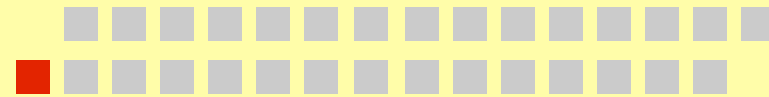


# week 01



# Theory and Practice of Tangible User Interfaces

---

## Introduction

# Welcome!

---

- Introduction
- Monday and Wednesday curriculum
- Course requirements
- Course survey

# Instructors

---

Kimiko Ryokai

Daniela Rosner

Niranjan Krishnamurthi

# Kimiko



# Teaching Assistants

---



**Daniela Rosner**  
PhD candidate  
School of Information

“Design Research Guru”



**Niranjan Krishnamurthi**  
Master's candidate  
School of Information

“Tech and Fab Guru”

# Office Hours

---

## **Kimiko Ryokai**

Mondays 2-3pm at 110 South Hall

and by appointment, [kimiko@ischool.berkeley.edu](mailto:kimiko@ischool.berkeley.edu)

## **Daniela Rosner**

by appointment, [daniela@ischool.berkeley.edu](mailto:daniela@ischool.berkeley.edu)

## **Niranjana Krishnamurthi**

by appointment, [niranjana@ischool.berkeley.edu](mailto:niranjana@ischool.berkeley.edu)

# My Childhood Object

---

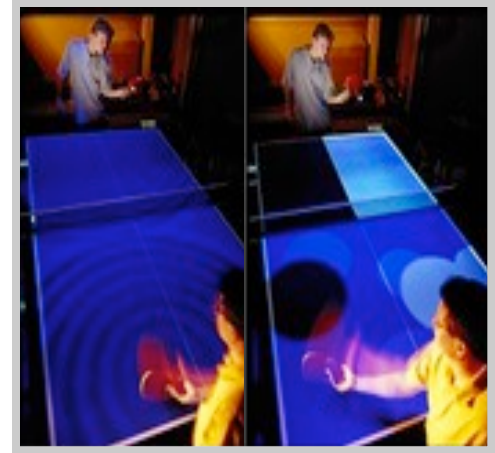
If my mat could tell a story...



# StoryMat (1999)







# What are Tangible User Interfaces?

---

- Theory?
- Taxonomy?
- Design principles?
- Enabling technologies?
- Evaluation?

# This Course

---

We will explore the theoretical framework of tangible user interfaces through a series of design examples to compare and contrast.

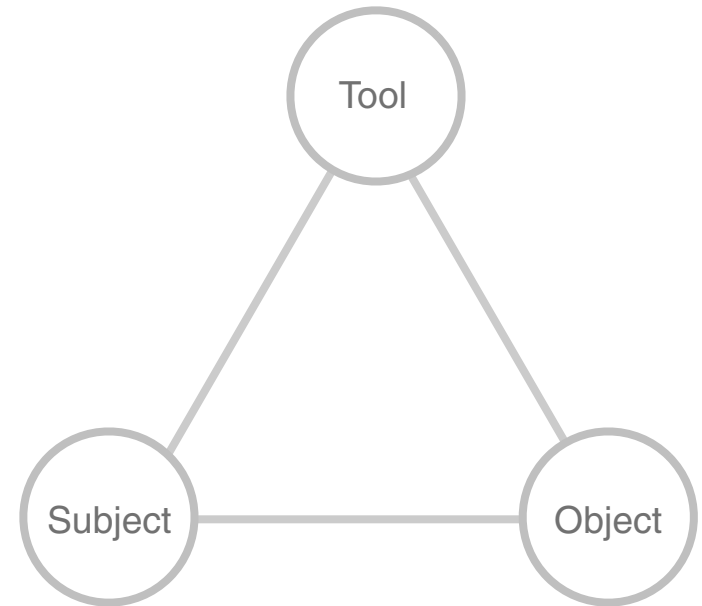
3Students will also design and develop experimental tangible user interfaces using physical computing prototyping tools.

