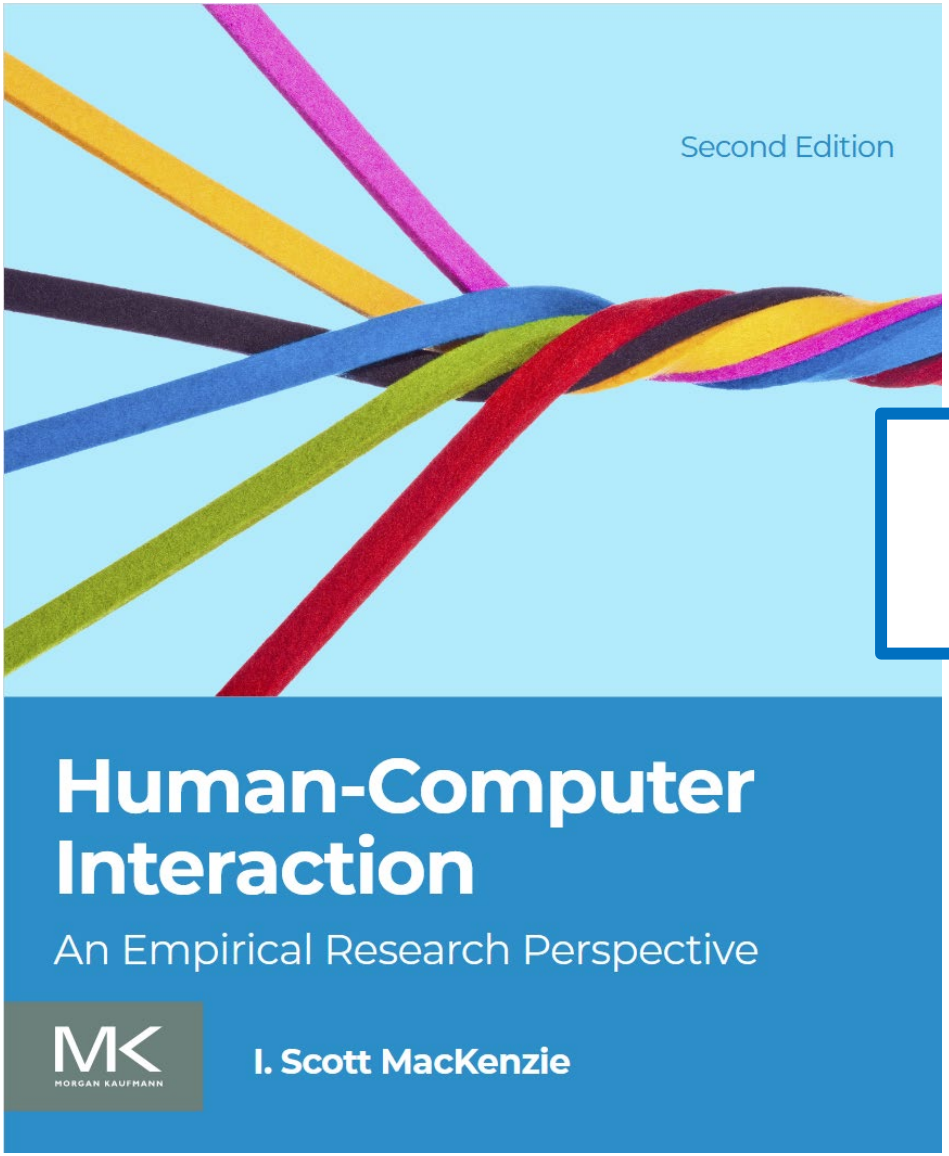
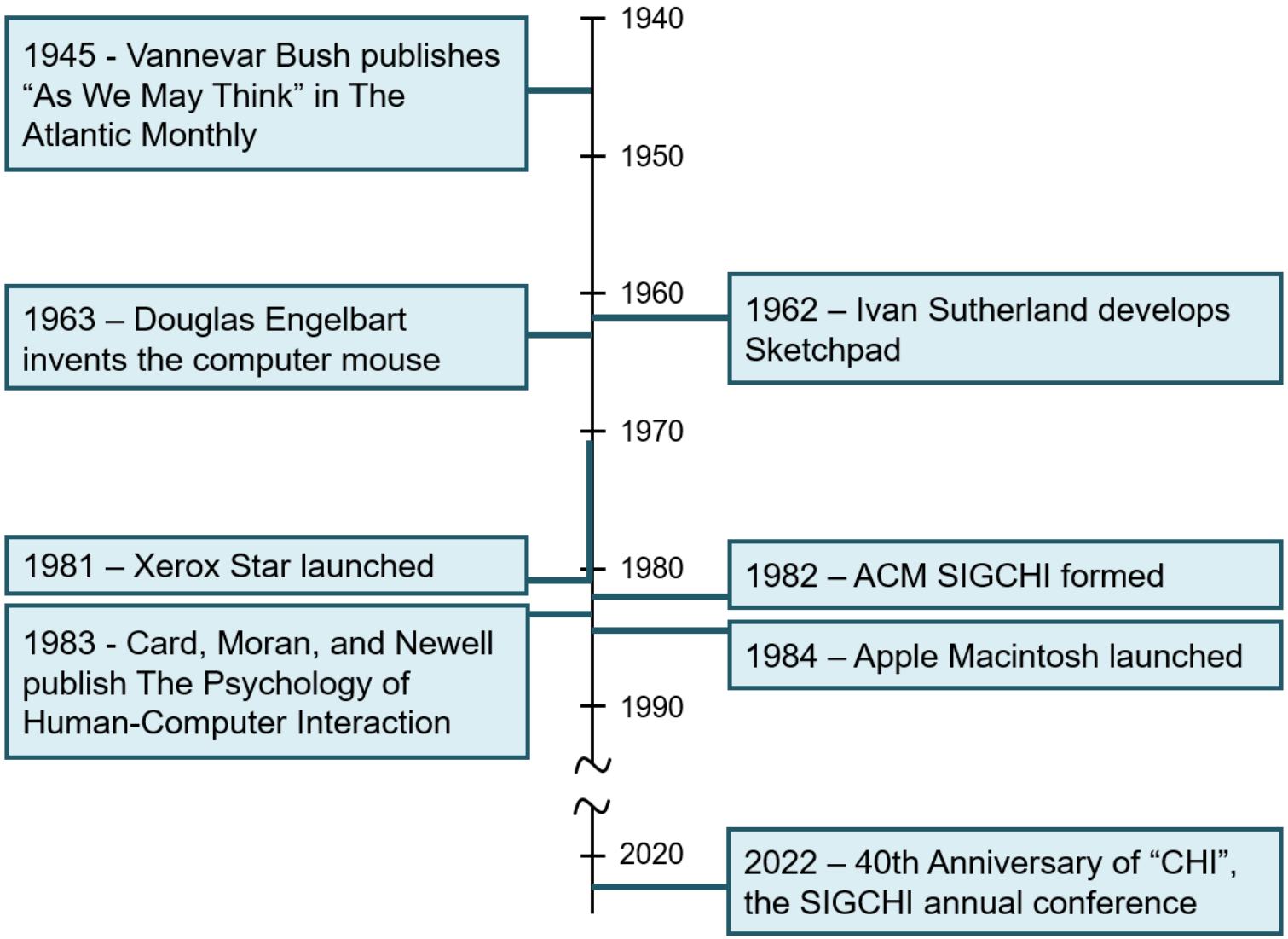
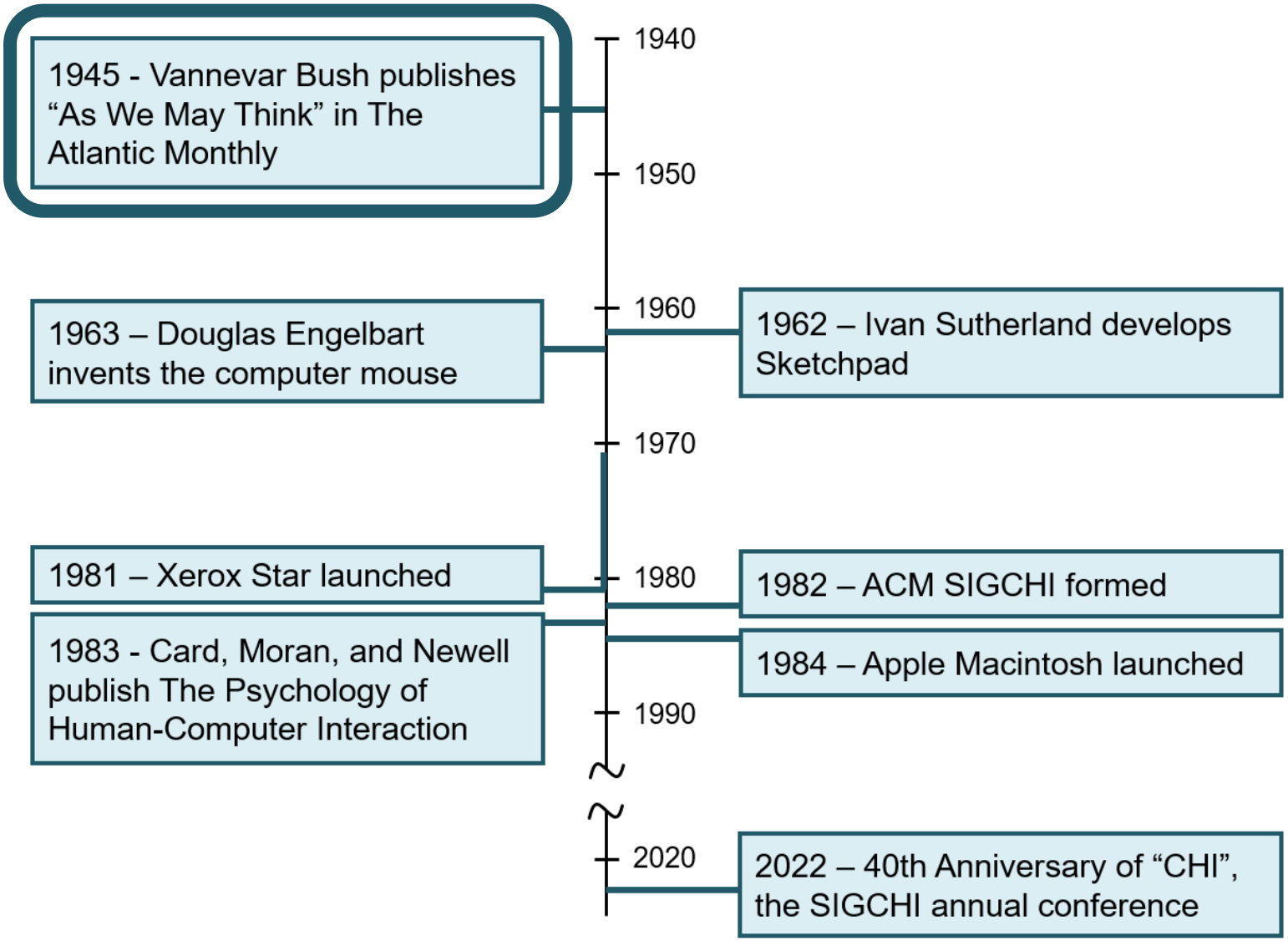


