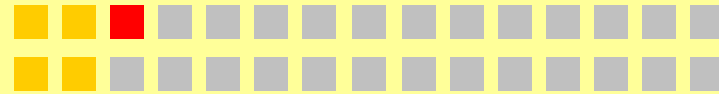


# week 03



# Tangible Bits

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Implications for user interfaces

# Lecture Outline

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- Designing Interactions
- Tangible User Interfaces
- Group forming exercise

# Designing Interactions

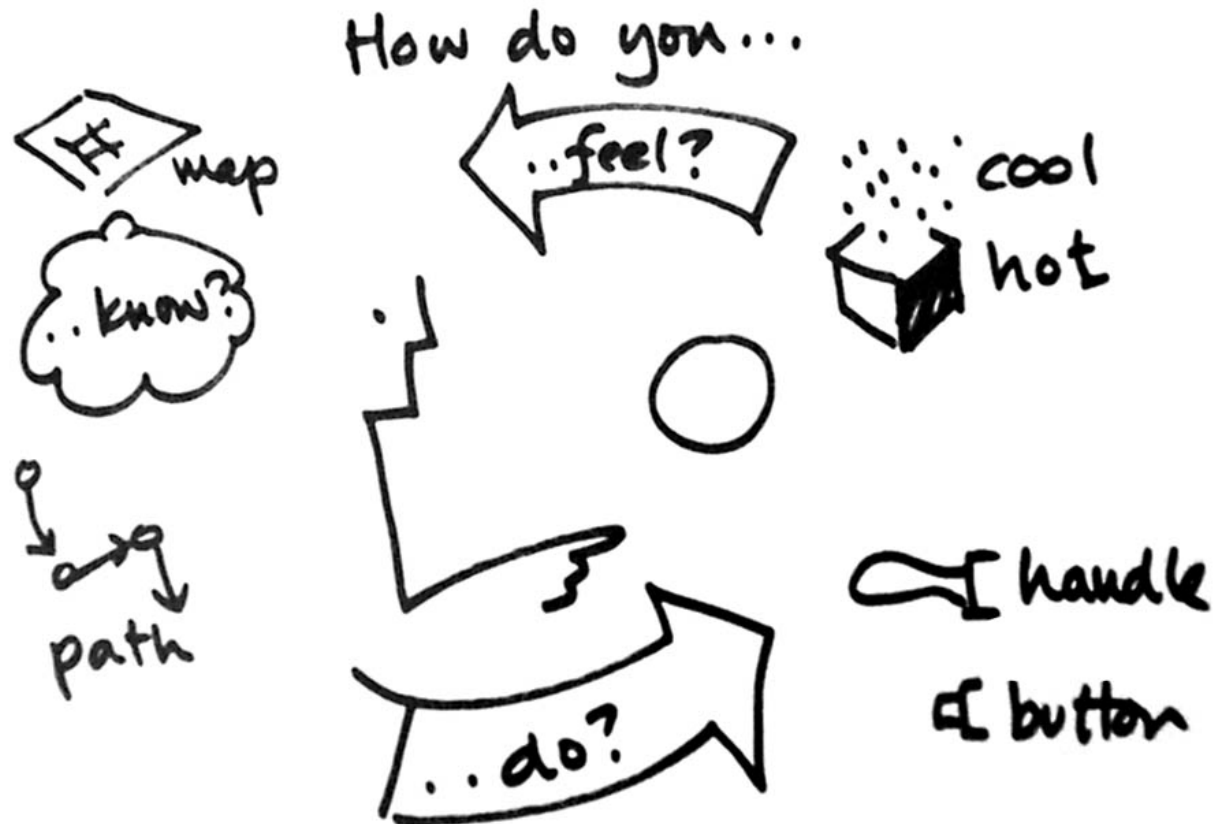
From designers' perspective

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The term “interaction design” was coined by Moggridge in late 1980’s. Until then, design was mostly design of physical things, but now it includes computer interface design.

Bill Moggridge, co-founder of IDEO

# Interaction Loop



# Design as Communication

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Design is a conversation between designer and user, even though the designer is no longer present once the user enters the scene.

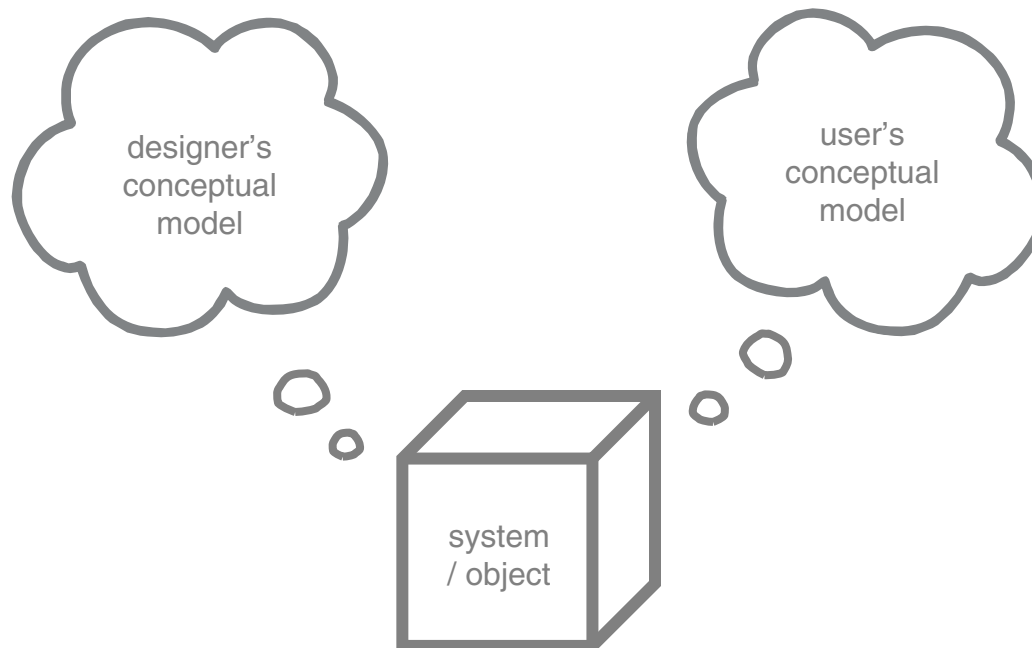
Norman (2004)

# Design as Communication

---

Design is a conversation between designer and user, even though the designer is no longer present once the user enters the scene.