	Monday LECTURE		Wednesday LAB	
Week 1			01/19	Introduction
Week 2	01/24	Activity Theory and HCI	01/26	Introduction to Physical Computing
Week 3	01/31	Tangible Bits	02/02	Digital I/O with Arduino Boards
Week 4	02/07	Containers, Tools, and Token: Taxonomy of TUIs	02/09	Sensing 1: Potentiometers
Week 5	02/14	Calm Computing and Ambient Media	02/16	Sensing 2: Force sensors and photocells
Week 6	02/21	[holiday]	02/23	Output 1: Piezo speakers
Week 7	02/28	Human Centered Design	03/02	Output 2: DC motors
Week 8	03/07	Midterm Project Review	03/09	Output 3: Servo motors
Week 9	03/14	Design and Innovation	03/16	Output 4: Simple Mechanics
Week 10	03/28	Guest Lecture by Hayes Raffle	03/30	Synthesis 1: Invent a music instrument (group work)
Week 11	04/04	Guest Lecture by Daniela Rosner	04/06	Synthesis 2: Invent a music instrument (group work)
Week 12	04/11	Guest Lecture by Mike Kuniavsky (ThingM)	04/13	Final Project Progress Report and Critique
Week 13	04/18	Final Project Progress Report and Critique	04/20	Fabrication and Prototyping
Week 14	04/25	Evaluating TUIs	04/27	Summary
Week 15	05/02	Final Project Exhibition (Part I)	05/04	Final Project Exhibition (Part II)

## Monday LECTURE

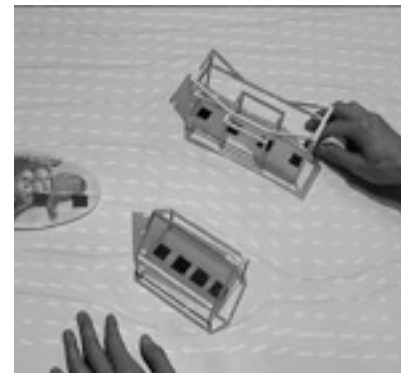
Week 1		
Week 2	01/24	Activity Theory and HCI
Week 3	01/31	Tangible Bits
Week 4	02/07	Containers, Tools, and Token: Taxonomy of TUIs
Week 5	02/14	Calm Computing and Ambient Media
Week 6	02/21	[holiday]
Week 7	02/28	Human Centered Design
Week 8	03/07	Midterm Project Review
Week 9	03/14	Design and Innovation
Week 10	03/28	Guest Lecture by Hayes Raffle
Week 11	04/04	Guest Lecture by Daniela Rosner
Week 12	04/11	Guest Lecture by Mike Kuniavsky (ThingM)
Week 13	04/18	Final Project Progress Report and Critique
Week 14	04/25	Evaluating TUIs
Week 15	05/02	Final Project Exhibition (Part I)

	<b>Monday LECTURE</b>	
Week 1		
Week 2	01/24	Activity Theory and HCI
Week 3	01/31	Tangible Bits
Week 4	02/07	Containers, Tools, and Token: Taxonomy of TUIs
Week 5	02/14	Calm Computing and Ambient Media
Week 6	02/21	[holiday]
Week 7	02/28	Human Centered Design
Week 8	03/07	Midterm Project Review
Week 9	03/14	Design and Innovation
Week 10	03/28	Guest Lecture by Hayes Raffle
Week 11	04/04	Guest Lecture by Daniela Rosner
Week 12	04/11	Guest Lecture by Mike Kuniavsky (ThingM)
Week 13	04/18	Final Project Progress Report and Critique
Week 14	04/25	Evaluating TUIs
Week 15	05/02	Final Project Exhibition (Part I)



# Monday LECTURE

Week 1		
Week 2	01/24	Activity Theory and HCI
Week 3	01/31	Tangible Bits
Week 4	02/07	Containers, Tools, and Token: Taxonomy of TUIs
Week 5	02/14	Calm Computing and Ambient Media
Week 6	02/21	[holiday]
Week 7	02/28	Human Centered Design
Week 8	03/07	Midterm Project Review
Week 9	03/14	Design and Innovation
Week 10	03/28	Guest Lecture by Hayes Raffle
Week 11	04/04	Guest Lecture by Daniela Rosner
Week 12	04/11	Guest Lecture by Mike Kuniavsky (ThingM)
Week 13	04/18	Final Project Progress Report and Critique
Week 14	04/25	Evaluating TUIs
Week 15	05/02	Final Project Exhibition (Part I)



## Monday LECTURE

Week 1		
Week 2	01/24	Activity Theory and HCI
Week 3	01/31	Tangible Bits
Week 4	02/07	Containers, Tools, and Token: Taxonomy of TUIs
Week 5	02/14	Calm Computing and Ambient Media
Week 6	02/21	[holiday]
Week 7	02/28	Human Centered Design
Week 8	03/07	Midterm Project Review
Week 9	03/14	Design and Innovation
Week 10	03/28	Guest Lecture by Hayes Raffle
Week 11	04/04	Guest Lecture by Daniela Rosner
Week 12	04/11	Guest Lecture by Mike Kuniavsky (ThingM)
Week 13	04/18	Final Project Progress Report and Critique
Week 14	04/25	Evaluating TUIs
Week 15	05/02	Final Project Exhibition (Part I)



