

Digital Fabrication Studio  
CSCE689

# **Week 1: Lecture**

## Introduction & Course Intro

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## Today's agenda

- Course Intro: What is and Why Digital Fabrication?
- Why digital fabrication in Computer Science?
- What you'll do and learn in this course
- Class Structure
- Deliverables & Grading
- Project overview

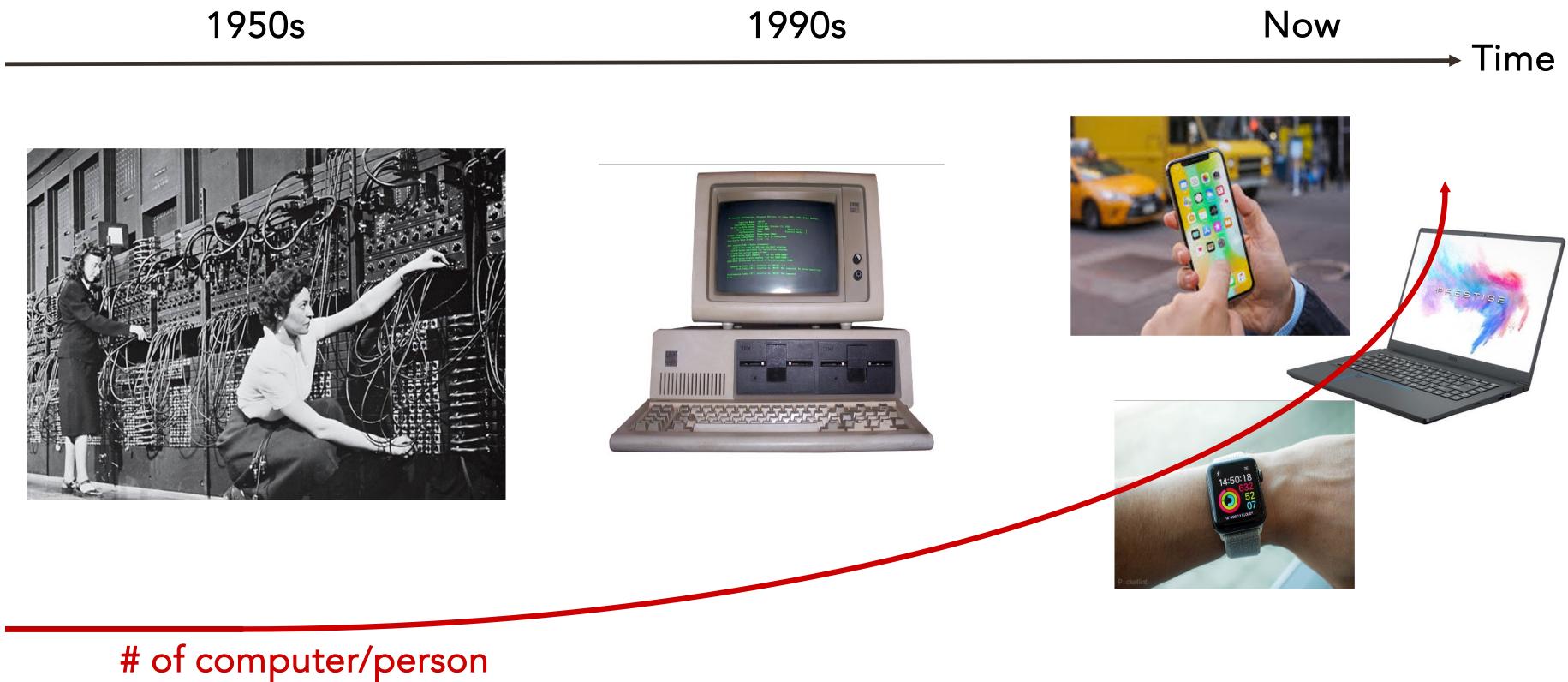


Caution

We will watch a LOT of short cool videos

... that will inspire you

# History of Computers



# History of Human-Computer Interaction

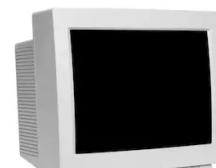
1950s



1990s



Now

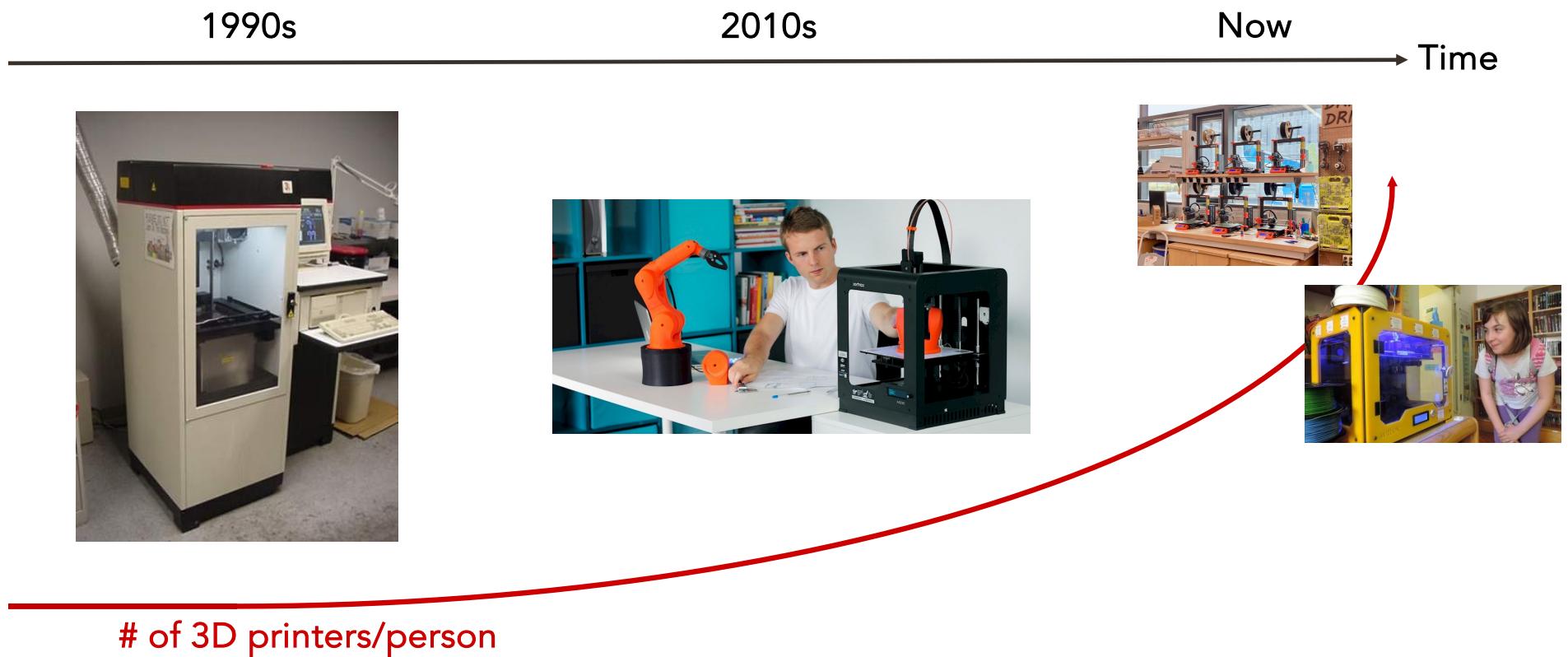


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# History of Digital Fabrication Machines

