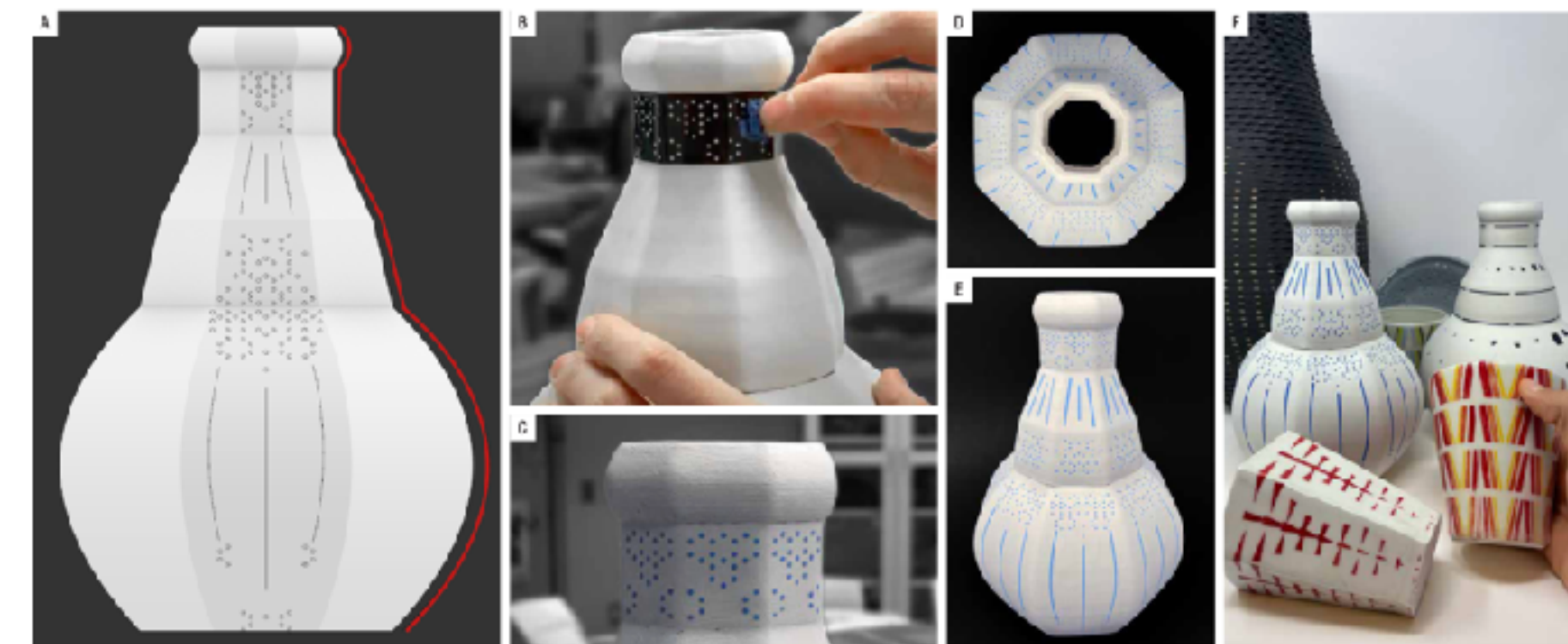# CS122 Class 5: Design tools for DFAB

Polagons by Sethapakdi et al. (CHI 2023)

Aesthetic Electronics by Lo et al. (UIST 2016)

CeramWrap by Toka et al. (UIST 2023)

Class 5 agenda

- ZC x 2

- Lecture: a very brief history of HCI research + Design tools for digital fabrication

- Break

- Seminar: digital fabrication research

Announcements

- **Mentor hours project work party: Sun 3-5pm, Hive common space**

- Meet with Prof Jacobs Friday 3:30-4pm, SGM 217 (upstairs)!

- RR grades have been released; hacking zine grades will be released by EOD - remember, you can resubmit a check minus within a week of receiving the grade

A very, very brief introductory history of HCI research
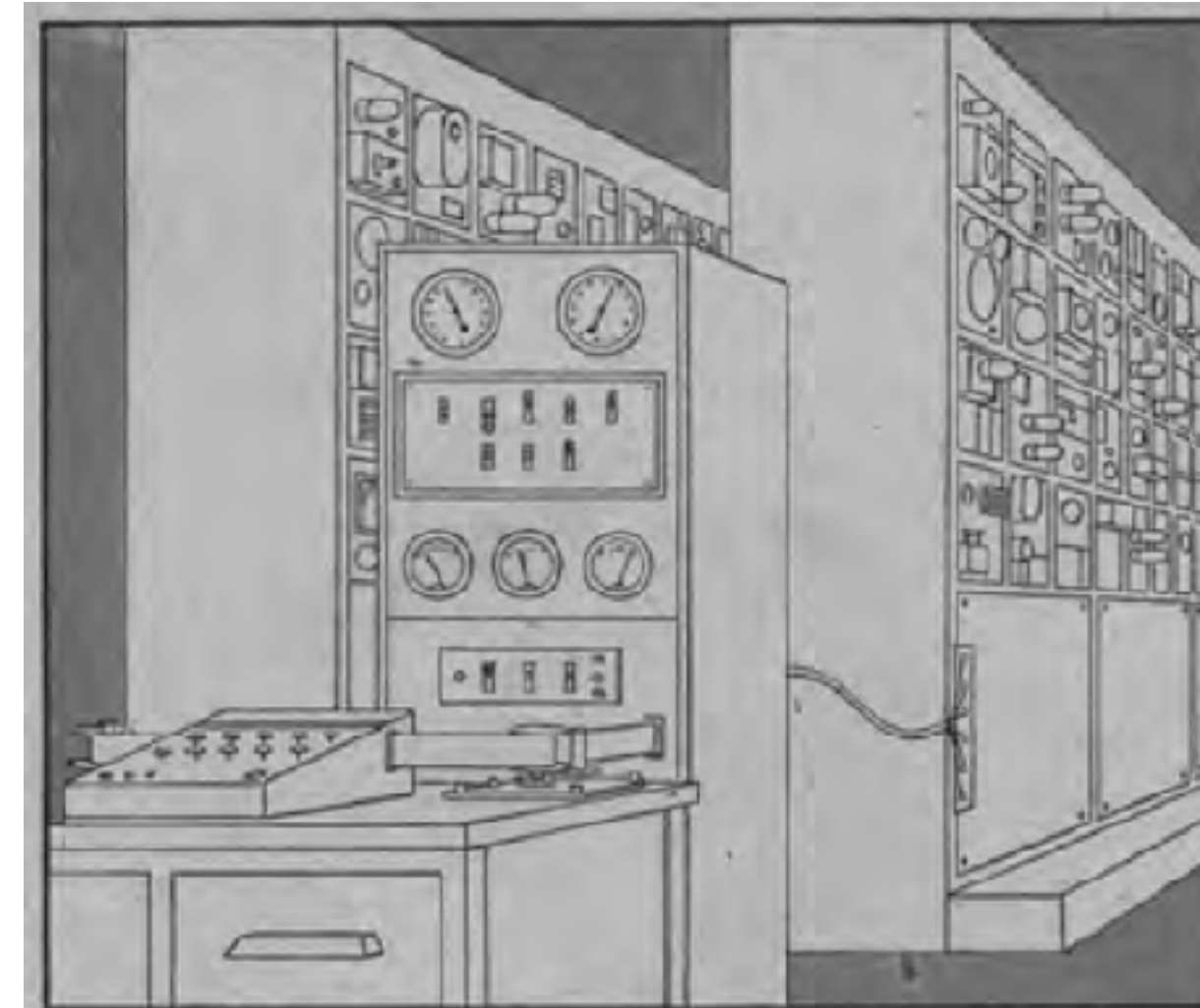
(with slides from Michael Bernstein)
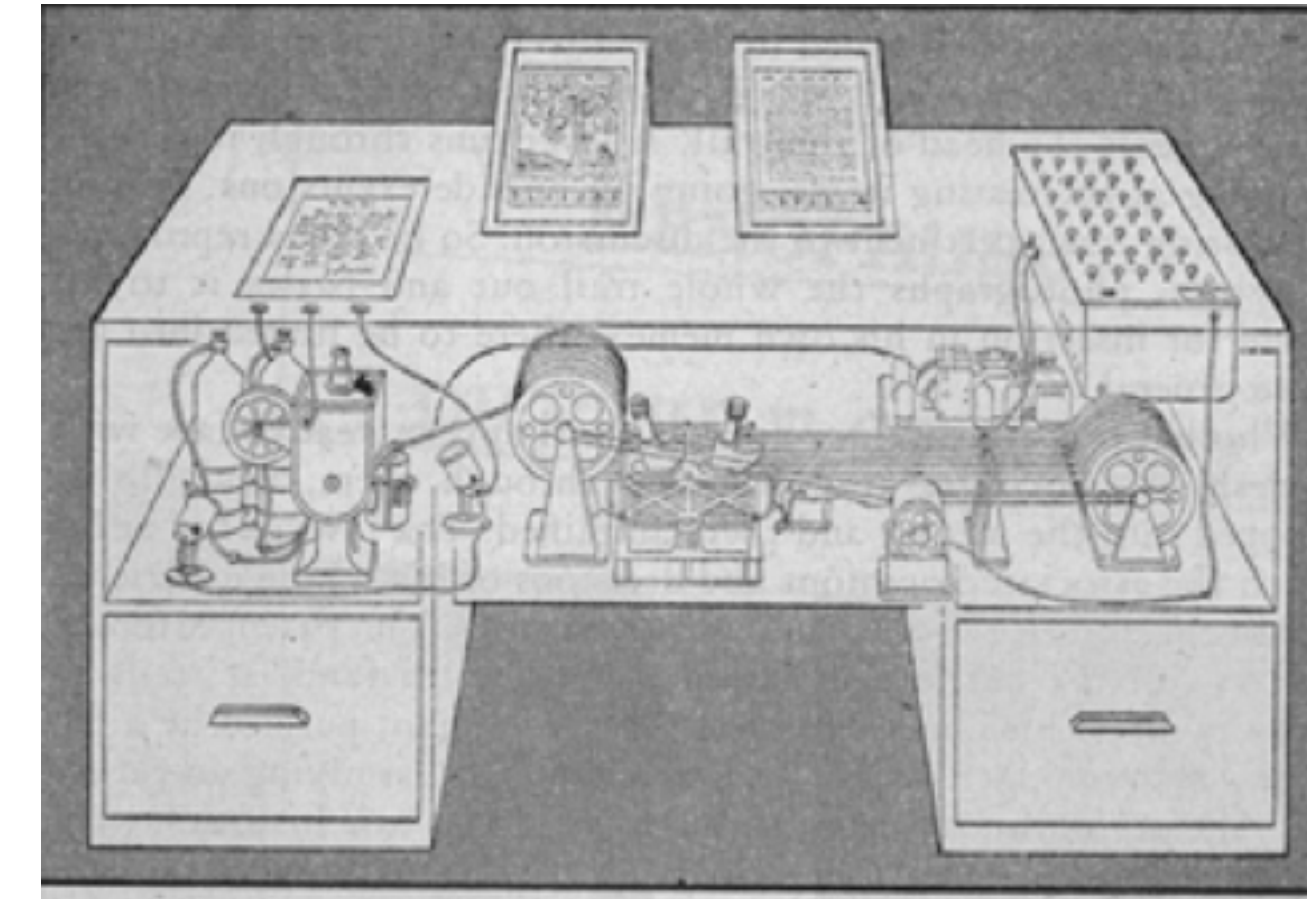
Computers to help us *think*, not just do math

