CSC4130
Introduction to Human-Computer Interaction

Lecture 1
Introduction

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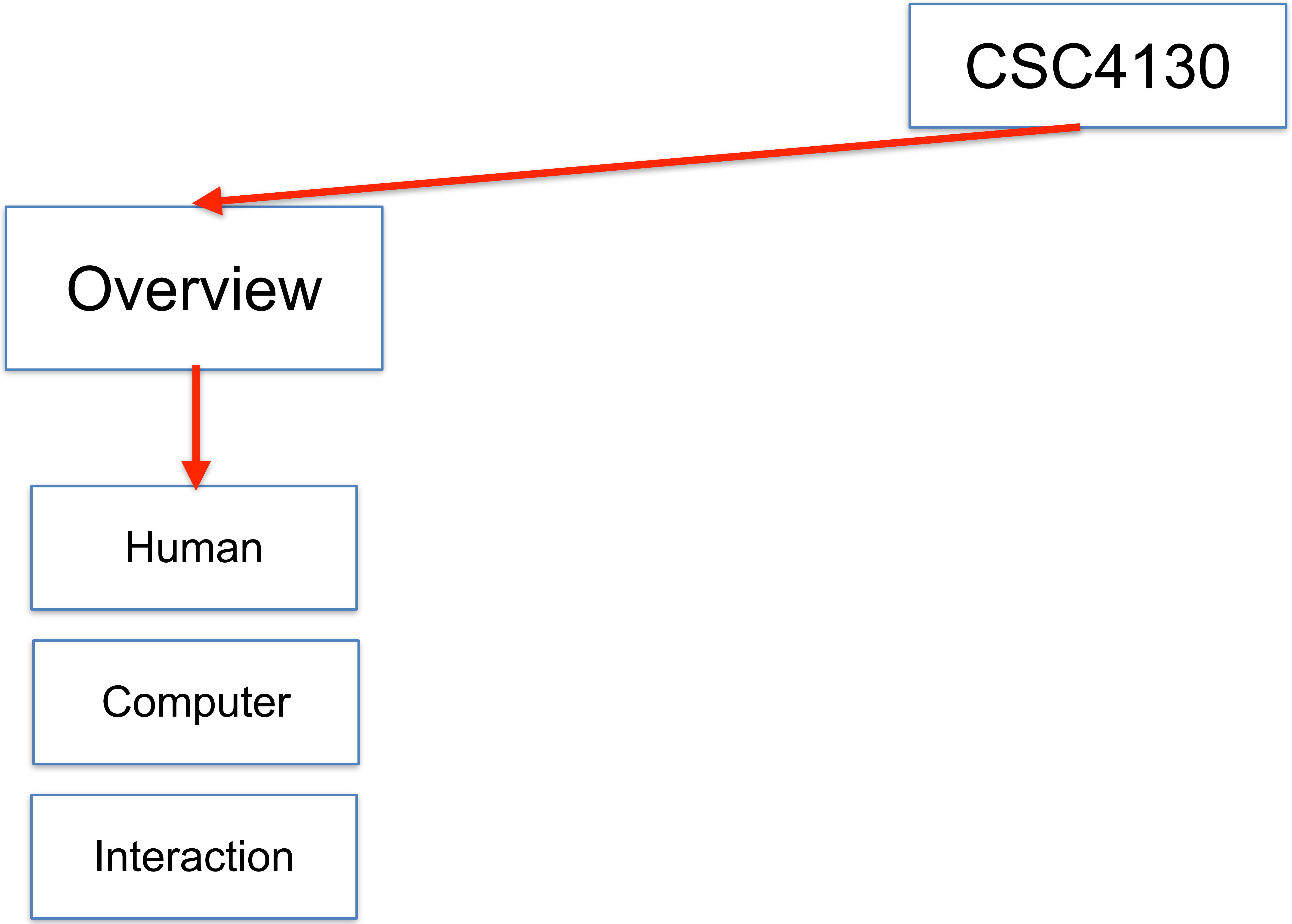
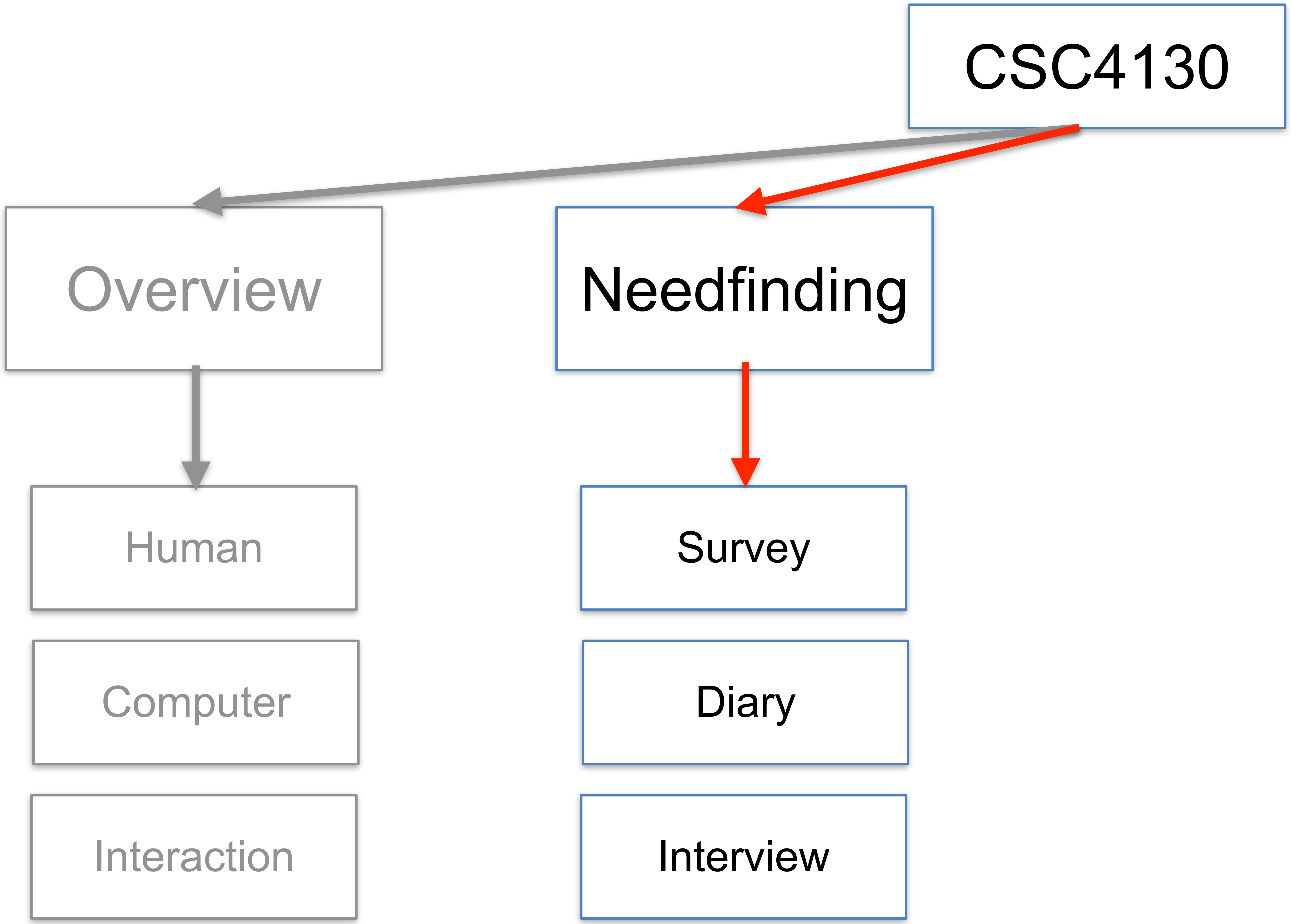
WeChat group QR code

Course roadmap



Course roadmap



Course roadmap

香港中文大學(深圳)
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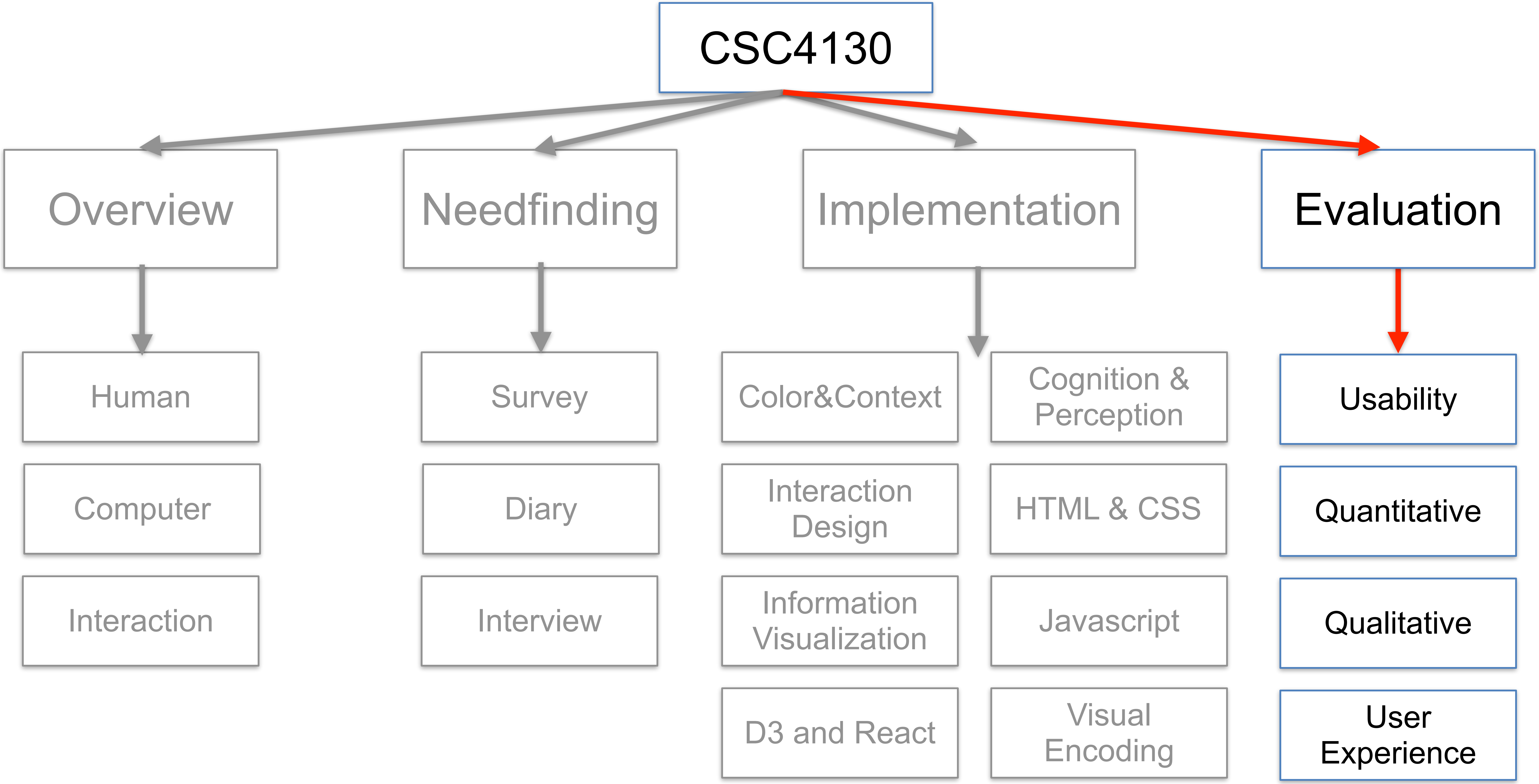
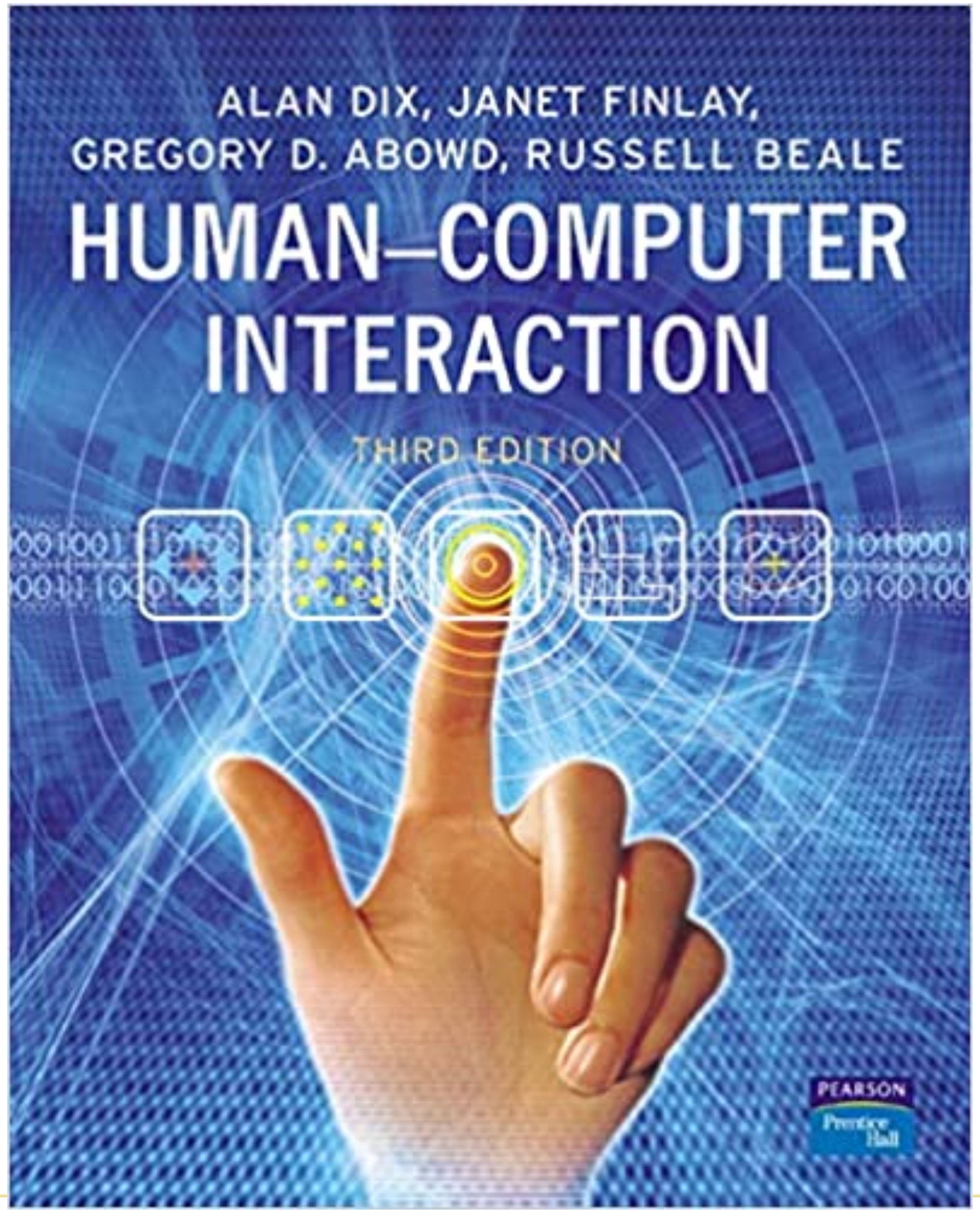
- CSC4130
  - Overview
    - Human
    - Computer
    - Interaction
  - Needfinding
    - Survey
    - Diary
    - Interview
  - Implementation
    - Color&Context
    - Cognition & Perception
    - Interaction Design
    - HTML & CSS
    - Information Visualization
    - Javascript
    - D3 and React
    - Visual Encoding