Chapter 1
Historical Context

Timeline of Significant Events

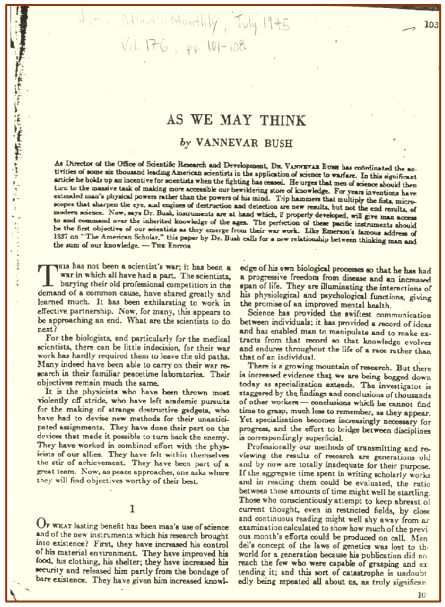


Timeline of Significant Events



"As We May Think"

- Essay published by Vannevar Bush in *The Atlantic Monthly* in 1945[1]
- Highly influential essay with 10,000+ citations on Google Scholar
- Reprinted in 1996 in ACM's interactions (next slide)
- Bush was Director of the Office of Scientific Research under President Franklin D. Roosevelt
- It was 1945! Bush's focus was on the possibilities that lay ahead in peacetime in applying science to more lofty and humane pursuits



AS WE MAY THINK

by VANNEVAR BUSH

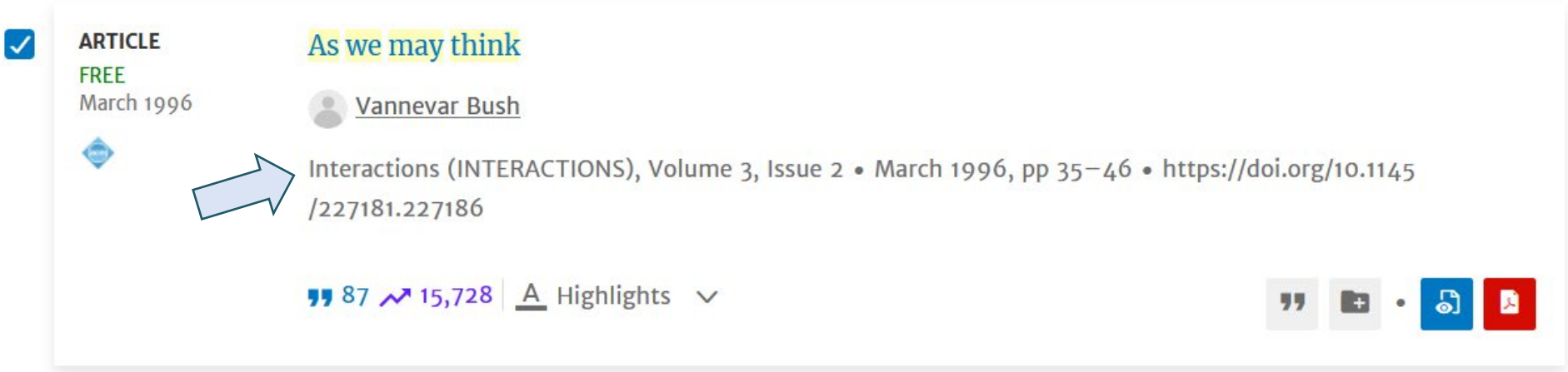
As Director of the Office of Scientific Research and Development, Dr. Vannevar Bush has coordinated the activities of some six thousand leading American scientists in the application of science to warfare. In this significant article he holds up an incentive for scientists when the fighting has ceased. He urges that men of science should then turn to the massive task of making more accessible our bewildering store of knowledge. For years inventions have extended man's physical powers rather than the powers of his mind. Trip hammers that multiply the fists, microscopes that sharpen the eye, and engines of destruction and detention are new results, but not the end results, of modern science. Now, says Dr. Bush, instruments are at hand which, if properly developed, will give man access to and command over the inherited knowledge of the ages. The perfection of these pacific instruments should be the first objective of our scientists as they emerge from their war work. Like Emerson's famous address of 1837 on "The American Scholar," this paper by Dr. Bush calls for a new relationship between thinking man and the sum of our knowledge. — THE EDITOR

1

[1] V. Bush, As we may think, The Atlantic Monthly 176 (1) (July 1945) 101–108, reprinted in the ACM's Interactions (March 1996) 35–46.

