

History of HCI

Chaklam Sil-pasuwanchai

Historical Context

Introduction

Vannevar Bush's "as we may think" (1945)

Ivan Sutherland's Sketchpad (1962)

Invention of the Mouse (1963)

Xerox Star (1981)

Birth of HCI (1983)

Graphical User Interfaces (GUI)

HCI Research

Resources

History of HCI

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Reminder

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- Phase 0: Team forming due soon

Overview

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- Mackenzie, Chapter 1, **History Context**, Human Computer Interaction: An Empirical Research Perspective, 1st ed. (2013)
- Shneiderman, **Direct Manipulation: A Step Beyond Programming Languages** (1983)
- Macintosh 128K,
https://en.wikipedia.org/wiki/Macintosh_128K

Early Days

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- In 1940s, computers are too **precious**, too **complicated**
- Only selected scientists/engineers were allowed to access
 - Most **non-user-friendly** tasks like *grep that requires regular expression* or *vi's editor that lack feedback when switching mode* is *NOT* an issue, because these people are the one **who invent themselves!**
- But by 1980s, everything changes. Computers become not only powerful, but **accessible by anyone!** HCI becomes a very important aspect

Interdisciplinary Nature of HCI

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- HCI owes a lot to older disciplines
- The most central is *human factors* or *ergonomics*
 - ACM CHI named after
 - Concerns **human capabilities, limitations, and performance** (but NOT user experience)
- HCI evolves and becomes very broad in scope.
 - Draws interests from many disciplines - psychology, design, engineering, etc.

Notable events in the history of HCI

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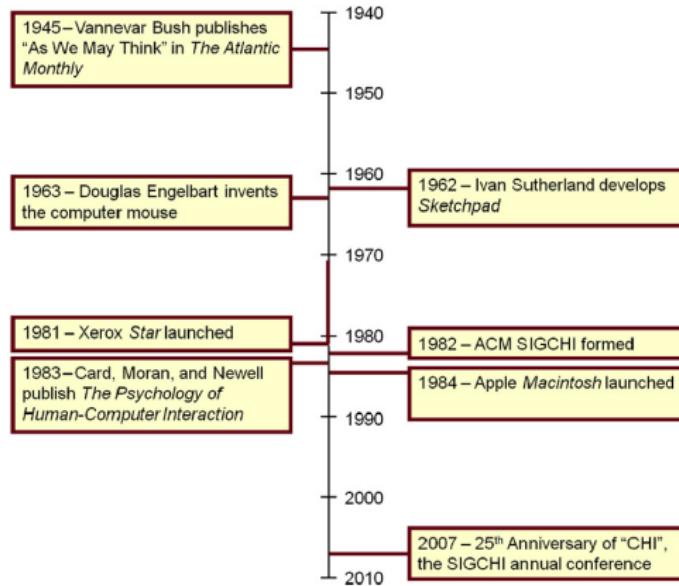


FIGURE 1.1

Timeline of notable events in the history of human-computer interaction HCI.

Figure: Source: Fg 1.1 (Mackenzie)

Who is Vannevar Bush

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Figure: Source: Figure 1.2 (Mackenzie)

- Bush published a **prophetic essay** “As We May Think” in Atlantic Monthly in July, 1945 (cited 4000+ times)
- Bush was U.S. government’s Director of the Office of Scientific Research and scientific advisor to Roosevelt
- During WWII, he leads 6,000 scientists in the application of science to warfare

Vannevar Bush's Essay (1945)

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HCI Research Resources

- His essay concerns the **dissemination, storage, and access** to scholarly knowledge
- Raises the problem of **information overload** and **difficulty** in accessing knowledge
- Proposes *memex*, which contains a key concept of *associative indexing* - selecting one item retrieves other relevant (sounds a lot like **hyperlink** today!)
- His brilliant foretelling are the beginning of many inspirations to follow (just like how *Doraemon* inspires engineering culture in Japan)