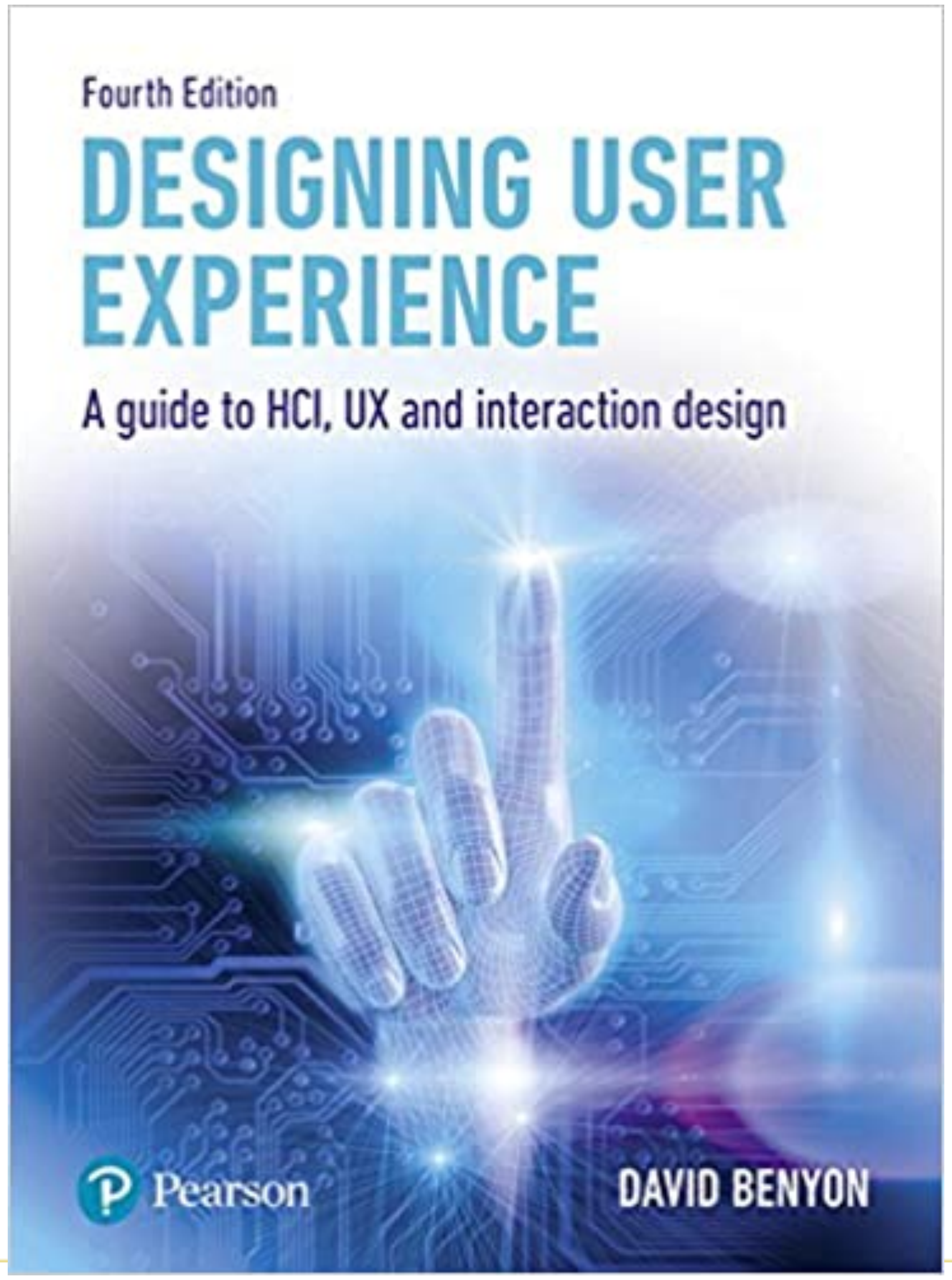
Course roadmap



Course resources

- Recommend books
  - Human-Computer Interaction, 3rd edition, Alan Dix
  - Designing User Experience, 4th edition, David Benyon





Evaluation

- 4 assignments (40%)
  - HTML and CSS
  - Javascript
  - D3
  - React
- 1 project (20%)
  - Interactive data clustering system
- Midterm exam (15%)
- Final exam (25%)

Course goals

- Facts
  – Systems and humans
- Analysis
  – Deep understanding of issues
- Design
  – From understanding to solutions
- Attitude
  – Thinking about real use and real users

Outline

- What is HCI
- History of HCI
- Relationship with other fields
- Why is interaction design hard

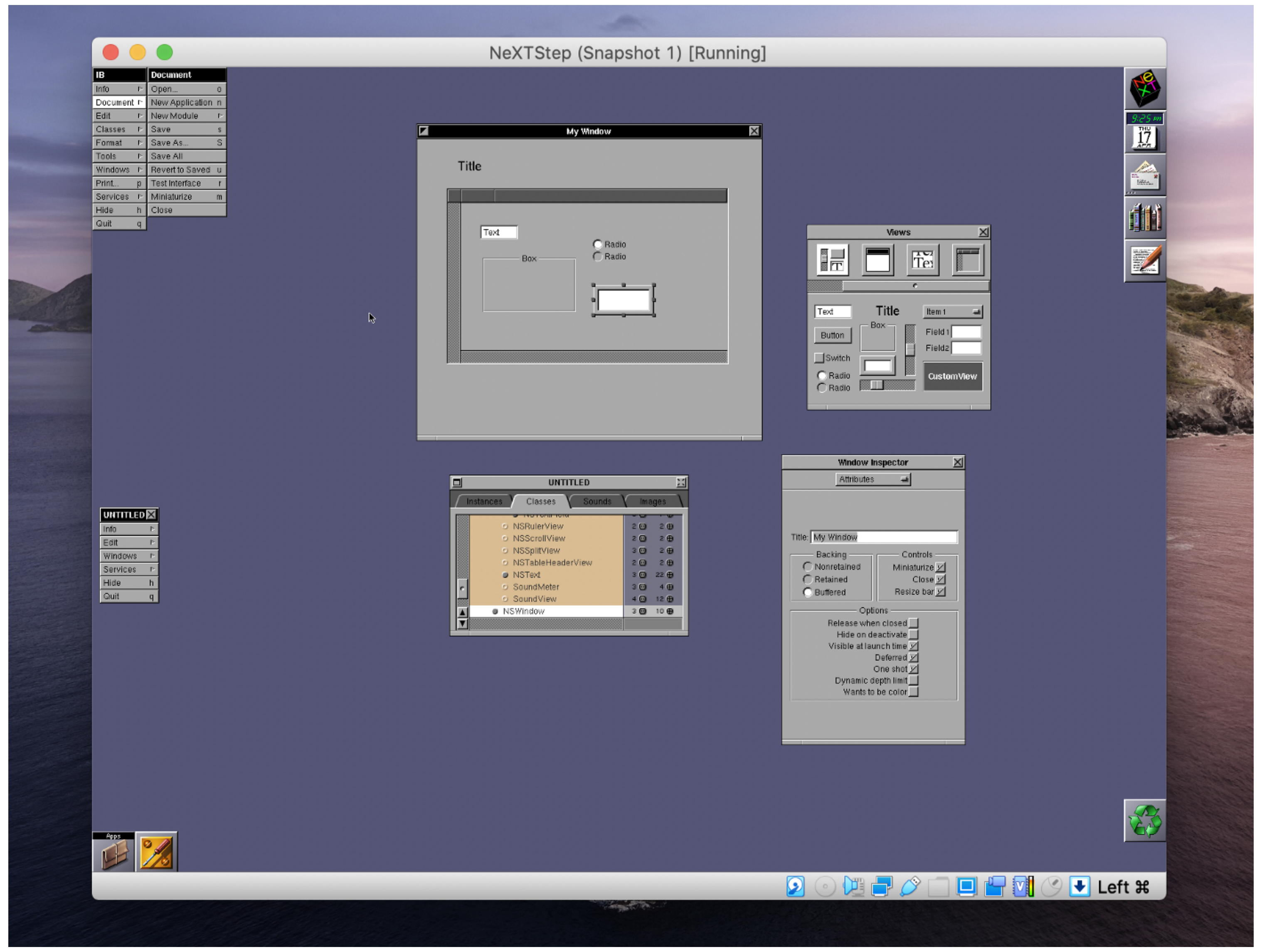
Outline

- What is HCI
- History of HCI
- Relationship with other fields
- Why is interaction design hard

What is HCI

- Academic aspect
  - Studying people interacting with computer
- Design aspect
  - Designing interventions from systems involving people and computer

HCI: academic



interface design

word processing,
database,
interface design

1980s

time

word processor

HCI: academic

graphical interface

word processing,
database,
interface design

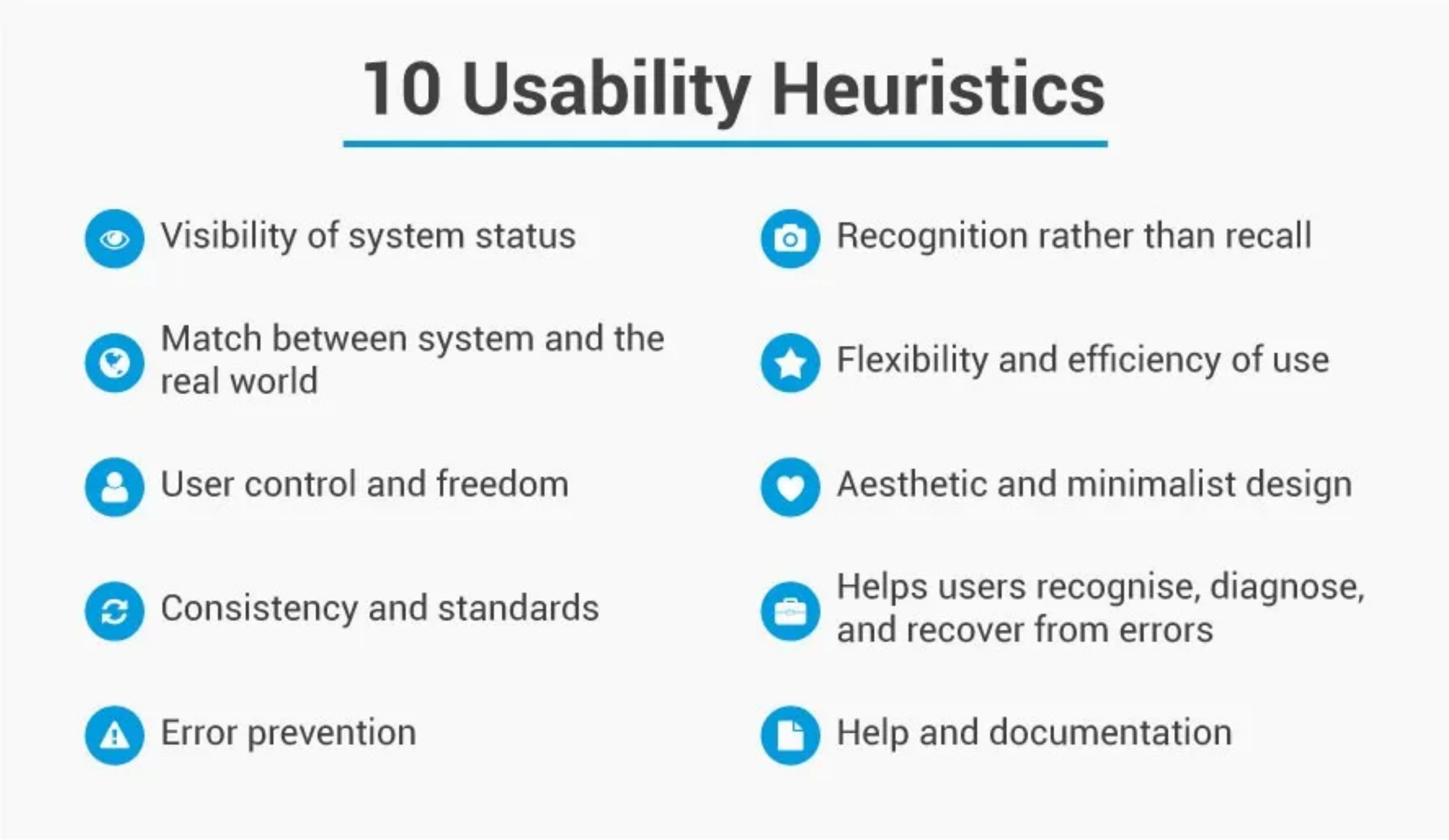
graphical interface,
usability,
communication

1980s

1990s

time

usability



HCI: academic

touch screen

word processing,
database,
interface design

graphical interface,
usability,
communication

user-generated content,
touch screen

1980s 1990s 2004 time

user-generated content

HCI: academic

1980s	1990s	2004	2010s
word processing, database, interface design	graphical interface, usability, communication	user-generated content, touch screen	collaboration, connections, emotion, communication

time

wearable computing

HCI: academic

- Empirical: data (qualitative or quantitative) collected through any of the methods: experimental design, surveys, focus groups, time diaries, sensors and other automated means, ethnography, and other methods

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"It Feels Like Taking a Gamble": Exploring Perceptions, Practices, and Challenges of Using Makeup and Cosmetics for People with Visual Impairments

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ABSTRACT

Makeup and cosmetics offer the potential for self-expression and the reshaping of social roles for visually impaired people. However, there exist barriers to conducting a beauty regime because of the reliance on visual information and color variances in makeup. We present a content analysis of 145 YouTube videos to demonstrate visually impaired individuals' unique practices before, during, and after doing makeup. Based on the makeup practices, we then conducted semi-structured interviews with 12 visually impaired people to discuss their perceptions of and challenges with the makeup process in more depth. Overall, through our findings and discussion, we present novel perceptions of makeup from visually impaired individuals (e.g., broader representations of blindness and beauty). The existing challenges provide opportunities for future research to address learning barriers, insufficient feedback, and physical and environmental barriers, making the experience of doing makeup more accessible to people with visual impairments.