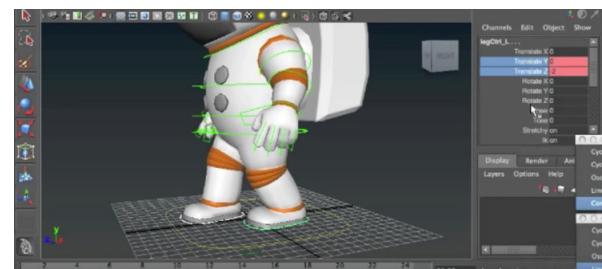
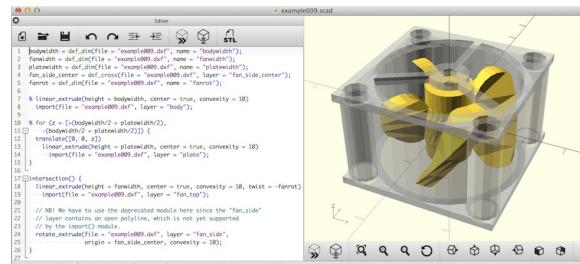


# History of Human-Digital Fabrication Interaction

1960s



2010s



Now



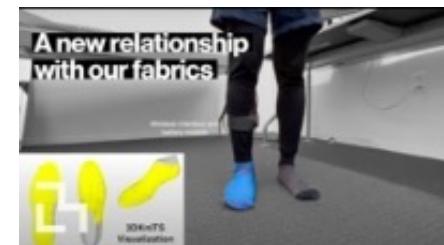
# Now you can build ANYTHING



3D printing



Laser cutting



Looming



Digital embroidery



Vinyl cutting

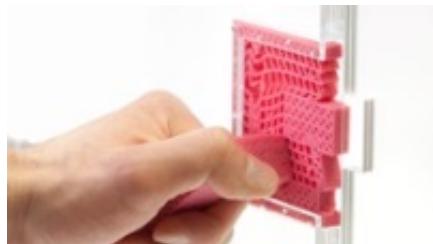


Inkjet printing

...integrating computing into everyday objects



Body



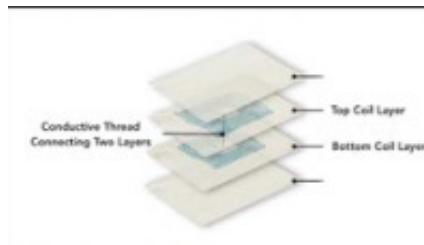
Physical interfaces (e.g., door)



Food



Batteryless Game devices



Furniture

## Learning Objective

- Learn fabrication techniques and special materials
- Learn fabrication process: how do future interfaces work?
- Build your own fabrication methods, OR
- Build your own physical objects that sense, actuate, and communicate with humans
- Develop non-invasive interactions that are useful for context-aware everyday devices

# Wait, non-invasive interactions?

Conventional



Non-invasive



Vs.

Non-invasive interaction builds upon context-awareness

Command-based



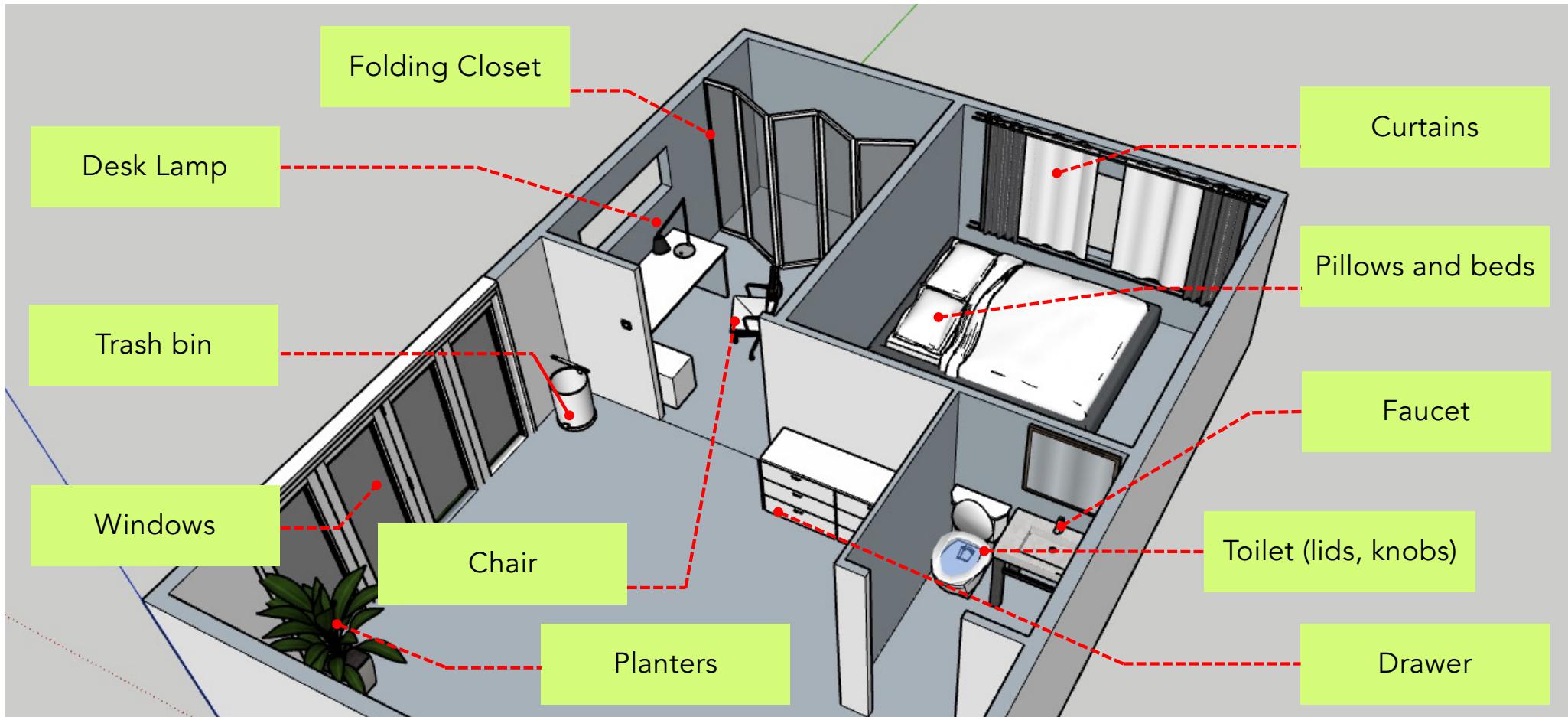
Vs.