Empathy Tool from  
IDEO Method Cards



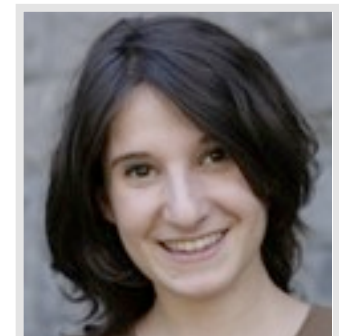
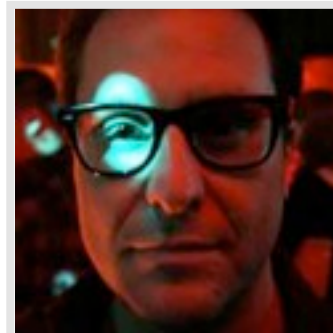
## Monday LECTURE

Week 1		
Week 2	01/24	Activity Theory and HCI
Week 3	01/31	Tangible Bits
Week 4	02/07	Containers, Tools, and Token: Taxonomy of TUIs
Week 5	02/14	Calm Computing and Ambient Media
Week 6	02/21	[holiday]
Week 7	02/28	Human Centered Design
Week 8	03/07	Midterm Project Review
Week 9	03/14	Design and Innovation
Week 10	03/28	Guest Lecture by Hayes Raffle
Week 11	04/04	Guest Lecture by Daniela Rosner
Week 12	04/11	Guest Lecture by Mike Kuniavsky (ThingM)
Week 13	04/18	Final Project Progress Report and Critique
Week 14	04/25	Evaluating TUIs
Week 15	05/02	Final Project Exhibition (Part I)



## Monday LECTURE

Week 1		
Week 2	01/24	Activity Theory and HCI
Week 3	01/31	Tangible Bits
Week 4	02/07	Containers, Tools, and Token: Taxonomy of TUIs
Week 5	02/14	Calm Computing and Ambient Media
Week 6	02/21	[holiday]
Week 7	02/28	Human Centered Design
Week 8	03/07	Midterm Project Review
Week 9	03/14	Design and Innovation
Week 10	03/28	Guest Lecture by Hayes Raffle
Week 11	04/04	Guest Lecture by Daniela Rosner
Week 12	04/11	Guest Lecture by Mike Kuniavsky (ThingM)
Week 13	04/18	Final Project Progress Report and Critique
Week 14	04/25	Evaluating TUIs
Week 15	05/02	Final Project Exhibition (Part I)

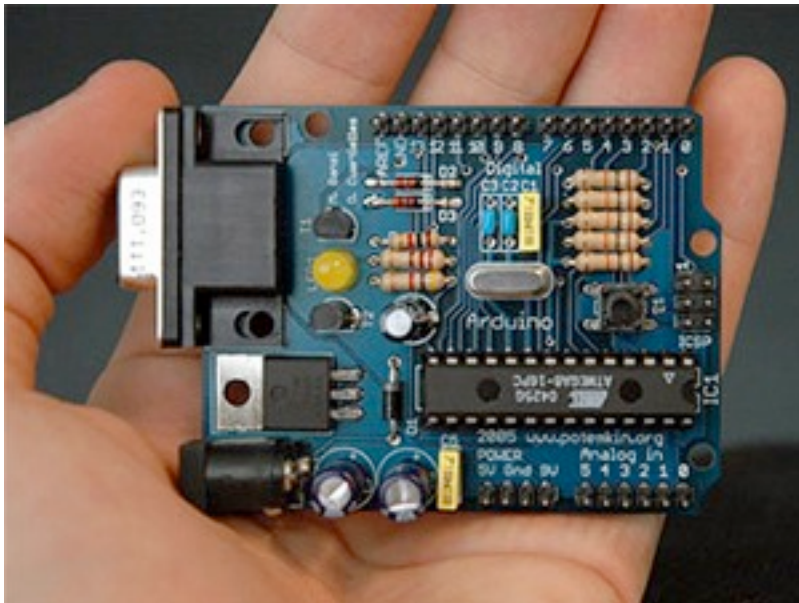


## Monday LECTURE

Week 1		
Week 2	01/24	Activity Theory and HCI
Week 3	01/31	Tangible Bits
Week 4	02/07	Containers, Tools, and Token: Taxonomy of TUIs
Week 5	02/14	Calm Computing and Ambient Media
Week 6	02/21	[holiday]
Week 7	02/28	Human Centered Design
Week 8	03/07	Midterm Project Review
Week 9	03/14	Design and Innovation
Week 10	03/28	Guest Lecture by Hayes Raffle
Week 11	04/04	Guest Lecture by Daniela Rosner
Week 12	04/11	Guest Lecture by Mike Kuniavsky (ThingM)
Week 13	04/18	Final Project Progress Report and Critique
Week 14	04/25	Evaluating TUIs
Week 15	05/02	Final Project Exhibition (Part I)