CCS CONCEPTS

• **Human-centered computing → Empirical studies in accessibility.**

KEYWORDS

Makeup, Cosmetics, People with Visual Impairments, Accessibility, Assistive technology, Qualitative study

*Equal contribution

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1 INTRODUCTION

For the estimated 44% of the US population that regularly uses cosmetic products [53], a makeup practice constitutes one of the most important avenues toward self-expression and self-care. Despite this fact, there is a near-absent representation of makeup use by people with visual impairments, a worldwide population of at least 2.2 billion [96]. Makeup practices are equally prevalent and meaningful for people with visual impairments, and embedded in a rich constellation of culture and identity signifiers [66]. *"When I first lost my eyesight, I was quite sad that I couldn't look in the mirror. Applying makeup is a way that I can control my appearance again,"* said Lucy Edward, CoverGirl's first blind beauty ambassador [66]. Although visually impaired people utilize various tips and tricks in makeup application [39], there are profound barriers to participating fully in such efforts of self-expression; purchasing, using, and vetting makeup remains inaccessible [79]. For instance, makeup products have a high reliance on visual information, as many manufacturers do not tactilely differentiate between colors and formulas in their product lines [81]. Nonetheless, people with visual impairments are attentive to their appearance in the same proportion as sighted peers, especially in spaces that are guided by social norms around makeup [79]. With Edward's testimony in mind, we believe there remain many opportunities for research that furthers the self-expression and personal well-being of people with visual impairments (e.g., [60, 88]).

HCI: academic

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- Artifact contributions: the design and development of new artifacts, including interfaces, toolkits, and architectures, mock-ups, and “envisionments.” These artifacts, are often accompanied by empirical data about feedback or usage. This type of contribution is often known as HCI systems research, HCI interaction techniques, or HCI design prototypes

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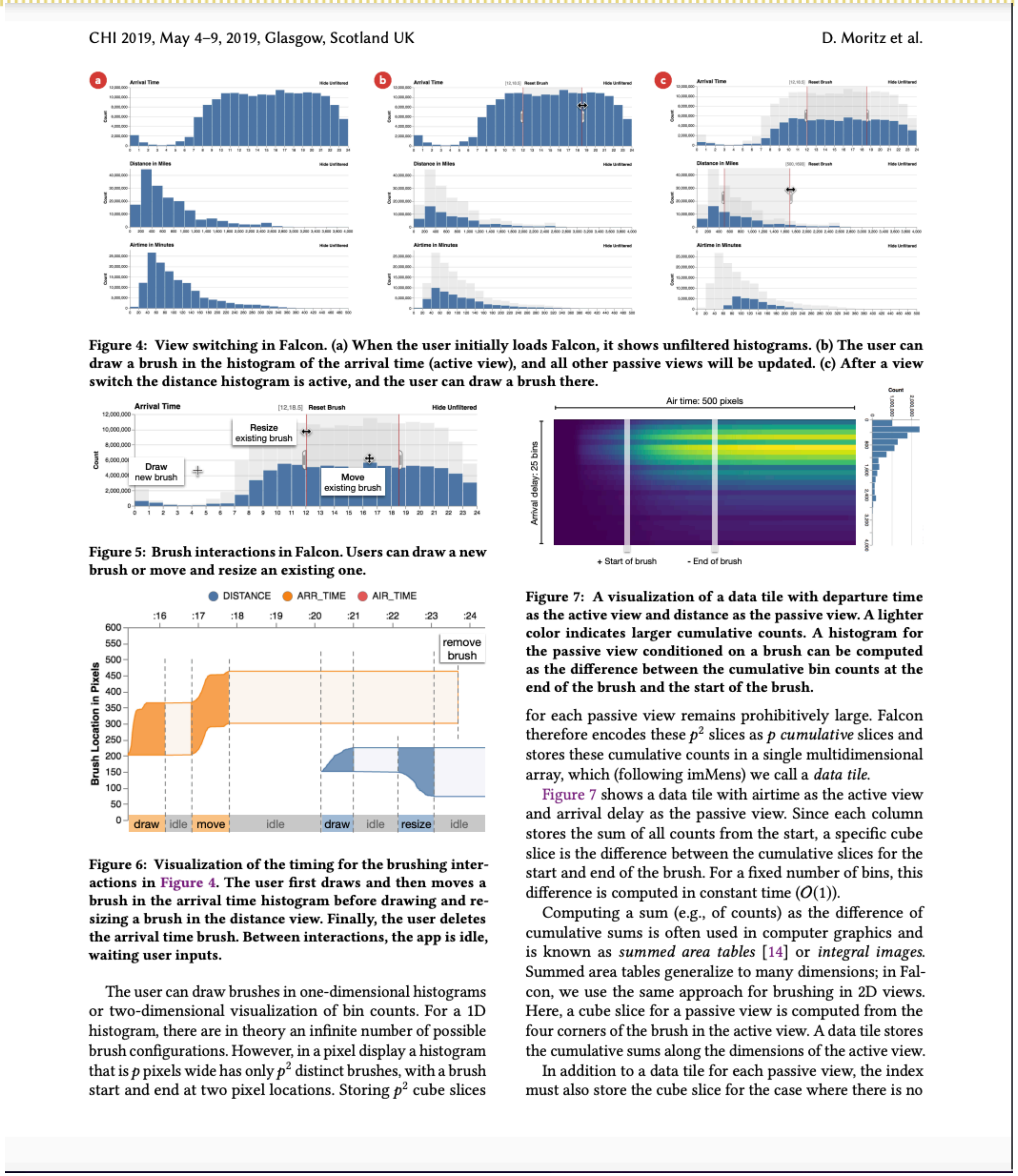

CHI 2019, May 4–9, 2019, Glasgow, Scotland UK — D. Moritz et al.

Figure 4: View switching in Falcon. (a) When the user initially loads Falcon, it shows unfiltered histograms. (b) The user can draw a brush in the histogram of the arrival time (active view), and all other passive views will be updated. (c) After a view switch the distance histogram is active, and the user can draw a brush there.

Figure 5: Brush interactions in Falcon. Users can draw a new brush or move and resize an existing one.

Figure 6: Visualization of the timing for the brushing interactions in Figure 4. The user first draws and then moves a brush in the arrival time histogram before drawing and resizing a brush in the distance view. Finally, the user deletes the arrival time brush. Between interactions, the app is idle, waiting user inputs.

The user can draw brushes in one-dimensional histograms or two-dimensional visualization of bin counts. For a 1D histogram, there are in theory an infinite number of possible brush configurations. However, in a pixel display a histogram that is p pixels wide has only p^2 distinct brushes, with a brush start and end at two pixel locations. Storing p^2 cube slices

Figure 7: A visualization of a data tile with departure time as the active view and distance as the passive view. A lighter color indicates larger cumulative counts. A histogram for the passive view conditioned on a brush can be computed as the difference between the cumulative bin counts at the end of the brush and the start of the brush.

for each passive view remains prohibitively large. Falcon therefore encodes these p^2 slices as p *cumulative* slices and stores these cumulative counts in a single multidimensional array, which (following imMens) we call a *data tile*.

Figure 7 shows a data tile with airtime as the active view and arrival delay as the passive view. Since each column stores the sum of all counts from the start, a specific cube slice is the difference between the cumulative slices for the start and end of the brush. For a fixed number of bins, this difference is computed in constant time ($O(1)$).

Computing a sum (e.g., of counts) as the difference of cumulative sums is often used in computer graphics and is known as *summed area tables* [14] or *integral images*. Summed area tables generalize to many dimensions; in Falcon, we use the same approach for brushing in 2D views. Here, a cube slice for a passive view is computed from the four corners of the brush in the active view. A data tile stores the cumulative sums along the dimensions of the active view.

In addition to a data tile for each passive view, the index must also store the cube slice for the case where there is no

HCI: academic

- Methodological: new approaches that influence processes in research or practice, such as a new method, new application of a method, modification of a method, or a new metric or instrument for measurement. Theoretical contributions—concepts and models which are vehicles for thought, which may be predictive or descriptive, such as a framework, a design space, or a conceptual model

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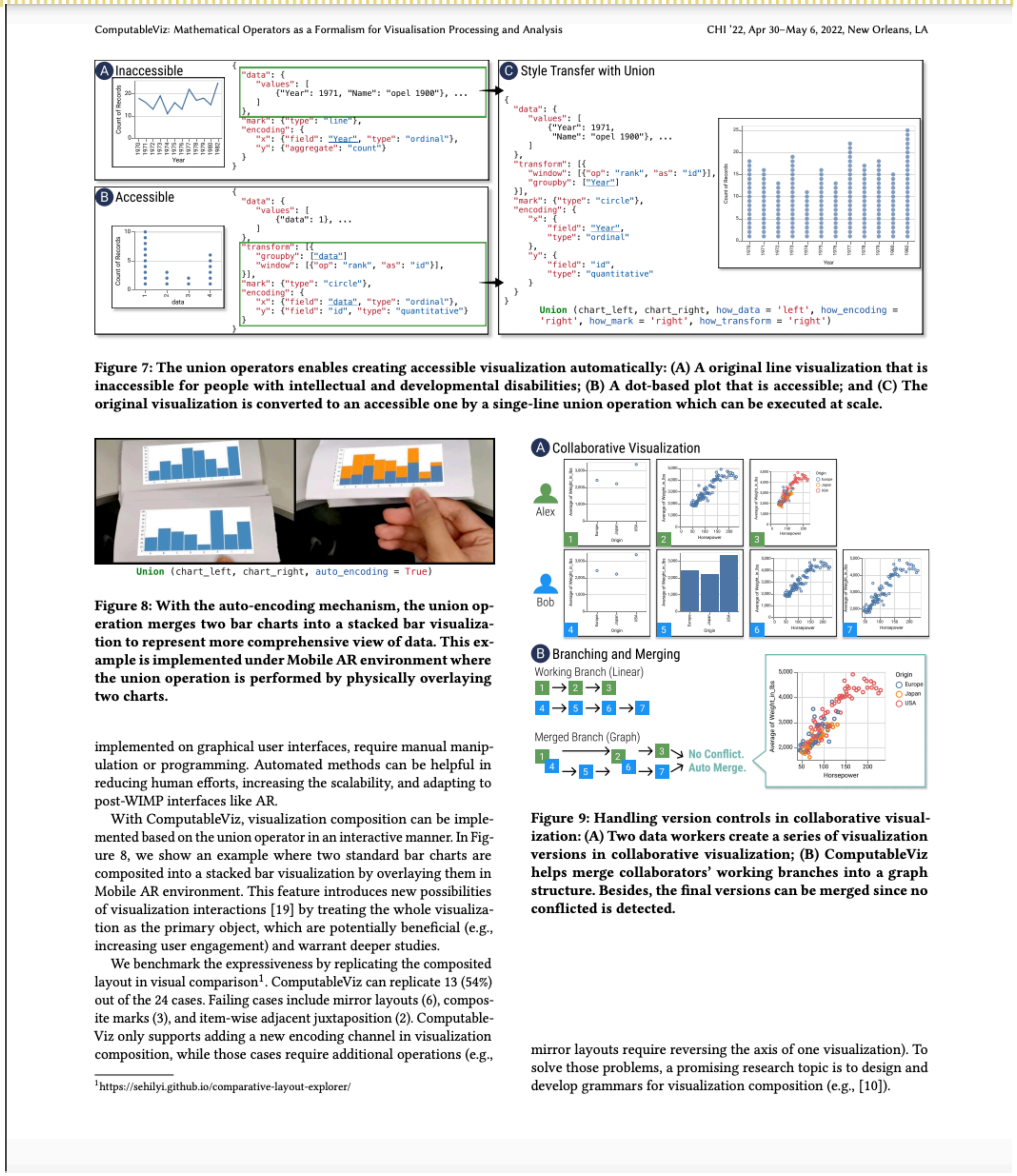

Figure 7: The union operators enables creating accessible visualization automatically: (A) A original line visualization that is inaccessible for people with intellectual and developmental disabilities; (B) A dot-based plot that is accessible; and (C) The original visualization is converted to an accessible one by a singe-line union operation which can be executed at scale.

Figure 8: With the auto-encoding mechanism, the union operation merges two bar charts into a stacked bar visualization to represent more comprehensive view of data. This example is implemented under Mobile AR environment where the union operation is performed by physically overlaying two charts.