Norman (2004)



# Design as a Form of Mediated Communication

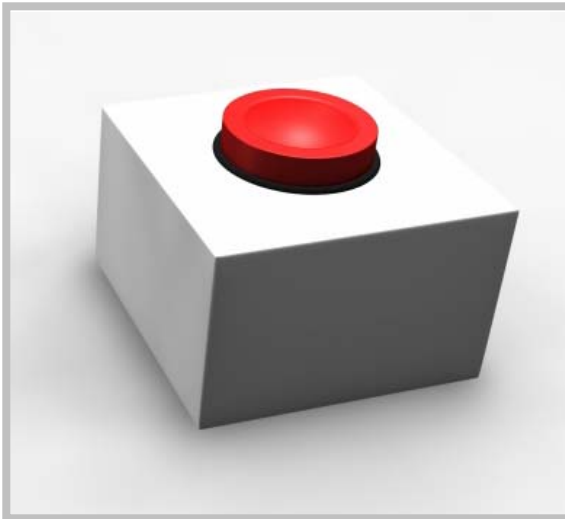
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Human-computer interaction can be thought of as a form of mediated communication between the end user and the system designer, who must structure the system so that it can be understood by the user, and so that the user can be led through a sequence of actions to achieve some end result. (Dourish, 2004)

# Designed affordances

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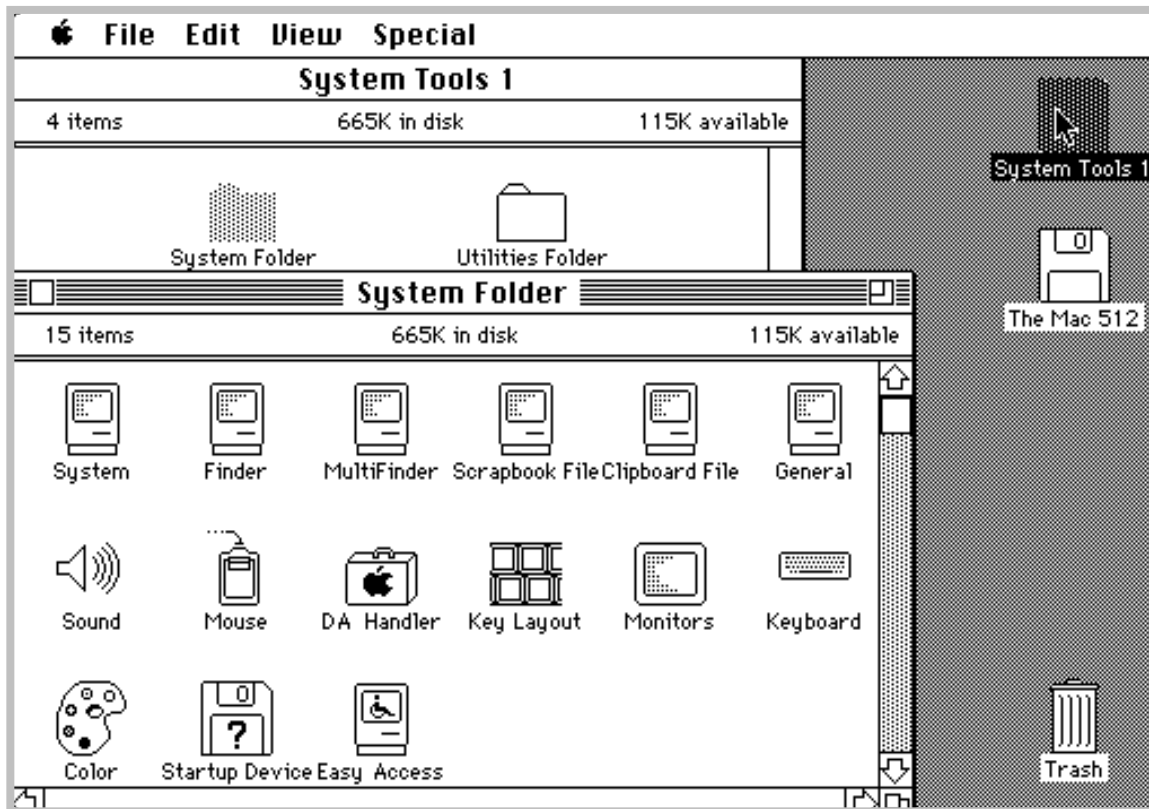
Messages from designer to user, attracting attention to the set of desired possible actions. (Norman, 2004)





## Historical Development of HCI

# Graphical



Macintosh System 4.2, 1987

- **Peripheral Attention**  
Primary space, secondary space (e.g., windows and dashboards)
- **Pattern recognition and spatial reasoning**  
Opportunities to arrange data spatially
- **Information density**  
A picture really can be worth a thousand words (e.g., diagrams)
- **Visual metaphors**  
File cabinets, trashcans, desktop tools

# User Interfaces: The Current State of Affairs

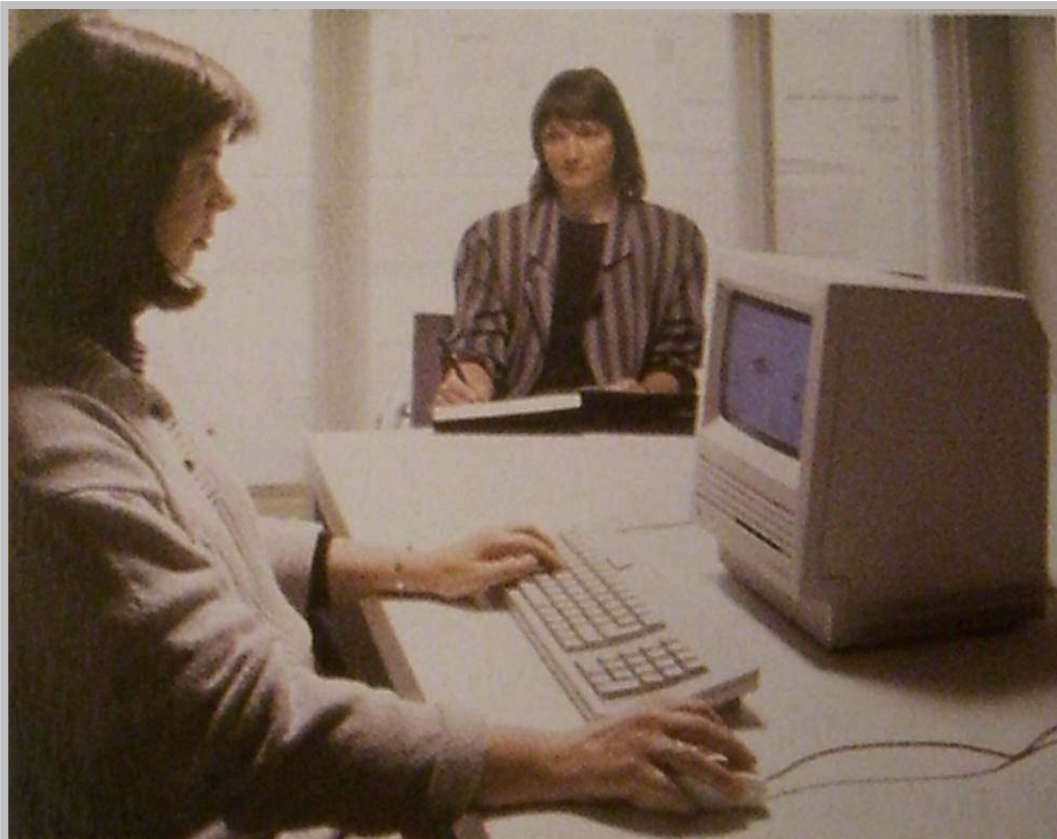
Hands, eyes, tools, and interactions

---

“The computer is inherently a tool for the mind—not the hands.”  
From *Abstracting Crafts* (McCullough, 1996)

# Eyes are in charge and hands are underemployed

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McCullough (1996)  
photo from Moggridge (2006)

# Eyes are in charge

---

Eyes guide tools, read notations, appraise designs. Eyes see wholes, and compare many objects simultaneously. McCullough (1996)



# Hands bring us knowledge of the world

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They are the most subtle, sensitive, probing, differentiated, and the most closely connected to the mind. They deserve to be admired.  
McCullough (1996)



# Hands are underrated

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By pointing, by pushing and pulling, by picking up tools, hands act as conduits through which we extend our will to the world.