Context-based



## Nissan self-organizing computers



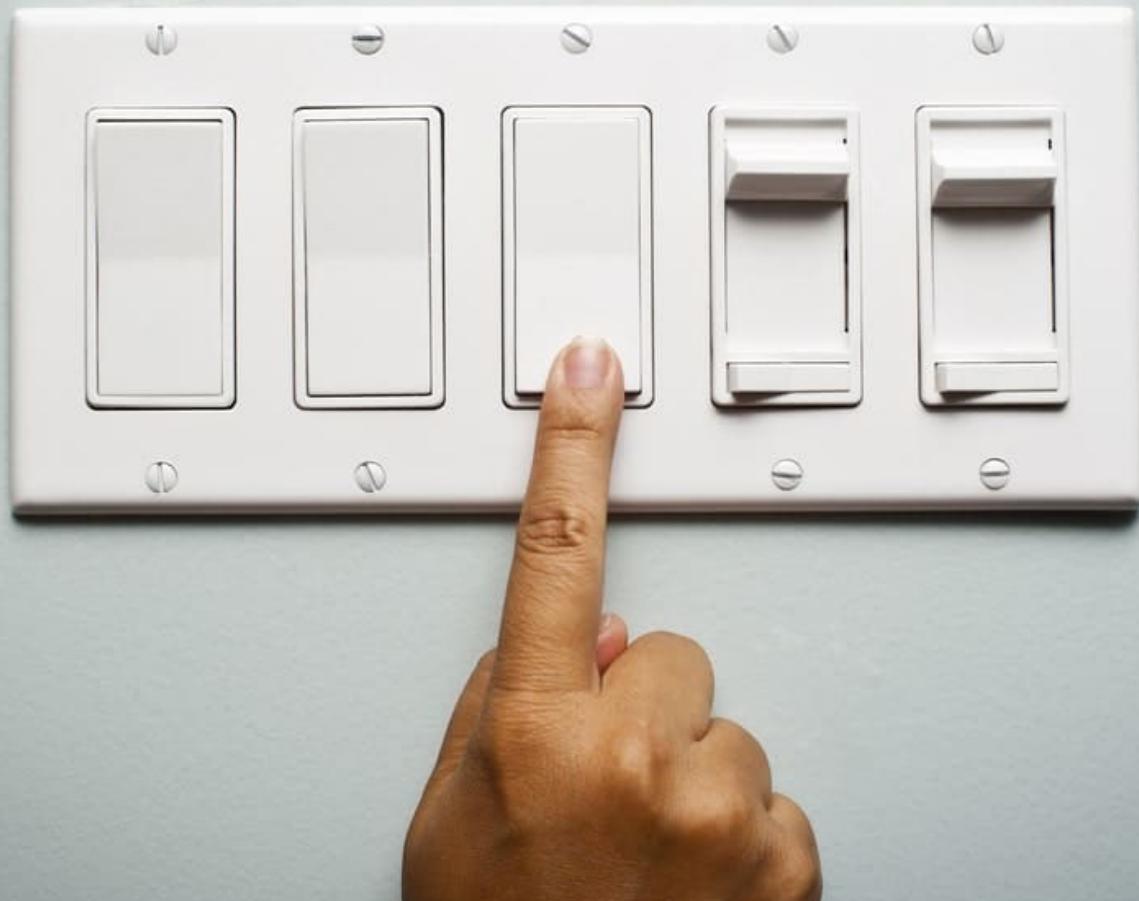


3min. Discussion: What can everyday objects sense?

## Learning Objective (Cont'd)

- Learn fabrication mechanisms and materials
- Learn fabrication process: how do they interpret human designs?
- Build your own fabrication methods
- Build your own physical objects that sense, actuate, or communicate with humans
- Fabricate non-invasive interactions that are useful for context-aware everyday devices
- Design design tools to improve accessibility

## Why should we care about Context Awareness?



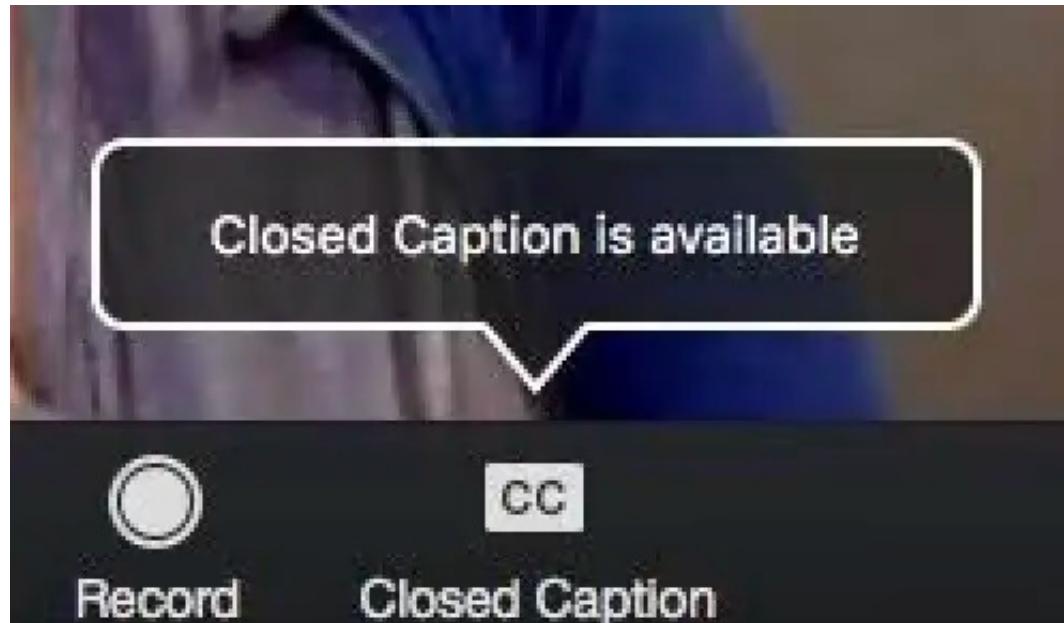
Accessibility is  
context-dependent

	Permanent	Temporary	Situational
Touch			
	One arm	Arm injury	New parent
See			
	Blind	Cataract	Distracted driver
Hear			
	Deaf	Ear infection	Bartender
Speak			
	Non-verbal	Laryngitis	Heavy accent

