History & Theories in Human-Computer Interaction


Figure 7.1: Fields with major HCI threads. Left edges of items align with the dates that articles or books were published, organizations or conference series initiated, and so on. Details are in the text.
I’m still looking for the definition of “Human-Computer Interaction”......
Human-Computer Interaction (HCI) is a multidisciplinary field that focuses on the study, design, and evaluation of the interactions between humans (users) and computers (or more broadly, machines). The history of HCI is intertwined with the evolution of computers and encompasses various research areas including computer science, cognitive psychology, ergonomics, and design. Here’s a brief history of Human-Computer Interaction:

1. **1940s-1950s: The Beginning**
   1. Computers, primarily large mainframes, were used mostly for scientific calculations. Interaction was done using punched cards.

2. **1960s: Graphical and Direct Interaction**
   1. **Sketchpad**: Invented by Ivan Sutherland in 1963, this was one of the first graphical computer interfaces.
   2. **Mouse**: Douglas Engelbart, in the late 1960s, invented the computer mouse, fundamentally changing the way users interacted with computers. He also showcased a demo of collaborative real-time editing, hypertext, and video conferencing in 1968, which is famously known as "The Mother of All Demos."

3. **1970s: Personal Computing and WIMP Interfaces**
   1. The idea of a personal computer started to gain traction.
   2. Development of WIMP interfaces (Window, Icon, Menu, Pointing device). This became a foundational aspect of HCI.

4. **1980s: Birth of HCI as a Field and Desktop Metaphor**
   1. Apple Macintosh, released in 1984, popularized the GUI (Graphical User Interface) for the masses.
   2. Xerox PARC played a crucial role in refining and inventing GUI elements.
   3. Universities started offering HCI courses, and the term "User Experience" (UX) began to emerge.
   4. The CHI (Conference on Human Factors in Computing Systems) conference was established, marking the formalization of HCI as a research field.

5. **1990s: Web and Mobile Interaction**
   1. The World Wide Web was born, changing the dynamics of HCI from localized software to globally distributed applications.
   2. The Palm Pilot, released in the mid-90s, was an early example of a popular mobile user interface.

6. **2000s: Ubiquitous Computing and Multitouch Interfaces**
   1. Devices began to be embedded in everyday objects (Ubiquitous Computing).
   2. Apple introduced the iPhone in 2007, revolutionizing touch interfaces and mobile computing.
   3. Social media platforms like Facebook and Twitter shifted HCI considerations towards social interactions and group dynamics.

7. **2010s: Natural User Interfaces and Immersive Experiences**
   1. Gesture-based systems like Microsoft Kinect.
   2. Voice assistants such as Apple’s Siri, Amazon's Alexa, and Google Assistant.
   3. Virtual Reality (VR) and Augmented Reality (AR) began to gain mainstream traction.

8. **2020s and Beyond: AI, Ambient Interaction, and Ethics**
   1. Machine learning and AI became integral to user experiences, influencing recommendations, personalization, and interaction dynamics.
   2. A growing emphasis on ethical considerations in HCI, focusing on privacy, inclusivity, and avoiding biases.
   3. The concept of ambient interaction, where interactions become seamless with our environment, reducing the need for traditional interfaces.

Through the years, HCI has grown from simple command-line interactions to a complex field that seeks to understand and improve the overall user experience, considering accessibility, usability, aesthetics, and emotional connections. As technology continues to evolve, so too will HCI, as it adapts to new paradigms and user needs.
Distributed Cognition

Main Concepts:

• The theory of distributed cognition, like any cognitive theory, seeks to understand the organization of cognitive systems

• What is a cognitive process?
  o “A cognitive process is delimited by the functional relationships among the elements that participate in it, rather than by the spatial colocation of the elements”

• Three elements of cognitive processes:
  o Cognitive processes may be distributed across the members of a social group
  o Cognitive processes may involve coordination between internal and external (material or environmental) structure
  o Processes may be distributed through time in such a way that the products of earlier events can transform the nature of later events

• Central Hypothesis:
  o Cognitive and computational properties of systems can be accounted for in terms of the organization and propagation of constraints.
  o Integrated framework for research that combines ethnographic observation and controlled experimentation as a basis for theoretically informed design of digital work materials and collaborative workplaces

• We continue with “human computer symbiosis” and try to define tasks that involve coordination amongst multiple cognitive systems.

Direct manipulation

The central ideas seemed to be visibility of the object of interest; rapid, reversible, incremental actions; and replacement of complex command language syntax by direct manipulation of the object of interest—hence the term "direct manipulation."

-Ben Shneiderman, University of Maryland, 1983

The best way to describe a direct manipulation interface is by example. The term direct manipulation was coined by Shneiderman (1974, 1982, 1983) to refer to systems having the following properties:

1. Continuous representation of the object of interest.
2. Physical actions or labeled button presses instead of complex syntax.
3. Rapid incremental reversible operations whose impact on the object of interest is immediately visible. (Shneiderman, 1982, p. 251)

-Edwin L. Hutchins, James D. Hollan, and Donald A. Norman, 1985
Theory-Gulf of Execution & Evaluation (Semantic & Articulatory Distance)

Figure 3. The guls of execution and evaluation. Each gulf is unidirectional: The gulf of execution goes from goals to system state; the gulf of evaluation goes from system state to goals.

Evolving nature, e.g., shoemaker novice (Dourish, 2004)

Ubiquitous Computing

To develop novel uses, often focusing on implicit user input to minimize the intrusion of technology into everyday life. The objective of this application-centered research is to understand how everyday tasks can be better supported, and how they are altered by the introduction of ubiquitous technologies.

- Natural interfaces
- Context-aware applications
- Automated capture and access
- 7*24 continuous interaction

Awareness: a user’s internal knowing and understanding of a situation including other users and the environment that is gained through subtle practices of capturing and interpreting information; and this awareness information partly exists in the environment and is partly provided by awareness technology.

AI opportunities and challenges

Human-Centered AI Opportunities:
(i) automation and human agency,
(ii) system uncertainty and user confidence,
(iii) system’s objective complexity and a user’s perceived complexity

Challenges:
Unclear expectations of AI (existing and future),
Communication between user-centered and technology-driven approaches

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