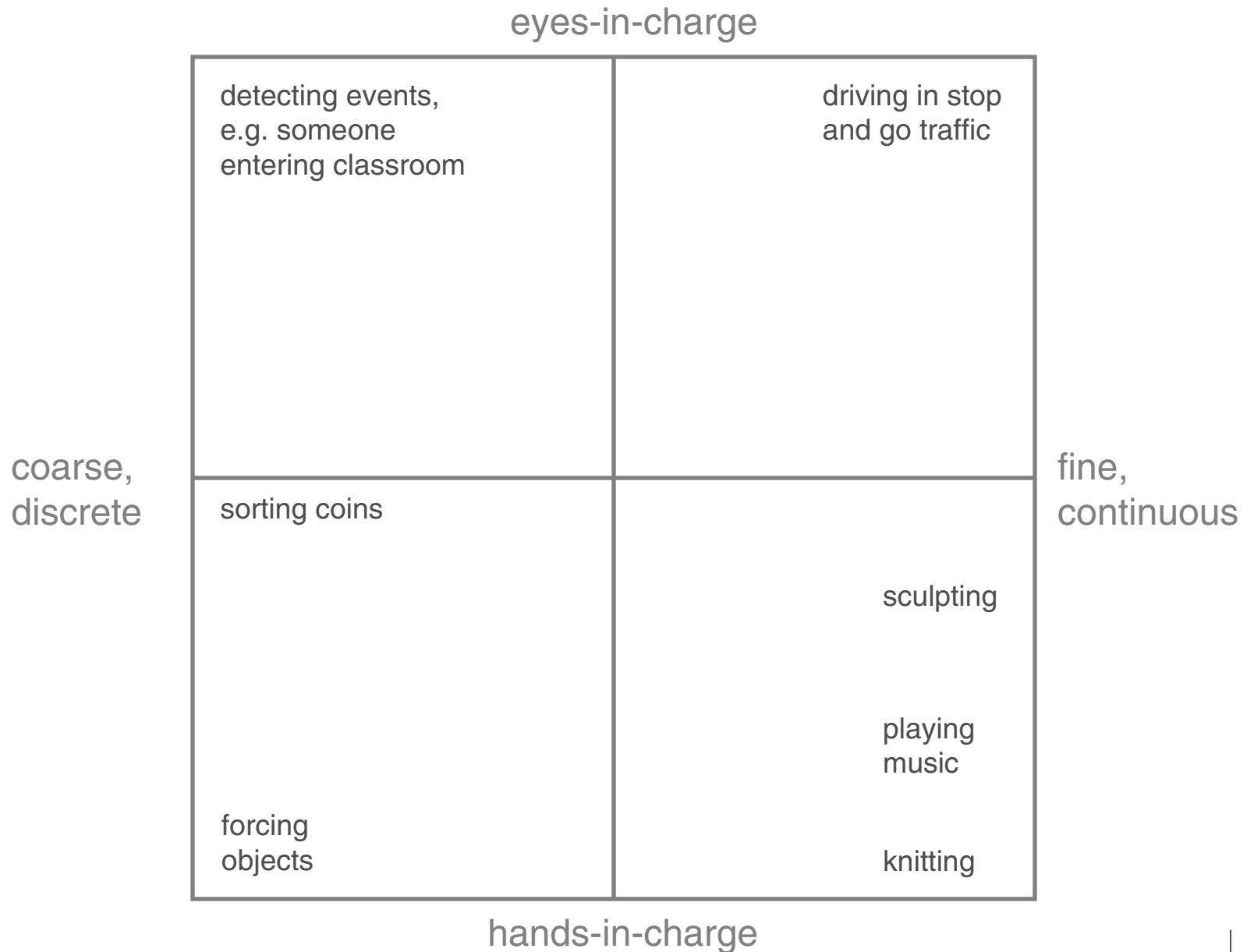
McCullough (1996)

# Eyes activate the hands and hands direct the eyes

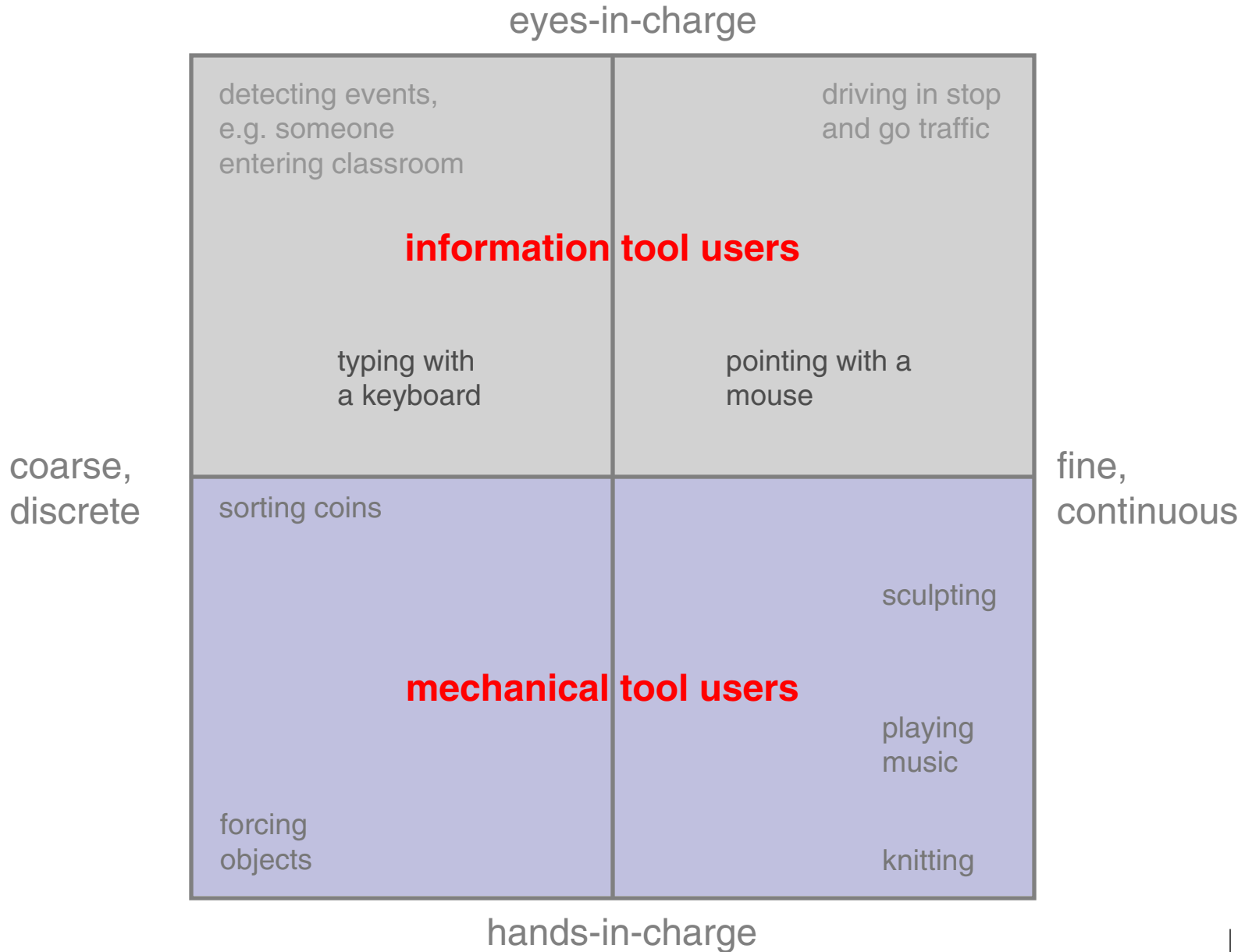
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Hand-eye coordination distinguishes humanity as the maker of things: *homo faber*. McCullough (1996)