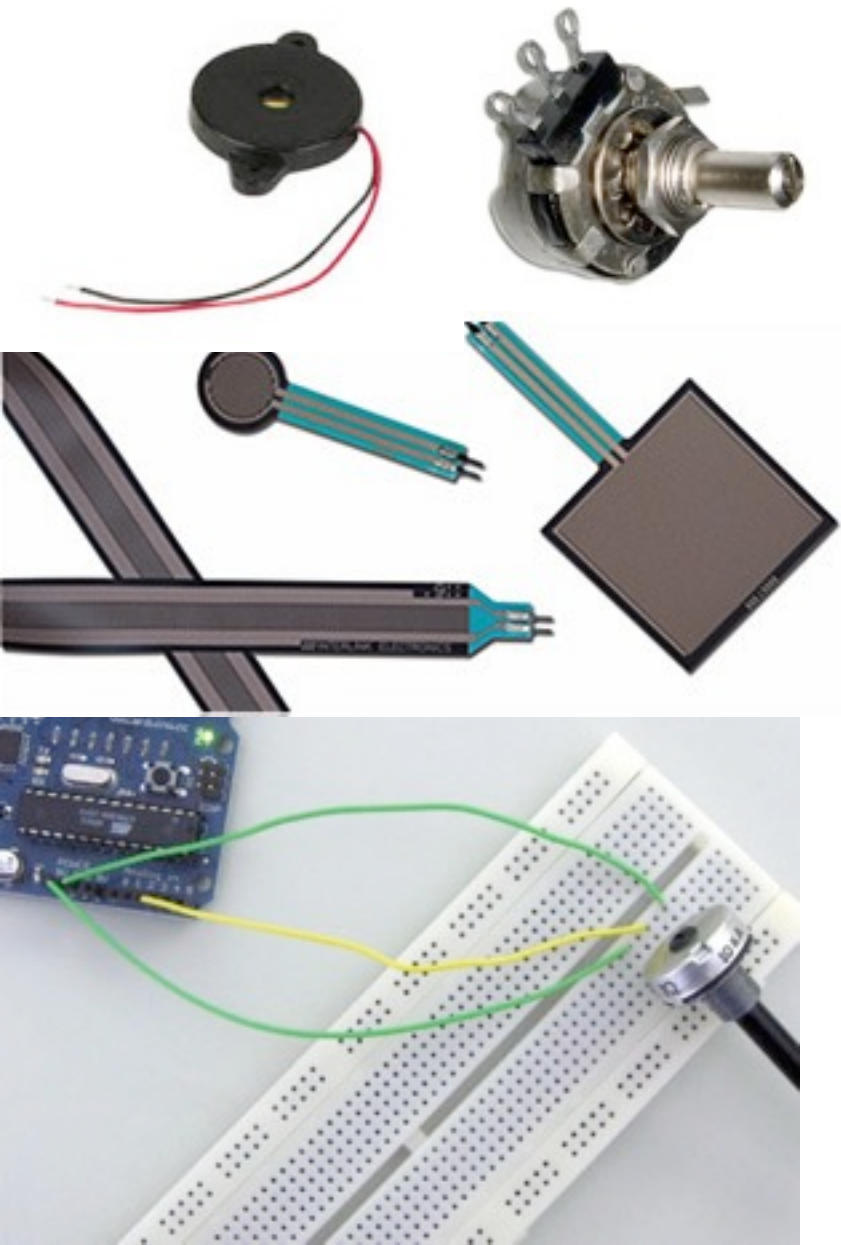
## Wednesday LAB

01/19	Introduction
01/26	Introduction to Physical Computing
02/02	Digital I/O with Arduino Boards
02/09	Sensing 1: Potentiometers
02/16	Sensing 2: Force sensors and photocells
02/23	Output 1: Piezo speakers
03/02	Output 2: DC motors
03/09	Output 3: Servo motors
03/16	Output 4: Simple Mechanics
03/30	Synthesis 1: Invent a music instrument (group work)
04/06	Synthesis 2: Invent a music instrument (group work)
04/13	Final Project Progress Report and Critique
04/20	Fabrication and Prototyping
04/27	Summary
05/04	Final Project Exhibition (Part II)



## Wednesday LAB

01/19	Introduction
01/26	Introduction to Physical Computing
02/02	Digital I/O with Arduino Boards
02/09	Sensing 1: Potentiometers
02/16	Sensing 2: Force sensors and photocells
02/23	Output 1: Piezo speakers
03/02	Output 2: DC motors
03/09	Output 3: Servo motors
03/16	Output 4: Simple Mechanics
03/30	Synthesis 1: Invent a music instrument (group work)
04/06	Synthesis 2: Invent a music instrument (group work)
04/13	Final Project Progress Report and Critique
04/20	Fabrication and Prototyping
04/27	Summary
05/04	Final Project Exhibition (Part II)