Figure 9: Handling version controls in collaborative visualization: (A) Two data workers create a series of visualization versions in collaborative visualization; (B) ComputableViz helps merge collaborators' working branches into a graph structure. Besides, the final versions can be merged since no conflicted is detected.

implemented on graphical user interfaces, require manual manipulation or programming. Automated methods can be helpful in reducing human efforts, increasing the scalability, and adapting to post-WIMP interfaces like AR.

With ComputableViz, visualization composition can be implemented based on the union operator in an interactive manner. In Figure 8, we show an example where two standard bar charts are composited into a stacked bar visualization by overlaying them in Mobile AR environment. This feature introduces new possibilities of visualization interactions [19] by treating the whole visualization as the primary object, which are potentially beneficial (e.g., increasing user engagement) and warrant deeper studies.

We benchmark the expressiveness by replicating the composited layout in visual comparison[1]. ComputableViz can replicate 13 (54%) out of the 24 cases. Failing cases include mirror layouts (6), composite marks (3), and item-wise adjacent juxtaposition (2). ComputableViz only supports adding a new encoding channel in visualization composition, while those cases require additional operations (e.g., mirror layouts require reversing the axis of one visualization). To solve those problems, a promising research topic is to design and develop grammars for visualization composition (e.g., [10]).

[1]https://sehilyi.github.io/comparative-layout-explorer/

HCI: academic

- Dataset: a contribution which provides a corpus for the benefit of the research community, including a repository, benchmark tasks, and actual data. Survey contributions—a review and synthesis of work done in a specific area, to help identify trends and specific topics that need more work. This type of contribution can only occur after research in a certain area has existed for a few years so that there is sufficient work to analyze

.

UISketch: A Large-Scale Dataset of UI Element Sketches

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Figure 1: UISketch dataset: Sample hand-drawn sketches of 21 UI element categories drawn using pen, pencil, or stylus by our participants

ABSTRACT

This paper contributes the first large-scale dataset of 17,979 hand-drawn sketches of 21 UI element categories collected from 967 participants, including UI/UX designers, front-end developers, HCI, and CS grad students, from 10 different countries. We performed a perceptual study with this dataset and found out that UI/UX designers can recognize the UI element sketches with ~96% accuracy. To compare human performance against computational recognition methods, we trained the state-of-the-art DNN-based image classification models to recognize the UI elements sketches. This study revealed that the ResNet-152 model outperforms other classification networks and detects unknown UI element sketches with 91.77% accuracy (chance is 4.76%). We have open-sourced the entire dataset of UI element sketches to the community intending to pave the way for further research in utilizing AI to assist the conversion of lo-fi UI sketches to higher fidelities.

CHI '21, May 8–13, 2021, Yokohama, Japan

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https://doi.org/10.1145/3411764.3445784

CCS CONCEPTS

• **Human-centered computing** → **Interface design prototyping**; *User interface design*; Wireframes; • **Computer systems organization** → Neural networks; • **Computing methodologies** → **Image representations**; *Supervised learning by classification*.

KEYWORDS

Dataset, UI element sketches, Sketch dataset, Deep Neural Networks, Sketch recognition, Low-fidelity prototypes, Wireframes, Sketching interfaces

ACM Reference Format:
Vinoth Pandian Sermuga Pandian, Sarah Suleri, and Matthias Jarke. 2021. UISketch: A Large-Scale Dataset of UI Element Sketches. In *CHI Conference on Human Factors in Computing Systems (CHI '21), May 8–13, 2021, Yokohama, Japan*. ACM, New York, NY, USA, 14 pages. https://doi.org/10.1145/3411764.3445784

1 INTRODUCTION

Sketching is a natural way for humans to convey and store information. Since prehistoric times, humans have used cave paintings to preserve their memories and share information across generations [11]. As important as it is, sketching is not just a communication tool; it is also a thinking tool [7, 11]. Bill Buxton, in his book "Sketching User Experiences", emphasizes the importance of sketching by acknowledging it as an archetypical activity of designers [7]. In

HCI: academic

- Opinion: writings which seek to persuade the readers to change their minds, often utilizing portions of the other contributions listed above, not simply to inform, but to persuade

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Mobile-Friendly Content Design for MOOCs: Challenges, Requirements, and Design Opportunities

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ABSTRACT

Most video-based learning content is designed for desktops without considering mobile environments. We (1) investigate the gap between mobile learners' challenges and video engineers' considerations using mixed methods and (2) provide design guidelines for creating mobile-friendly MOOC videos. To uncover learners' challenges, we conducted a survey (n=134) and interviews (n=21), and evaluated the mobile adequacy of current MOOCs by analyzing 41,722 video frames from 101 video lectures. Interview results revealed low readability and situationally-induced impairments as major challenges. The content analysis showed a low guideline compliance rate for key design factors. We then interviewed 11 video production engineers to investigate design factors they mainly consider. The engineers mainly focus on the size and amount of content while lacking consideration for color, complex images, and situationally-induced impairments. Finally, we present and validate guidelines for designing mobile-friendly MOOCs, such as providing adaptive and customizable visual design and context-aware accessibility support.

CCS CONCEPTS

• **Human-centered computing → Empirical studies in HCI**; *User studies; Empirical studies in ubiquitous and mobile computing.*

KEYWORDS

Mobile Learning; MOOCs; Video-based Learning; Learning Difficulty; Content Design

ACM Reference Format:
Jeongyeon Kim, Yubin Choi, Meng Xia, and Juho Kim. 2022. Mobile-Friendly Content Design for MOOCs: Challenges, Requirements, and Design Opportunities. In *CHI Conference on Human Factors in Computing Systems (CHI '22), April 29-May 5, 2022, New Orleans, LA, USA.* ACM, New York, NY, USA, 16 pages. https://doi.org/10.1145/3491102.3502054

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https://doi.org/10.1145/3491102.3502054

1 INTRODUCTION

Mobile learning has gained popularity and has been a key driver in enabling ubiquitous learning [55, 64]. In addition, major online learning and Massive Open Online Courses (MOOC) platforms including edX [19], Coursera [38], Khan Academy [40], and Udemy [41] provide mobile apps to support learning on mobile devices. Despite the rise in popularity, mobile video-based learning has physical (e.g., small screen size) as well as environmental (e.g., limitations on sensory channels posed by ambient noise and light) [66] constraints. Existing learning frameworks suggest that tiny font sizes and content-heavy lecture materials on small screens increase learners' cognitive load [47, 70, 71] and lower judgments of learning (JOLs) [25, 63]. Meanwhile, situational factors such as ambient noise [76], ambient light [21], and the mobile state of the learner [21, 66] may saturate mobile learners' visual and auditory channels and cause situationally-induced impairments and disabilities (SIIDs). Prior work revealed that SIIDs might impede learning, deteriorating text legibility [54], reading comprehension, and cognitive performance [2]. Furthermore, most of the existing educational videos have been primarily designed for desktop environments. Although a body of research suggested design guidelines for mobile educational apps and websites [20, 42, 53, 67], few studies have contributed guidelines specific to mobile video-based learning content. Unlike static content, educational videos are temporally dynamic with both audio and visual information, and contain unique design components such as talking-head instructors and real-time handwriting. Also, existing literature mainly focuses on the learner side, leaving how designers currently consider the difficulties of the learner side in the design process largely unknown.

To fill in this gap, we conducted quantitative and qualitative analysis on the visual design of video content that causes readability issues and SIIDs from three perspectives: (1) learners (through surveys and interviews), (2) video content (through content analysis), and (3) video production engineers (through interviews).

To uncover the challenges learners face in mobile MOOC learning, (1) we surveyed 134 learners and conducted follow-up interviews with 21 learners. The results revealed two main difficulties learners experience with visual content design: readability issues and limitations on sensory channels. We then evaluated whether the current MOOC videos are suitable for mobile learning. Through the content analysis, we diagnosed how severe the problem is,

- Design is about making things
- [Design is] a plan for arranging elements in such a way as to best accomplish a particular purpose." - Charles Eames (designer of some famous chairs)

HCI: design

- Humans and computers interact using an interface and that interface is what we design

HCI: design

- Useful
  - Functional, does things
- Usable
  - Easy to do things, does the right things, enjoyable user experience
- Used
  - Attractive, available, acceptable to organization

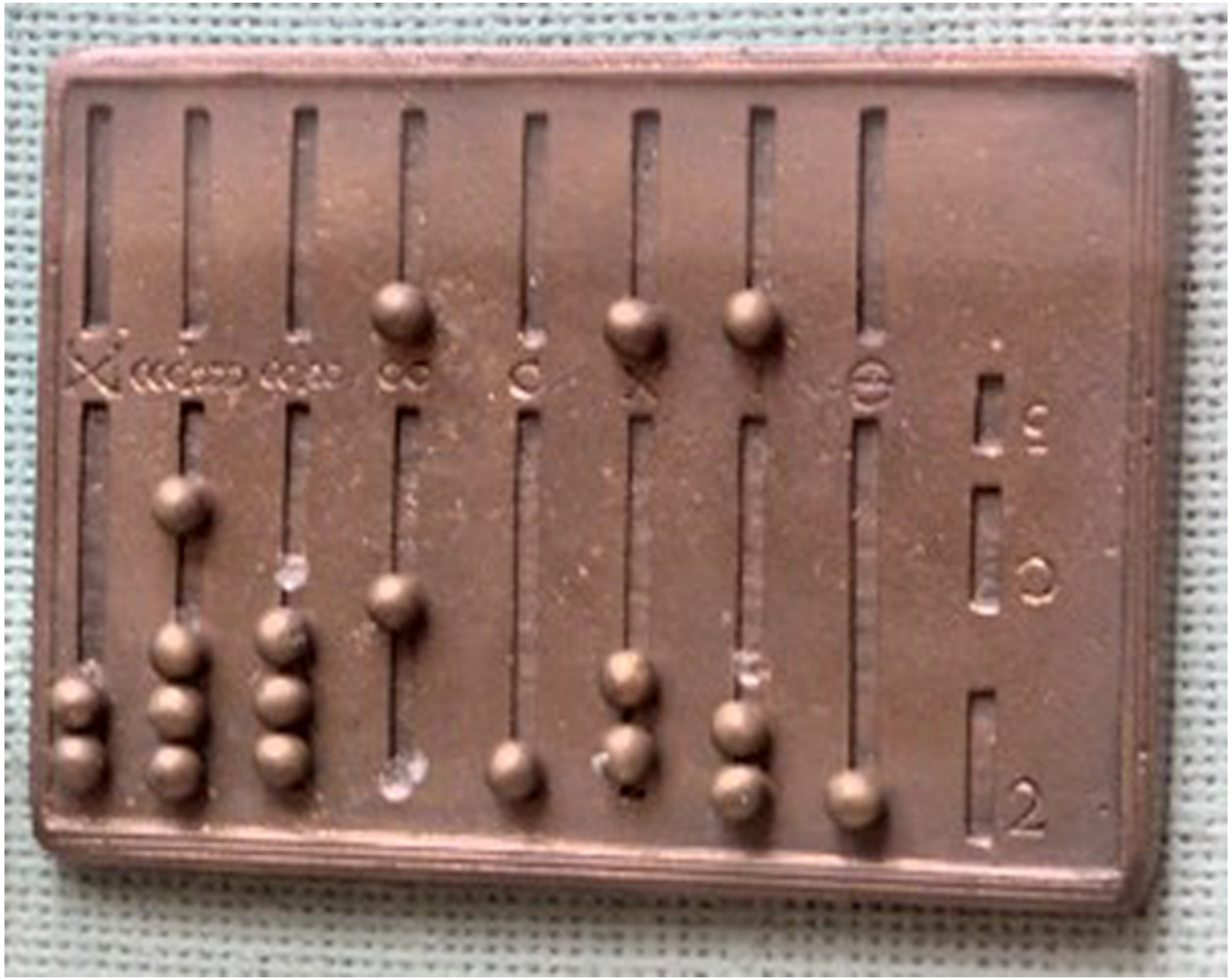
HCI roots


Computer
Engineering
Computing
HCI
Psychology
Sociology
Ethnography
Design
Interaction
Human