Meta smart glasses

CARAMEL

...UNIVERSAL-FOCUS LENS. THE SMALL SQUARE IN THE EYEGLASS AT THE LEFT SIGHTS THE OBJECT

...AY THINK

...EES A POSSIBLE FUTURE WORLD
...CHINES WILL START TO THINK

...NEVAR BUSH
...CIENTIFIC RESEARCH AND DEVELOPMENT
...Atlantic Monthly, July 1945

Right after WWII, created lots of funding for CS
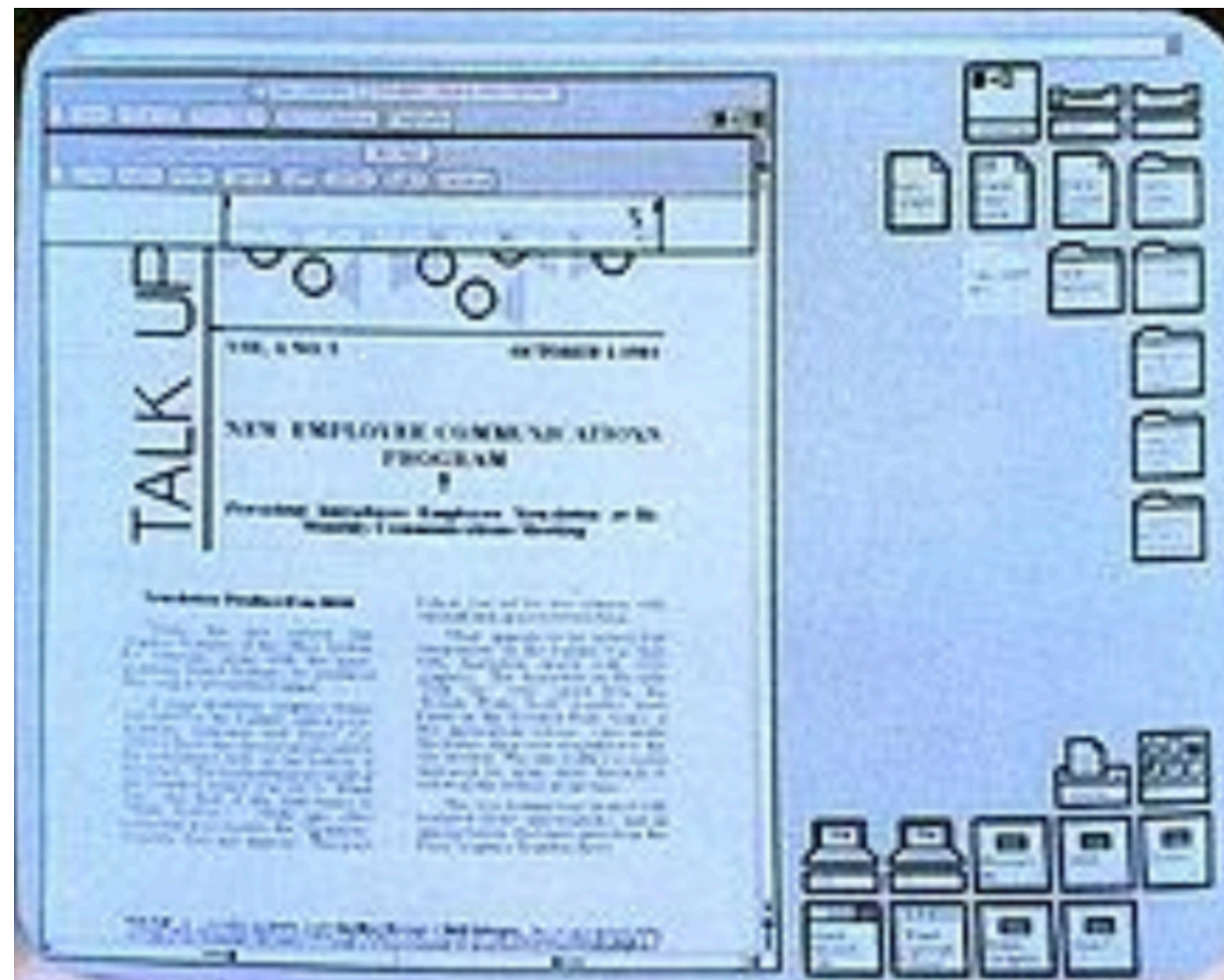
Thinking machines

Memex desk

"Wholly new forms of encyclopedias will appear, ready-made with a mesh of associative trails running through them."