Different people need different solutions



Many technologies are firstly developed for accessibility



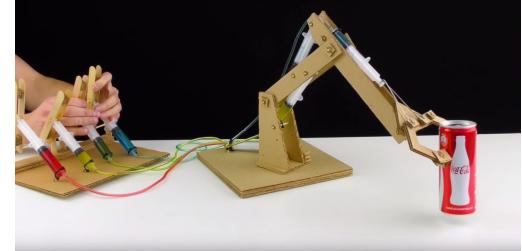
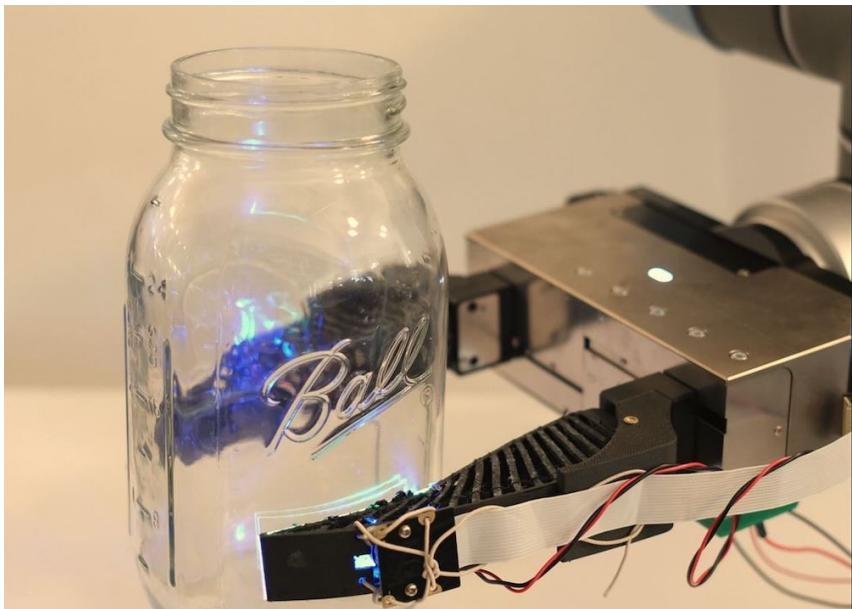
## Our Class goals

- Learn digital fabrication skills and special techniques
- Be able to replicate latest fabrication techniques
- Augment passive physical interfaces into novel interfaces
- Enable new design/fabrication workflows
- Redesign interaction
- Repurpose or transform existing objects using fabrication

What do we mean by repurpose through augmentation?



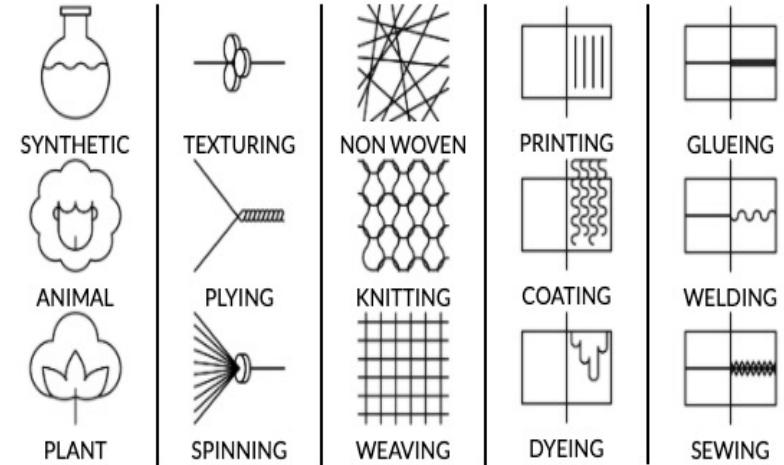
# Digitally Fabricated!



# Why Fabrication?

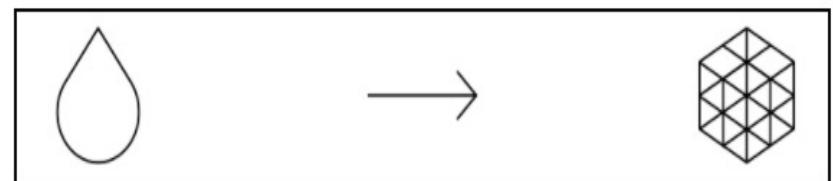
# So it simplifies a supply chain

## Current Supply Chain



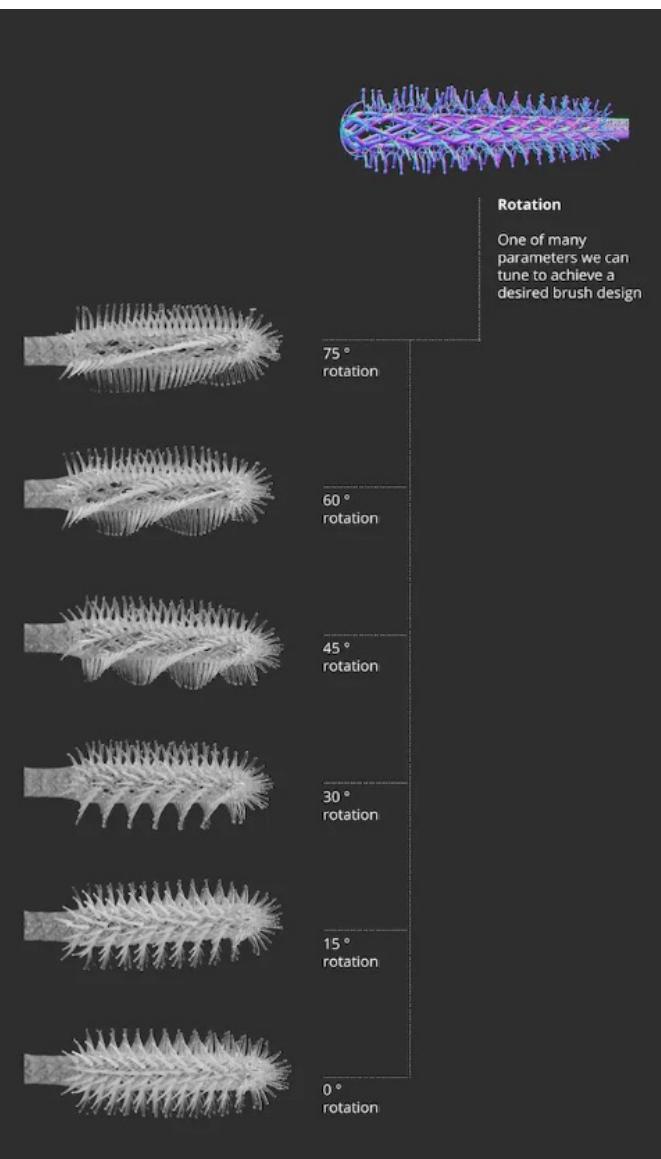
FIBER SOURCING	YARN MAKING	FABRIC MAKING	SURFACE FINISHING	FINAL ASSEMBLY
$\sim 1 \mu m$	$\sim 10 \mu m$	$\sim 1 mm$	$\sim 1 m$	$\sim 1 m$