Ivan Sutherland's Sketchpad (1962)

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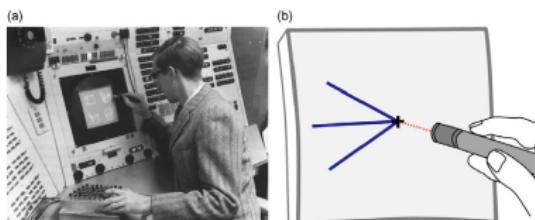


FIGURE 1.3

(a) Demo of Ivan Sutherland's Sketchpad. (b) A light pen dragging ("rubber banding") lines, subject to constraints.

Figure: Source: Fg 1.3 (Mackenzie)

- Developed *Sketchpad* as part of his PhD research at MIT
- Sketchpad was a graphic system supported the **drawings** of shapes and lines using a **light pen**
- <https://www.youtube.com/watch?v=YB3saviItTI>

Direct Manipulation

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Sketchpad - the first *direct manipulation* interface

- **Visibility of objects** - continuous representations
- **Incremental action** - action such as mouse selection
- **Rapid feedback** - immediate feedback
- **Reversibility** - can be easily undo
- **Exploration** - permits discovery and learning
- **Syntactic correctness of all actions** - menus and buttons
- **Replacing language with action** - directly manipulating

Douglas Engelbart's mouse (1963)

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Resources

- Mouse **symbolizes** the emergence of HCI
- Invented by Douglas Engelbart in 1963
- The light pen was not so usable as **user held the pen in the air which is tiring.**
- Device besides the keyboard makes sense

Engineering of the Mouse

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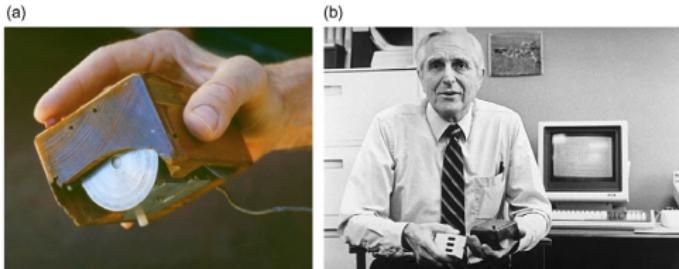


FIGURE 1.4

(a) The first mouse. (b) Inventor Douglas Engelbart holding his invention in his left hand and an early three-button variation in his right hand.

Figure: Source: Fg 1.4 (Mackenzie)

- The first prototype included **one button** and **two wheels** positioned at right angles to each other, marking xy
- A selection button at the user's index finger.
- Later, Engelbart developed a three-button version

HCI First User Study

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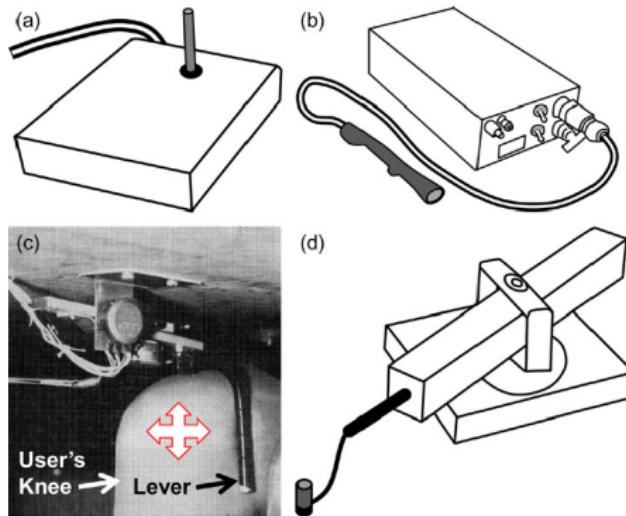


FIGURE 1.5

Additional devices used in the first comparative evaluation of a mouse: (a) Joystick. (b) Lightpen. (c) Knee-controlled lever. (d) Grafacon.