WIKIPEDIA
The Free Encyclopedia

English
6,782,000+ articles

Русский
1,963,000+ статей

日本語
1,403,000+ 記事

Español
1,930,000+ artículos

Deutsch
2,881,000+ Artikel

Français
2,590,000+ articles

Italiano
1,847,000+ voci

中文
1,403,000+ 条目 / 條目
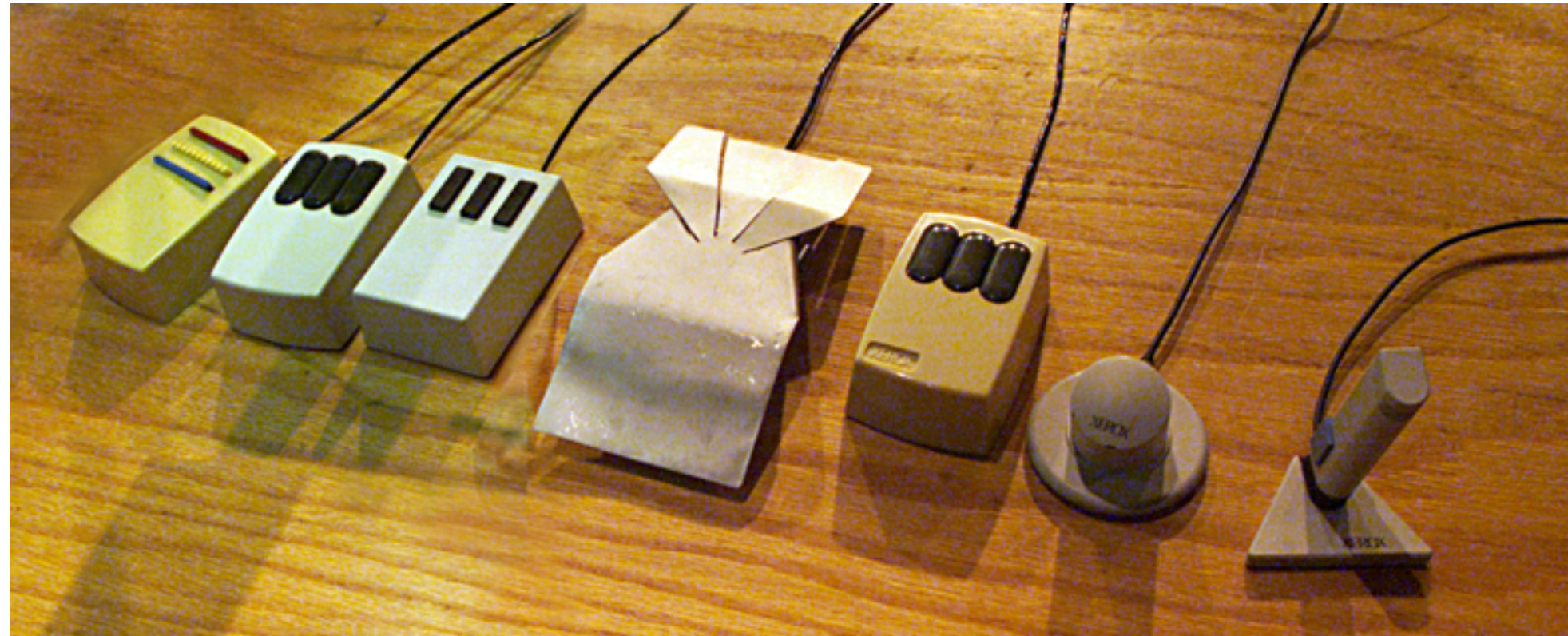
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فارسی

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العربية
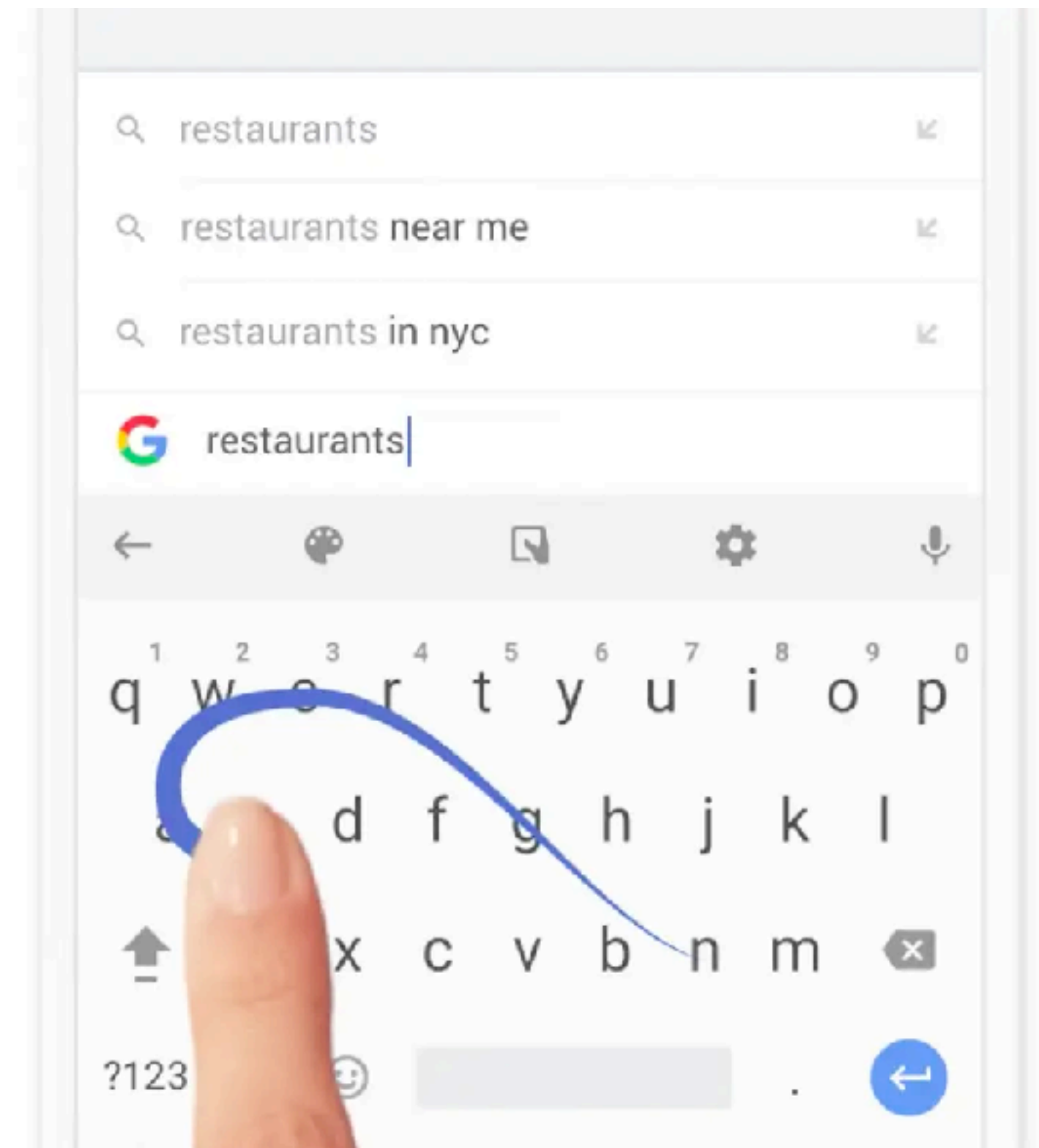
The Xerox Alto

Xerox PARC, 1973

Modern MacOS

Card, English and Burr. *Evaluation of mouse, rate-controlled isometric joystick, step keys, and text keys for text selection on a CRT.* 1978