Reprinted in…

ACM DL DIGITAL LIBRARY

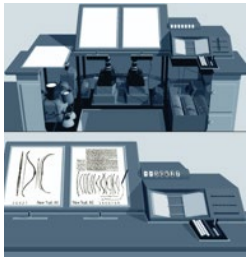


Click here

http://dl.acm.org/citation.cfm?id=227186

memex

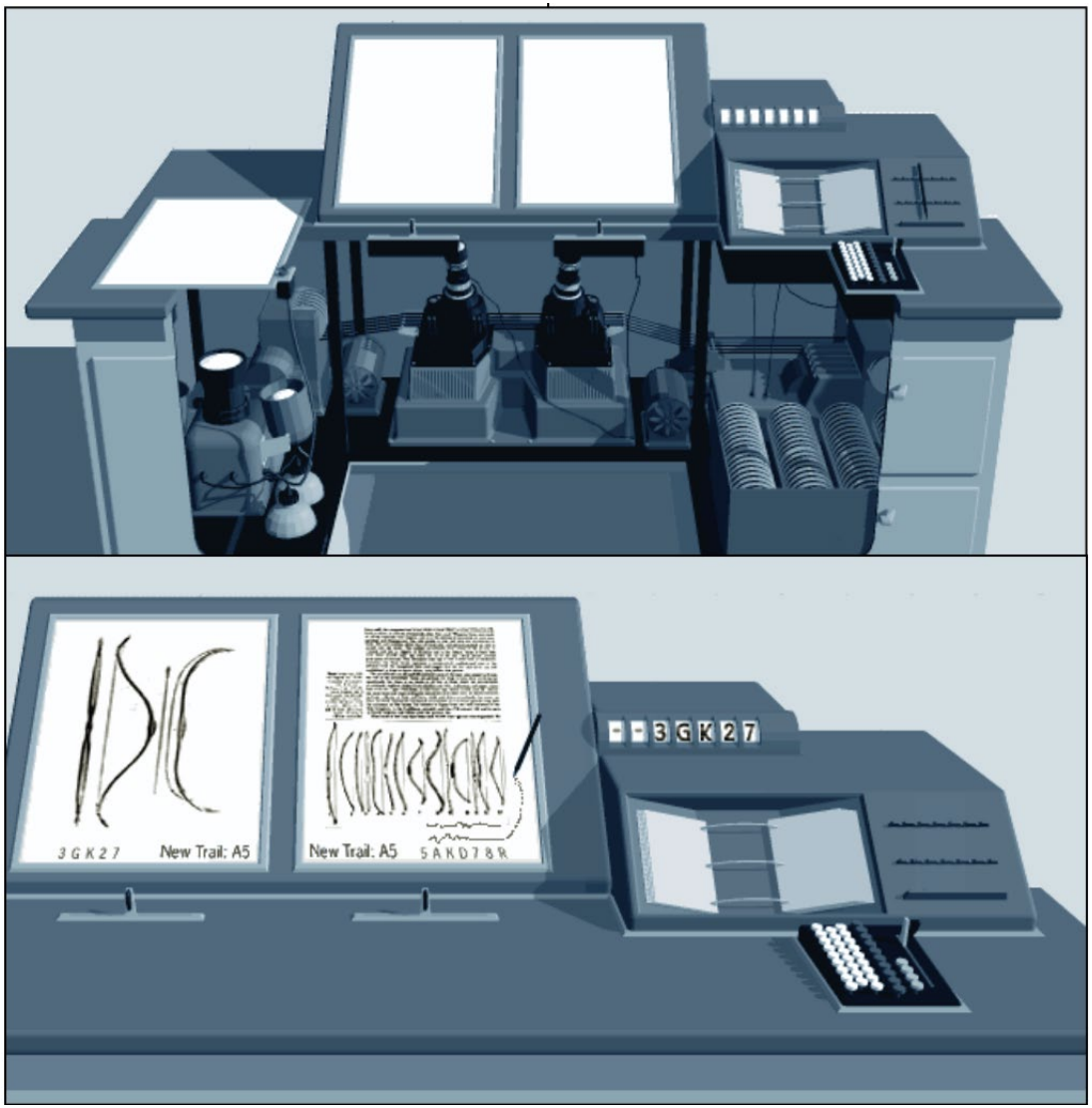
- To address "information overload," Bush proposed *memex* → a detailed concept (never built)



(next slide)

- memex featured *associative indexing*, whereby points of interest are connected and joined so that selecting one item automatically selects another:
  - *When the user is building a trail, he names it, inserts the name in his code book, and taps it out on his keyboard*
- Sound familiar? (hypertext, World Wide Web)
- Bush's inspiration for memex was… (review the article or see **HCI:ERP2e**)

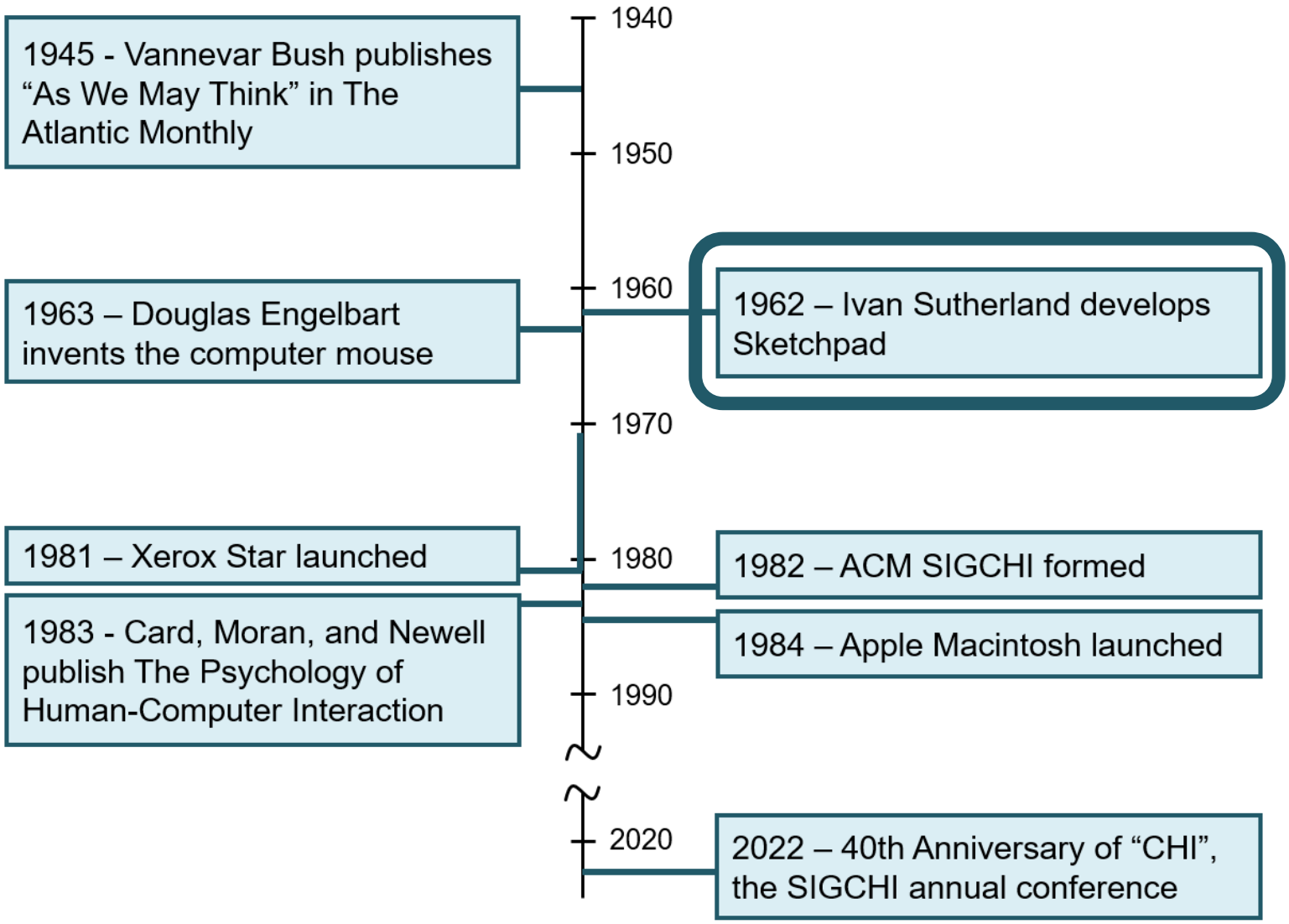
memex Concept (of the concept!)



?

Source: ACM *interactions* reprint, 1996, page 42

Timeline of Significant Events



Sketchpad (1962) by Ivan Sutherland

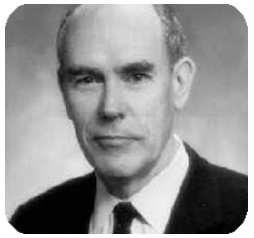
Ivan Sutherland's Sketchpad is one of the most influential computer programs ever written by an individual, as recognized in his citation for the Turing award in 1988.[1]

- *Sketchpad* was part of Sutherland's PhD research at MIT in the 1960s
- In Sutherland's words:

  Heretofore, most interaction between man and computers has been slowed by the need to reduce all communication to written statements that can be typed. In the past we have been writing letters to, rather than conferring with, our computers.[2]

- *Sketchpad* → interactive graphics
- Input device: light pen
- Setup: 

Next slide



Ivan Sutherland

SKETCHPAD
A MAN-MACHINE GRAPHICAL COMMUNICATION SYSTEM*

Ivan E. Sutherland
Consultant, Lincoln Laboratory**
Massachusetts Institute of Technology

I. INTRODUCTION

The Sketchpad system makes it possible for a man and a computer to converse rapidly through the medium of line drawings. Heretofore, most interaction between man and computers has been slowed down by the need to reduce all communication to written statements that can be typed; in the past, we have been writing letters to rather than conferring with our computers. For many types of communication, such as describing the shape of a mechanical part or the connections of an electrical circuit, typed statements can prove cumbersome. The Sketchpad system, by eliminating typed statements (except for legends) in favor of line drawings, opens up a new area of man-machine communication.

AN INTRODUCTORY EXAMPLE

To understand what is possible with the system at present let us consider using it to draw the hexagonal pattern in Figure 4. We will issue specific commands with a set of push buttons, turn functions on and off with switches, indicate position information and point to existing drawing parts with the light pen, relate and magnify picture parts by turning knobs, and observe the drawing on the display system. This equipment as provided at Lincoln Laboratory's TX-2 computer[1] is shown in Figure 1. When our drawing is complete it may be inked on paper, as were all the drawings in this paper, by a PACE plotter.[2]

If we point the light pen at the display system and press a button called "draw," the computer will construct a straight line segment which stretches like a rubber band from the

Figure 1. TX-2 operating area—Sketchpad in use. On the display can be seen part of a bridge similar to those of Figure 15. The Author is holding the light pen. The push buttons "draw," "move," etc., are on the box in front of the Author. Part of the bank of toggle switches can be seen behind the Author. The size and position of the part of the total picture seen on the display are controlled by the four black knobs just above the tables.