(Source: a, b, d, adapted from English et al., 1967; c, 1967 IEEE. Reprinted with permission)

Figure: Source: Fg 1.5 (Mackenzie)

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HCI Research

Resources

- First ever “user study”
- **Selecting and manipulating text**
- Compared **mouse** with
 - **Light pen**
 - **Joystick**
 - **Knee-controlled lever**
 - **Grafacon**
- Two metrics
 - **Access time** - hand from keyboard to device
 - **Motion time** - onset of cursor to the final selection

HCI First User Study

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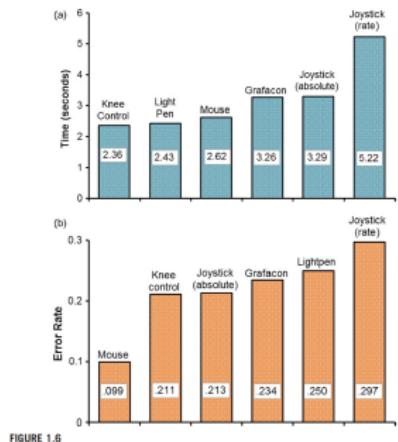


FIGURE 1.6
Results of first comparative evaluation of a computer mouse: (a) Task completion time in seconds. (b) Error rate as the ratio of missed selections to all selections.
(Adapted from English et al., 1967)

Figure: Source: Fg 1.6 (Mackenzie) - Access time + Motion time = Task Completion time

- 13 participants (8 experienced and 3 inexperienced)
- **A character target appeared,** with surrounding distractors
- The trial begin with a spacebar hit, a cursor will appear, and participant move his or her hand to the input device and move the cursor to the target, and make selection
- Ten trials / device

HCI First User Study

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Resources

- Although **Knee-controlled lever** is best in terms of time, since Knee-controlled has zero access time, the authors argued that considering only motion time, Knee control does not perform well
- **Light pen** performs slightly better than **mouse**, but because of possible fatigue, mouse will be better in the long run
- **Mouse** is the clear winner in terms of accuracy

Discussion

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Resources

- Why require **distractors**?
- Why require a **spacebar hit**?
- Why require **10 trials** and not 1 or 2? How to determine 10?
- Why not only measure **time**, but also **errors**?
- Why a mix of **experienced** and **inexperienced**? and why 13 participants?
- How do you choose your **comparison tools**? Why light pen or joystick, for example? Why command line is not being compared?
- Do you think the **order of factor** matters? For example, always do light pen first.

HCI First User Study

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HCI Research

Resources

- This evaluation marks an important milestone in HCI
 - Participants
 - Apparatus
 - Cautious procedure
 - Input methods → **Independent Variable (IV)**
 - Time and error rate → **Dependent Variables (DV)**
 - **Counterbalancing** procedure
 - No **statistical analysis** but is excusable

5-mins break

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At the NCC (1981)

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Figure: Source: Fig 1.7 (Mackenzie)

- **National Computer Conference (NCC)** was the yearly conference for computing. Gathered major players like IBM. The attendance exceeded 100,000
- In May 1981 at NCC, **Xerox** attracted a lot of buzz regarding their **Xerox 8100 Star Information System** that supports
 - Windows, icons, menus and a pointing device (WIMP)
 - Direct manipulation and what-you-see-is-what-you-get (WYSIWYG) interaction

Star

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<https://www.youtube.com/watch?v=w0Am7EiFNu8>

Star's Desktop Metaphor

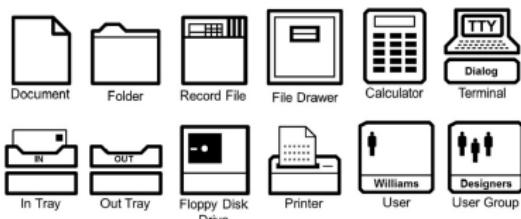


FIGURE 1.8

Examples of icons appearing on the Xerox Star desktop.