Outline

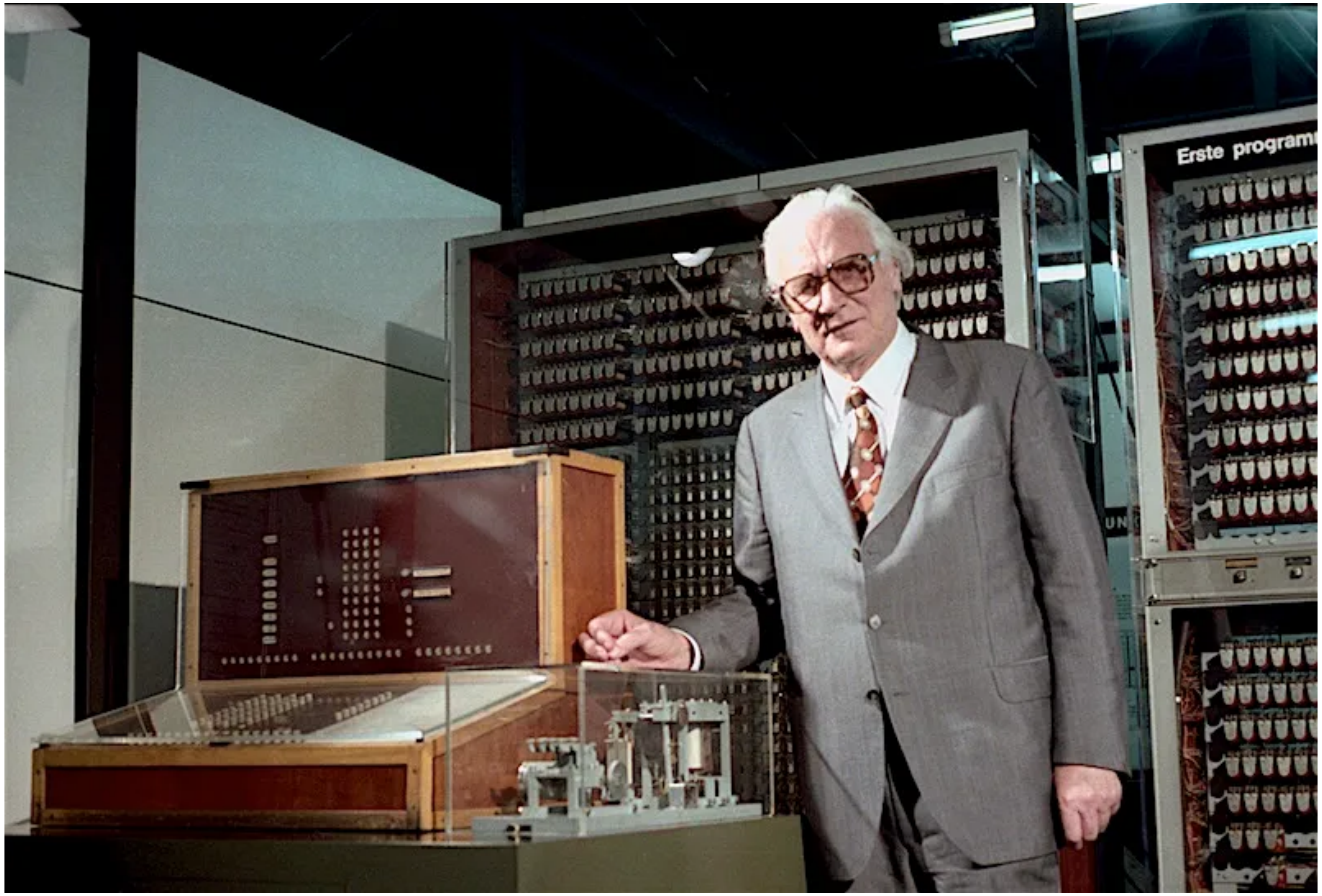
- What is HCI
- History of HCI
- Relationship with other fields
- Why is interaction design hard

Calculating devices in antiquity



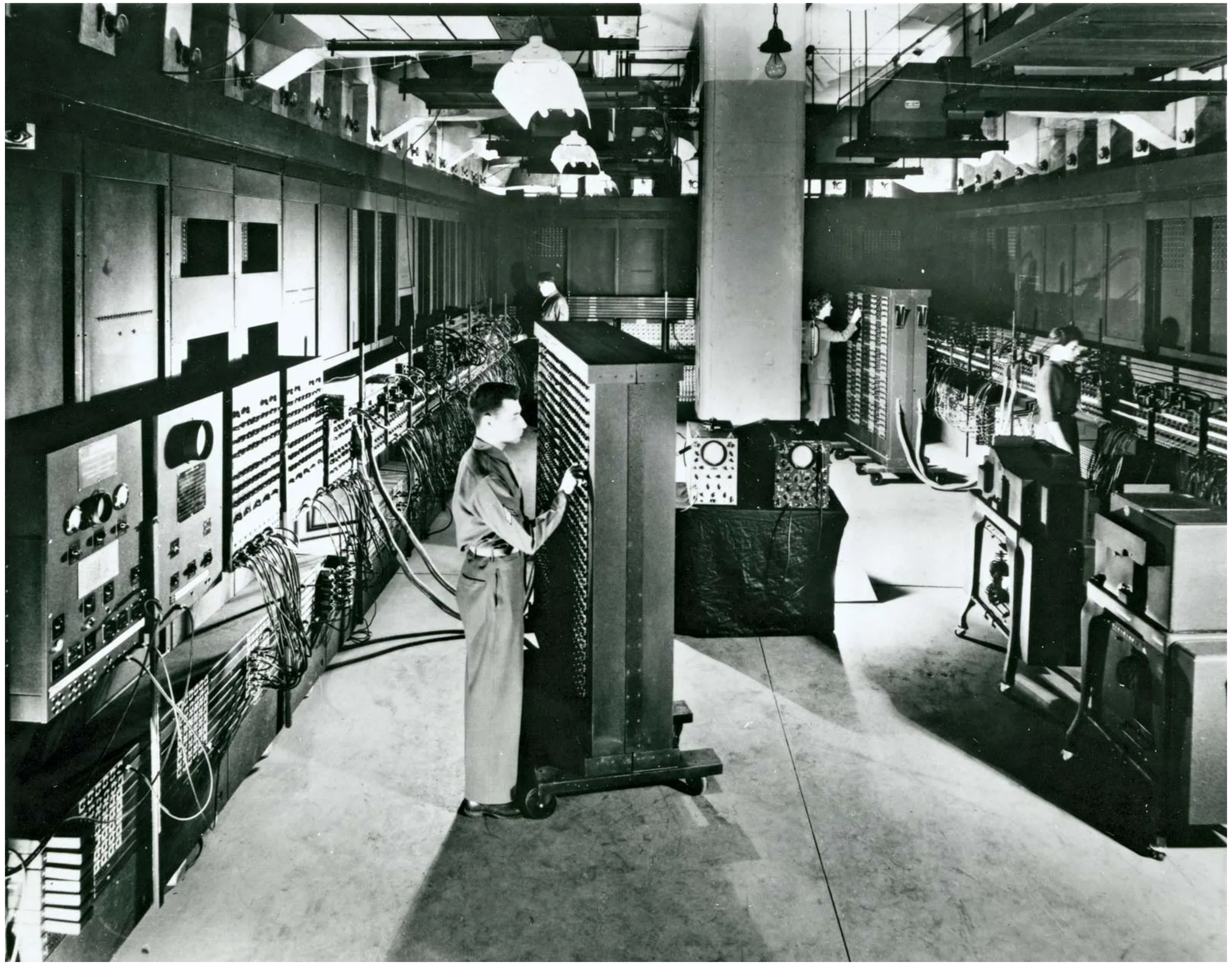
Konrad Zuse (1910-1995)

- Invented the world's fist programmable computer in 1941



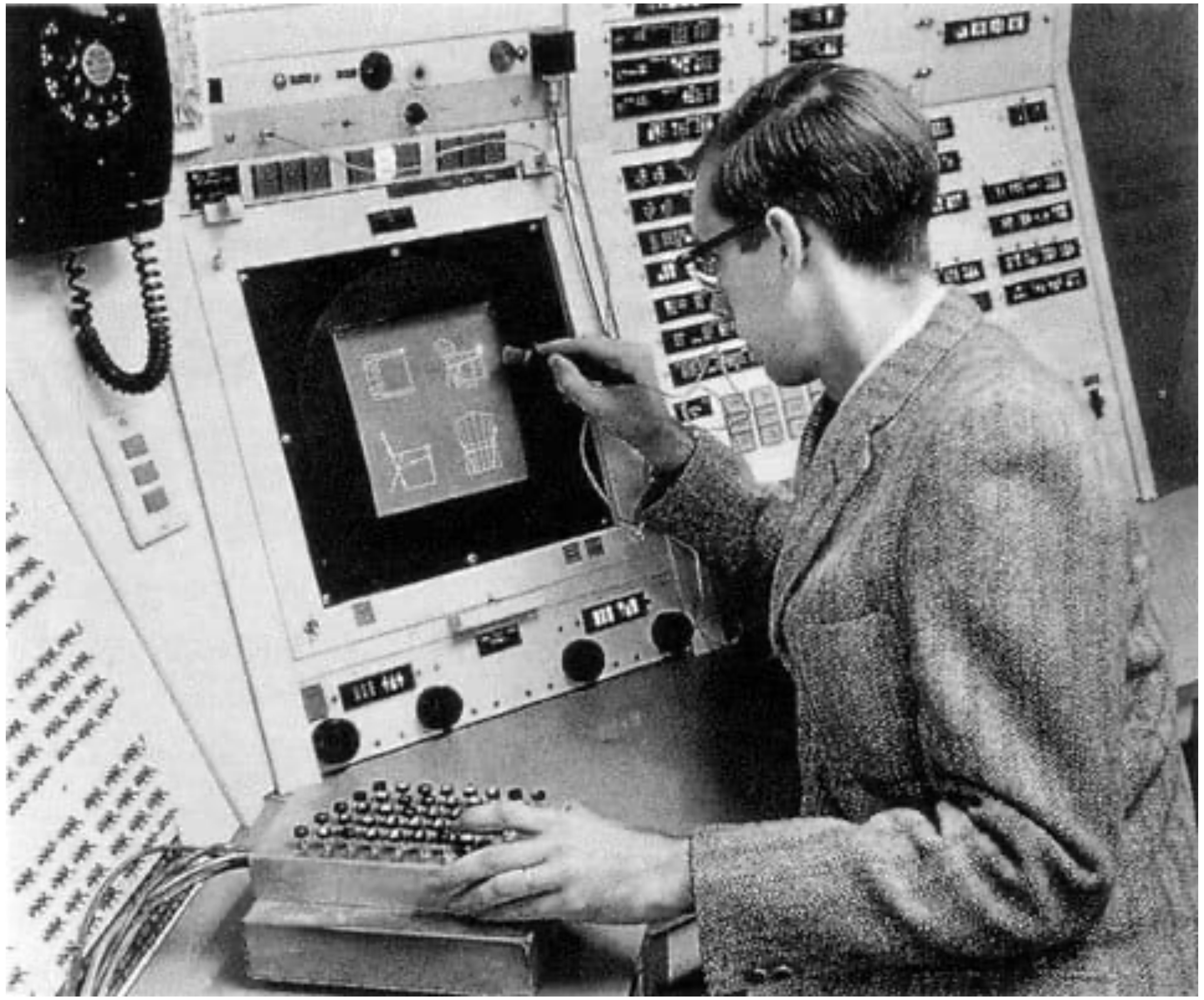
ENIAC (~1946)

- First electronic numerical integrator and computer in the US
- The fist programmers of the ENIAC were six women

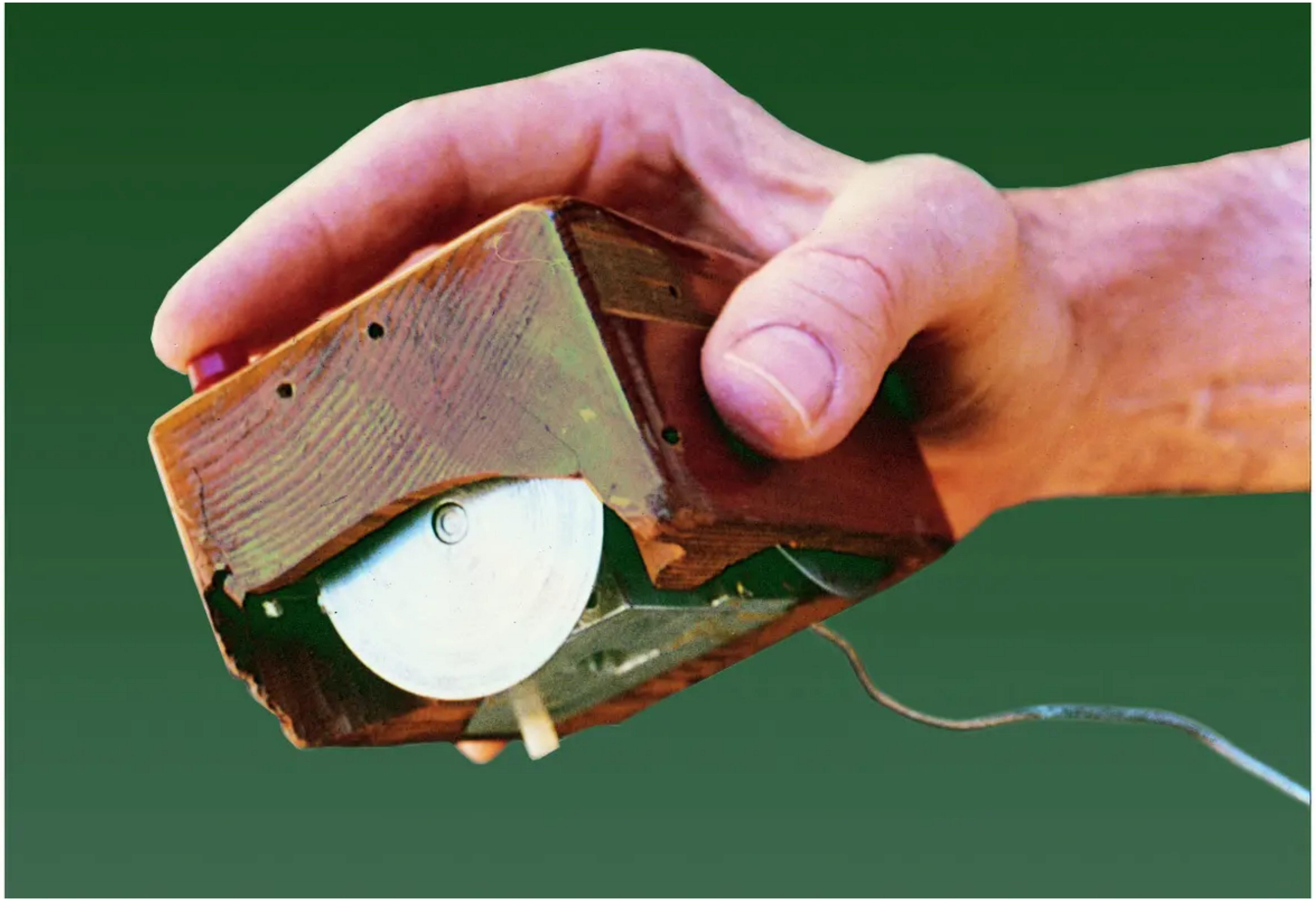


SketchPad (1963)

- Direct manipulation of objects
- Pave the way for the Graphical User Interface
- The first object-oriented programming system



Mouse (1963)