Modern mouse

Zhai and Kristensson. *Shorthand writing on a stylus keyboard.* 2003

Swipe text keyboards

Fiala. *ARTag, a fiducial marker system using digital techniques*. 2005
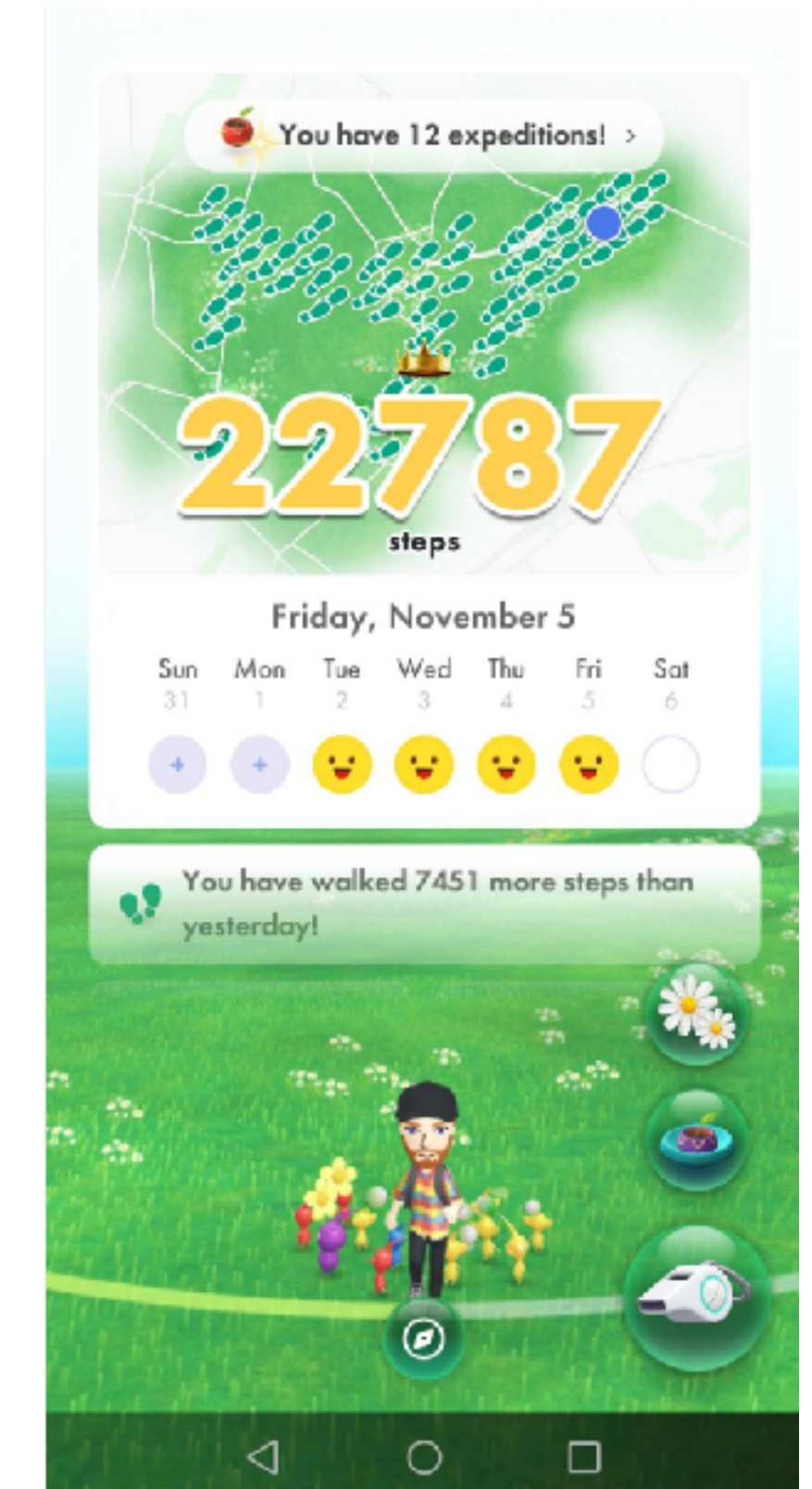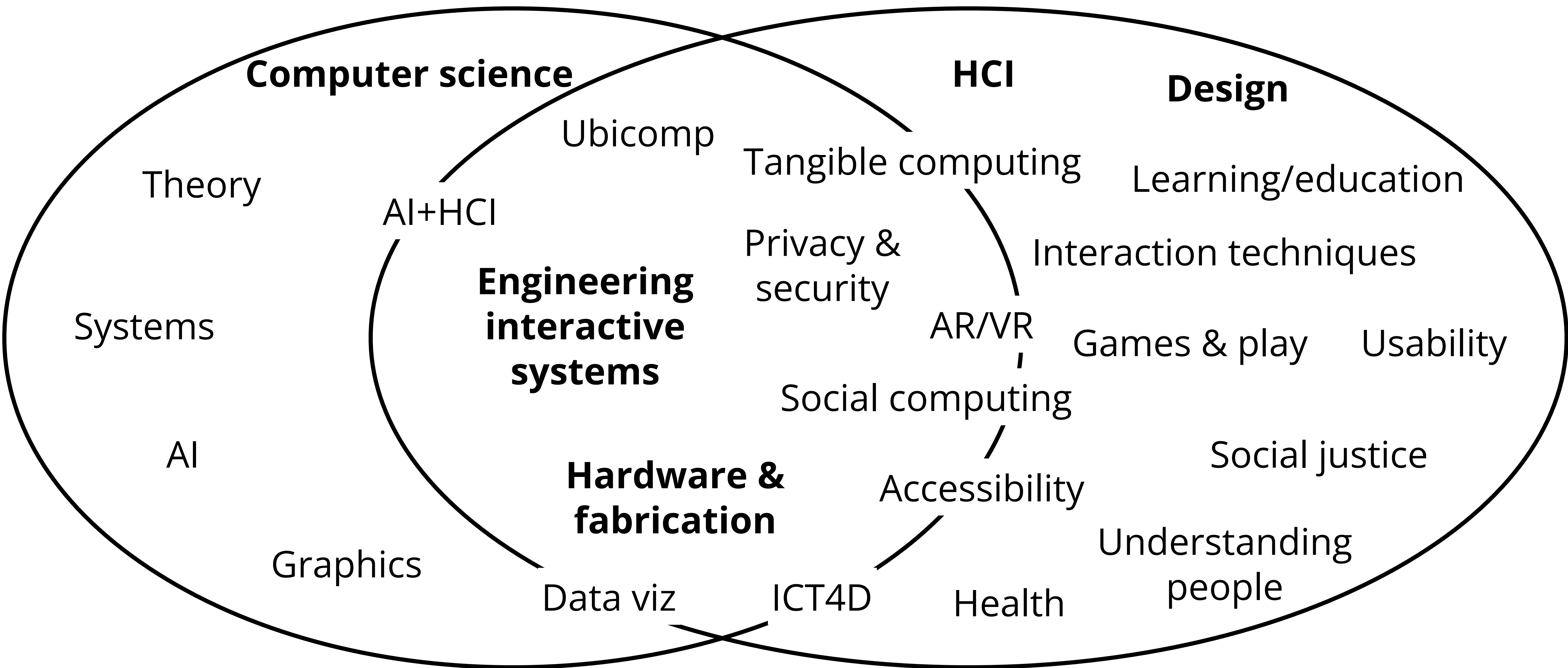

