Rethinking the composition of computer science

Jon Froehlich
CS Assistant Professor
jonf@cs.umd.edu
me
me

hci

psychology

design

engineering

computer science
Minneapolis, MN
Ames, IA
Orange County, CA
Portland, OR
Seattle, WA
Maryland!
How does one go from to?
early exposure to computing
my computer class in high school
Dell Dimension

Pentium I, 133MHz, 1GB hard drive, 32MB Ram
This Talk

1. Rethinking CS
2. Reapplying CS
This Talk

1. Rethinking CS
2. Reapplying CS
Create and share your own interactive stories, games, music, and art

Check out the 2,476,796 projects from around the world!

To create your own projects:
Download Scratch

Featured Projects
French Verb Con...
by trinity
A Day In the Li...
by TigerStripes
alphabet game...
by gcobiner11

Projects Selected by Collab-Camp
SoundSurge-Beta 1.0
by Kayzee
Fandango...
by ffred
xIYphone hero...
by fireaction2001

Collab Camp
Check out all the music mashups created by Scratchers in Collab Camp.
Learn more

Scratch Day
Be a part of Scratch Day - a worldwide network of gatherings, where Scratchers come together to meet, share, and learn.
Find out more

ScratchEd
Do you help people learn Scratch? Join ScratchEd, our new online community for educators.
Find out more
Processing is an open source programming language and environment for people who want to create images, animations, and interactions. Initially developed to serve as a software sketchbook and to teach fundamentals of computer programming within a visual context, Processing also has evolved into a tool for generating finished professional work. Today, there are tens of thousands of students, artists, designers, researchers, and hobbyists who use Processing for learning, prototyping, and production.

- Free to download and open source
- Interactive programs using 2D, 3D or PDF output
- OpenGL integration for accelerated 3D
- For GNU/Linux, Mac OS X, and Windows
- Projects run online or as double-clickable applications
- Over 100 libraries extend the software into sound, video, computer vision, and more...
- Well documented, with many books available

To see more of what people are doing with Processing, check out these sites:

- Processing Wiki
- Processing Discussion Forum
- OpenProcessing
- CreativeApplications.Net
seachange
NEW CONSTRUX.
BY FISHER-PRICE.

THE ACTION BUILDING SYSTEM.

Make a helicopter with whirling blades.
Make a Formula 1 racing car that races.
Make a fire engine with turning ladder.

Make a dinosaur with a jaw that bites.
Make a bridge that can raise and lower.
Make anything! It builds imagination.

Construx™ is a terrific, new building system that’s really different. With it, kids can play with what they build! Construx comes with lots of moving parts, like wheels, propellers and pulleys. So your kids can make almost anything they can imagine: cars, bridges, even monsters!

It’s easy to build with Construx: The pieces snap together and twist apart. No nuts, bolts or tools. There are 11 different Construx sets for kids 5 to 9, each with its own put-together figure. And sets can be combined to build even more! Construx is fun to build with, fun to play with. It’s the Action Building System.
Arduino
Raspberry Pi
Lilypad Arduino
#inspiration

Leah Buechley
Assistant Professor
MIT Media Lab
welcome to LilyPad Arduino!

The LilyPad Arduino is a set of sewable electronic components that let you build your own soft, interactive fashion. To get started, snag this LilyPad starter kit that I put together. Or, browse through the LilyPad category on SparkFun to get just the pieces you need.

Work through the tutorials here to learn how to build all sorts of soft interactive stuff...perhaps fortune telling shirts, jackets that sing when you're squeezed or turn signal equipped cycling wear? Enjoy!

Note: for a more general introduction to electronics, programming, and the regular (non-LilyPad) Arduino, see ladyada's excellent tutorials.

Click here to return to my home page.
programming the LilyPad Arduino: color (RGB LEDs)

1. If you haven't yet, make a coaster for your LilyPad and RGB LED module.

See this tutorial for instructions. This will prevent the alligator clips that we'll be using from sliding around on the LilyPad. Trust me, it's worth it to do this!

2. Use alligator clips to attach an RGB LED module to your LilyPad

Use a red alligator clip to attach the + petal of the RGB LED module to the +5V petal on the LilyPad. With three more clips, attach the R/9 petal of the RGB LED to petal 9 on the LilyPad, the B/10 to 10 and the G/11 to 11. Your final connection should look something like this:

3. Attach the LilyPad to your computer and start the Arduino software

4. Copy this sample code into an Arduino window
LilyPad home

help!

1. setup

2. software install

3. introduction to Arduino

4. light (LEDs)

5. sensing (switches)

6. color (RGB LEDs)

7. sound

8. sensing (sensors)

9. build something!

10. share it

build something!

![Image of a person wearing a jacket with LED lights]

**turn signal biking jacket**

This tutorial will show you how to build a jacket with turn signals that lets people know where you're headed when you're on your bike. Click here or on the heading above to get to the tutorial.