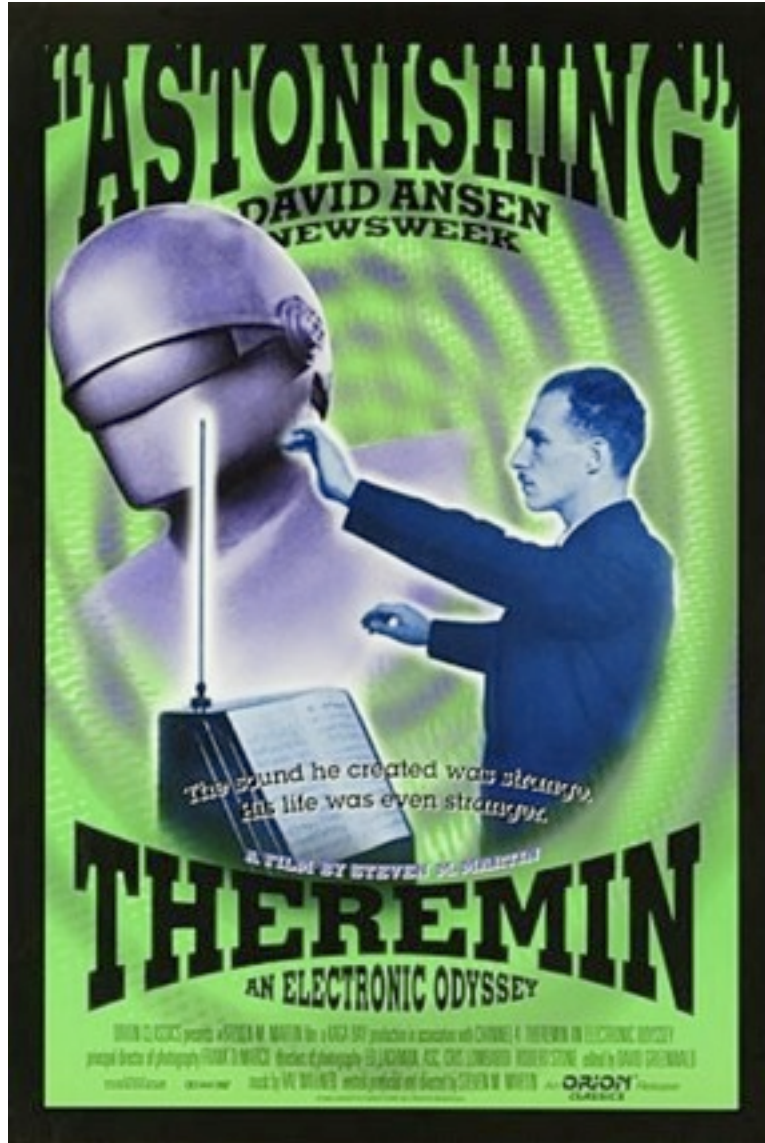
## Wednesday LAB

01/19	Introduction
01/26	Introduction to Physical Computing
02/02	Digital I/O with Arduino Boards
02/09	Sensing 1: Potentiometers
02/16	Sensing 2: Force sensors and photocells
02/23	Output 1: Piezo speakers
03/02	Output 2: DC motors
03/09	Output 3: Servo motors
03/16	Output 4: Simple Mechanics
03/30	Synthesis 1: Invent a music instrument (group work)
04/06	Synthesis 2: Invent a music instrument (group work)
04/13	Final Project Progress Report and Critique
04/20	Fabrication and Prototyping
04/27	Summary
05/04	Final Project Exhibition (Part II)



## Wednesday LAB

01/19	Introduction
01/26	Introduction to Physical Computing
02/02	Digital I/O with Arduino Boards
02/09	Sensing 1: Potentiometers
02/16	Sensing 2: Force sensors and photocells
02/23	Output 1: Piezo speakers
03/02	Output 2: DC motors
03/09	Output 3: Servo motors
03/16	Output 4: Simple Mechanics
03/30	Synthesis 1: Invent a music instrument (group work)
04/06	Synthesis 2: Invent a music instrument (group work)
04/13	Final Project Progress Report and Critique
04/20	Fabrication and Prototyping
04/27	Summary
05/04	Final Project Exhibition (Part II)