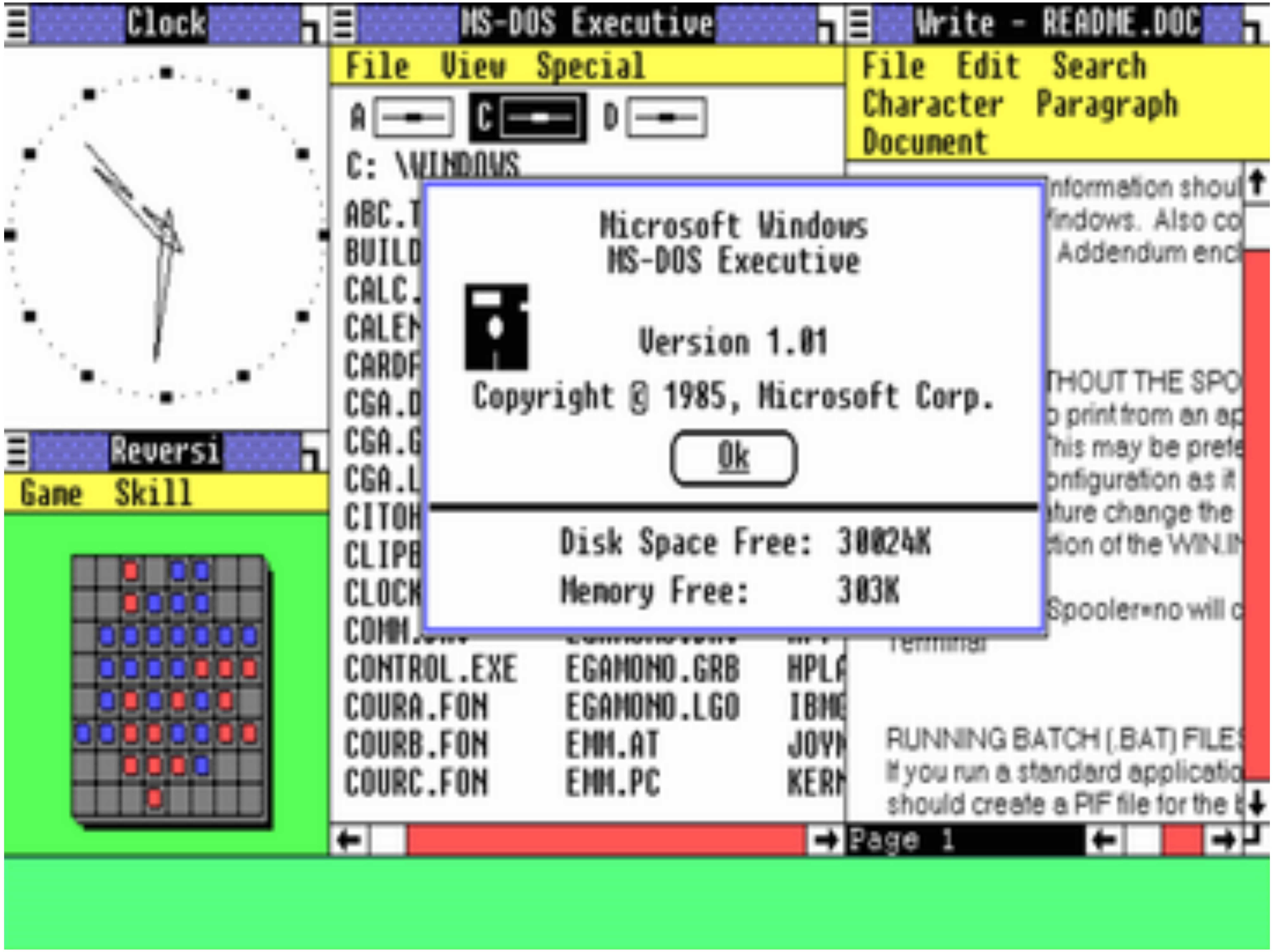
First HCI wave (1980s)

- Computer scientists interested in changes in ways people interact with information systems
- Psychologists interested in implications of these changes

Xerox Star (1981)

Apple Lisa (1981)

Windows 1.0 (1985)

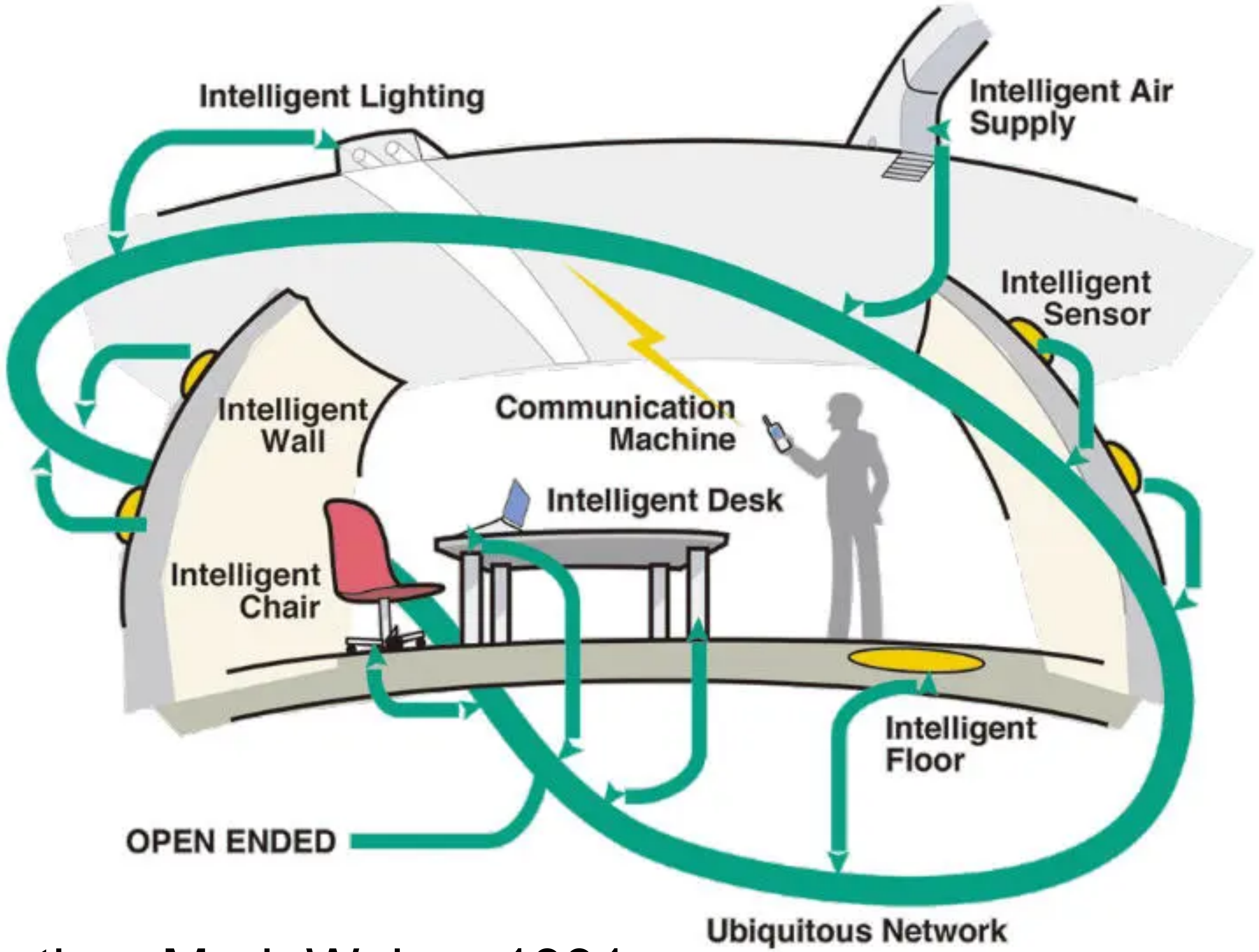


Ten usability heuristics (1995)

- Jakob Nielsen’s 10 general principles for interaction design

Second HCI wave (1990s)

Second HCI wave (1990s)

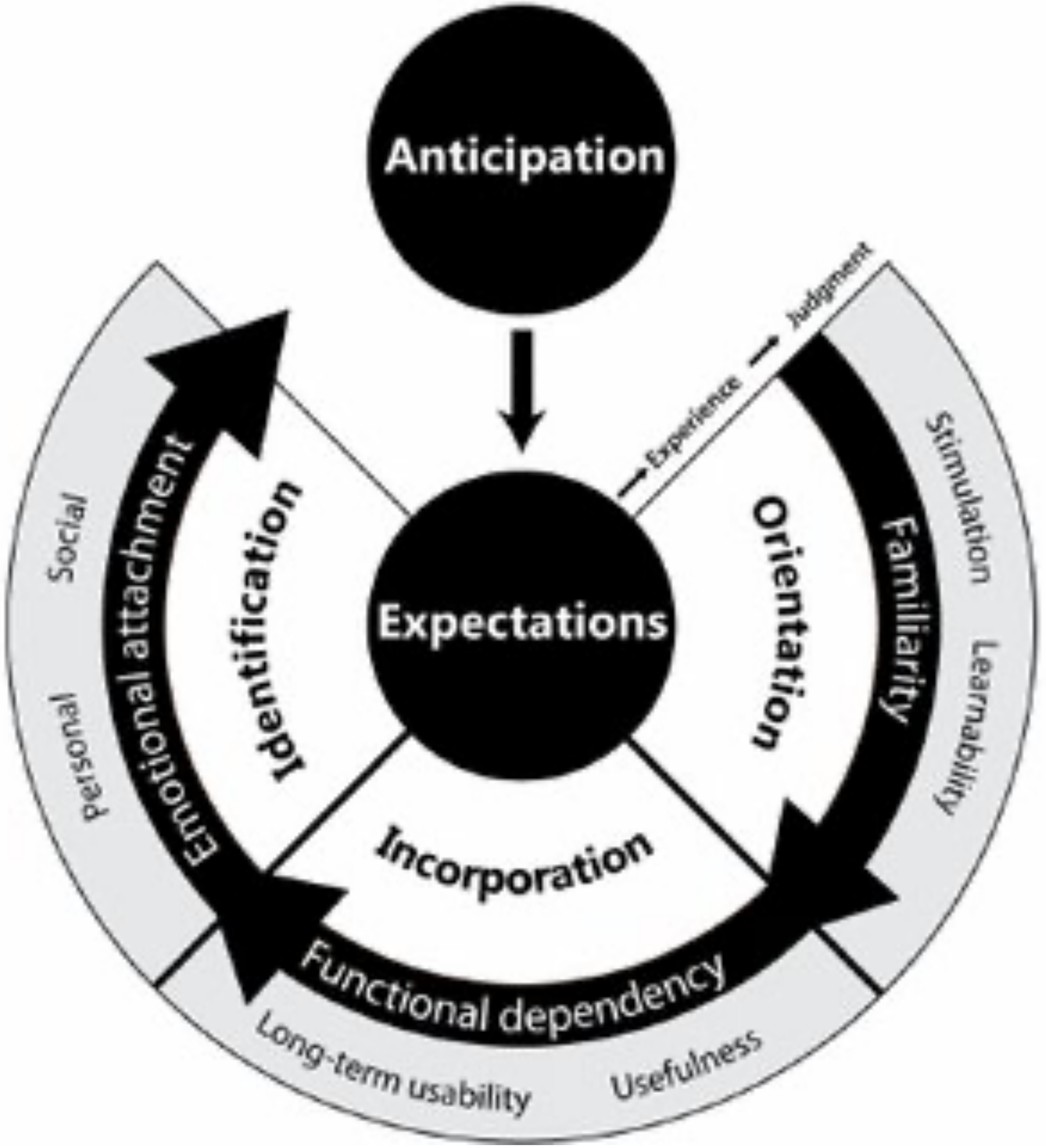


ubiquitous computing, Mark Weiser 1991

Third HCI wave (2000s)

iPhone

Third HCI wave (2000s)