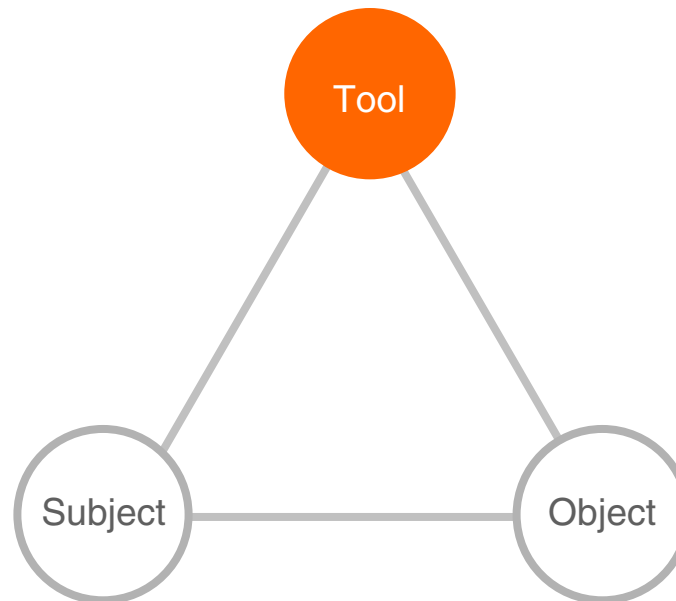


## Activity Theory

# Tools and Mediation

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Tools shape the way human beings interact with reality. The shaping of external activities eventually results in the shaping of internal ones, and vice versa.