## Future Supply Chain

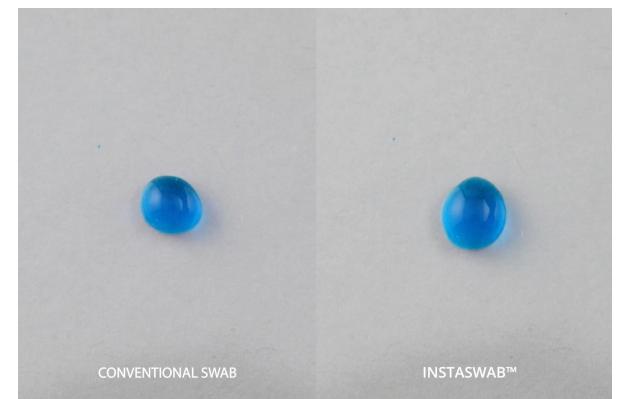


STRUCTURED  
MATERIAL

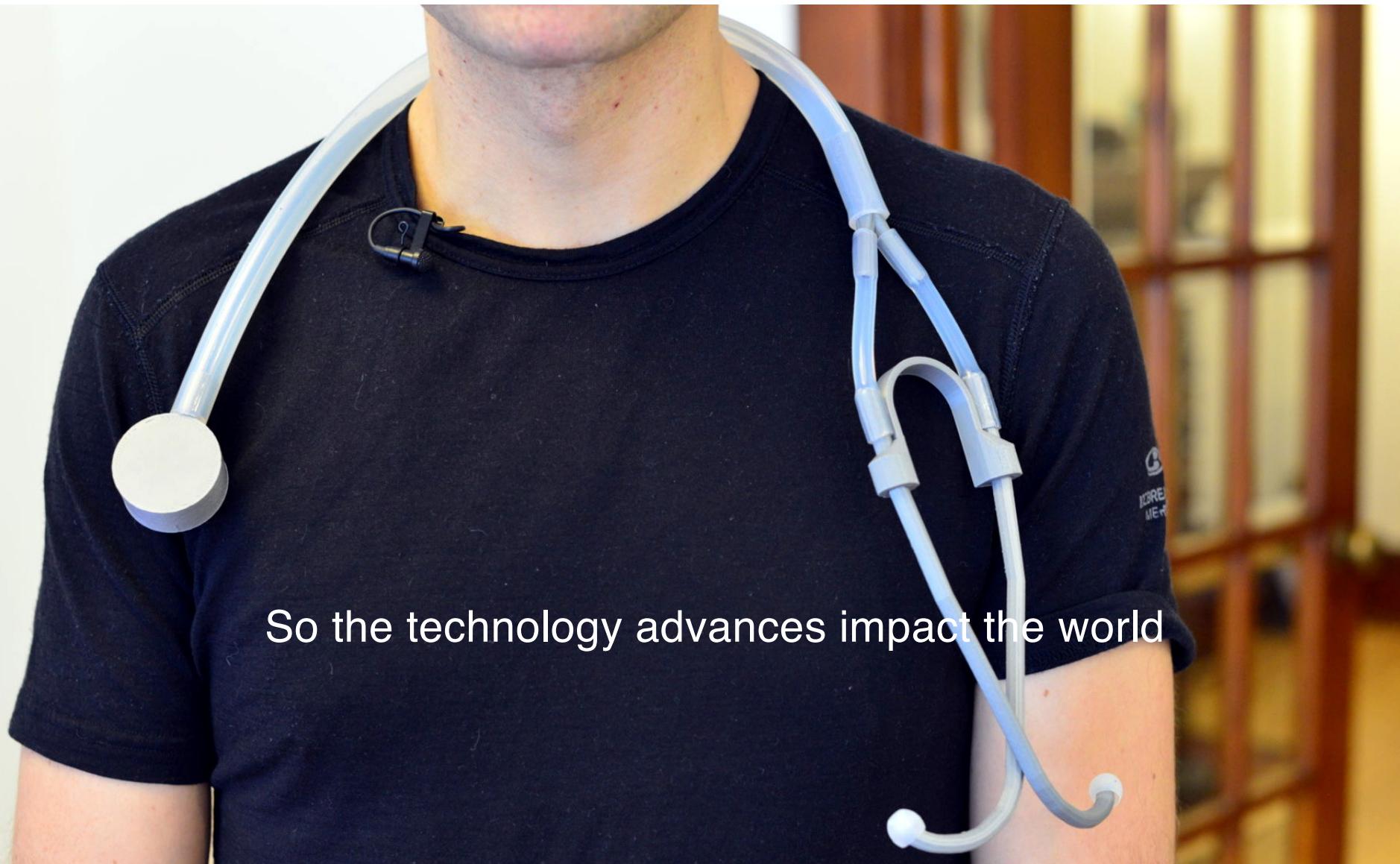
Credit: OPT Industries



Yes, these are 3D printed!



Credit: OPT Industries



So the technology advances impact the world

## How One Organization Is Pioneering The 3-D Printed Prosthetic Revolution

e-NABLE, a global network dedicated to making 3-D printed limbs for those in need, is doing more than offering a helping hand, it's changing lives.



Due to a birth defect, 8-year-old Aidan was born without fingers so he couldn't grip things unless he used his "nubby" hand to hold them. Aidan's lack of fingers didn't bother him. But in public, he never hid his arm or pretended he didn't have an arm at all.



### Putting 3D Printers to Work in Ukraine's War Zone

**Forbes**

Amy Feldman  
March 31, 2022

## Stethoscope

1. Snap pieces together as shown
2. Connect large tube to head and Y-piece
3. Connect small tubes to Y-piece and ear tubes
4. Attach earbuds to ear tubes

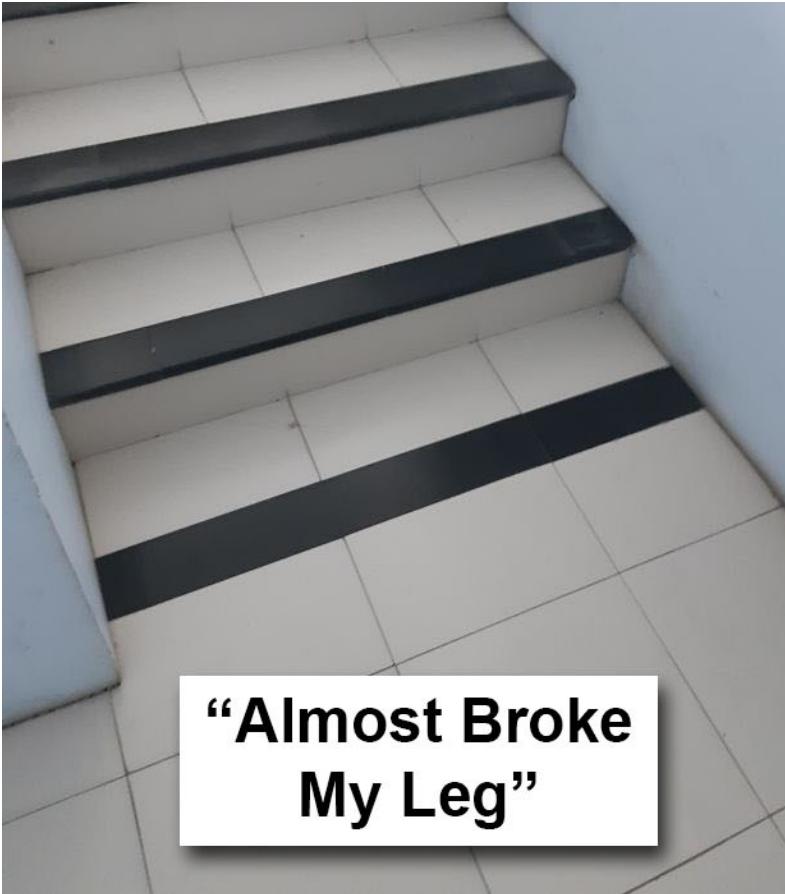


## سماعة طبية

1. جمع القطع مع بعضها كما هو موضح بالرسم
2. ركب الأنابيب الكبير ما بين القطعة Y وقطعة السماعة
3. ركب الأنابيب الصغيرة تفصل ما بين القطعة Y وأنابيب الأذن
4. تركيب وسادات الأذن مع أنابيب الأذن

land are rushing three-dimensional (3D) printers to manufacture of defensive equipment like tourniquets, drones for the besieged country. The flexibility and ease of use is crucial in wartime, and ease the logistical debacle of getting supplies; many 3D printers also are ideal for wartime because they are small and can be deployed in basement