* This paper is based in part on a thesis submitted to the Department of Electrical Engineering, M.I.T., in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.
** Operated with the support of the U.S. Army, Navy, and Air Force.

329

[1] A. Blackwell and K. Rodden, preface to reprint of Sutherland's PhD thesis (2nd ed., 2003).
[2] I.E. Sutherland, Sketchpad: a man-machine graphical communication system, in: Proceedings of the AFIPS Spring Joint Computer Conference, vol. 23, ACM, New York, 1963, pp. 329–346.

Sketchpad Setup

Viewable on…

Click here

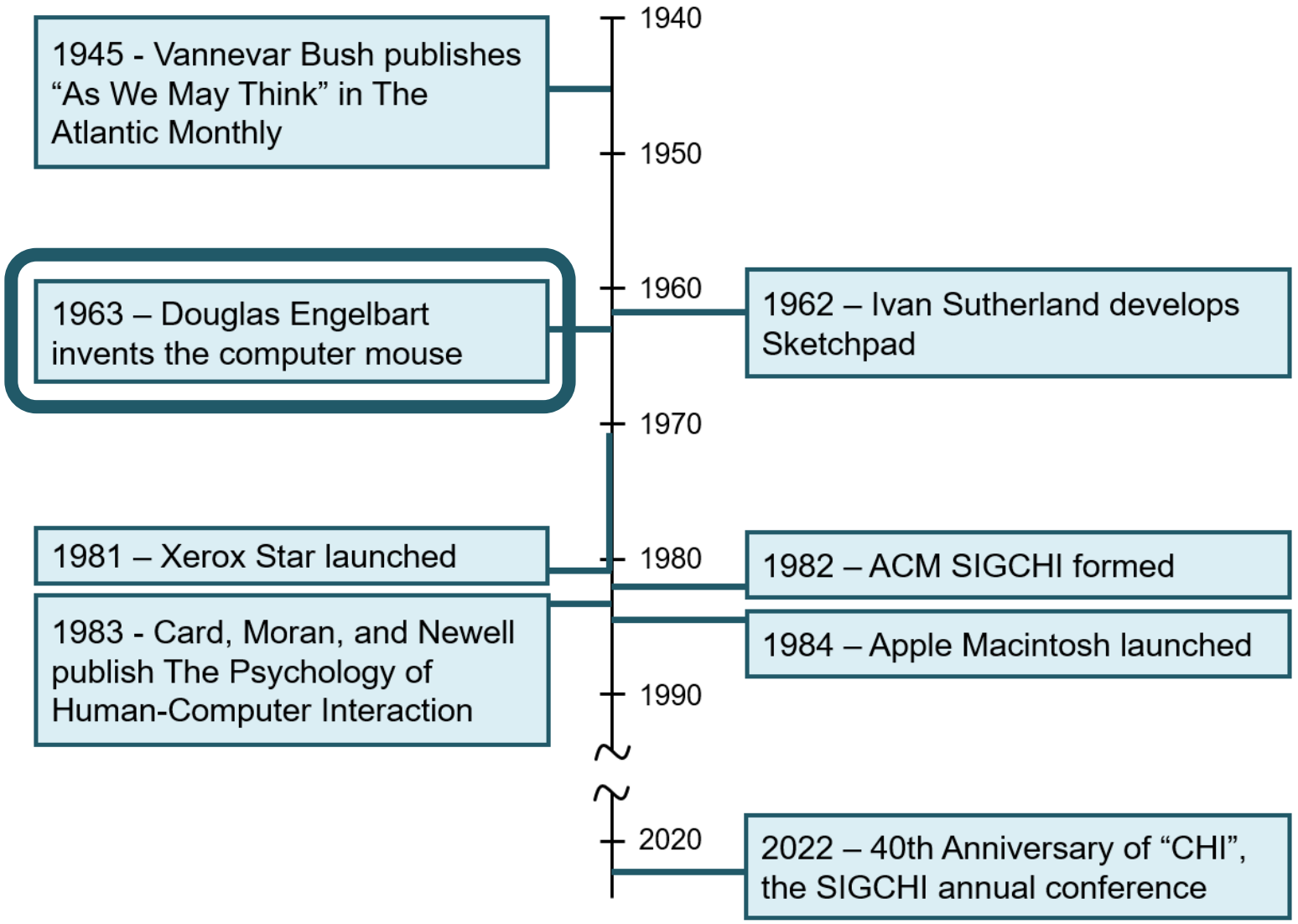
https://www.youtube.com/watch?v=6orsmFndx_o

Direct Manipulation

- Sketchpad features *direct manipulation*:
  - Visibility of objects
  - Incremental action and rapid feedback
  - Reversibility
  - Exploration
  - Syntactic correctness of all actions
  - Replacing language with action
- Term coined by Ben Shneiderman[1]

[1] B. Shneiderman, Direct manipulation: a step beyond programming languages, IEEE Computer 16 (8) (Aug. 1983) 57–69.

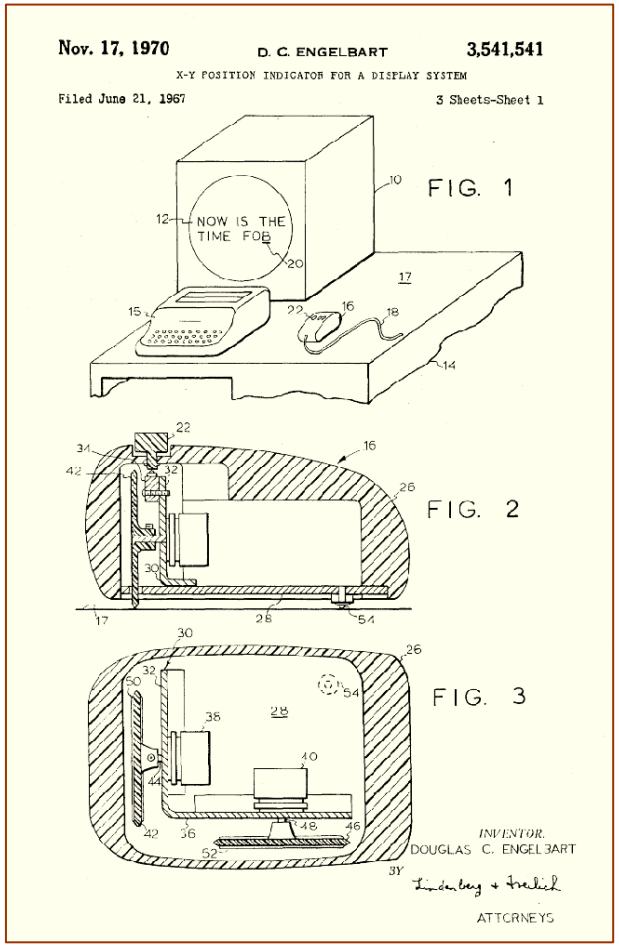
Timeline of Significant Events



Invention of the Mouse
Doug Engelbart (1963)

- The mouse, above all other devices, defines the emergence of HCI
- Developed in the early 1960s by Doug Engelbart at SRI (Stanford Research Institute)
- Allows point-select operations with the user's arm supported on a desktop
- Avoids fatigue of holding a light pen in the air in front of a display
- Patent filed in 1967, issued in 1970[1]
- No commercial mouse until 1981
- First mouse: 

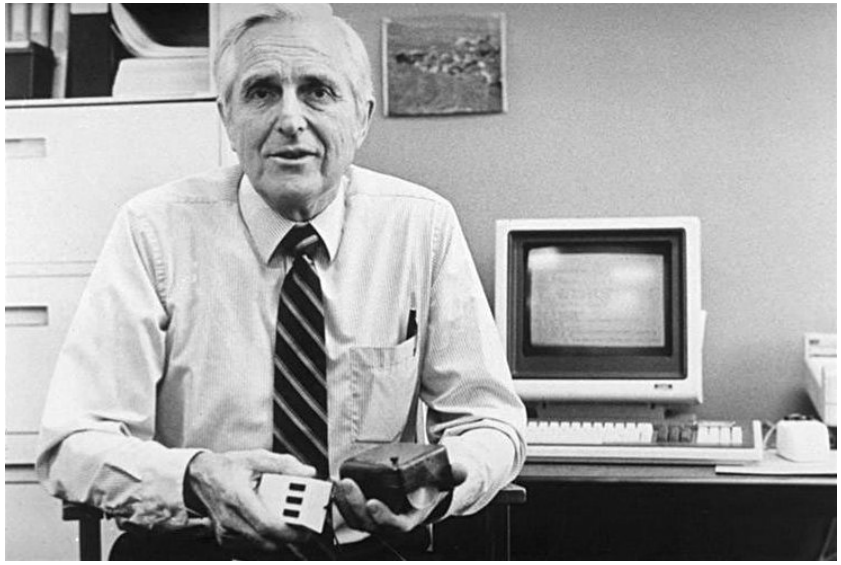
Next slide



[1] D. Engelbart, X-Y position indicator for a display system (U.S. Patent 3,541,541), 1970.