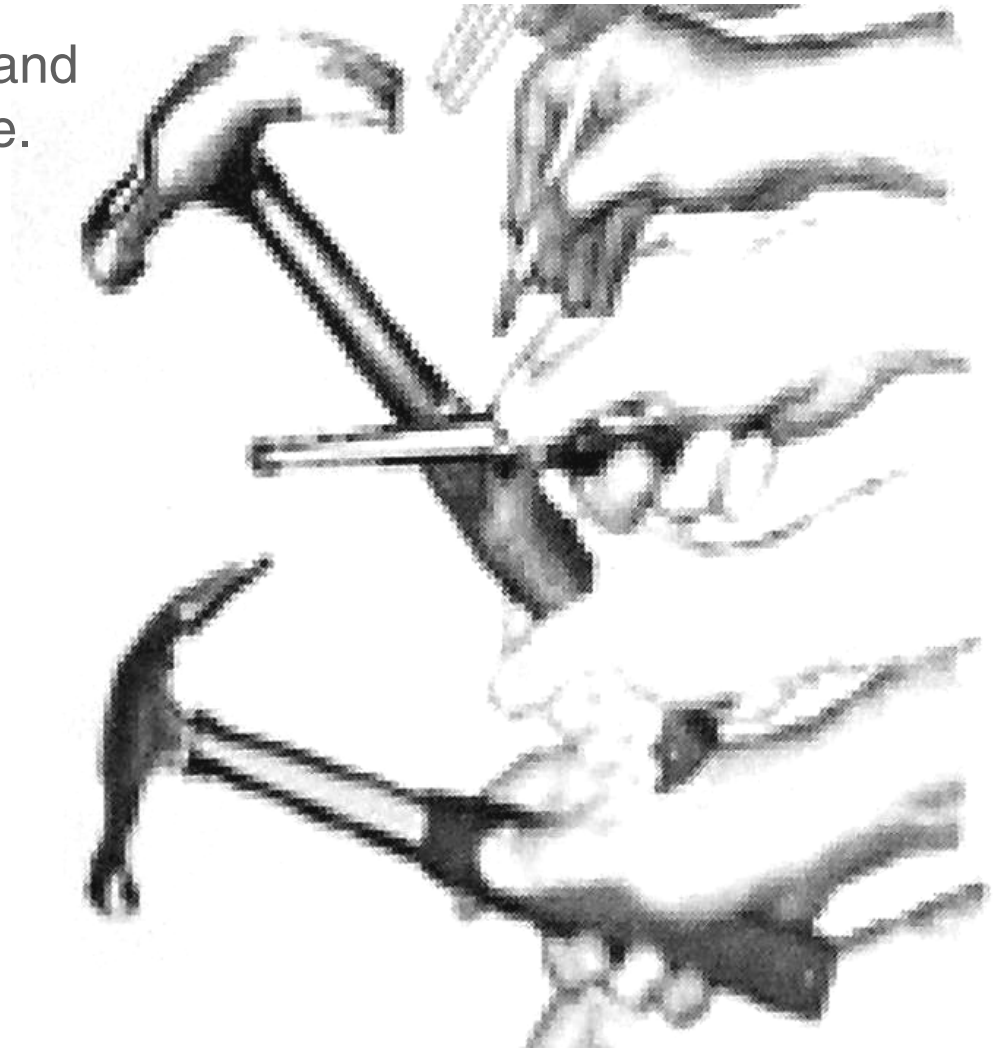


## Activity Theory

# Tools and Mediation

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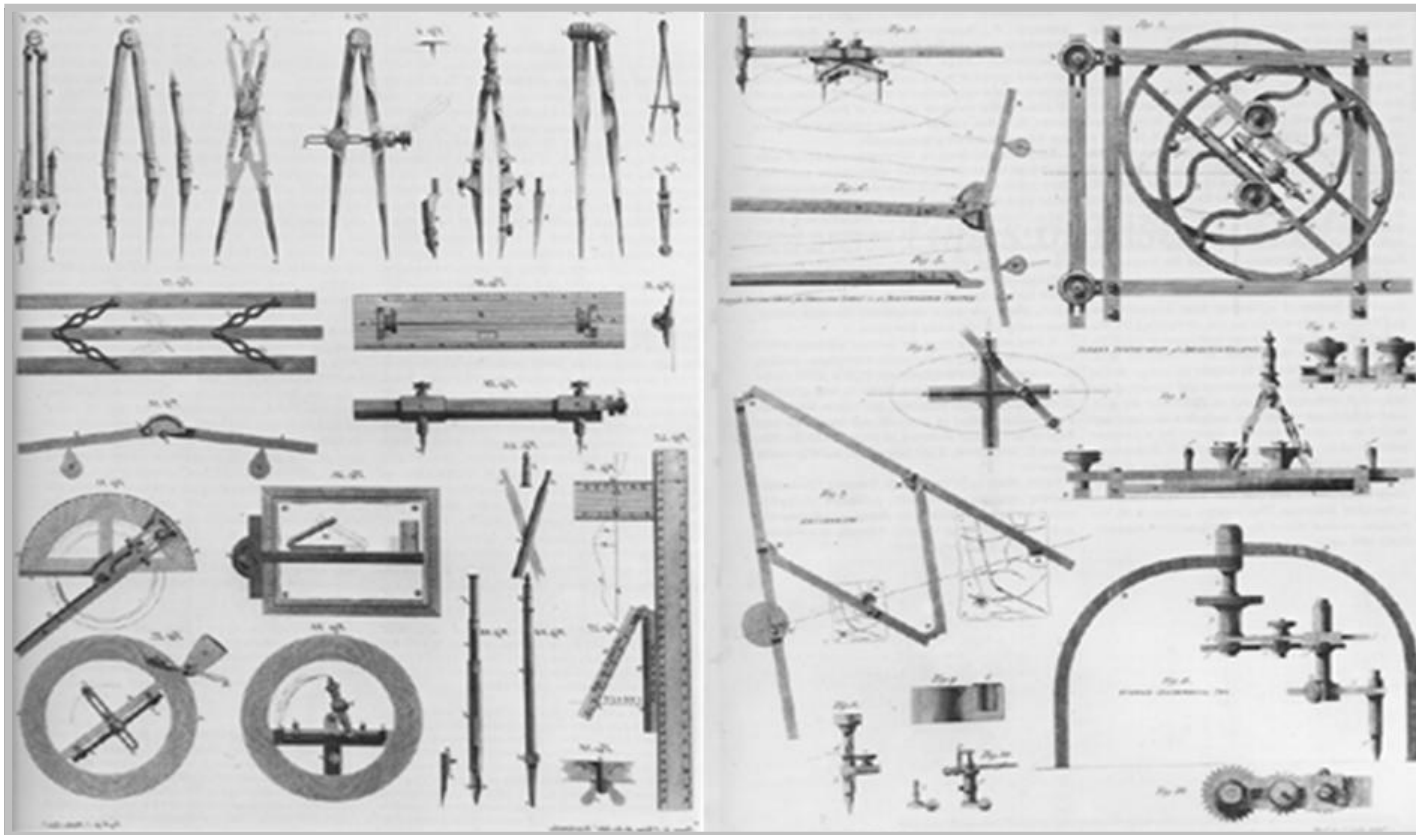
Use of tools is an accumulation and transmission of social knowledge.



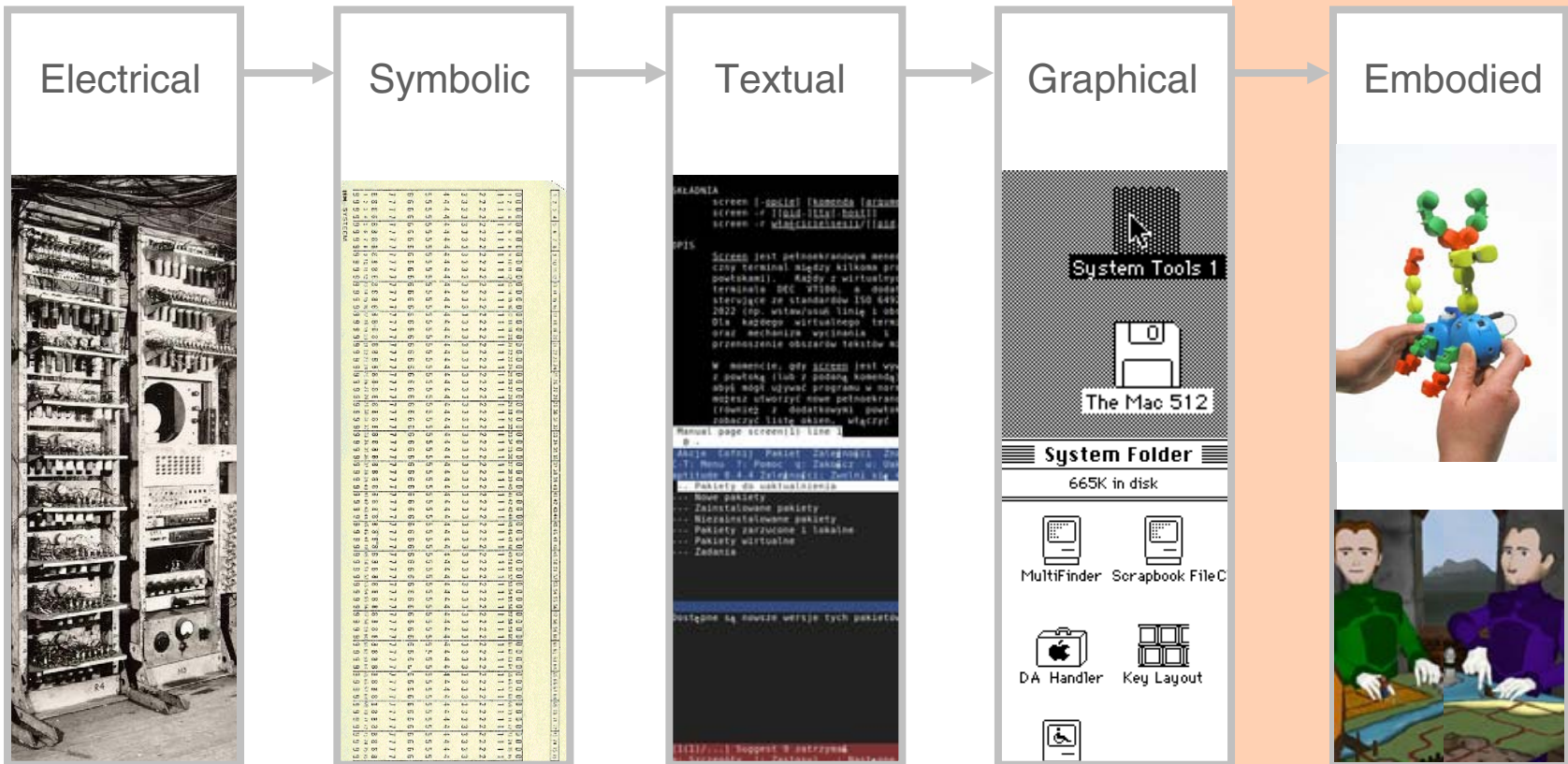
# Tools

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Aesthetics of the tools lost in the flood of PCs?



# Embodied Interaction



# Combining the skillful hand with the reasoning mind

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Computers let us turn the table — to apply something we know about using tools to achieve richer symbolic processing.