Bad designs are everywhere





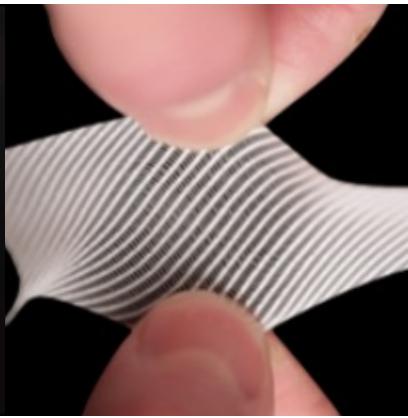
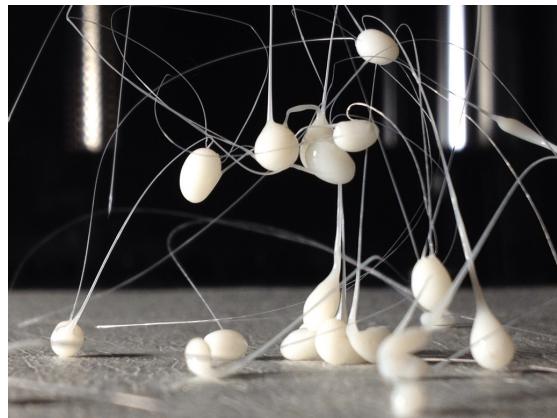
Wait, everything fails..



GIFSec.com



Wait, everything fails, AND that's the start!



# Course Overview

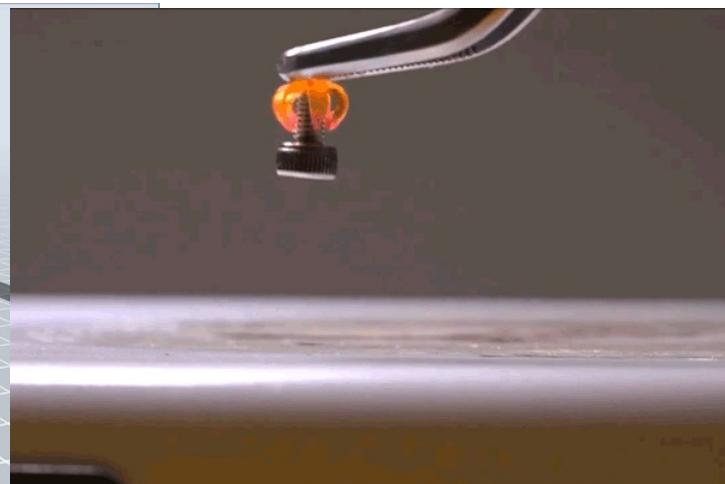
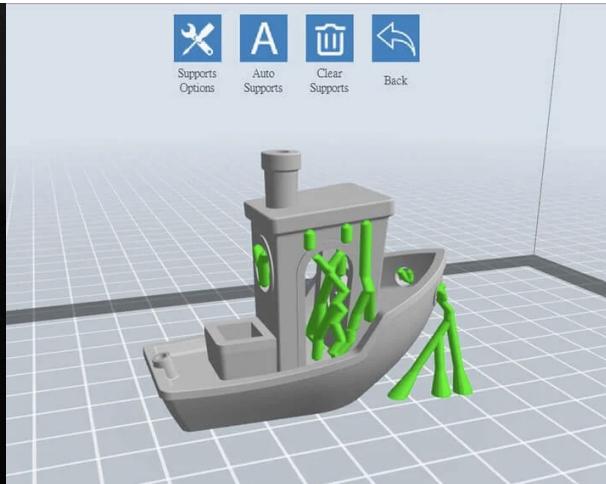
## What do we learn?

- Laser cutting and engraving– by parameters!
- Basics, Applications
- Design to laser cut