QR codes

Consolvo et al. *Activity sensing in the wild: a field trial of UbiFit Garden*. 2008
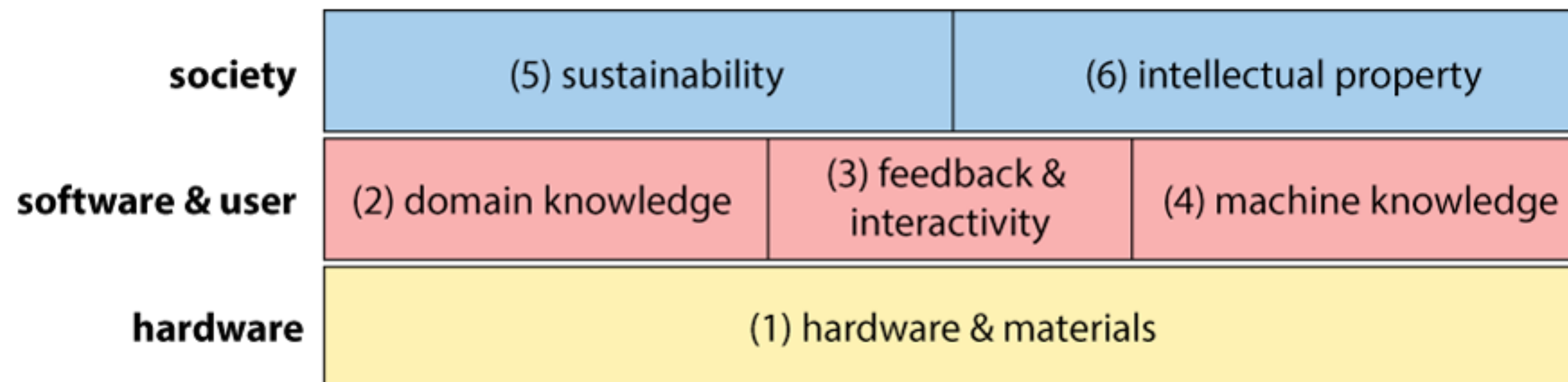

Modern fitness trackers

(and Pikmin Bloom)

Research areas of HCI

Design tools for digital fabrication

Digital fabrication -> Personal fabrication

• While there are huge machine fabrication factories and supply chains, most HCI research on digital fabrication focuses on *personal fabrication* at the consumer/hobbyist level

• Most researchers are consumers/hobbyists themselves, the machines are more accessible to labs, and it's much easier to design for a user who is yourself

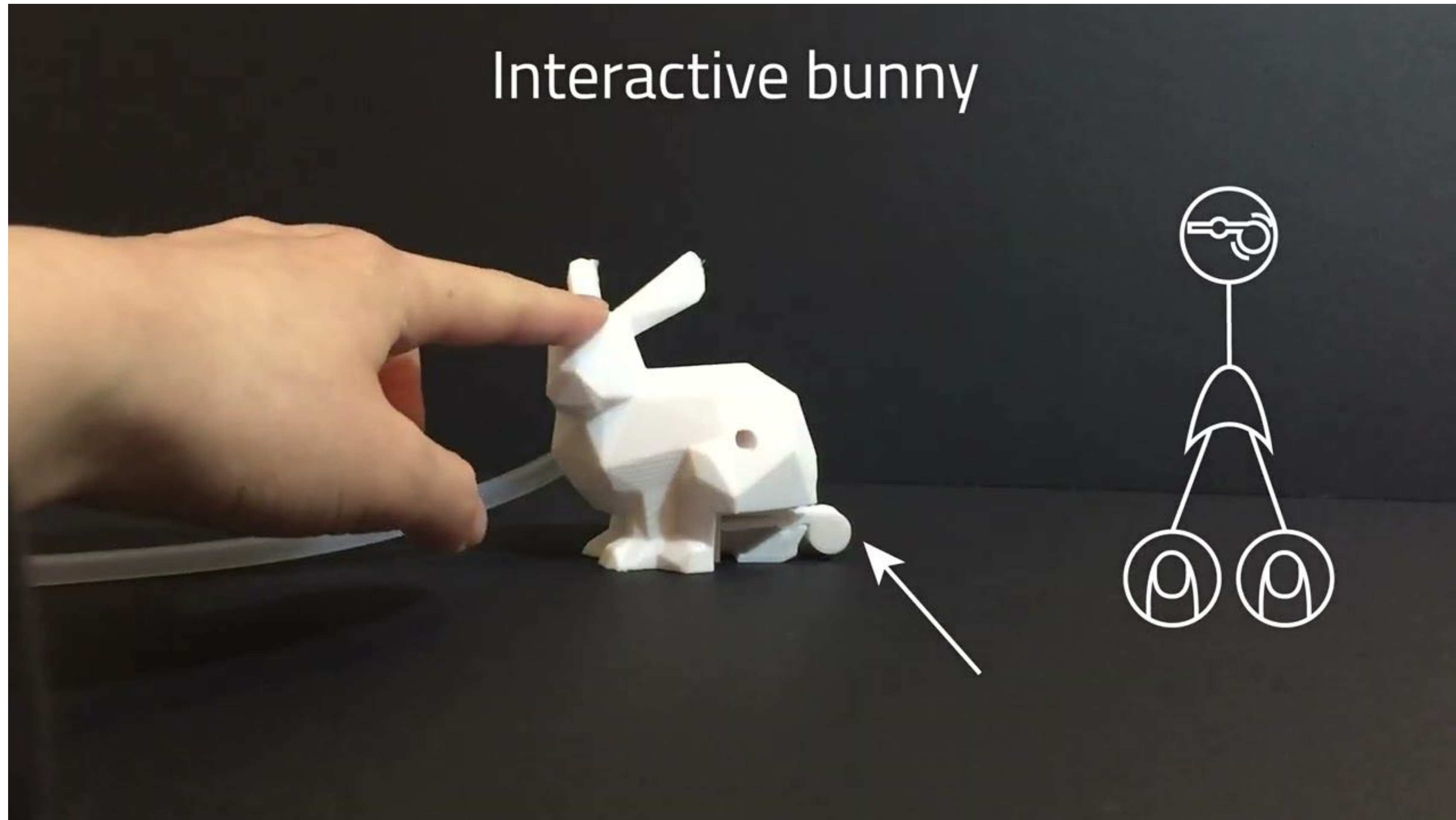• (General trend we'll also see in creativity support tools: design for novices)

society	(5) sustainability		(6) intellectual property
software & user	(2) domain knowledge	(3) feedback & interactivity	(4) machine knowledge
hardware	(1) hardware & materials		

https://hcie.csail.mit.edu/fabpub/
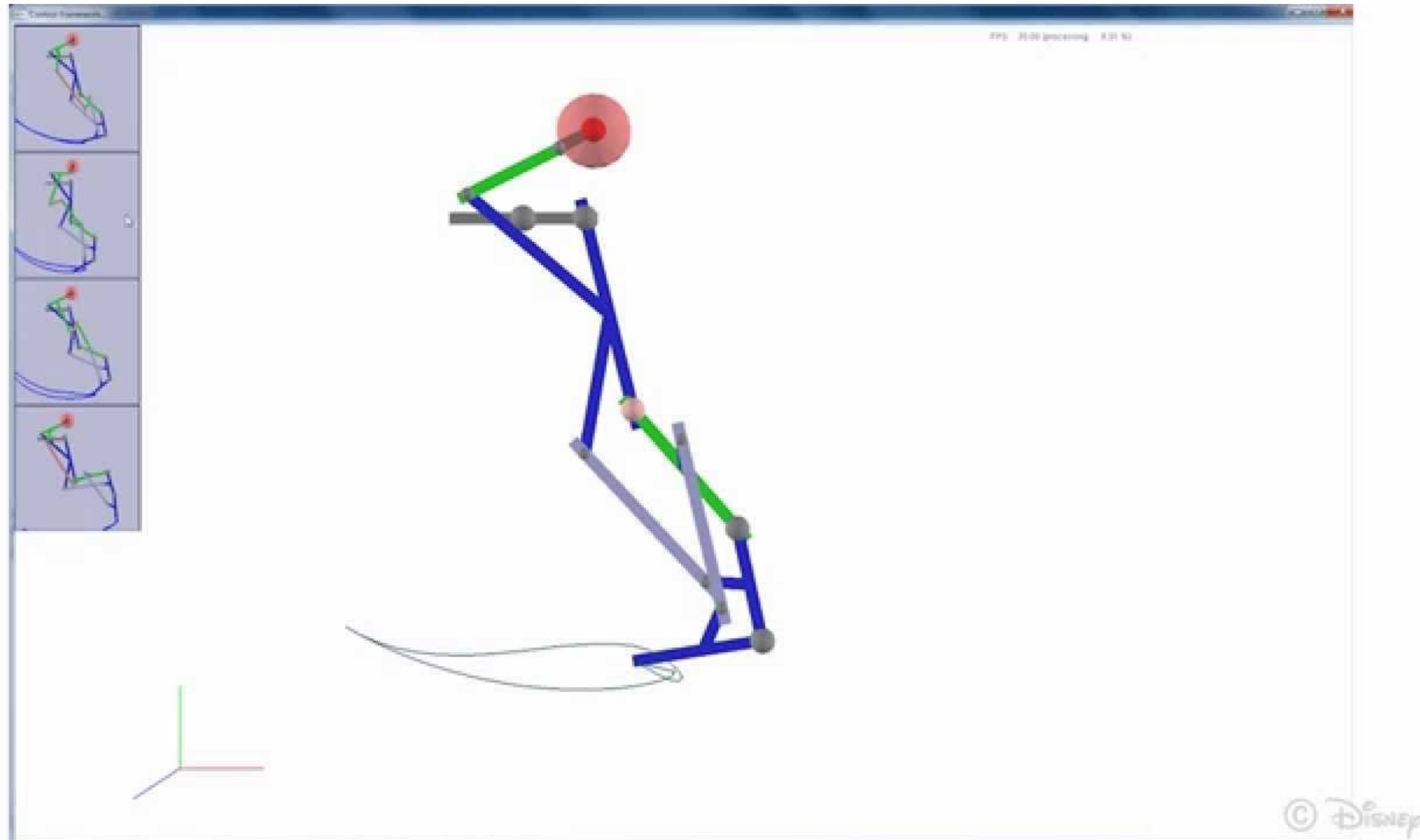
Hardware & materials

