

## digital fabrication in hci

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**Inspired by:** D. Mellis, S. Follmer, B. Hartmann, L. Buechley, and M.D. Gross. (2013). FAB at CHI: digital fabrication tools, design, and community. In CHI '13 Extended Abstracts on Human Factors in Computing Systems (CHI EA '13). Some slides come from Lora Oehlberg

## who likes to make stuff?

- Soldering?
- Electronics?
- Cooking?
- Knitting? Crochet?
- Sewing?
- Woodworking?
- Welding?
- Casting?
- Ceramics?
- Glass-blowing?

## traditional vs. digital fabrication



<http://www.browardtrailer.net/>



Flickr user matthewvenn

## digital fab at different scales



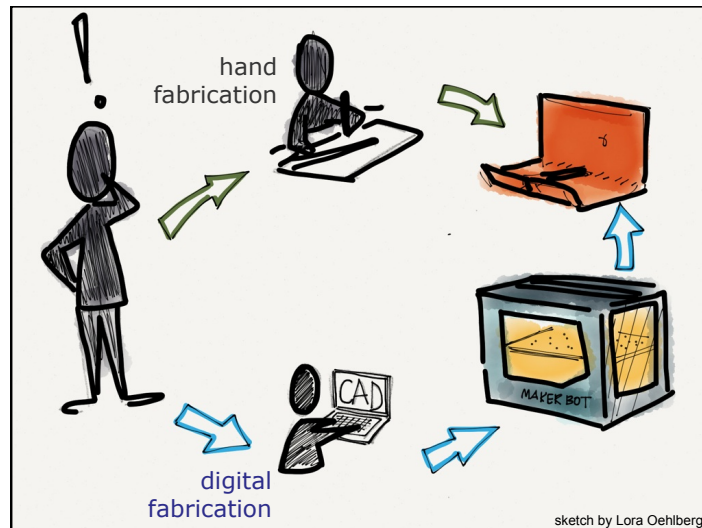
BanQ restaurant



[www.creativeapplications.net](http://www.creativeapplications.net)



TinyDrino



## When should I use...

### ... hand fabrication?

- You are more expressive by hand than using computer tools (CAD, Vector Graphics)
- It's a one-off object, not worth bothering with CAD
- It's faster to just make it, and not over-think

### ... digital fabrication?

- I want to create a data-driven object
- I want to make small batches (4+)
- I will eventually make VERY large batches (1000+)
- I *need* something more precise than I can produce by hand

## "fab lab"

### Machine shop

**fab lab** (fabrication laboratory)

small-scale workshop for (personal) digital fabrication, accessible to the public

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#### fab lab movement history:

2001: Grassroots Invention Group +  
Center for Bits and Atoms (CBA) MIT Media Lab  
Community outreach initiative  
Maker culture (tec DIS movement)

hundreds of fab-labs world-wide (and many in Paris)

a fabrication lab in our university (not yet open to the public)

## medium-scale fabrication



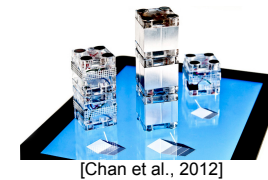
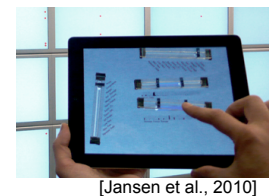
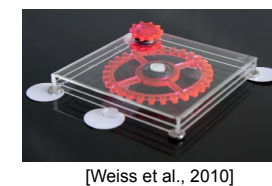
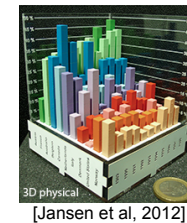
and many more ...

## fab + hci

1. Fab for prototyping interaction and tangibles
2. HCI interfaces for design and Fab
3. Online communities and Fab collaboration

## fabrication in service of hci ...

## ... remember tangibles?



**Midas [Savage et al., 2012]**

eecs.berkeley.edu  
[http://youtu.be/WHcQgtjD\\_zY](http://youtu.be/WHcQgtjD_zY)

**Topogo [Raffle et al., 2004]**

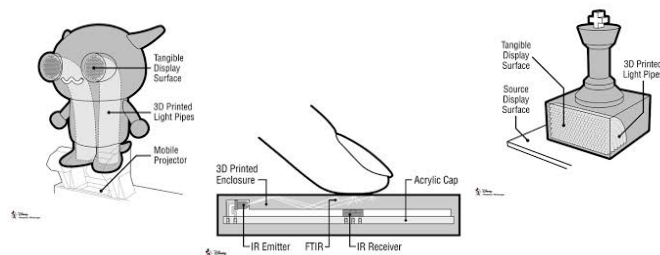
3D constructive assembly kit with « kinetic » memory



stuff.mit.edu  
[http://youtu.be/50JdK\\_K2NWk](http://youtu.be/50JdK_K2NWk)