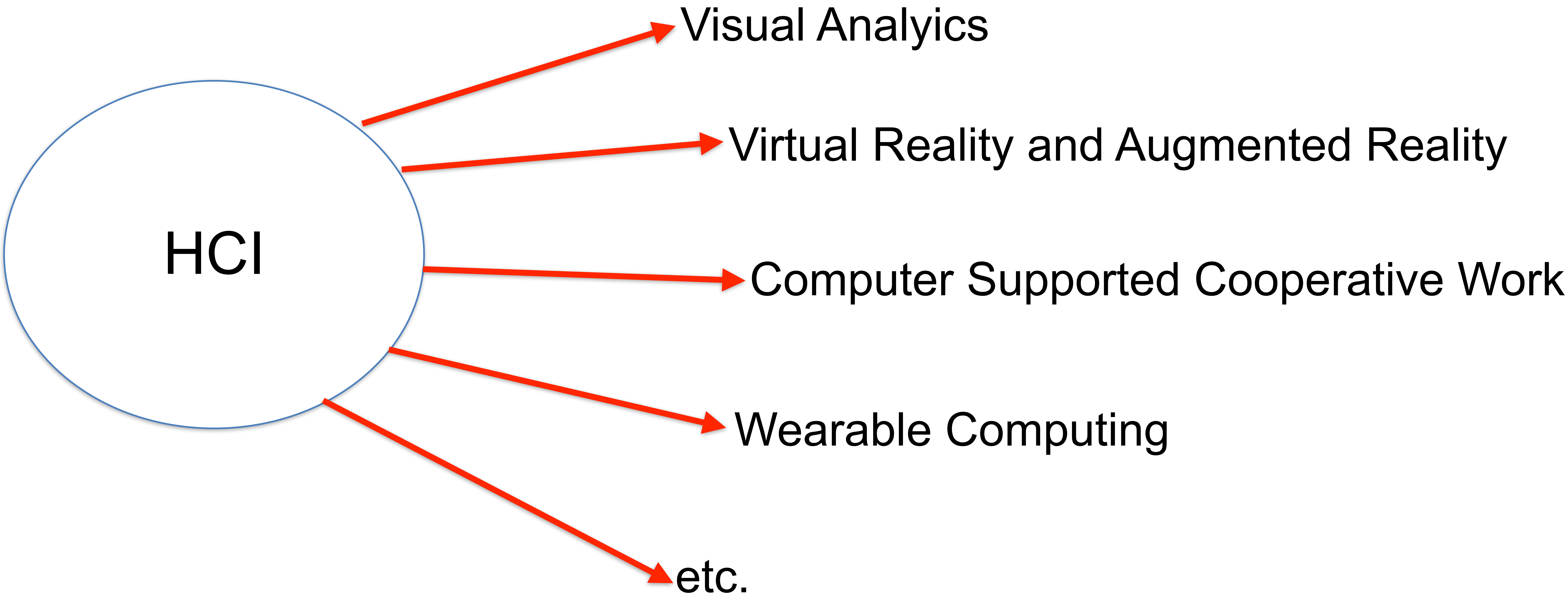


user experience over time

Outline

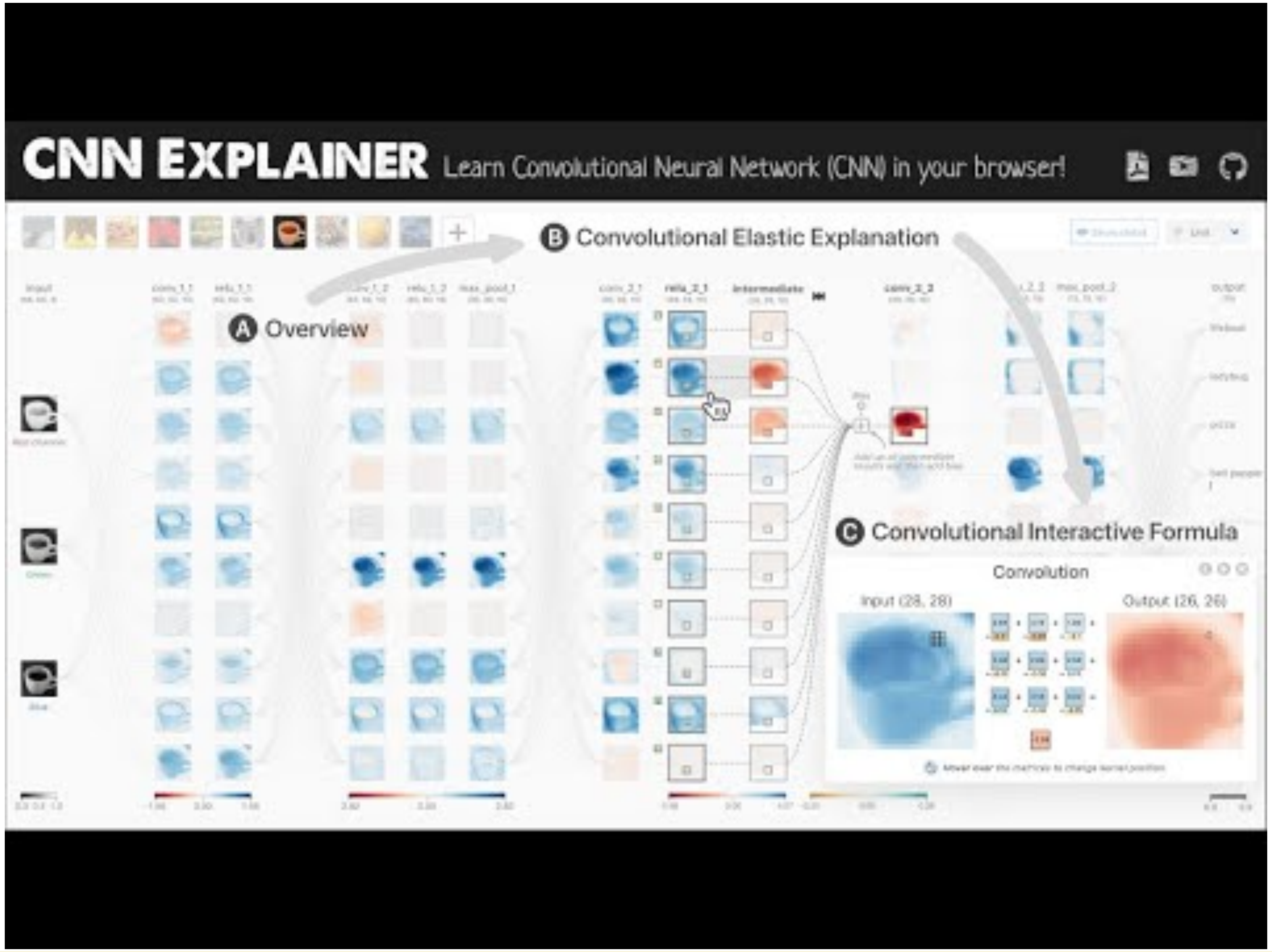
- What is HCI
- History of HCI
- Relationship with other fields
- Why is interaction design hard

HCI braches


HCI
Visual Analytics
Virtual Reality and Augmented Reality
Computer Supported Cooperative Work
Wearable Computing
etc.

Visual analytics

- The use of sophisticated tools and processes to analyze datasets using visual representations of the data



Computer supported cooperative work

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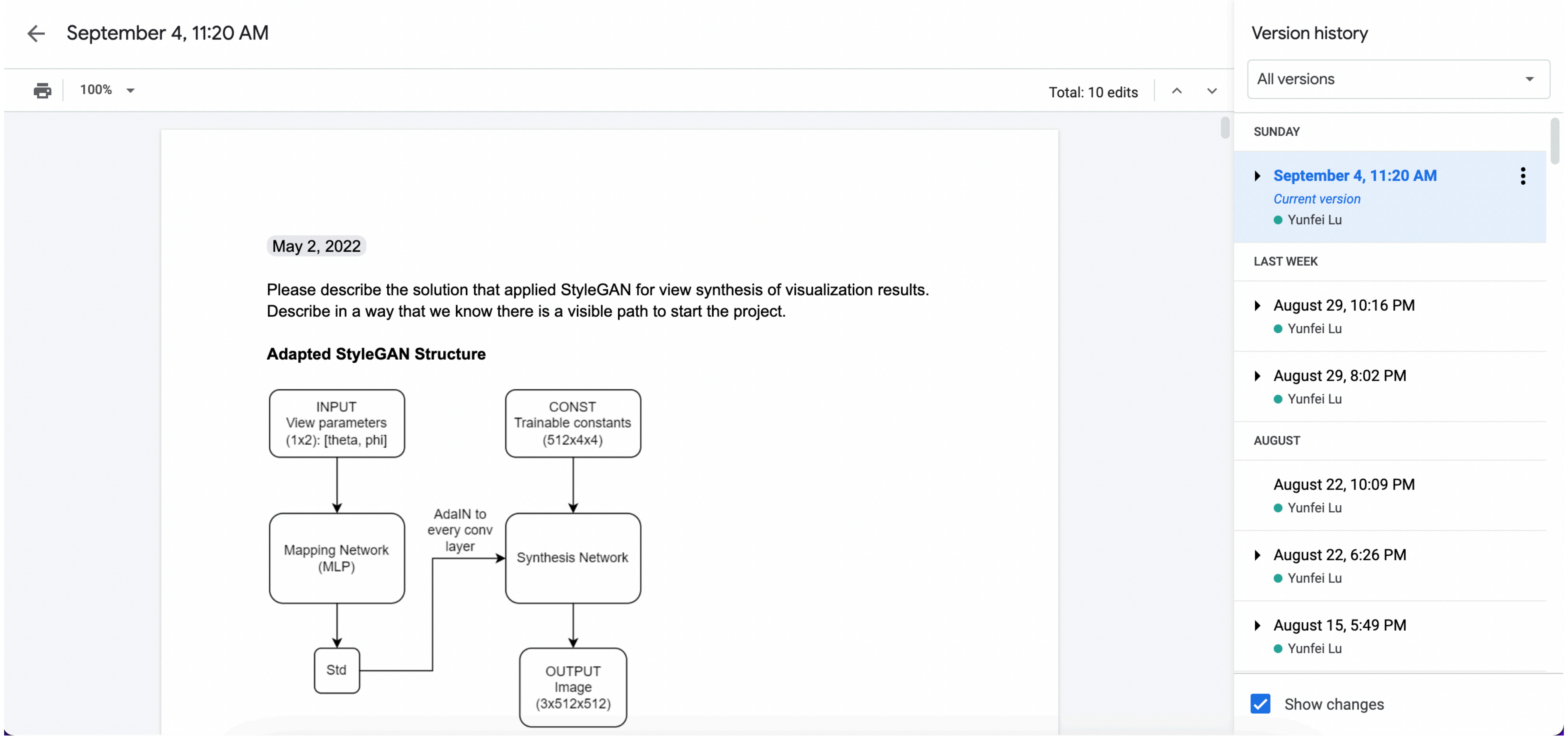
- The study of how people utilize technology collaboratively, often towards a shared goal



Virtual reality

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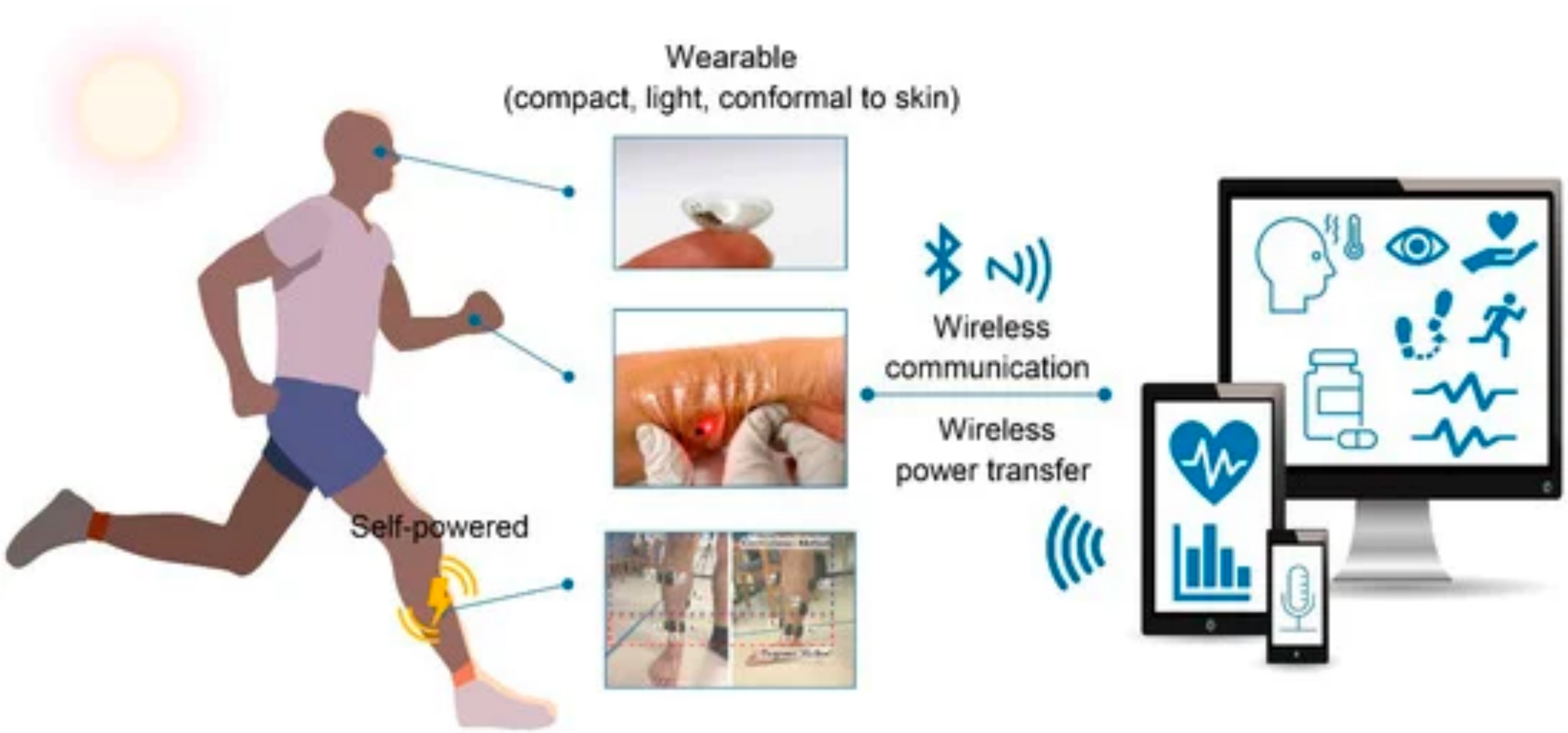
- A simulated experience that can be similar to or completely different from the real world

Wearable computing

- The use of a miniature, body-borne computer or sensory device worn on, over, under or integrated within, clothing