# Tangible Bits

Seamless couplings between physicality and virtuality

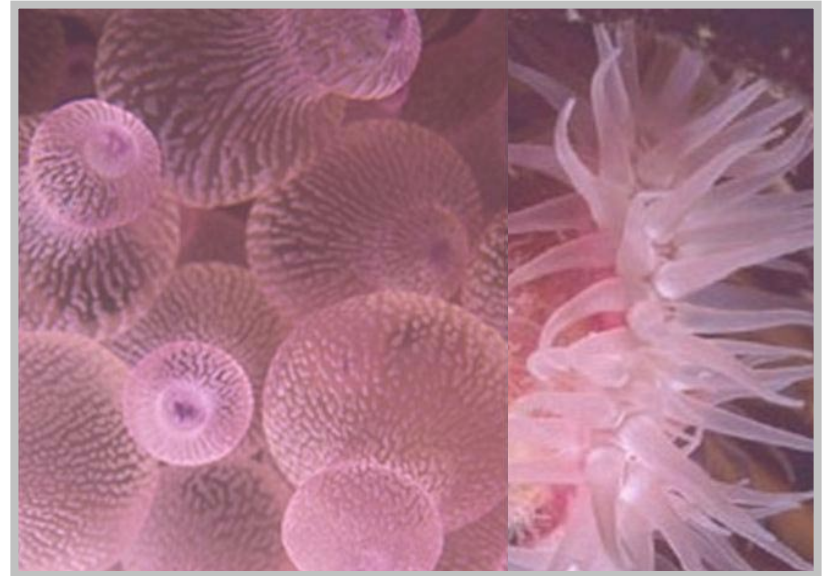
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“We live between two worlds: our physical environment and digital space.” (Ishii, 2007)



# At the border between elements

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# At the border

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We live on the border where bits meet atoms. In the flood of pixels from the ubiquitous GUI screens, we are losing our sense of body and places. [Ishii, 1997]



## Tangible User Interfaces

# Coincidence of input and output spaces

# Curlybot

[Frei, Su, & Ishii, 2000]



# Topobo

[Raffle, Parkes, & Ishii, 2004]



# Coincidence of input and output spaces



## Tangible User Interfaces

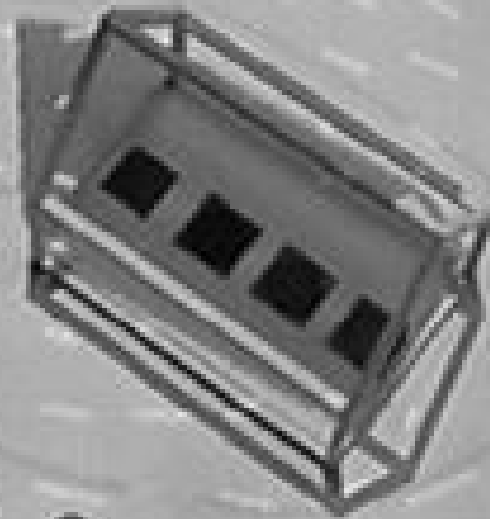
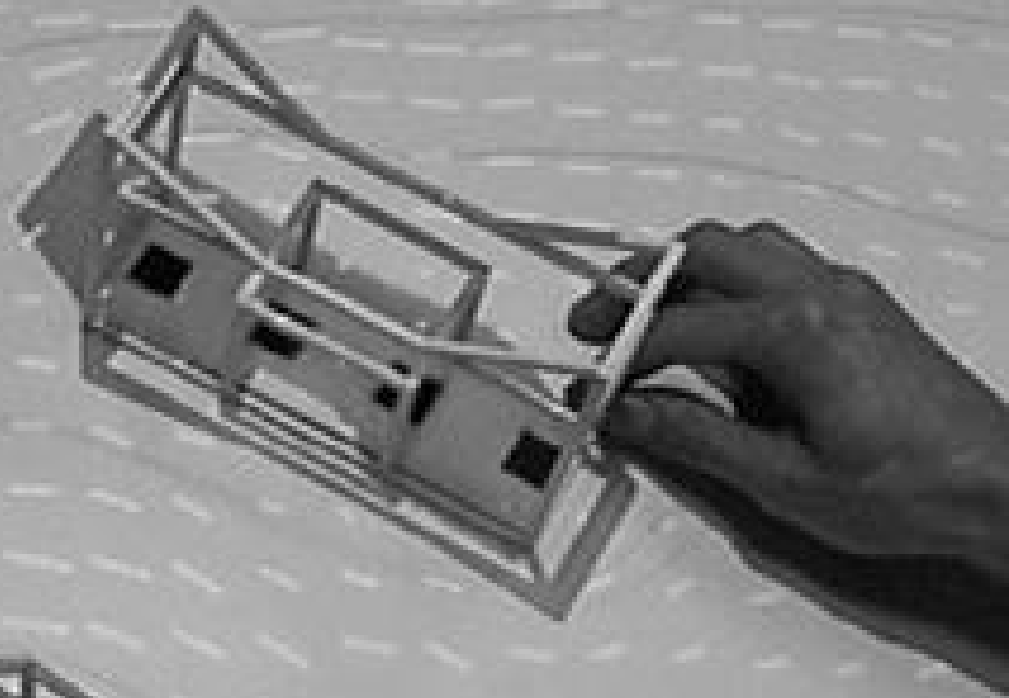
# Tabletop TUIs

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Coupling tangible representations to digital information and computation

# Urp

[Underkoffler & Ishii, 1997]





# Illuminating Clay

[Piper, Ratti, & Ishii, 1999]



# AudioPad

[Patten, Recht, & Ishii, 2004]