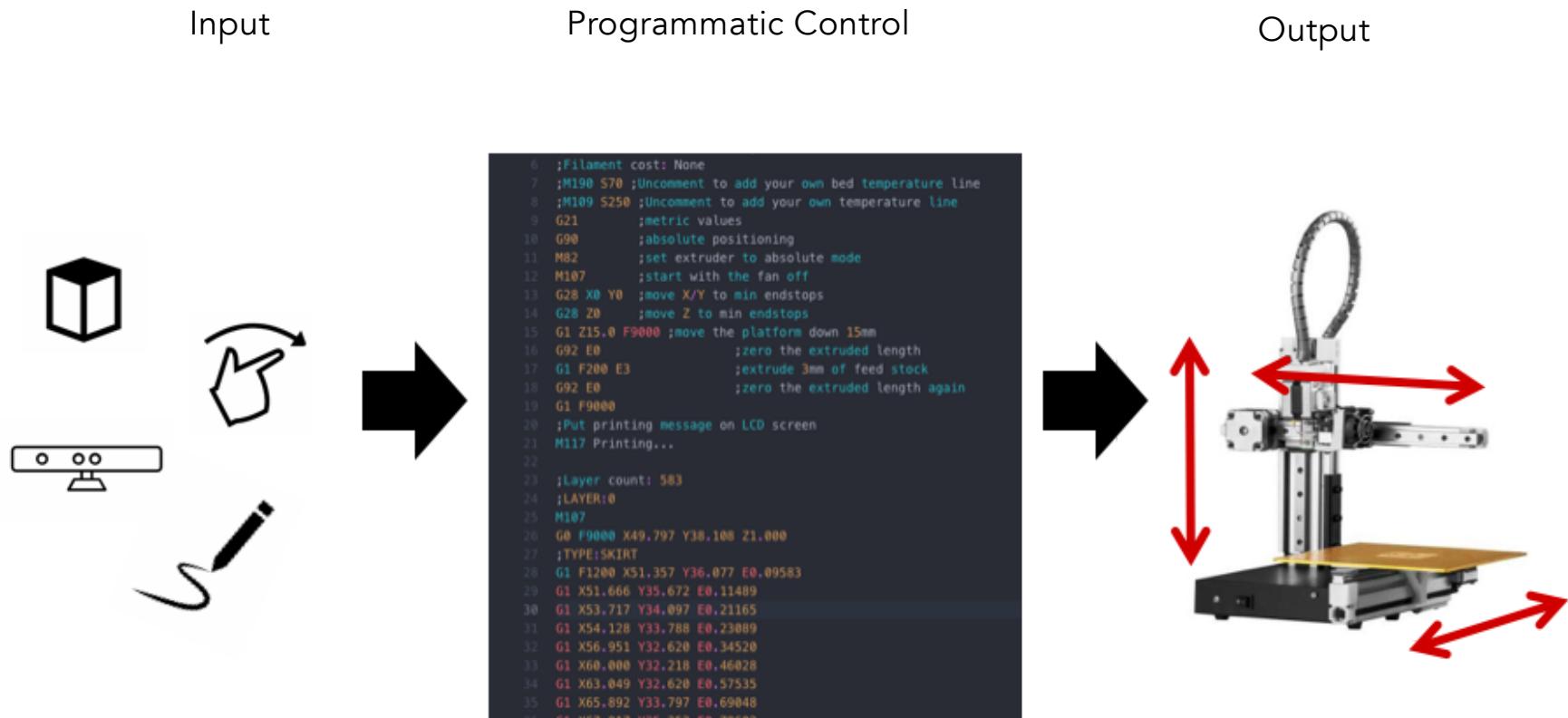


## What do we learn?

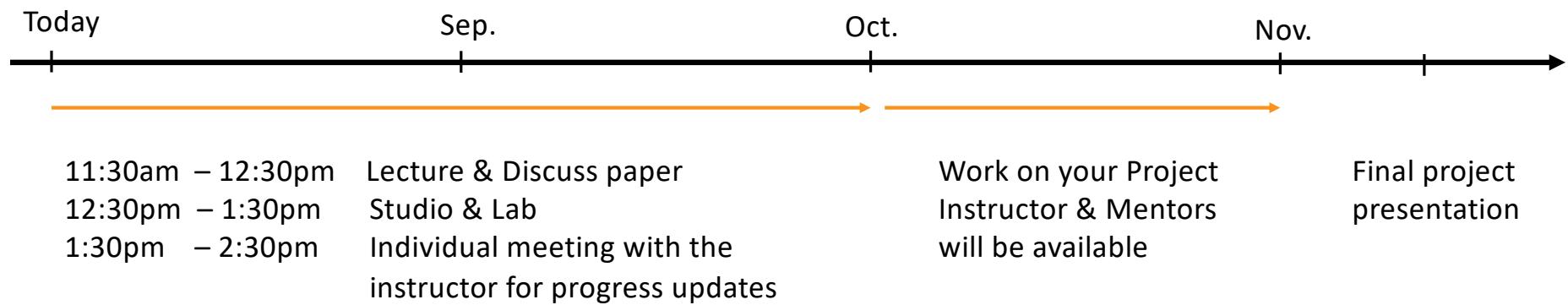
- Basic/advanced 3D printing (Machines, Materials, Slicers)
- Applications
- Design to model 3D objects



# What do we learn?



# Class Structure



# Class Structure

1 hour:

- Discuss the read paper
- Meet in EABA121 (here!)

The rest:

- Try, design, and build
- Meet in EABC 107C

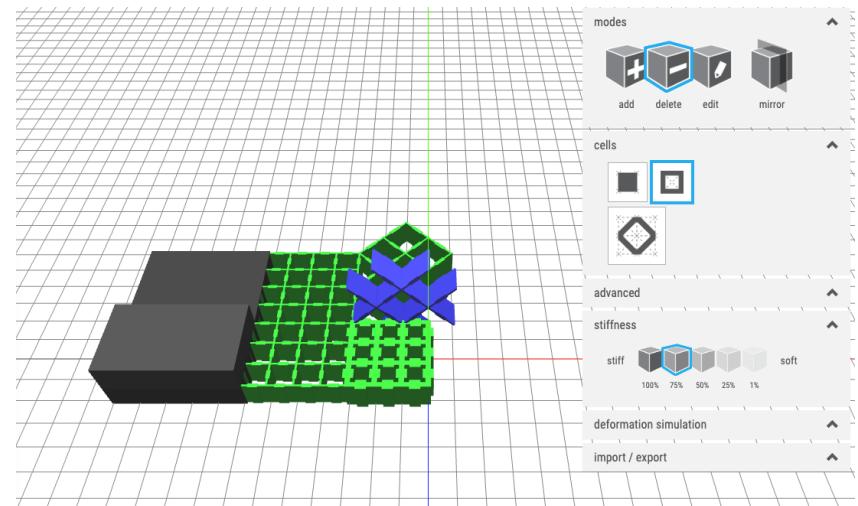


Figure 1: (a) This door latch is implemented as a metamaterial mechanism; it consists of a single block of material based on a regular grid of cells that further implement a handle, latch, and spring mechanism. (b) When we move the central hinge arms to deform and to pull the latch inwards, which unlocks the door. (c) We created this mechanism in our custom editor. Here we place two hinge arms and necessary connecting bars to the handle so the handle can rotate that connects to the door frame. Researchers also started to design the inside of 3D objects by changing the structure of the 3D printed object itself.

## A Little bit about myself

**Jeeeun Kim, PhD**  
 *Triple 'e's!*

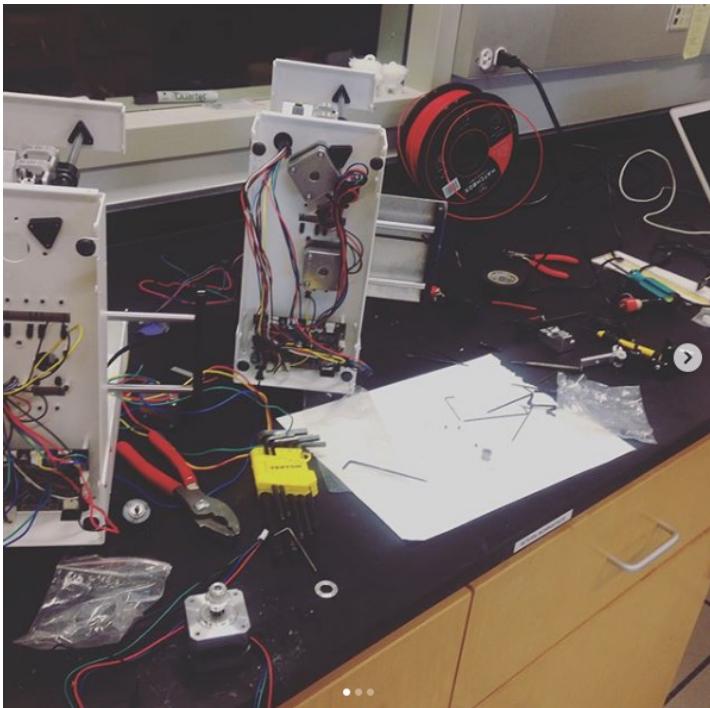
Assistant Professor in Computer Science & Engineering

5th year at A&M and Texas

Lead HCled Lab

Studied at University of Colorado (Boulder)