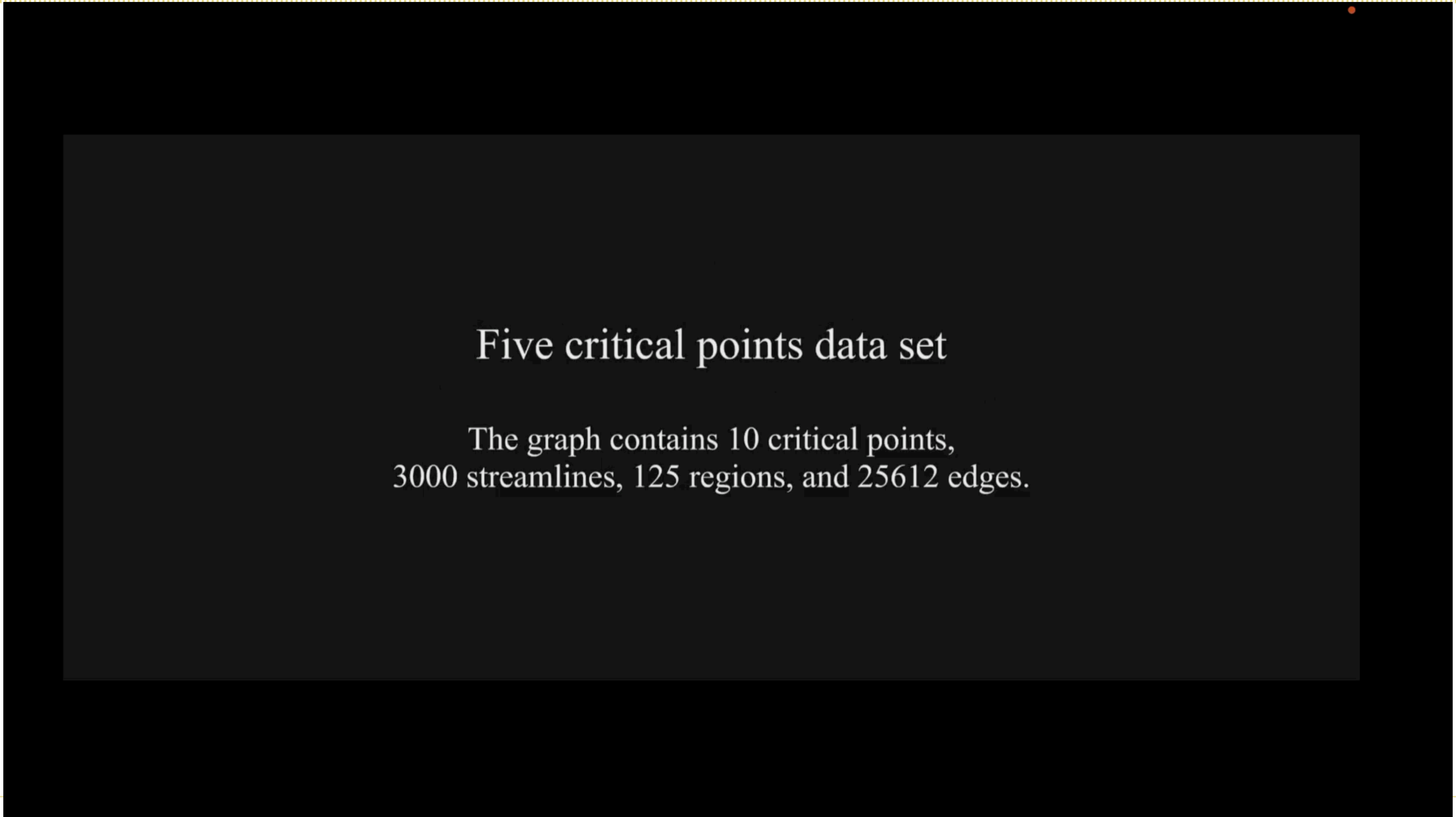
Outline

- What is HCI
- History of HCI
- Relationship with other fields
- Why is interaction design hard

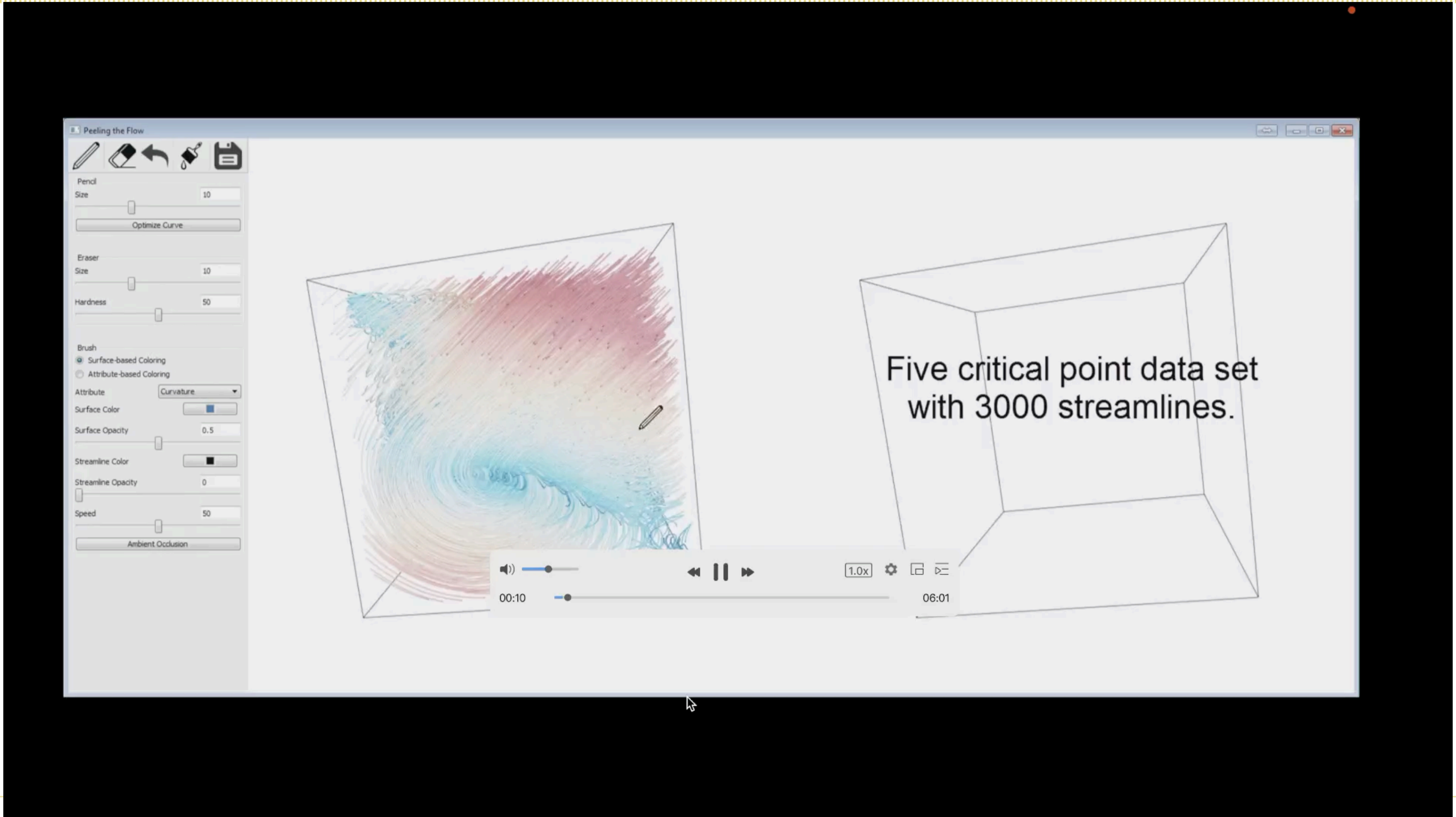
Why is the interaction design hard

- User interfaces are abut communicating with users. Users are not like you
- As an engineer, you already know a lot more about your application than any user will, and its difficult to un-learn it

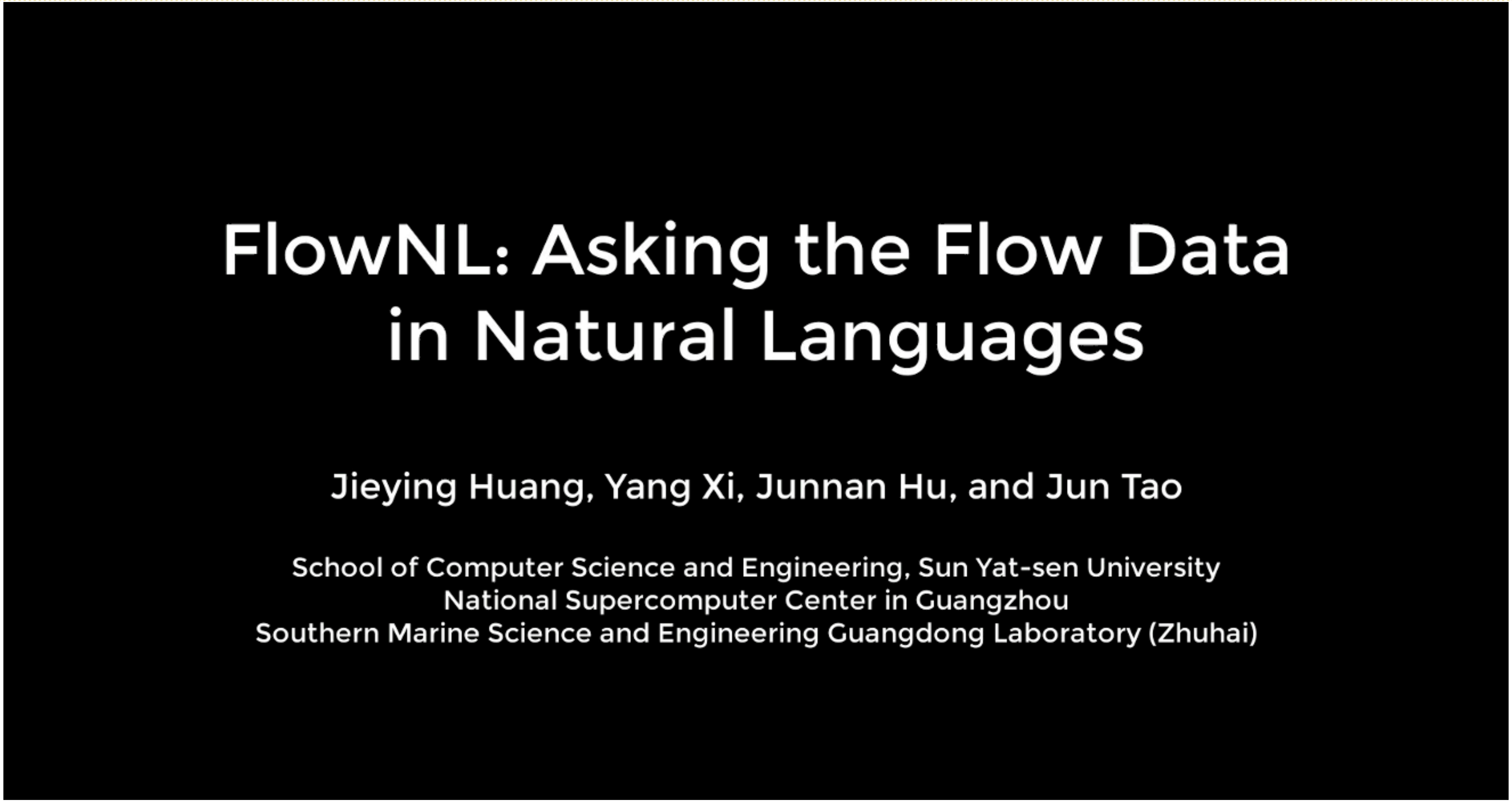
Why is the interaction design hard



Why is the interaction design hard



Why is the interaction design hard



Why is the interaction design hard

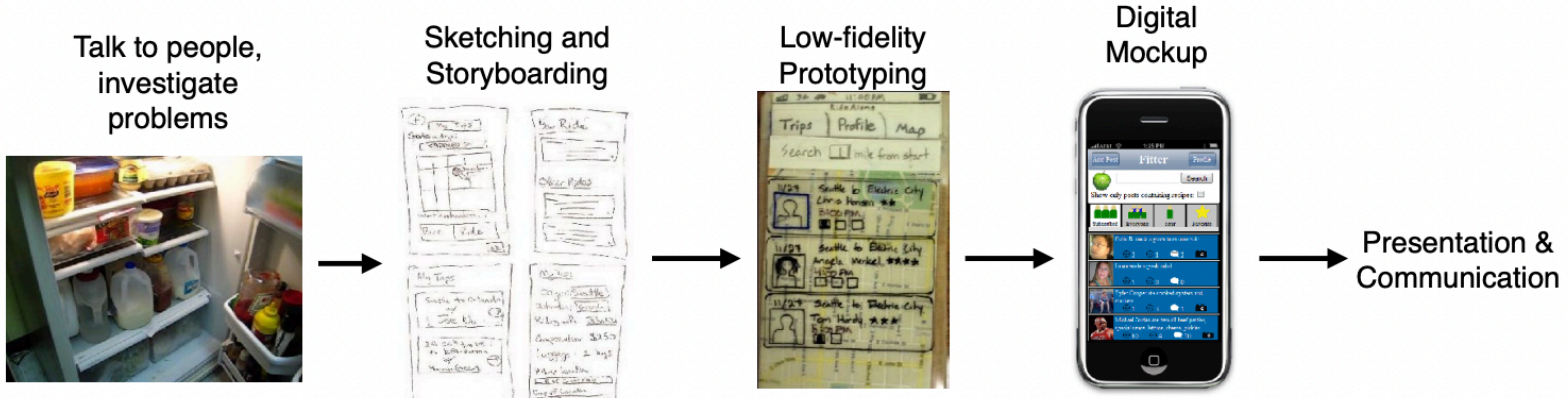
- What do we mean when we say the user is always right
- Telephone handset weight
  – Users said: it’s fine but they want lighter
- # of Google search results
  – Users said: 30 results, but they really wanted 10
- Command abbreviations
  – Users made 2x more errors with their own custom abbreviations

Design as a process

- To synthesize a solution from all the relevant constraints
- To frame, or reframe, the problem and objective
- To create and envision alternatives
- To select from those alternatives
- To visualize and prototype the intended solution

Design as a process

- Design process as iterative and explorative, constantly involving users and investigating use, since we cannot just trust our instincts



Design as an open-ended series of principles

- Usability: how well users can use the system's functionality
- Learnability: how easy is it to learn
- Efficiency: once learned, how quickly can it be used
- Safety: are errors few and recoverable

Design as an open-ended series of principles

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- There are trade-offs between different design principles, so you cannot just apply them mindlessly
- Emphasis depends on the user
  - Novice users need greater learnability
  - Expert users need efficiency
  - But everyone can be a novice or an expert at different points in time
- Emphasis depends on the task
  - Highly critical tasks should emphasize safety (amber alert system)
  - Less critical, repetitive tasks need eficiency (unlocking your smartphone)

Other tradeoffs

- Functionality
- Performance
- Cost
- Security
- Maintainability
- Reliability

Thank Prof. Amy Zhang and Prof. Alan Dix for many of the slides!