**movement controlled RGB LED example**

This tutorial will show you how to build a shirt with a flower lapel that changes color in response to movement. Click here or on the heading above to get to the tutorial.
Leah Buechley
Blending Art, Craft, and Technology
@ the Cyberlearning Research Summit
January 18th, 2012
paper, craft and embedded computing
paper, drawing, and embedded computing
#inspiration2

Ann Marie Thomas
Assistant Professor
University of St. Thomas
play dough and embedded computing
Squishy Speaker

[http://www.youtube.com/watch?v=y0LCTLKV2II]
Making Conductive Dough

Materials:
1 cup Water
1 1/2 cups Flour
(1/4 cup Salt)
3 Tbsp. Cream of Tartar*
1 Tbsp. Vegetable Oil
Food Coloring (optional)

*A Tbsp. of Lemon Juice may be Substituted

Procedure:
1. Mix water, 1 cup of flour, salt, cream of tartar, vegetable oil, and food coloring in a medium sized pot.
2. Cook over medium heat and stir continuously.
3. The mixture will begin to boil and start to get chunky.
Squishy Circuits

Building Squishy Circuits

Safety:
These activities are designed such that the dough is used to connect components. Never connect components, such as LEDs, directly to the battery pack, as running too much current through components can damage them, possibly causing them to overheat or pop. Follow standard electricity safety considerations. (Our youngest participants are fans of these brightly colored safety glasses!)

Click on the picture for a how-to guide specific to each activity.
This Talk

1. Rethinking CS
2. Reapplying CS
Topic 1

Sustainability
What are the most water consuming activities in the average North American home?
Top Water Usage Activities

- **Outdoor Use**: 31.4%
- **Toilets**: 18.3%
- **Laundry Machine**: 14.9%
- **Showers**: 11.5%
- **Faucets**: 10.8%
- **Leaks**: 9.4%
- **Other**: 1.6%
- **Baths**: 1.2%
- **Dishwasher**: 1.0%

[Vickers, Handbook of Water Use and Conservation, 2001]
we asked 656 people the same thing

select the top 3 most water consuming activities in an average home
survey results

Outdoor Use: 31.4%
Toilets: 18.3%
Laundry Machine: 14.9%
Showers: 11.5%
Faucets: 10.8%
Leaks: 9.4%
Other: 1.6%
Baths: 1.2%
Dishwasher: 1.0%

Selected in top 3 by only 33%
Selected in top 3 by ~50%
Selected in top 3 by 26%

[Vickers, Handbook of Water Use and Conservation, 2001]
Traditional water meters measure aggregate consumption.

Requires cutting into pipe to install.
today’s usage

- Refrigerator: 0.3 gallons
- Dishwasher: 6.5 gallons
- Kitchen sink: 28 gallons
today's usage

- shower: 62.4 gallons
- bath: 6.5 gallons
- toilet: 78.4 gallons
- bathroom sink 1: 4.2 gallons
- bathroom sink 2: 0.8 gallons
today's usage: hot vs. cold

- shower: 52.4 gallons
- bath: 6.5 gallons
- toilet: 78.4 gallons
- shower sink: 3.2 gallons
- bathroom sink 1: 1.2 gallons
- bathroom sink 2: 2.4 gallons
- bathroom sink 2: 0.8 gallons
direct sensing
direct sensing

- shower: 62.4 gallons
- bath: 6.5 gallons
- toilet: 78.4 gallons
- bathroom sink 1: 4.2 gallons
- bathroom sink 2: 0.8 gallons

shower 62.4 gallons
bath 6.5 gallons
toilet 78.4 gallons
bathroom sink 1 4.2 gallons
bathroom sink 2 0.8 gallons
direct sensing

- Shower: 52.4 gallons
- Shower: 62.4 gallons
- Bath: 6.5 gallons
- Bath: 6.5 gallons
- Bathroom sink 1: 3.2 gallons
- Bathroom sink 1: 4.2 gallons
- Bathroom sink 2: 2.4 gallons
- Bathroom sink 2: 0.8 gallons
- Toilet: 78.4 gallons
scalable
fixture-level sensing
easy-to-install
easy-to-maintain
low-cost
single, screw-on sensor identifies fixture usage estimates flow

Froehlich et al., UbiComp2009; Larson et al., PMC2010; Froehlich et al., Pervasive2011
plumbing primer
Water tower

Plumbing primer

Incoming cold water from supply line
water tower

pressure regulator

incoming cold water from supply line

utility water meter

pressure regulator
plumbing layout

- Water tower
- Incoming cold water from supply line
- Utility water meter
- Pressure regulator
A closed pressure system diagram showing the flow of water from the utility water meter through the pressure regulator, thermal expansion tank, and into the hot water heater. The system supplies hot water to the kitchen, bathroom 1, and bathroom 2, as well as to the dishwasher and laundry area.
A diagram of a typical water flow system in a household. The system begins with water tower providing cold water through the supply line. The utility water meter measures the incoming water flow. A pressure regulator maintains the water pressure. The thermal expansion tank helps regulate temperature changes. The hot water heater supplies hot water to various fixtures such as the toilet, kitchen, and bathrooms. The dishwasher also uses water from the supply line.
Have another toilet as 2nd example rather than kitchen sink.
what do you do with that data?
Real-time Water Feedback
time-series day view