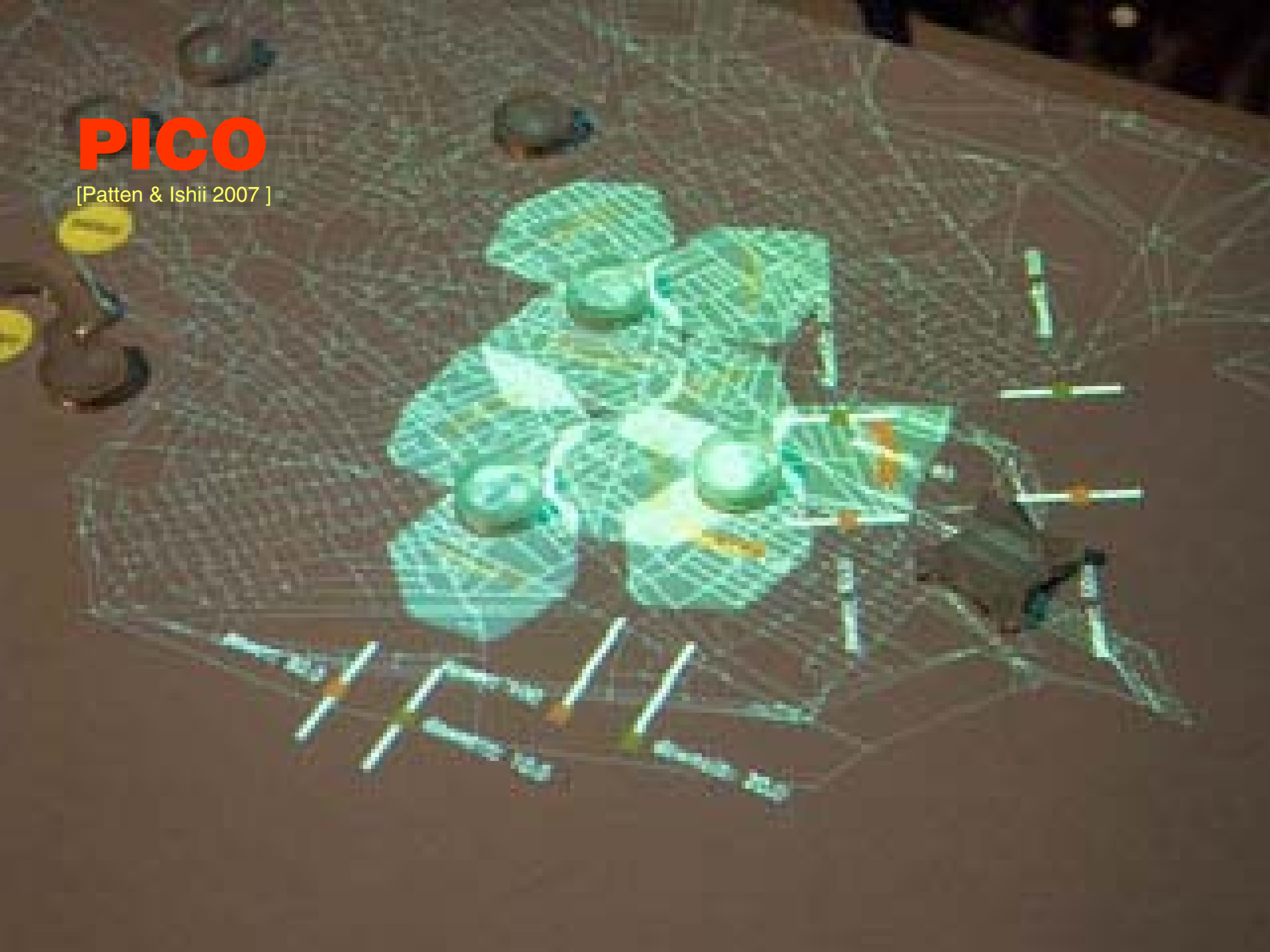
# Actuated Workbench

[Pangaro, Maynes-Aminzade, & Ishii 2002 ]



# PICO

[Patten & Ishii 2007]



## Tangible User Interfaces

# Augmented everyday objects

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Embodiment of mechanisms for interactive control with tangible representations

# Music bottles

[Ishii et al., 2000]



# I/O Brush

[Ryokai, Marti, & Ishii, 2004]