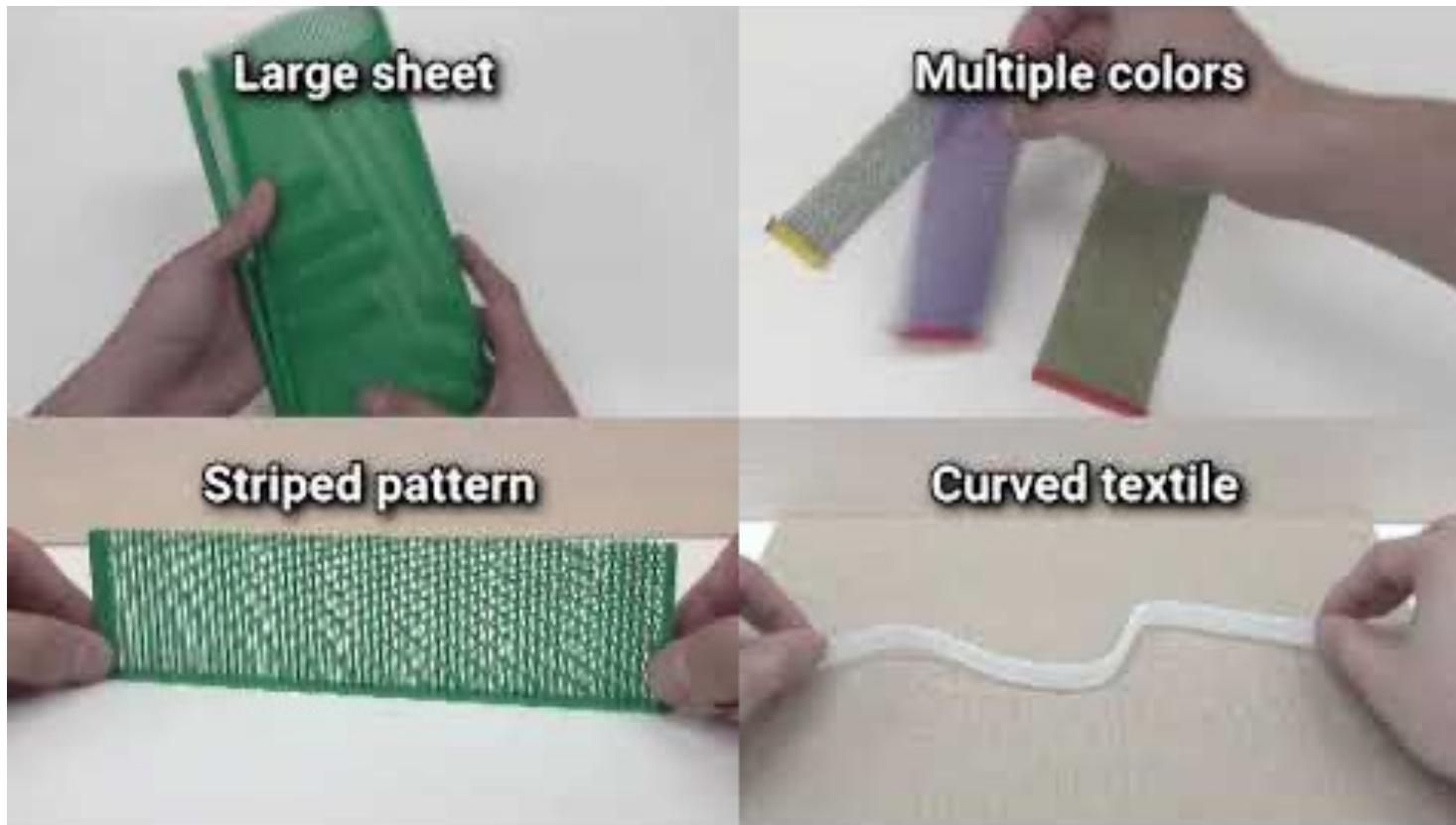
## A Little bit about myself



## Assignment in 2 weeks (Next week is Labor day!)

- Fill in the Intro Survey
- Use free slide template, watch the videos in this slide
  - 2 pages: Introduction
    - major, background, the biggest project o you've done so far
    - the motivation for taking this class
    - what you want to achieve in this class
  - 5 pages: 1 page each for 5 final project ideas
    - What problem does this solve?
    - Why is it important?
    - How did previous works/projects approach the same problem?
    - What are the major challenges expected?
    - How will world be different with this?

## More Inspirations: 3D printed textile

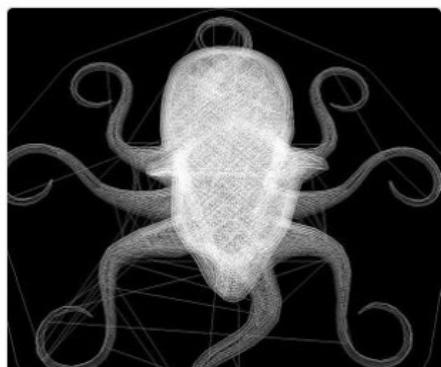


## More Inspirations: 4D printing

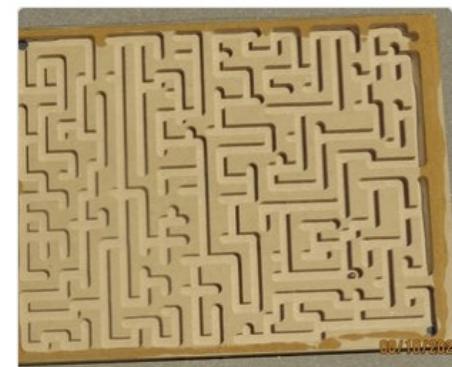


LET'S MAKE: g-code

All Categories



```
G01 X6.5 Y2.95  
G03 X7. Y3 R1.  
G02 X11. Y4 R8.  
G02 X11.5 Y3.3 R.625  
G01 X11. Y0 75  
G03 X11. Y-.75 R3.  
G03 X12.5 Y-3.25 R4.  
G02 X12.4 Y-4 R.75  
G02 X11.2 Y-4 R2.  
G01 X10. Y-3.75  
G03 X7. Y-4 R10.  
G02 X0 Y-3 R8.  
G03 X3. Y-1.5 R2.  
G03 X0 Y0 R2.
```

[G-code](#) by 3D Printing Ninja in 3D PrintingMany more available at Instructables <https://www.instructables.com/>

298 21K

[W4: G-Code](#) by merttoka in 3D Printing

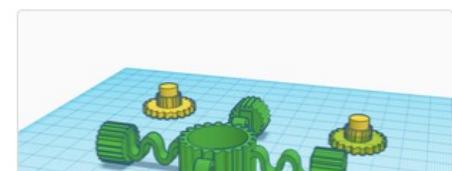
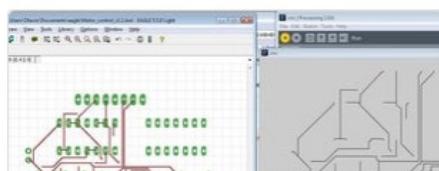
1 63

[How to write G code \(basics\)](#) by Mach95 in CNC

99 166K

[Toy Wood Mazes \(with G-codes\)](#) by doctorJim in CNC

2 214



## Course Website (Under Construction..)

- <https://HCled.info> → Classes
- Class announcements including assignment templates
- Lecture slides
- Class reading

Not everything will be perfect!

## Next week: Project Idea Presentation + Studio

- Paper pinhole camera
- Many great techniques to manipulate papers for physical fabrication
- Bring craft tools and materials
  - Must: scissors, paper knife, glues
  - Recommended: thick paper, ruler, color pens