Willis et al. Printed Optics. 2012

Hardware & materials

Savage et al. AirLogic. 2022
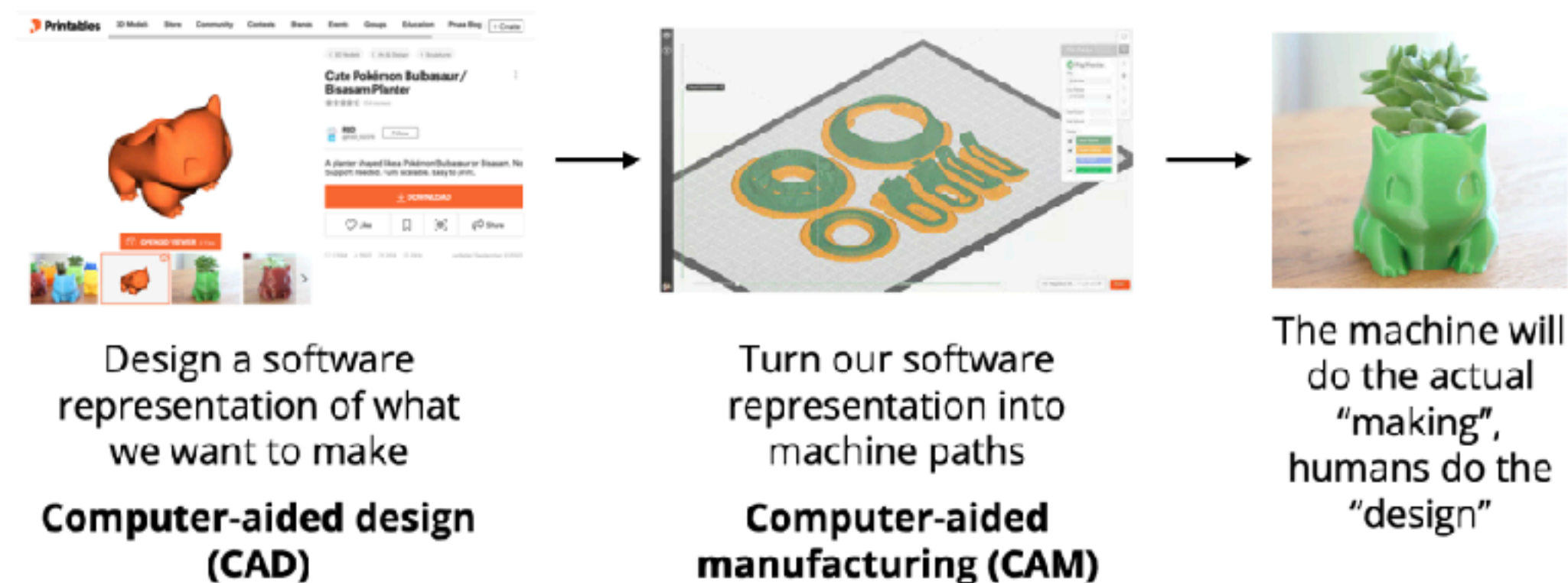
Domain Knowledge (kinematics)

Thomaszewski et al. Computational design of linkage-based characters. 2013

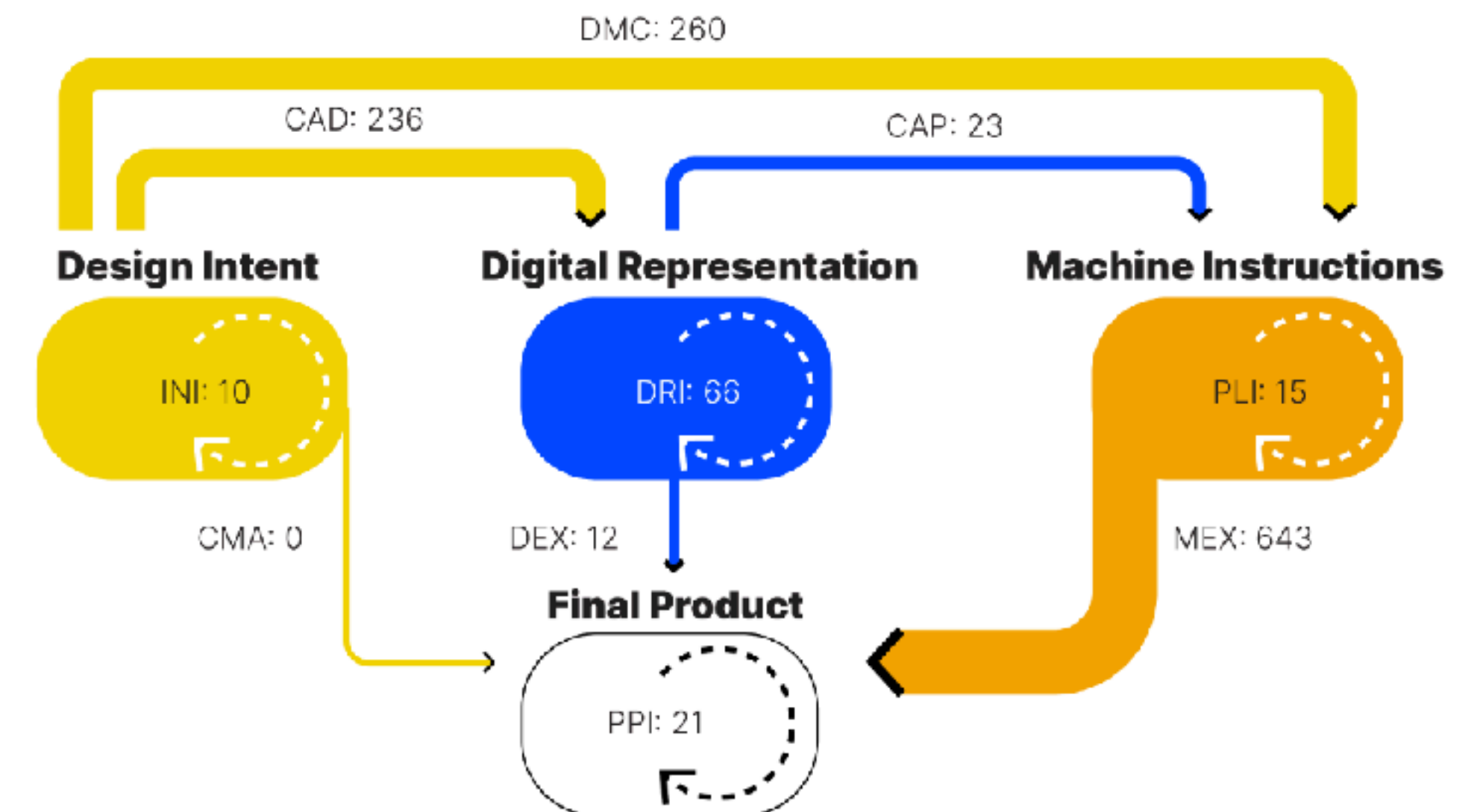# Domain Knowledge (understanding communities)