The First Mouse
(and inventor Doug Engelbart)

The First Mouse (prototype only)



Doug Engelbart, recipient of
- ACM Turing Award (1997)
- ACM SIGCHI Lifetime Achievement Award (1998; first recipient).

Read About Doug Engelbart at…

Click here

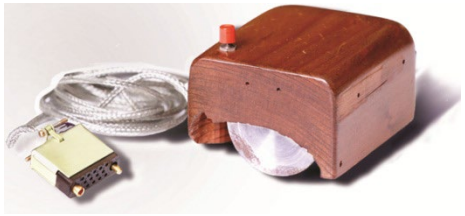
https://en.wikipedia.org/wiki/Douglas_Engelbart

Click here

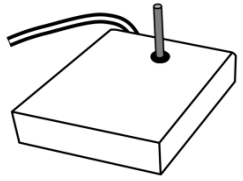
http://www.dougengelbart.org/

HCI's First User Study[1]

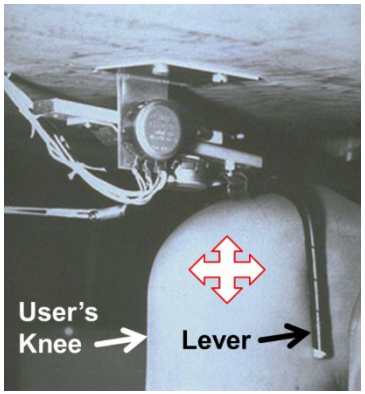
- A comparative evaluation of…



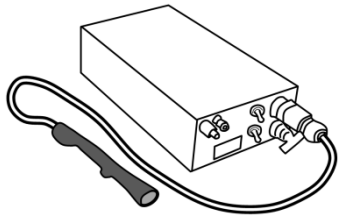
Mouse



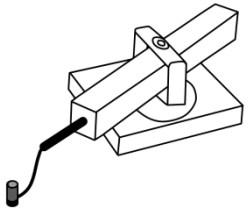
Joystick



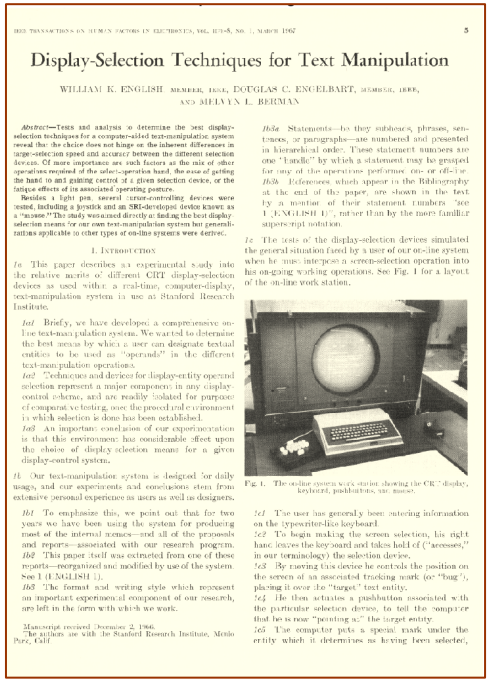
Knee-controlled lever



Lightpen



Grafacon



Display-Selection Techniques for Text Manipulation

WILLIAM K. ENGLISH, DOUGLAS C. ENGELBART, AND MELVYN L. BERMAN

Click here

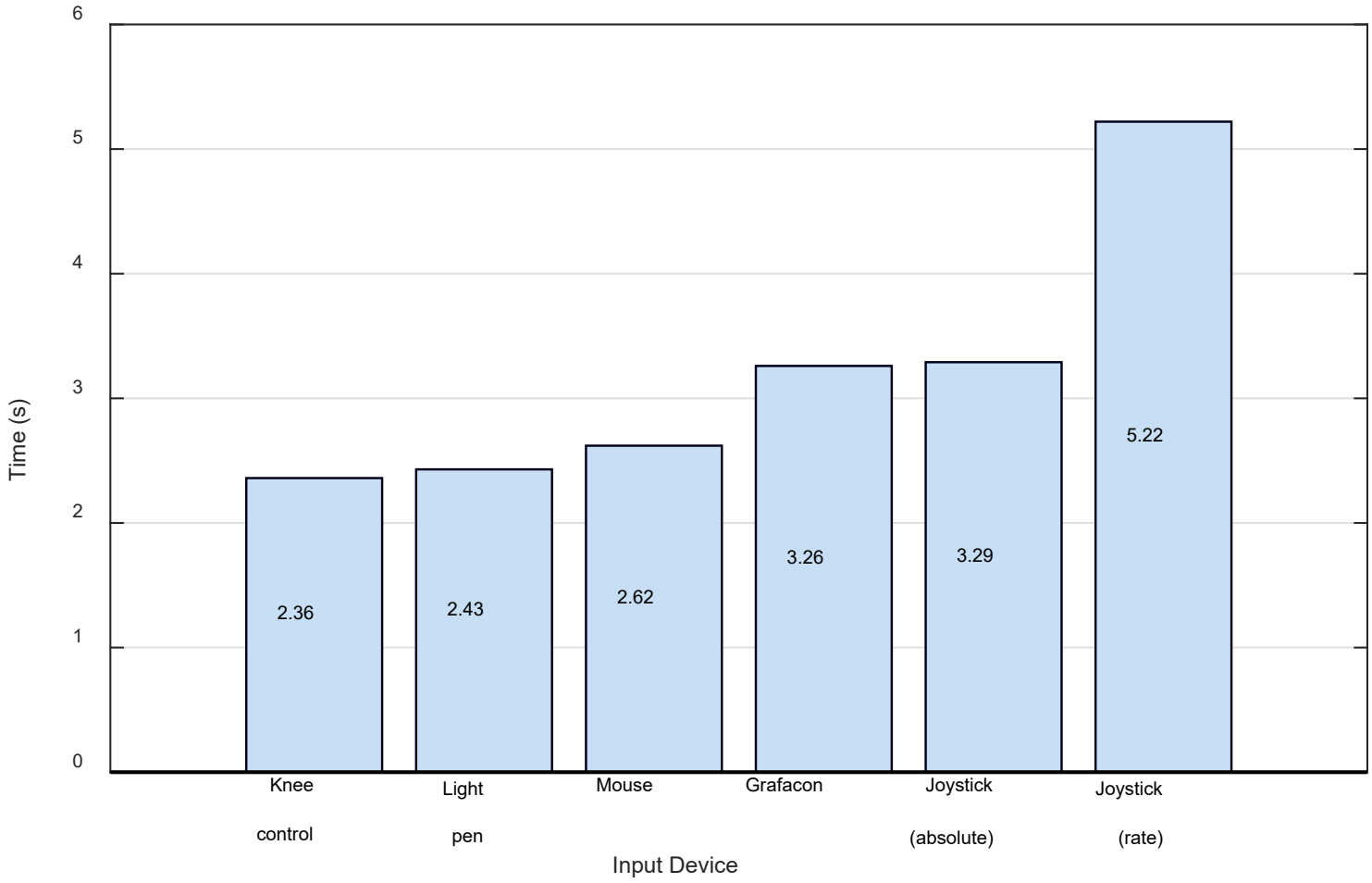
http://ieeexplore.ieee.org

[1] W.K. English, D.C. Engelbart, M.L. Berman, Display selection techniques for text manipulation, IEEE Transactions on Human Factors in Electronics HFE-8 (1) (1967) 5–15.

Experiment Design

- Participants: 13
- Independent variable
  - "Input method" with six levels: mouse, light pen, Grafacon, joystick (position-control), joystick (rate-control), knee-controlled lever
- Dependent variables
  - Task completion time, error rate
  - (Note: task completion time = access time + motion time)
- Within-subjects, counterbalanced
- Task:
  - Press spacebar, acquire device, position cursor on target, select target

Results (1)