Water Usage in Gallons
Today's Usage

- When Water Used
- gal/min
- Cumulative Water Used
- gallons

63°  Friday June 15th | 9:30 PM

352 | 440 gal

- Outdoor
- Shower
- avg

now
Today’s Water Usage in Gallons

**Room View**

**Bathroom Total:** 81.2 gal
- **Today:** 81.2 gal
- **Avg:** 108 gal

**Shower**
- **Today:** 40 gal
- **Avg:** 52 gal

**Toilet**
- **Today:** 30 gal
- **Avg:** 37 gal

**Bathroom Sink**
- **Today:** 10 gal
- **Avg:** 16 gal

**Bath**
- **Today:** 1.2 gal
- **Avg:** 3 gal

**Kitchen Total:** 25 gal
- **Today:** 25 gal
- **Avg:** 21 gal

**Kitchen Sink**
- **Today:** 13 gal
- **Avg:** 12 gal

**Dishwasher**
- **Today:** 12 gal
- **Avg:** 9 gal

**Laundry Total:** 40.6 gal
- **Today:** 40.6 gal
- **Avg:** 31 gal

**Laundry Machine**
- **Today:** 40 gal
- **Avg:** 30 gal

**Laundry Sink**
- **Today:** 0.6 gal
- **Avg:** 1 gal

**Friday June 15th | 9:30 PM**
Aquatic Ecosystem: Gamifying Water Savings

Water savings tracker

New water savings goal met

“Frank” the fish meets his mate

“Frank” the fish

Frank and his mate have children

and so on...

display is also interactive so fish respond to touch
time-series day view

Why bathroom usage during mid-day?
my collaborators

first row:
all undergrads
6/10 collaborators were female
Topic 2

Accessibility
Target Acquisition Challenges Faced by Motor-Impaired Users

- Difficulty gripping
- Difficulty holding
- Lack of sensation
- Tremor
- Spasm
- Rapid fatigue
- Poor coordination
- Low strength
- Slow movement
Submovement Analysis

Start location

Target

Velocity

Time

Raw
Smoothed

- Submovement Analysis
- Start location
- Target
- Velocity vs. Time
- Raw and Smoothed lines
Submovement Analysis

Start location

3.5 seconds

Target

22 seconds

Velocity

Time

Raw

Smoothed
We are currently building an HTML5/Javascript application to scale this research to 100s/1,000s of users across devices (including phones/iPads)
Debugging text on

Current condition = 64320
applying computing to solving real-world, physical accessibility problems
Tree roots can create dangerous sidewalk impediments by creating cracks, breaking apart materials, pushing up the concrete itself.
No smooth transition to alleyway
Overgrown vegetation

Temporary blockage (garbage in the way)
No Curb Cut
Smart Cities
FEDERAL DATA CENTER CONSOLIDATION

List of Federal Data Centers shut down by end of 2011 as a result of the Federal Data Center Consolidation Initiative

DATA AND APPS
- 390,831 raw and geospatial datasets
- 1,231 government apps
- 236 citizen-developed apps
- 86 mobile apps
- 172 agencies and subagencies
- Suggest a dataset or app!
- 2011 Next Generation Data.gov is interactive, exploratory, and social

COMMUNITIES
Come explore, discuss, most others in the same field, and develop the data and apps in the community that you care about. Join in the discussions by going to communities below that interest you.

OPEN DATA
- Health
- Energy
- Education

SEMANTIC WEB
- Law
- Ocean

OPEN GOVERNMENT
First open source code released for the Open Government Platform delivered by the governments of India and the U.S. [Find out more] and then [download the code]

The 2012 International Open Government Data Conference will be held July 10-12 at the World Bank in Washington DC. We hope to see you there.

What’s coming up on Data.gov? Check out [our blog]...
bicing in barcelona, spain

launched march 2007

by summer 2008:
- 373 stations
- 6,000 bicycles
- 150,000 subscribers
num checked-out bicycles across all stations

- evening commute
- late Spanish lunch
- morning commute

sleeping in on weekends
how are bicicing patterns shared across stations and distributed in the city?
biases of human behavior
other transit sources
currently logging 11 cities across the world including
  montreal
  London
  washington dc
  paris
  barcelona
  taipai
behavioral patterns of water usage

how predictable are home water usage patterns?
how can hydrosense be used to support aging in place applications?
assisted living applications
ubifit

- fitness monitoring application
- automatically senses activity
- at-a-glance goal information

[Consolvo et al., CHI2008; Consolvo et al., UbiComp2008;]
effectiveness of the ubiFit glanceable display

[Consolvo et al., CHI2008; Consolvo et al., UbiComp2008;]
ubifit in a shoe