Instead of this workflow (recall our maker movement lecture)...
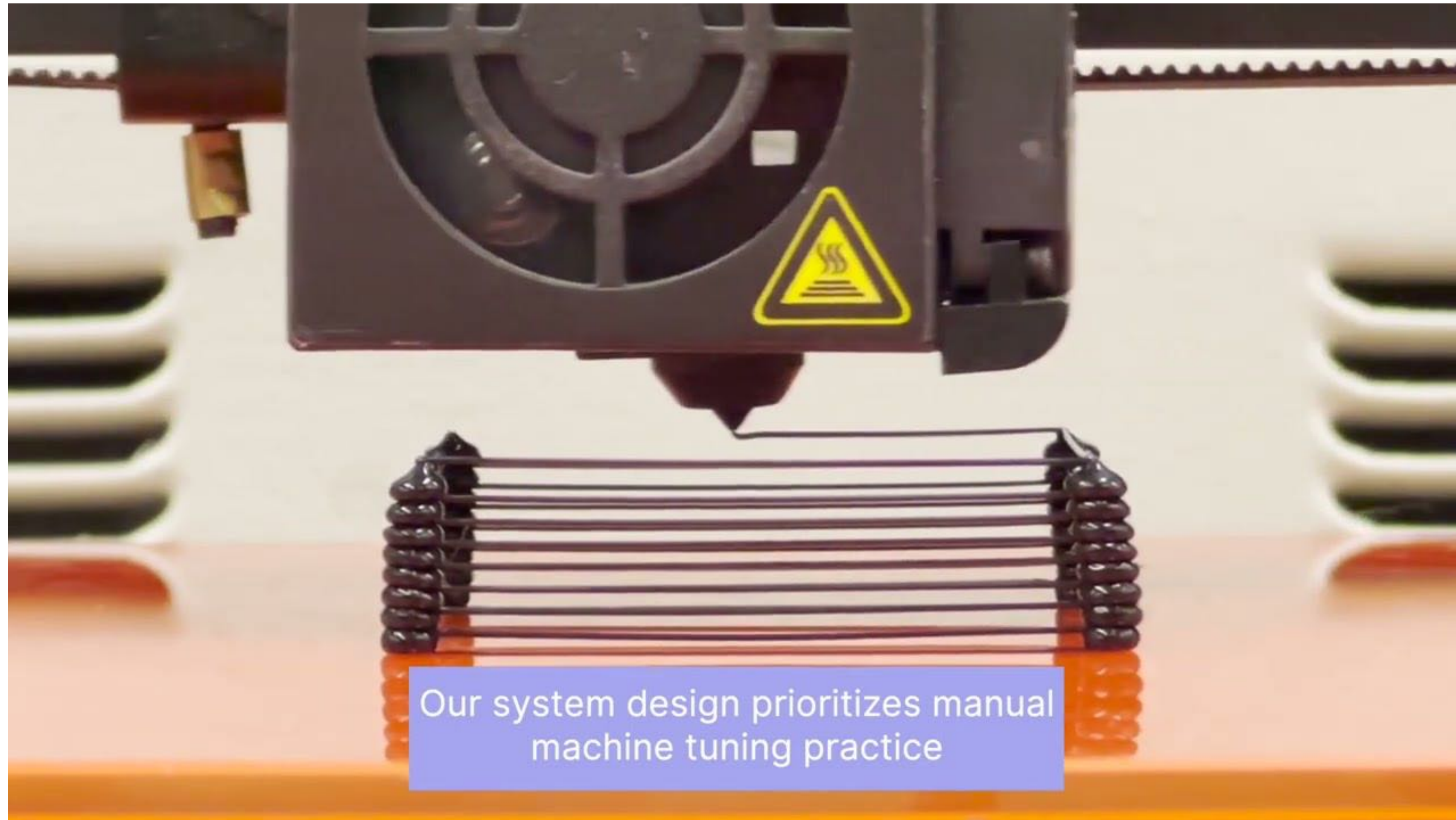
Dfab workflows are actually more complicated!

Twigg-Smith et al. Tools, Tricks, and Hacks: Exploring Novel Digital Fabrication Workflows on #PlotterTwitter. 2021
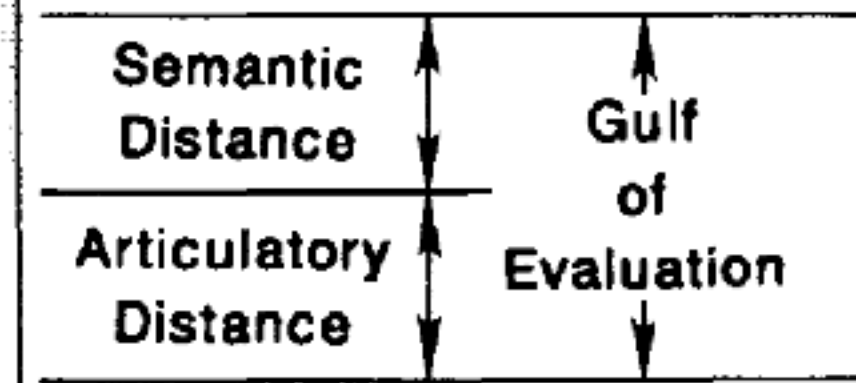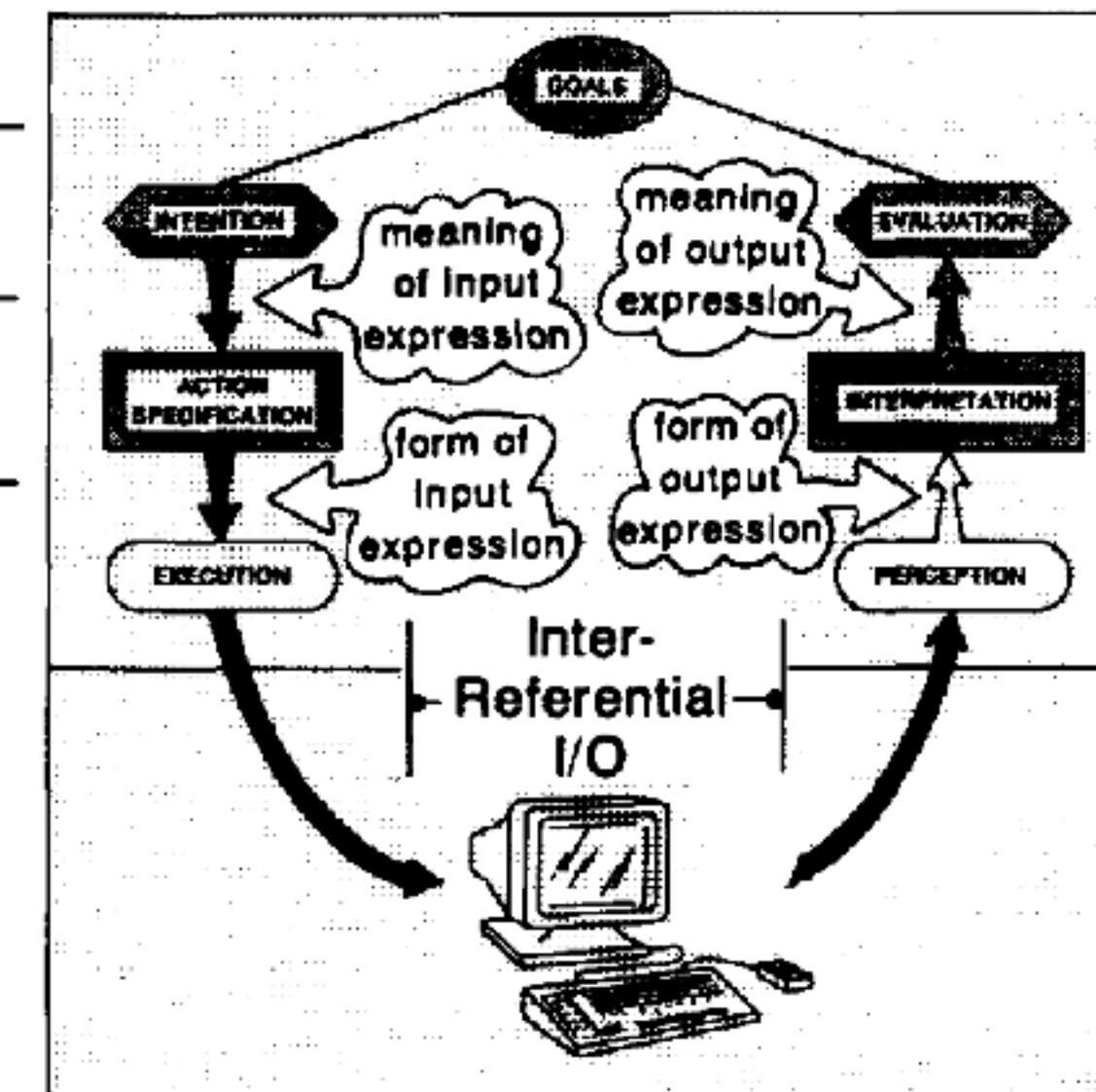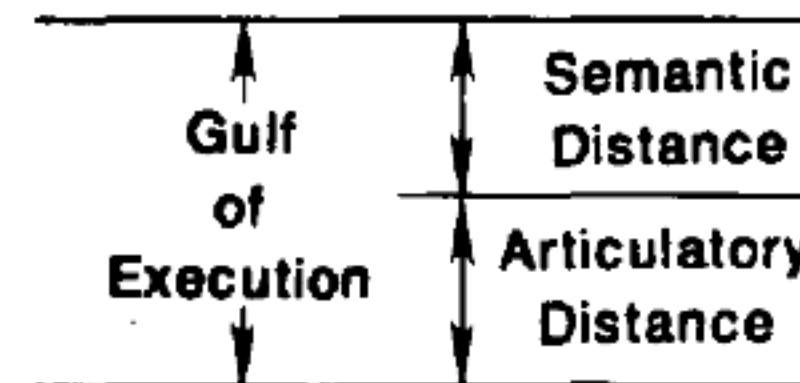
Machine knowledge