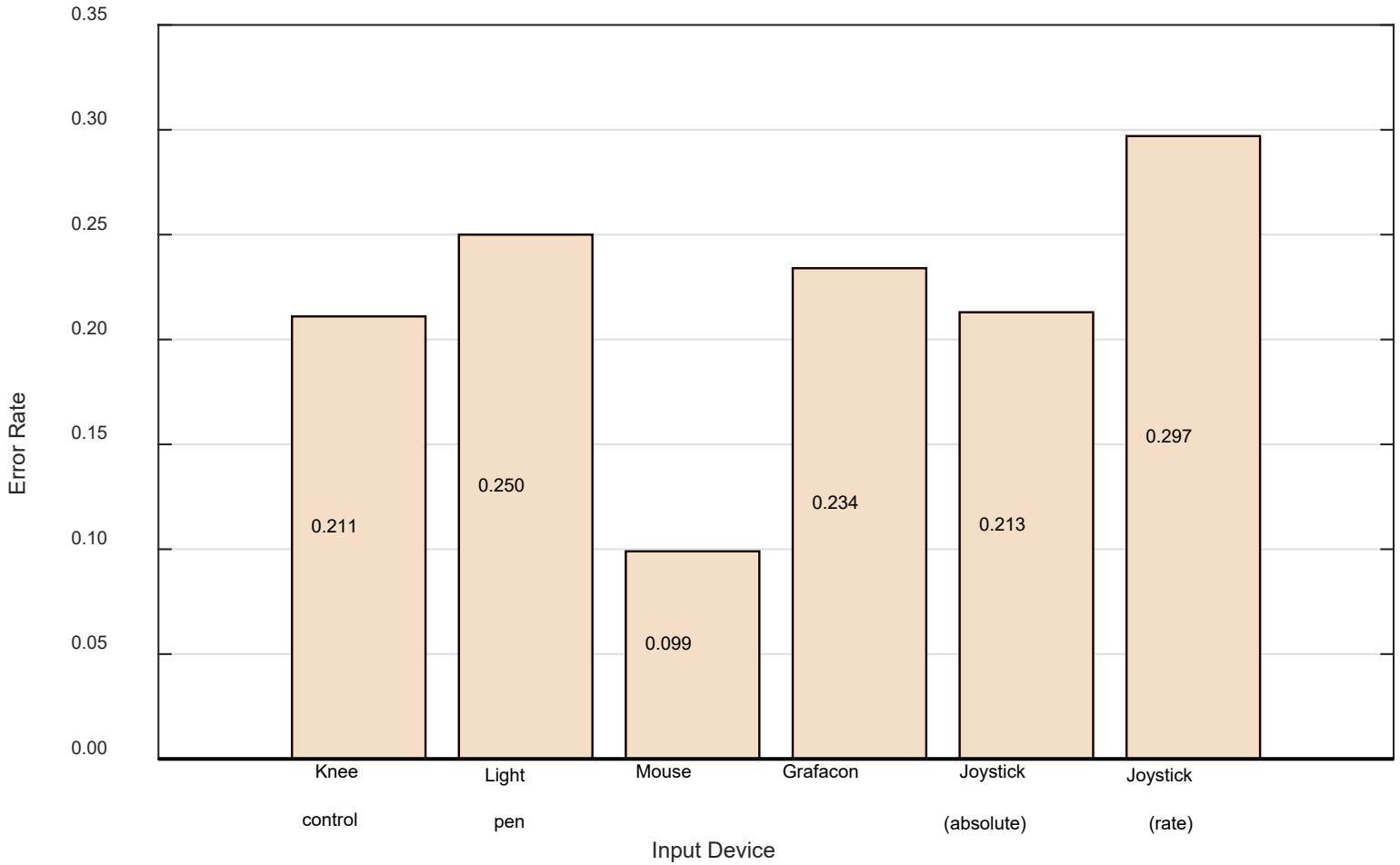


Notes:

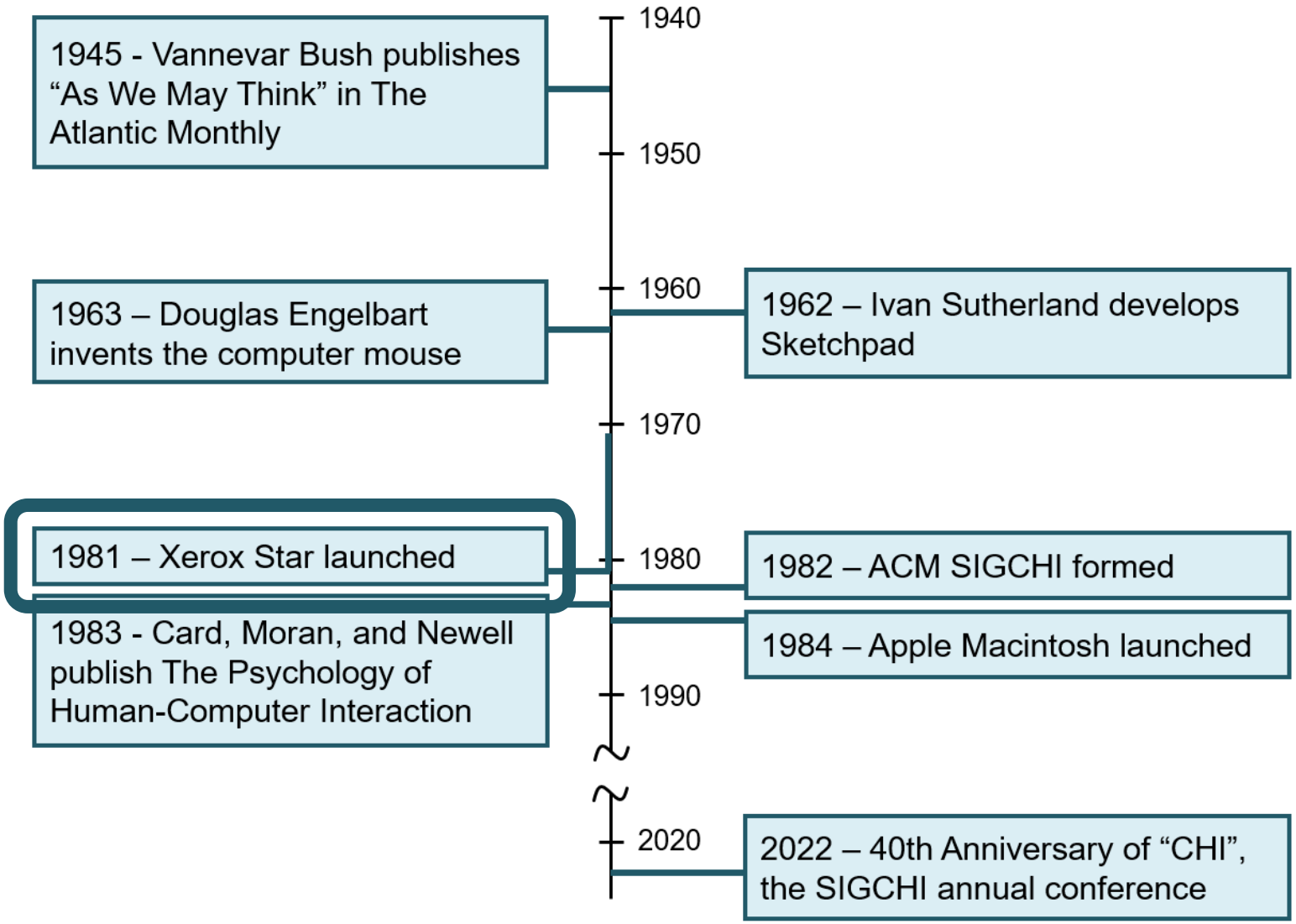
[1] Access time with the knee-controlled lever was zero (since the device is always “acquired”).

[2] Light pen use is fatiguing, since the user’s arm is held in the air in front of the display.

Results (2)


0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Error Rate
0.211
0.250
0.099
0.234
0.213
0.297
Knee control
Light pen
Mouse
Grafacon
Joystick (absolute)
Joystick (rate)
Input Device

Timeline of Significant Events



Xerox *Star* (1981)

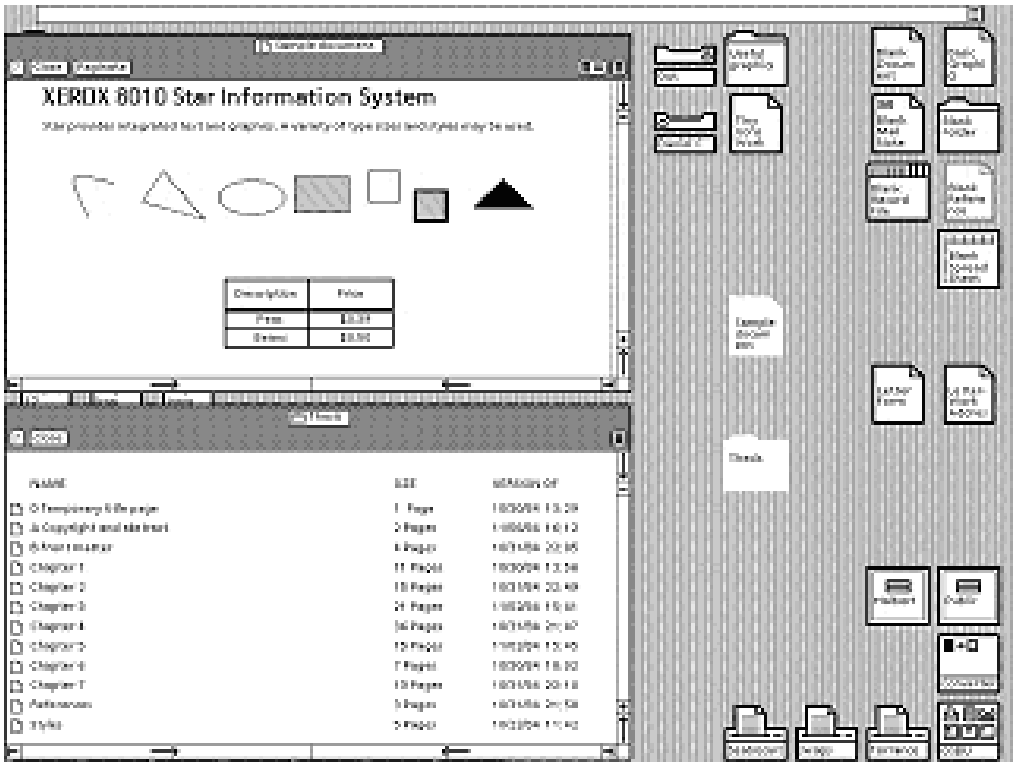
- Launched in Chicago at the 1981 NCC[1]
- First commercially released computer system with a graphical user interface (GUI) and point-select interaction using a mouse
- Ground-up, new concepts; 10 years to develop
- Watershed moment in computing
- However, the Star was an expensive, closed,[2] network-based office computer (i.e., not personal)
- In the end, not successful
- The Star and its GUI: 