## Wednesday LAB

01/19	Introduction
01/26	Introduction to Physical Computing
02/02	Digital I/O with Arduino Boards
02/09	Sensing 1: Potentiometers
02/16	Sensing 2: Force sensors and photocells
02/23	Output 1: Piezo speakers
03/02	Output 2: DC motors
03/09	Output 3: Servo motors
03/16	Output 4: Simple Mechanics
03/30	Synthesis 1: Invent a music instrument (group work)
04/06	Synthesis 2: Invent a music instrument (group work)
04/13	Final Project Progress Report and Critique
04/20	Fabrication and Prototyping
04/27	Summary
05/04	Final Project Exhibition (Part II)



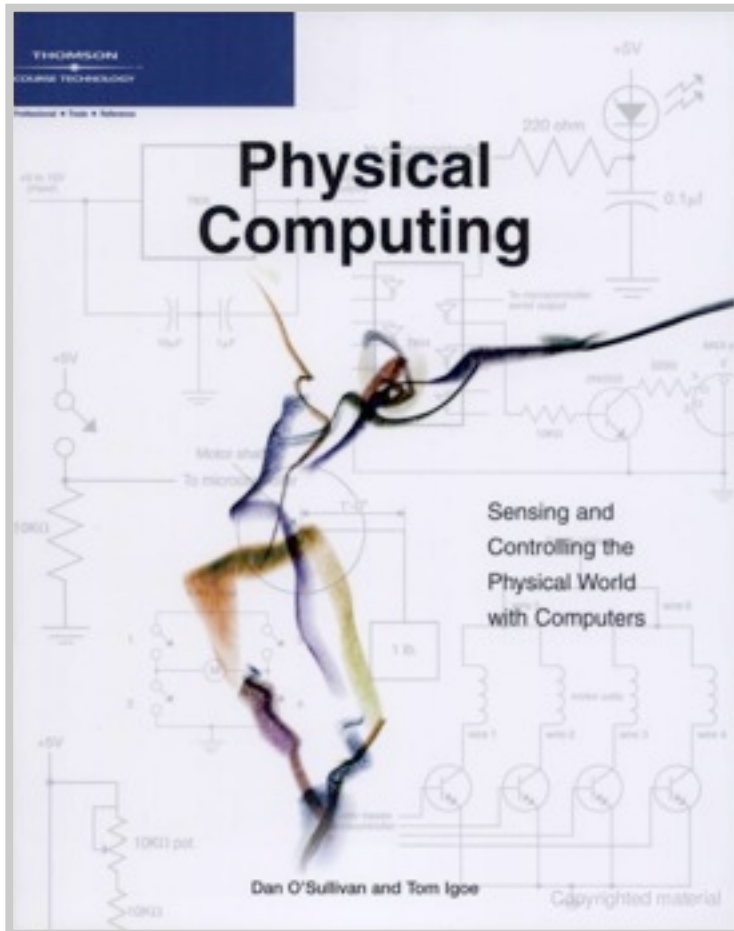
# Course Kit

---

Arduino UNO, SparkFun #Arduino-UNO	\$29.95
Solderless breadboard, Digikey #23273-ND	\$ 7.37
USB cable (3ft), Jameco #222607	\$ 1.39
Blue LED, Jameco #183222	\$ 2.95
Green LED, Jameco #334473	\$ 1.45
Red LED, Jameco #33481	\$ 0.27
Piezo buzzer, Jameco #336314	\$ 1.26
5.1V zener diode, Jameco #179047	\$ 0.04
220 ohm, 1/8W resistors (bag of 100), Jameco #107941	\$ 0.69
10k ohm, 1/8W resistors (bag of 100), Jameco #108126	\$ 0.69
1M ohm, 1/8W resistors (bag of 100), Jameco #108265	\$ 0.69
1K ohm, 1/4W resistors (bag of 100), Jameco #690865	\$ 0.69
10k ohm potentiometers, Jameco #255662	\$ 0.95
Photocells - from 100 grab bag, Jameco #169578	\$ 0.50
TIP120 Jameco#:32993	\$ 0.45
1N4004 diode Jameco#:35991	\$ 0.05
AA Batteries	\$ 1.00
2-AA battery holder Digikey #BC22AAW-ND	\$ 0.51
DC motor, 16K RPM@3V Jameco#:154923	\$ 1.01
RC Servo - standard, HobbyPeople #759310	\$ 9.99
22 gauge solid hookup wire in red, black, and yellow	\$ 6.00
Force sensors	\$ 10.00