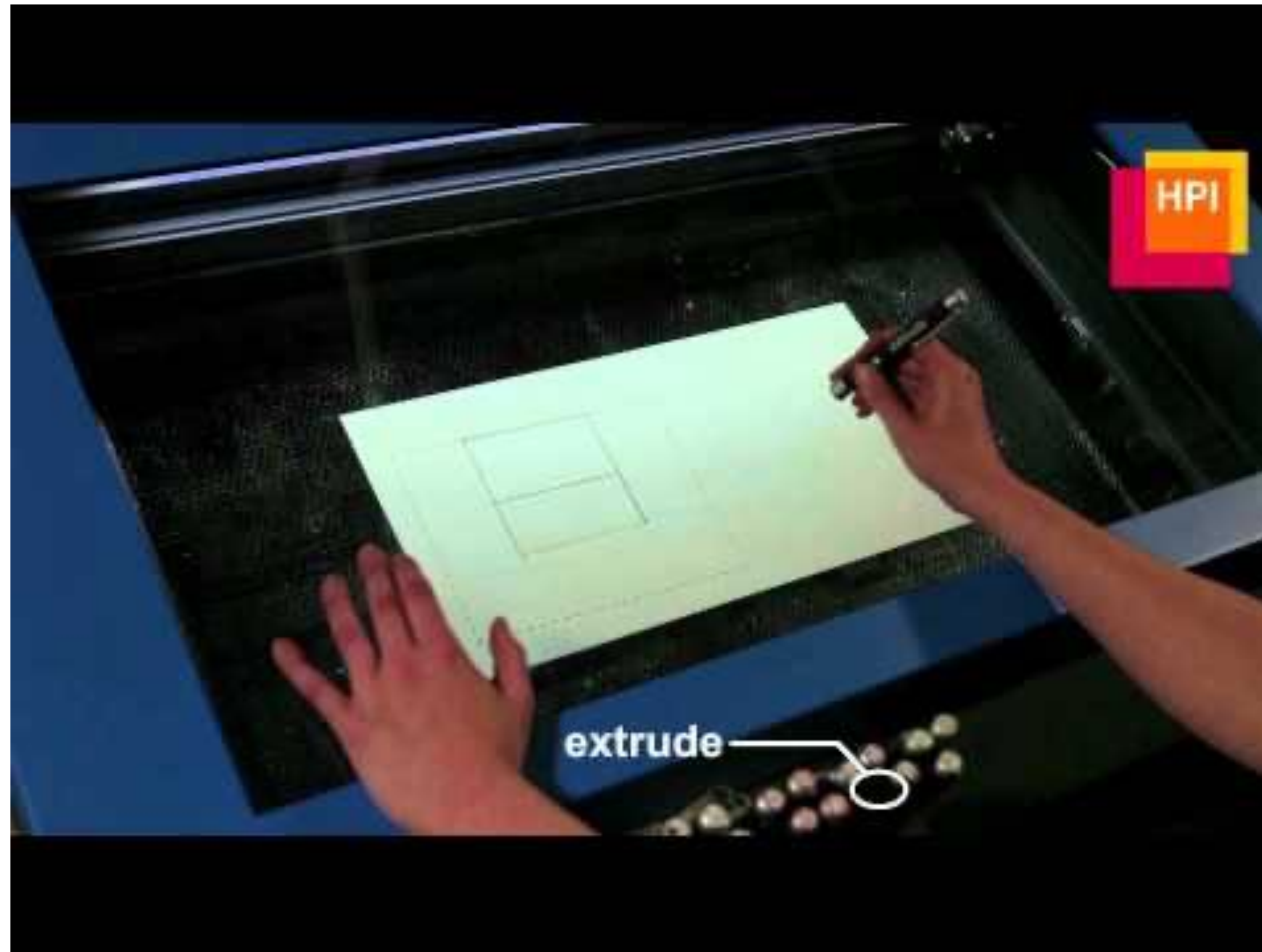Our system design prioritizes manual machine tuning practice

Subbaraman et al. p5.fab: Direct control of digital fabrication machines from a creative coding environment. 2022.

Aside: Direct manipulation interfaces

- Coined by Hutchins, Hollan, Norman, 1985 (UCSD CogSci department)

- Contrast with command-line text interfaces, DM interfaces have:

  - Continuous visibility

  - Physical actions

  - Rapid, reversible feedback

- The Interactive Fabrication reading referenced this: how can we make interacting with fabrication machines more like "direct manipulation"?

- More about these concepts in a future class!

https://vis.csail.mit.edu/classes/6.859/readings/pdfs/Hutchins-DirectManipulationInterfaces.pdf

Feedback & interactivity

Mueller et al. Constructable: interactive laser cutting. 2012.

Sustainability

Teibrich et al. Patching physical objects. 2015

Expressivity

Torres et al. MetaMorphe: Designing Expressive 3D Models for Digital Fabrication. 2015

(Physical) design tool strategies

- Make new materials workable (light, air)

- Work based off of your existing domain knowledge or expertise (what are problems you're encountering?)

- Work to make the machines (tools) themselves better or more controllable

- Work to make making more sustainable (lots of plastic waste!)

- Work to allow users to more easily be expressive in otherwise rigid computational forms

- In the Creativity Support Tools (CSTs) class, we'll talk about *digital* design tool strategies

Break/Seminar

Class 5 recap

- Todos:
  - **Sunday:** Project work party with mentors, Sun 3-5pm, Hive
  - By next **Monday**:
    - ZC from River
    - PM2: Sensory Cardboard
    - Miriam/Tara guest lecture about laser cutting, PM3 released
  - By next **Wednesday**:
    - Finish HMC safety trainings x 3 (general, laser cutter, 3D printer)