Next slide

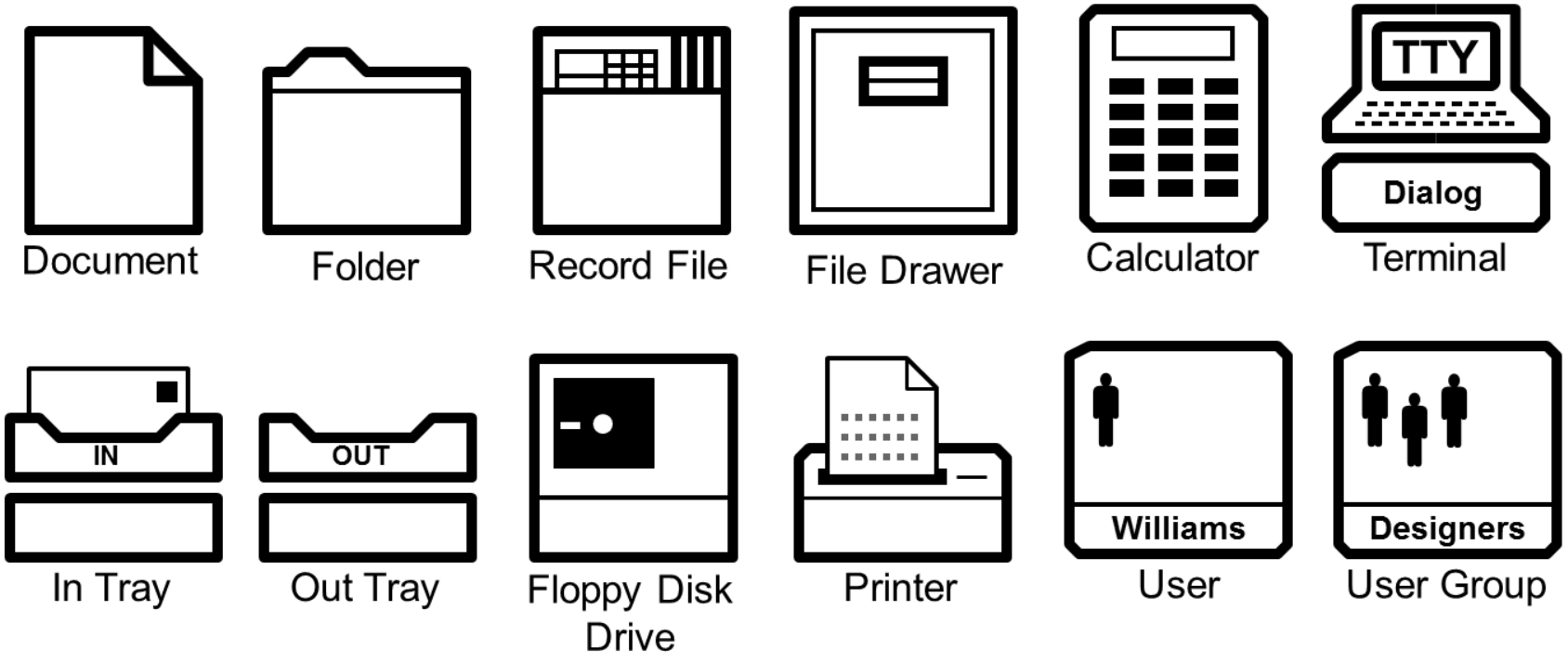
[1] NCC = National Computer Conference, 1981 attendance was 73,000.

[2] Closed → the Star could only run software developed by Xerox

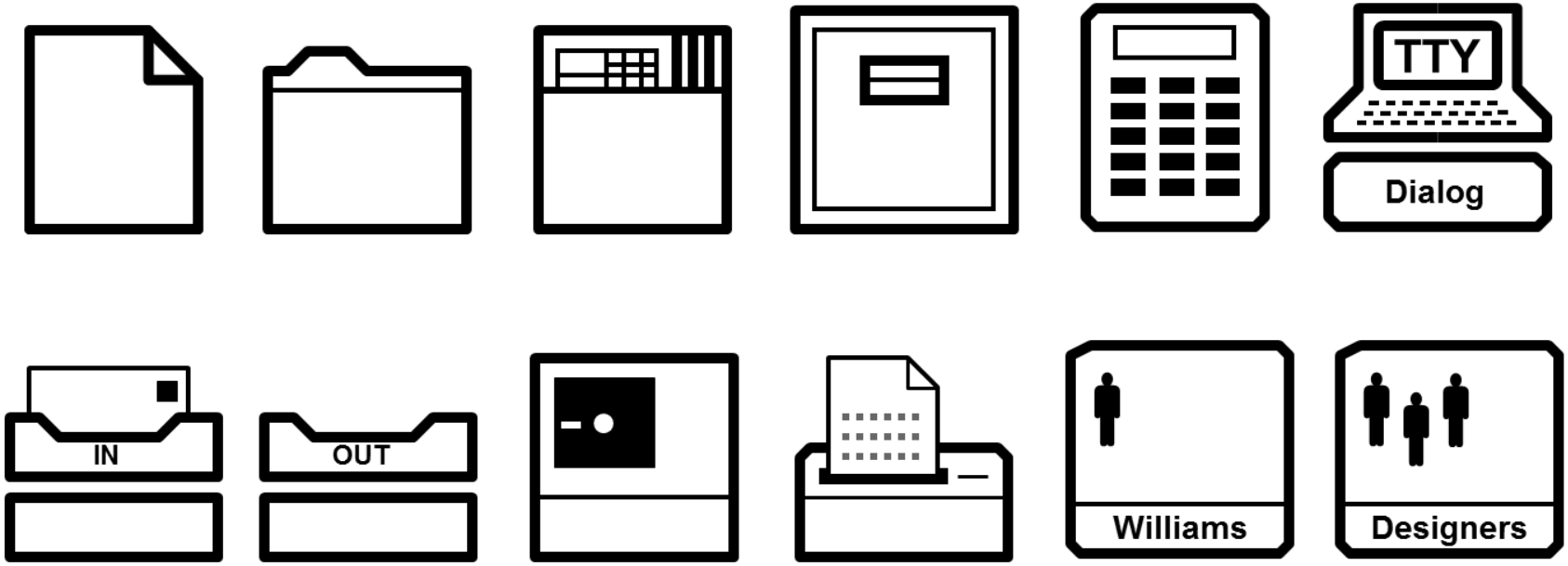
Xerox *Star* (1981)