(Adapted from Smith, Irby, Kimball, and Harslem, 1982)

Figure: Source: Fg 1.8 (Mackenzie)

- One novel feature of the Star was the use of *desktop metaphor*
- **Metaphors** are important in HCI. It allows almost no learning in understanding how to use systems

Star's File Systems

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- To make the system usable, Star focus on **interactions with files, rather than program**. Thus, when user clicked a file, the file should automatically open the associated program
- All these programs are hidden from the users, thus users are not burdened with lots of programs, but instead, work with the more familiar “file-system”

Star's Direct Manipulation

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- Supports point-select interaction
- Direct manipulation in Star supports **multiple input channels**, and each channel has a direct correspondent of the task - **display brightness or sound** use *slider*, **font size** or **family** use *menu item*
- These direct manipulation channels can be done **in any order** - giving users the sense of **control**
- To implement direct manipulation, systems shifted from *sequential programming* to *event-driven programming*

Star's GUI

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- To design GUI, PARC lead by Alan Kay developed a new object-oriented programming language known as *Smalltalk* and a software architecture known as Model-View-Controller
- This GUI takes almost 10 years to develop, where a lot of the time was spent on inventing the architecture

Star's commercial failure and Apple II

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- In the end, Star was not so successful
- 3 reasons were identified
 - ① Star was not really a *personal* computer. PARC viewed Star as a beefed up version of a terminal connected to a central server.
 - ② Star architecture was “closed” - could only run Xerox applications
 - ③ Expensive - \$16,000
- Anyhow, the *Apple II*, introduced in 1977, was hugely successful. The original retail price was \$1,298 featuring the same components as Star and supports 4KB of ram (but without mouse) thus require typing to launch programs
 - the platform for VisiCalc, the first spreadsheet application which sells over 700,000 copies and become known as the first “killer app”

Other personal computers

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- Around the same time as Apple II, there were other personal computers include *PET*, *VIC-20*, *Commodore 64*, and *TRS-80*
- However, they were unsuccessful because of their **terrible** user interface - worked mostly with traditional command-line
- Technical users love these systems but that's it. These systems did not go far.

Birth of HCI (1983)

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HCI Research

Resources

- 1983 was possibly among the most notable milestone of HCI and were defined by three important feats:
 - ① the first **ACM SIGCHI conference**
 - ② publication of Card, Moran, and Newell's *The Psychology of Human Computer Interaction (1983)*
 - ③ arrival of **Apple Macintosh** in January 1984

(1) First ACM SIGCHI Conference (1983)

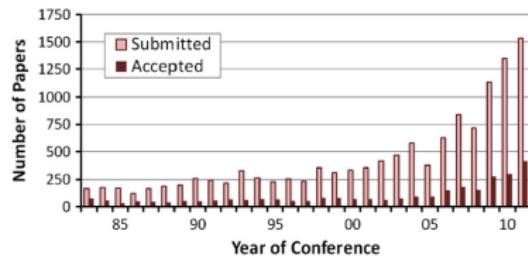


Figure: Source: Fg 1.9 (Mackenzie)

- The **first SIGCHI conference** was held in Boston with 59 technical papers presentations.
- Since then, SIGCHI is widely known as CHI (k sound) and has attendance of about 4,000
- CHI publication has since becomes the standard of HCI academia

(2) The Psychology of Human-Computer Interaction (1983)

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- Card and Moran arrived at PARC in 1974 and seek to **apply the knowledge of human sensory, cognitive and motor systems to HCI.**
- This knowledge was eye-opening where *Model Human Processor* (MHP) was proposed
- The MHP had an **eye** and a **ear** (for sensory input to a perceptual processor), a **brain** (with a cognitive processor, short-term memory, and long-term memory), and an **arm**, **hand**, and **finger** (for motor responses)
- MHP is the first to show that **human can be modeled**