**TOTAL \$75.00~**

# Lab Textbook



*Physical Computing* by O'Sullivan and Igoe

# Recommended book

---



*Making Things Talk* by Igoe

	Monday LECTURE		Wednesday LAB	
Week 1			01/19	Introduction
Week 2	01/24	Activity Theory and HCI	01/26	Introduction to Physical Computing
Week 3	01/31	Tangible Bits	02/02	Digital I/O with Arduino Boards
Week 4	02/07	Containers, Tools, and Token: Taxonomy of TUIs	02/09	Sensing 1: Potentiometers
Week 5	02/14	Calm Computing and Ambient Media	02/16	Sensing 2: Force sensors and photocells
Week 6	02/21	[holiday]	02/23	Output 1: Piezo speakers
Week 7	02/28	Human Centered Design	03/02	Output 2: DC motors
Week 8	03/07	Midterm Project Review	03/09	Output 3: Servo motors
Week 9	03/14	Design and Innovation	03/16	Output 4: Simple Mechanics
Week 10	03/28	Guest Lecture by Hayes Raffle	03/30	Synthesis 1: Invent a music instrument (group work)
Week 11	04/04	Guest Lecture by Daniela Rosner	04/06	Synthesis 2: Invent a music instrument (group work)
Week 12	04/11	Guest Lecture by Mike Kuniavsky (ThingM)	04/13	Final Project Progress Report and Critique
Week 13	04/18	Final Project Progress Report and Critique	04/20	Fabrication and Prototyping
Week 14	04/25	Evaluating TUIs	04/27	Summary
Week 15	05/02	Final Project Exhibition (Part I)	05/04	Final Project Exhibition (Part II)



**Theories and Approaches**

**Enabling Technologies**

**Your original IDEA!**

**Theories and Approaches**

**Enabling Technologies**

	Monday LECTURE		Wednesday LAB	
Week 1			01/19	Introduction
Week 2	01/24	Activity Theory and HCI	01/26	Introduction to Physical Computing
Week 3	01/31	Tangible Bits	02/02	Digital I/O with Arduino Boards
Week 4	02/07	Containers, Tools, and Token: Taxonomy of TUIs	02/09	Sensing 1: Potentiometers
Week 5	02/14	Calm Computing and Ambient Media	02/16	Sensing 2: Force sensors and photocells
Week 6	02/21	[holiday]	02/23	Output 1: Piezo speakers
Week 7	02/28	Human Centered Design	03/02	Output 2: DC motors
Week 8	03/07	Midterm Project Review	03/09	Output 3: Servo motors
Week 9	03/14	Design and Innovation	03/16	Output 4: Simple Mechanics
Week 10	03/28	Guest Lecture by Hayes Raffle	03/30	Synthesis 1: Invent a music instrument (group work)
Week 11	04/04	Guest Lecture by Daniela Rosner	04/06	Synthesis 2: Invent a music instrument (group work)
Week 12	04/11	Guest Lecture by Mike Kuniavsky (ThingM)	04/13	Final Project Progress Report and Critique
Week 13	04/18	Final Project Progress Report and Critique	04/20	Fabrication and Prototyping
Week 14	04/25	Evaluating TUIs	04/27	Summary
Week 15	05/02	Final Project Exhibition (Part I)	05/04	Final Project Exhibition (Part II)

# Midterm Project

---

Design a Tangible User Interface that takes advantage of your hands to manipulate digital information. Apply it to a topic of your research interest (e.g., tool for communication, learning/education, design, etc.). Your project may be based on a completely new design or redesign of familiar everyday objects.

- **2/14** Form a group (maximum of 3 members) for your project and write a 1-page proposal and post it on the course website
- **2/28** Progress sketches due (post your sketches on the course website)
- **3/7** In-class midterm project presentation. Present your poster and optional mockups



# Final Project

---

You may expand your midterm project, or take a new approach. You may continue to work as a group (maximum of 3 members) or as an individual. If you work in a group, be clear about each member's role in the project.

- An interactive prototype to be exhibited at the final course exhibition on **May 2nd and May 4th**. Your prototype is to demonstrate your original idea for a Tangible User Interface that takes advantage of your hands to manipulate digital information, and
- A write-up due **May 9th, 2011** in the ACM SIGCHI Extended Abstract format (6-8pgs)  
<http://www.chi2010.org/authors/chi2010extendedabstracts.doc>

# course website

# Course Requirements

---

- Midterm Project (20%)
- Final Project (30%)
- Lab (20%)
- Homework (20%)
- Participation (10%)

