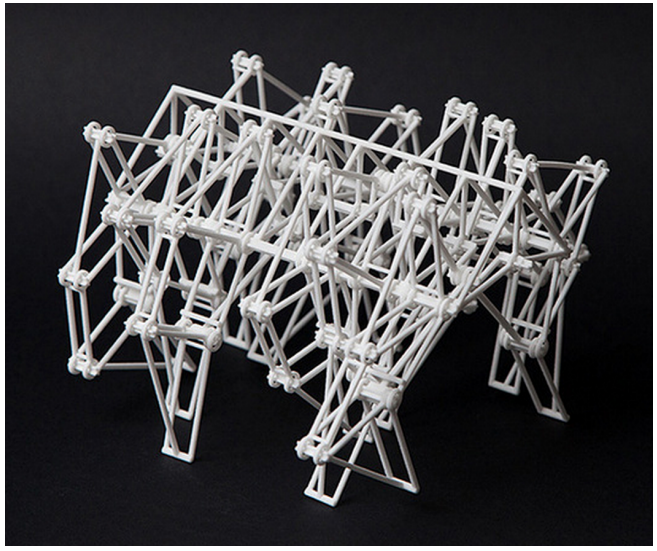


Material Interpolation Schemes in Topology Optimization – BendsÃźe + Sigmund

- eight week project
- digifab based projects
- quick pitches
- written project proposals
- live project proposals
- 1-1s
- critiques



spin – livelong kindegarten group @ mit media lab



strandbeest – theo jansen

- ones for lab zero
- twos for remaining and sections
- try to get complementary skills

Grading

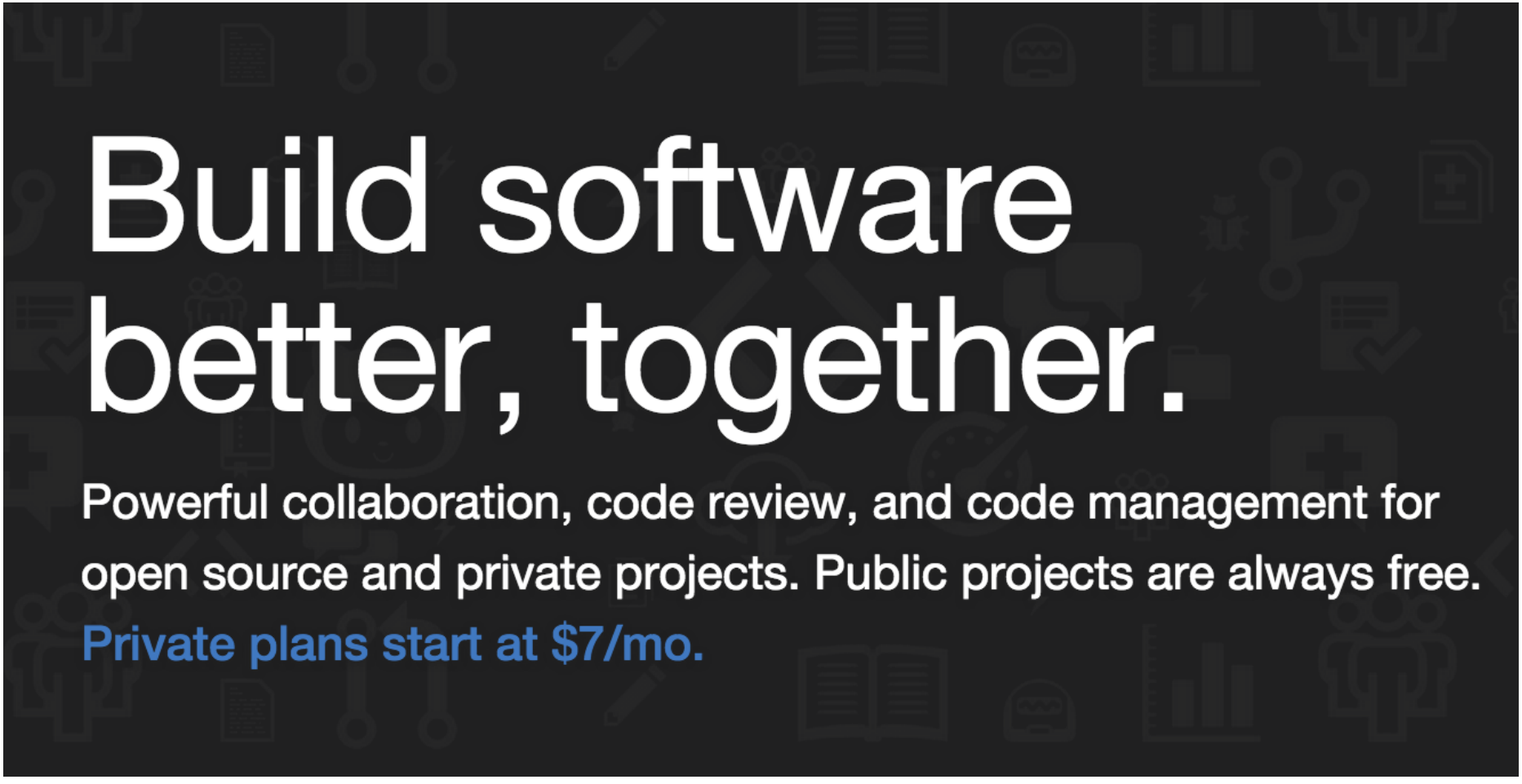
- from eecs grading guidelines
- 5% participation
- 45% labs
- 50% project

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).

Piazza

- cs194-028
- sign up
- send message to instructors with
  - availability for wednesday
  - github username
  - teams
- questions posted and answered there

- cs194-028
- homework done here
- each student gets their own repo



- virtual box compliant computer

- http://inst.eecs.berkeley.edu/ cs194-28/fa15/

Computer Science 194-028/294-119: Computational Design + Fabrication

Fall 2015

Prof. Jonathan Bachrach

Lectures: Tuesday and Thursday, 3:30-5:00PM, 320 Soda

Course Info and Poster

Course Calendar with Handouts

Subject to Change.

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- tue – sep 15th
- think its classroom 123

Invention Lab

- meanwhile will be in invention lab
- how to get trained `http://invent.citris-uc.org/about/calendar/`

- students must purchase materials through jacobs