Model Human Processor

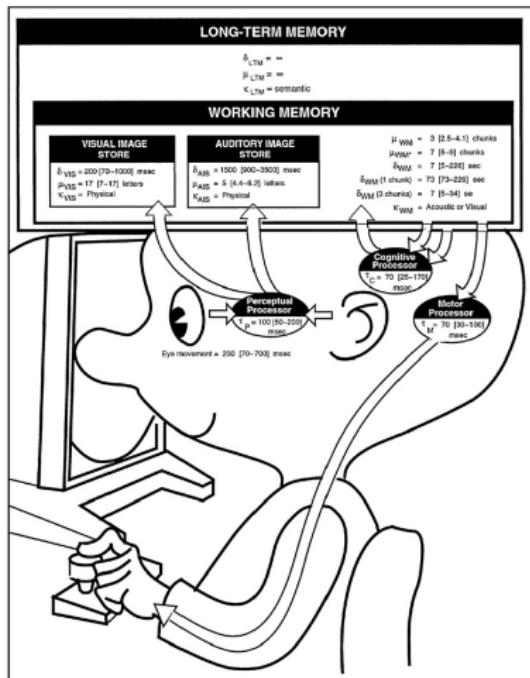


Figure: Source: Fg 1.11 (Mackenzie)

(3) Launch of the Apple Macintosh (1984)

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Figure: Source: Fg 1.12 (Mackenzie)

<https://www.youtube.com/watch?v=3vq9p00T08I>

Launch of the Apple Macintosh (1984)

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- Apple Macintosh was launched in January 22, 1984, selling at \$2,495. Sold 70,000 unit by May 3, 1984
- Introducing **one-button mouse**
- Used **MacOS - icons-based**
- Featured 128KB Ram, and for storage, it introduced **3.5 inch disks** that stored 400K (later 800K then 1.44MB), enough to store application
- Bundled with System, Finder, MacPaint, MacWrite, MacProject, MacTerminal, and Microsoft Word

Growth of HCI and GUIs

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- Microsoft was a latecomer in GUIs. Early version of Microsoft *Windows* appeared in 1985, but it was not until *Windows 3.0* (1990) and *Windows 3.1* (1992) that Microsoft became a real threat to Mac
- Major **universities** offered courses in HCI
- **Companies** also paid great effort in their HCI departments
- **SIGCHI conferences** remain the main driver

Early Days HCI research

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- A classic example of early days is on the **design of menus.**
 - **Speed:** *Marking menus* -
<https://www.youtube.com/watch?v=dth9GdFSQaw>
 - **Order:** How menu items should be ordered?
Alphabetically or by function?
 - **Metaphor:** Is access improve if an icon is added to the label?
 - **Depth vs. Breadth:** Go deeper or wider?
 - **Organization:** Which menu to put "Indent Text" ?
- **Spirit of HCI research** is similar to above questions

Online Resources

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- ACM Digital Library - <http://dl.acm.org>
- HCI pioneers - <https://hcipioneers.wordpress.com/>
- ACM Interactions - <http://interactions.acm.org/>
- HCI Bibliography - <http://www.hcibib.org/>
- Textbook - <http://www.yorku.ca/mack/HCIbook/>
- Human Computer Interaction - **Brief Intro by John Carroll**, <https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-edition/human-computer-interaction-brief-intro>

Readings For Next Week

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- Norman, **The Design of Everyday Things**, Revised and Expanded ed. (2013)
- Shneiderman, **Designing the User Interfaces**, 6th ed. (2016).
- Steve, **Don't Make Me Think: A Common Sense Approach to Web Usability**, 2nd ed. (2006).
- Keith, Chapter 4, 6, 7, **Human Computer Interaction Course Notes**, Graz University (2017) -
<https://courses.isds.tugraz.at/hci/hci.pdf>
- Jeff, **Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines**, 2nd ed. (2014).

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Questions