# Grading

---

Based on both the **quality** and **originality** of your work

# Beyond the Course: Possible Venue 1

---

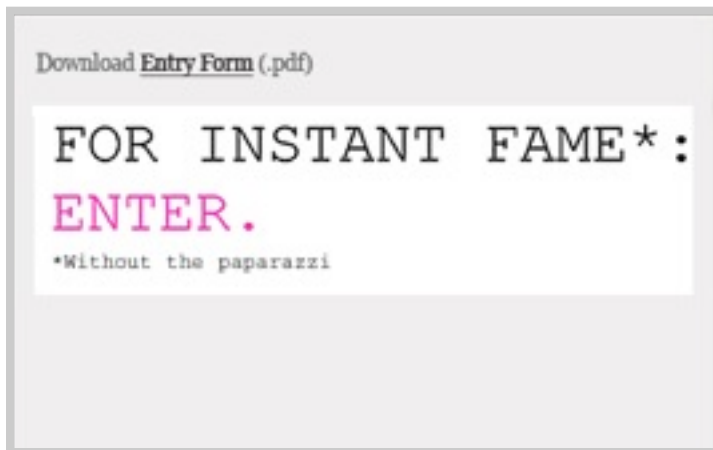
## Conference paper submissions

- **CHI 2012** (full paper deadline in fall 2011)
- **UIST 2012** (poster around June 2011, full paper around March 2012)
- **Ubicomp 2012** (poster around June 2011, full paper around March 2012)

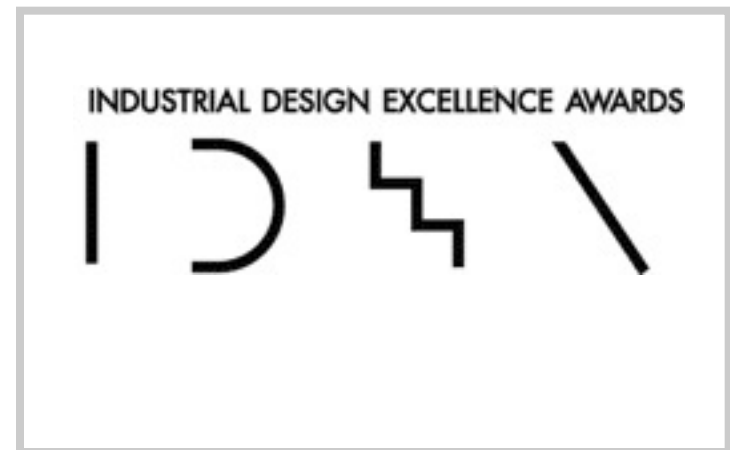
# Beyond the Course: Possible Venue 2

---

## Student design competitions



ID Magazine Student Competition  
Deadline spring 2012



Industrial Design Excellence Awards  
Deadline spring 2012

# Beyond the Course: Possible Venue 3

## Maker Faire®

May 3 & 4
San Mateo  
Expo Center



Jug Hero

## Bubblegum Sequencer

Making Music With Candy

News

News: German electronic music magazine De-Bug covers Bubblegum Sequencer 2008

See us at [Maker Faire 2008](#), May 3-4 in San Mateo



### What is the Bubblegum Sequencer?

The Bubblegum Sequencer is a physical [step sequencer](#) that lets you create drumloops by arranging colored balls on a tangible surface. It generates MIDI events and can be used as an input device to control audio hardware and software. Finally, people can't claim anymore that electronic music isn't handmade.

Here's how it works: A grid of holes, consisting of several rows with 16 holes each is the canvas. On it, you arrange colored gumballs. The 16 columns represent the 16th-notes in a measure. Each color is mapped to a specific sample.

Because the output is generated in the form of MIDI events, the Bubblegum Sequencer can be used to control any kind of audio hardware or software.

If you'd like to know more about the Bubblegum Sequencer, read our [course notes](#).

### Demo

Here's a video showing some of the Bubblegum Sequencer's current features:



[Download](#) video as .mov file)

How it's done



## Tangible fun at UC Berkeley's virtual projects

[Back to Article](#) | [Buy Photos](#) | [More Photo Galleries](#)

1 of 5



Paul Chinn / The Chronicle

Shawna Hein tries to catch a virtual butterfly in a simulated elevator, one of the students' projects.

Photo: Paul Chinn / The Chronicle

[E-MAIL](#) [SHARE](#) [COMMENTS](#)

### Comments

### More Galleries

1-3 of 21



Tiburon treat

Through the  
Lens: Aug.  
17 - Aug. 23Seensters:  
Boogie SF

advertisement | your ad here

### Most Commented Photo

**The Walk-Through: 85  
Spring Lane, Tiburon**[View Photo](#)  
[View Comments](#)

MOST COMMENTED

MOST READ

MOST E-MAILED

1. A torch extinguished: Ted Kennedy dead at 77
2. Attack on Obama riles Beck's advertisers
3. Milk Day backers try to change governor's mind
4. Giants serve up walks, Rockies walk off with win
5. Assembly leaves the clock, find community



# For Monday, January 24

---

- Read
  - *Acting with Technology* (chapters 1, 2, & 3)  
by Victor Kaptelinin and Bonnie A. Nardi
  - *Where the Action Is* (chapters 1 & 2) by Paul Dourish

# Q&A