**Printed Optics [Willis et al., 2012]**

Help 3D print items that allow sensing, display and illumination



disneyresearch.com  
<http://youtu.be/eTeTbXA6-Y>  
 newer versions  
<http://www.disneyresearch.com/project/papillon/>

**PneUI [Yao et al., 2013]**

A way to build shape-changing interactive components

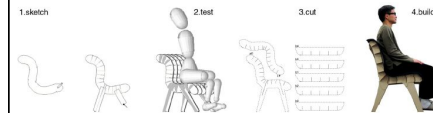


<http://tangible.media.mit.edu/project/193/>



## hci in service of fabrication ...

### Domain specific



SketchChair [Saul et al., 2011]

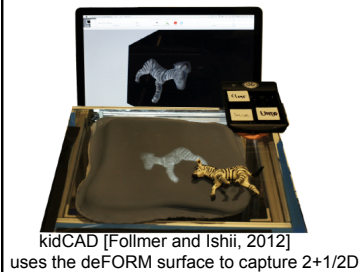
<http://www.jst.go.jp/erato/igarashi/en/projects/sketchchair/>



Plushie [Mori and Igarashi, 2007]

[http://www.geocities.jp/igarashi\\_lab/plushie/index-e.html](http://www.geocities.jp/igarashi_lab/plushie/index-e.html)

### Tangible interaction for fab



kidCAD [Follmer and Ishii, 2012]  
uses the deFORM surface to capture 2+1/2D



[Willis et al., 2010] Prototype devices  
« sense » input to drive fabrication

### Midas (again!) [Savage et al., 2012]



## Laser Origami [Mueller et al., 2013]

Using software to design and laser cut (some) 3D shapes



<http://stefaniemueller.org/>

## Constructable [Mueller et al., 2012]

Removing CAD from the design process



<http://stefaniemueller.org/>

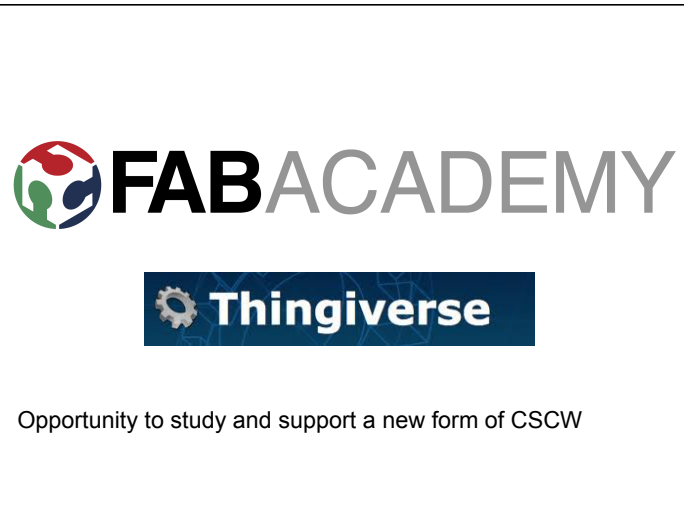
## ReForm [Weichel et al., 2015]

Rapid prototyping and iteration ...



<https://youtu.be/w4Q9JCObLM0>

**hci and fab  
in service of collaboration**



and more ...

## Silk Pavilion, MIT media lab

Combine digital fabrication and biological fabrication (?)

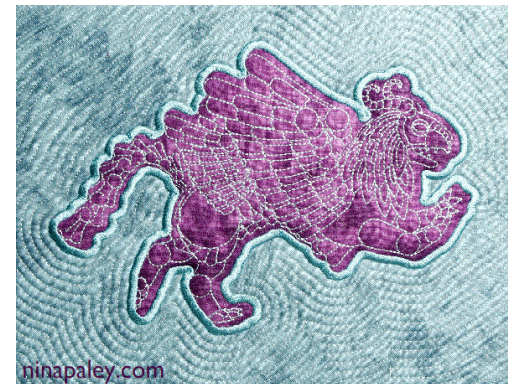
polygonal silk structure using a CNC machine (Computer-Numerically Controlled)

+

real silkworms fill in the structure



<http://www.creativeapplications.net/environment/silk-pavilion-cnc-deposited-silk-silkworm-construction-at-the-mit-media-lab/>

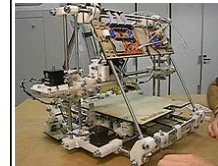




## where is it all going?

Some claims:

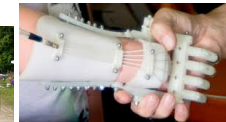
Personal fab will change manufacturing  
Download blueprint instead of product



RepRap 3D printer



Urbee 3D printed car



3D printed prosthetics  
robohand

and a more sinister side ...