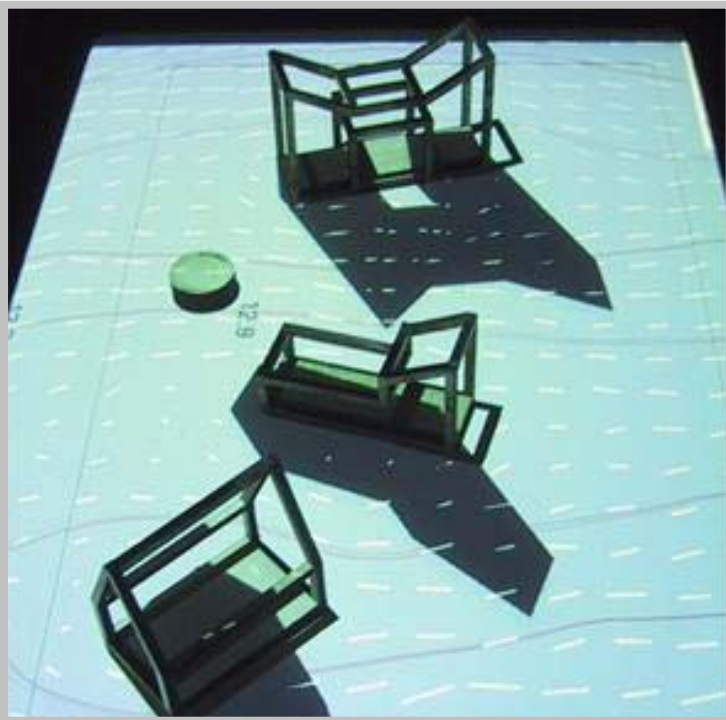




# TUI vs. GUI

## TUI

Tangible bits  
Coincidence of input and output space

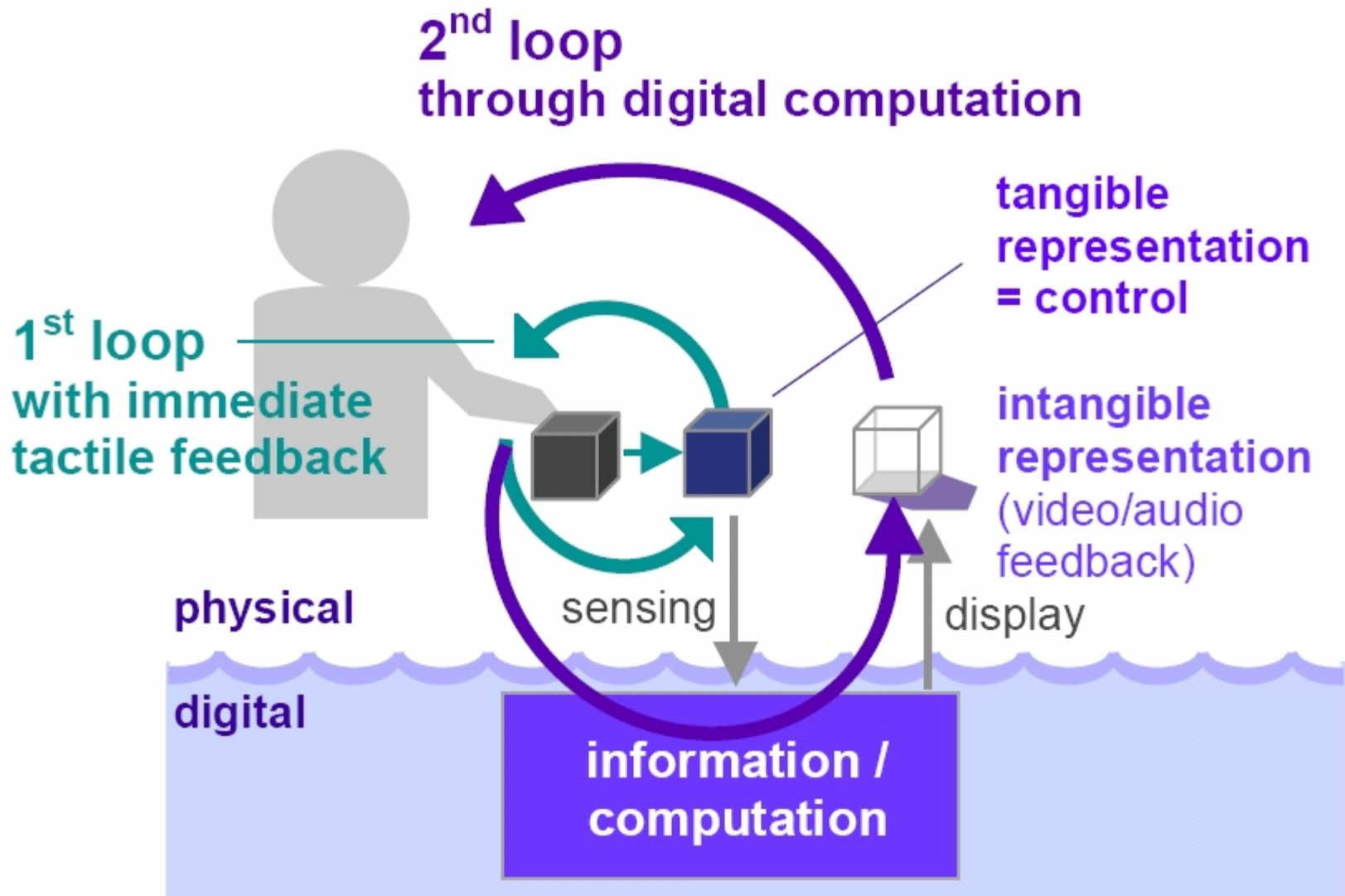


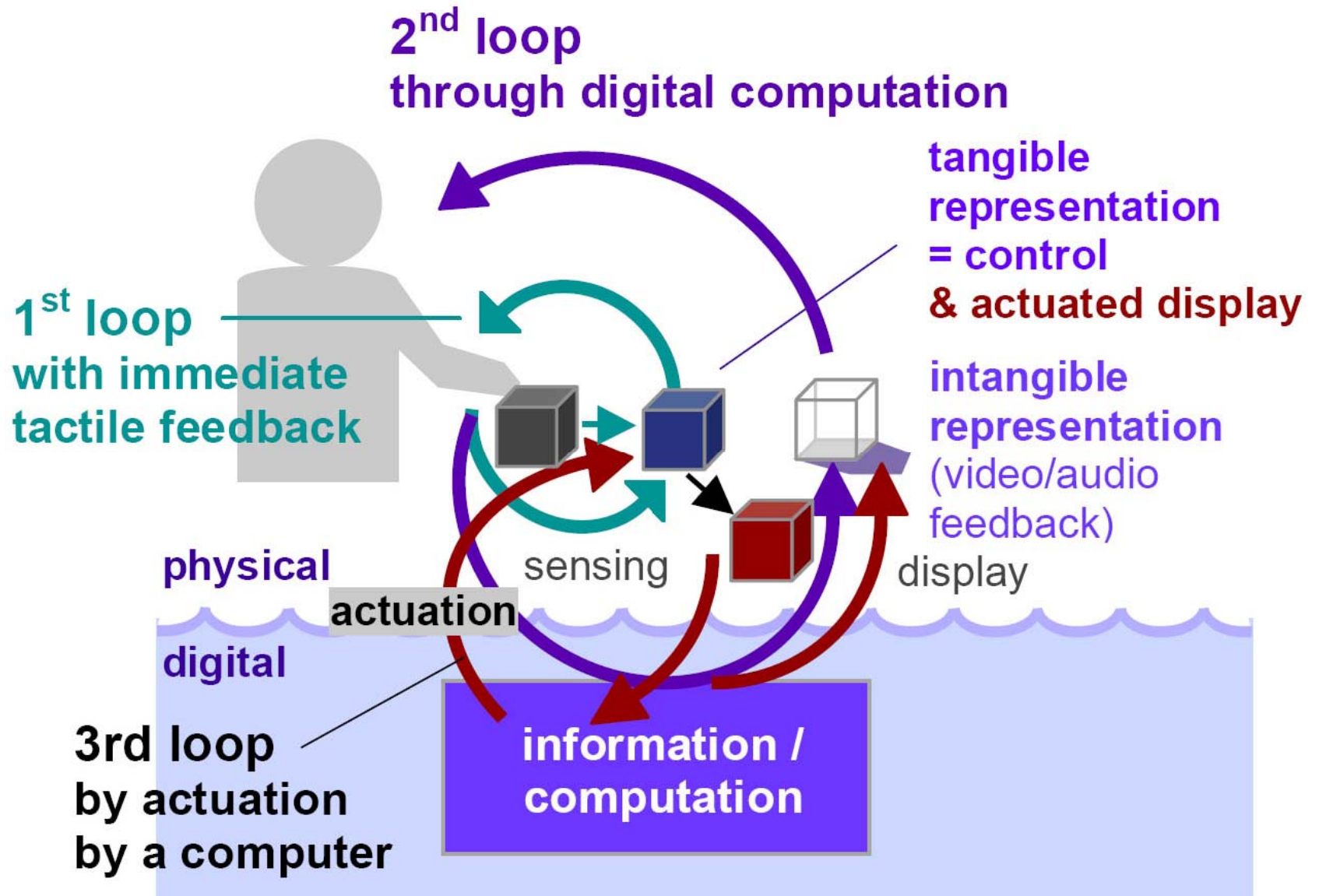
## GUI

Painted bits  
Generic remote control





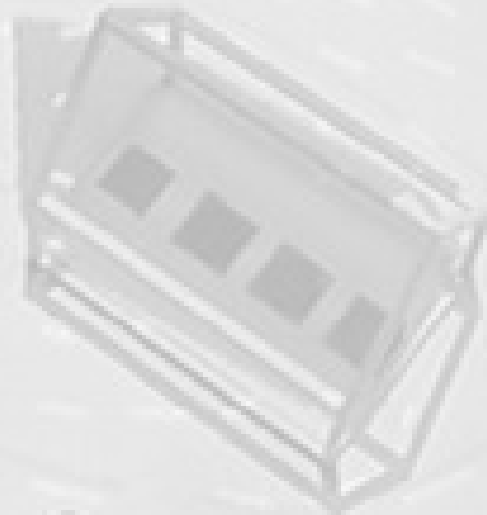




# TUI Interaction Loop

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Combining the skillful hand with the reasoning mind



# Tuesday Next Week (Sept 18)

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- Tokens, tools, and containers
- Taxonomy of Tangible User Interfaces

# For this Thursday (Sept 13<sup>th</sup>, 2007)

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- Read Physical Computing:
  - Analog input: p.102-104
  - Soldering: p.41-42
- Don't forget to bring your laptop and lab kit on Thursday
- Post your lab homework (diffuser and code) on the course website
- Office hours this week: Tuesday (today), 3:30-4:30 in 110 South Hall

# Midterm Project

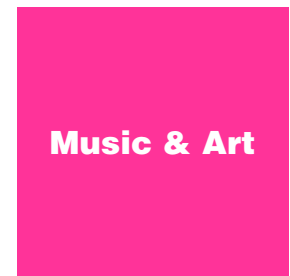
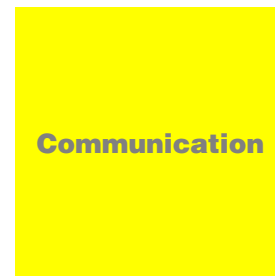
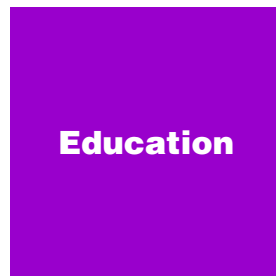
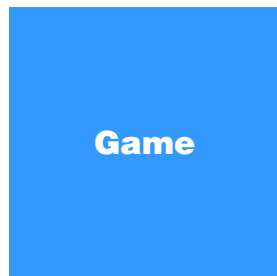
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Design a Tangible User Interface that takes advantage of your hands to manipulate digital information. Apply it to a topic of your research interest (e.g., tool for communication, learning/education, design, etc.). Your project may be based on a completely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

- 9/25 Form a group (maximum of 3 members) for your project and write a 1-page proposal and post it on the course website
- 10/9 Progress sketches due (post your sketches on the course website)
- 10/23 In-class midterm project presentation. Present your poster and optional mockups

# Group forming exercise

1. Select topics you are interested in developing Tangible User Interface for (5 minutes)



2. Meet at least 15 people (15 minutes)

3. Form a group (10 minutes)

# Thanks!