Star GUI Icons



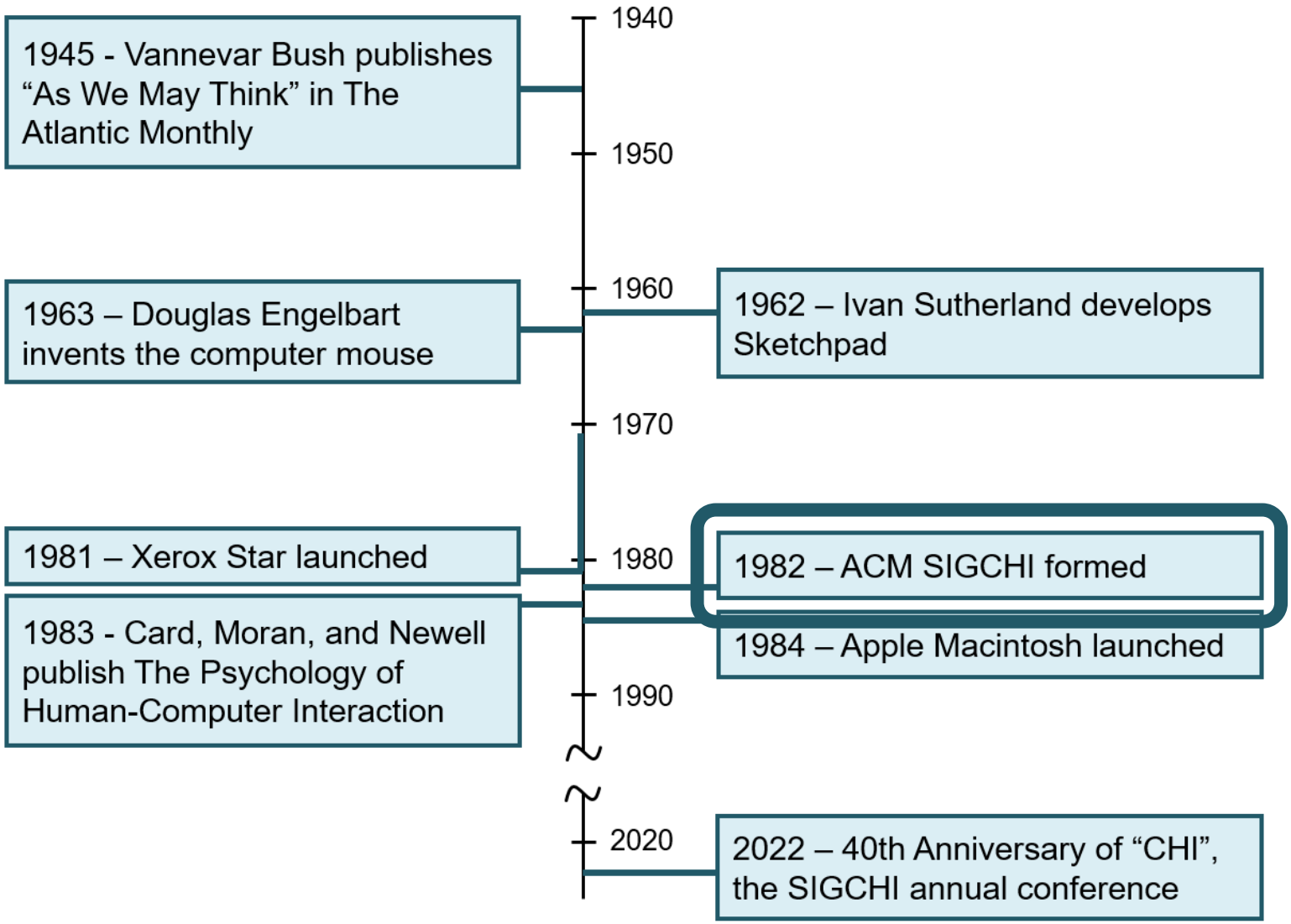
Research Topic – Icon Recognition



Can you guess the purpose of each icon?

(See also Figure 3.38 and Student Exercises 3.2 and 3.3.)

Timeline of Significant Events



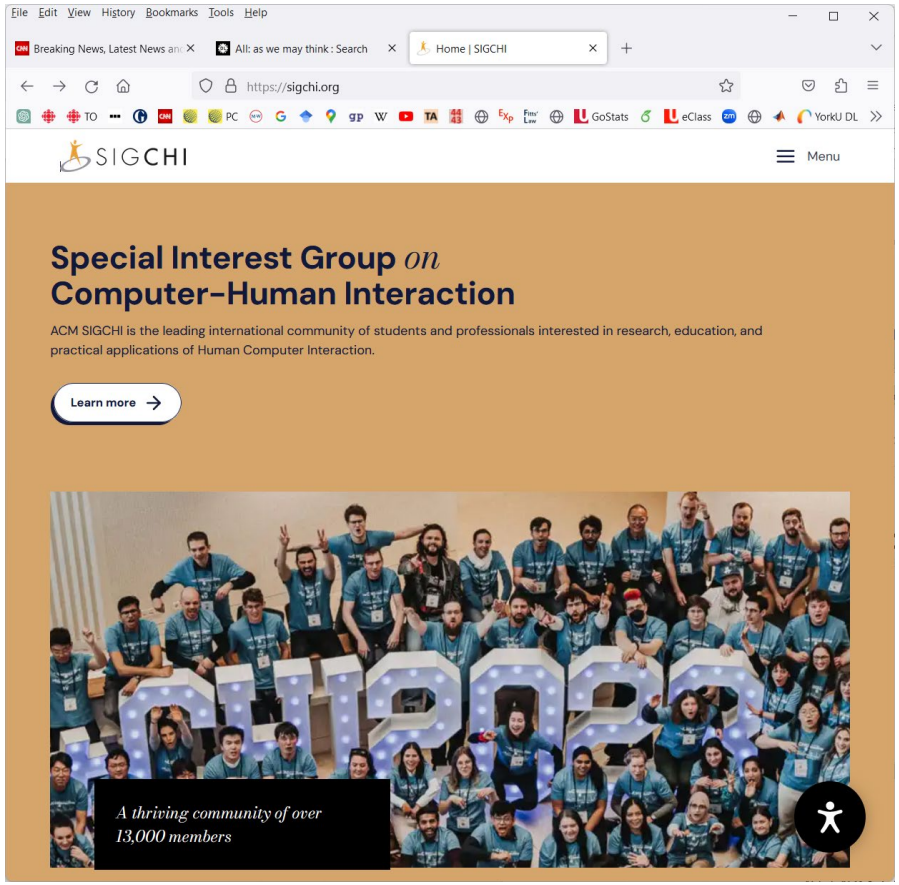
Birth of HCI - 1983

- Notable events:
  1. First ACM SIGCHI conference (1983)
  2. Publication of *The Psychology of Human-Computer Interaction* by Card, Moran, and Newell (1983)
  3. Apple *Macintosh* announced via brochures (December, 1983) and launch (January, 1984)

ACM SIGCHI Mission

The ACM Special Interest Group on Computer-Human Interaction is the world's largest association of professionals who work in the research and practice of computer-human interaction. This interdisciplinary group is composed of computer scientists, software engineers, psychologists, interaction designers, graphic designers, sociologists, and anthropologists, just to name some of the domains whose special expertise come to bear in this area. They are brought together by a shared understanding that designing useful and usable technology is an interdisciplinary process, and believe that when done properly it has the power to transform persons' lives.

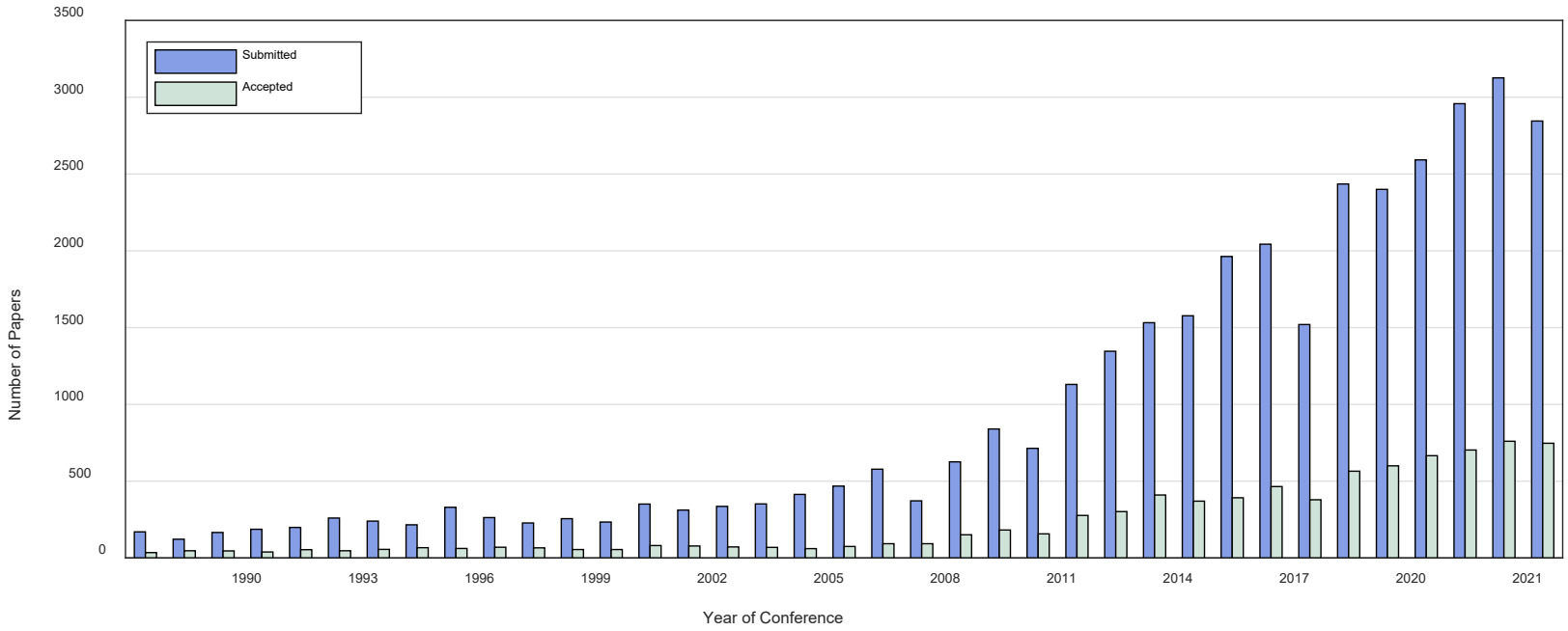
SIGCHI Web Site



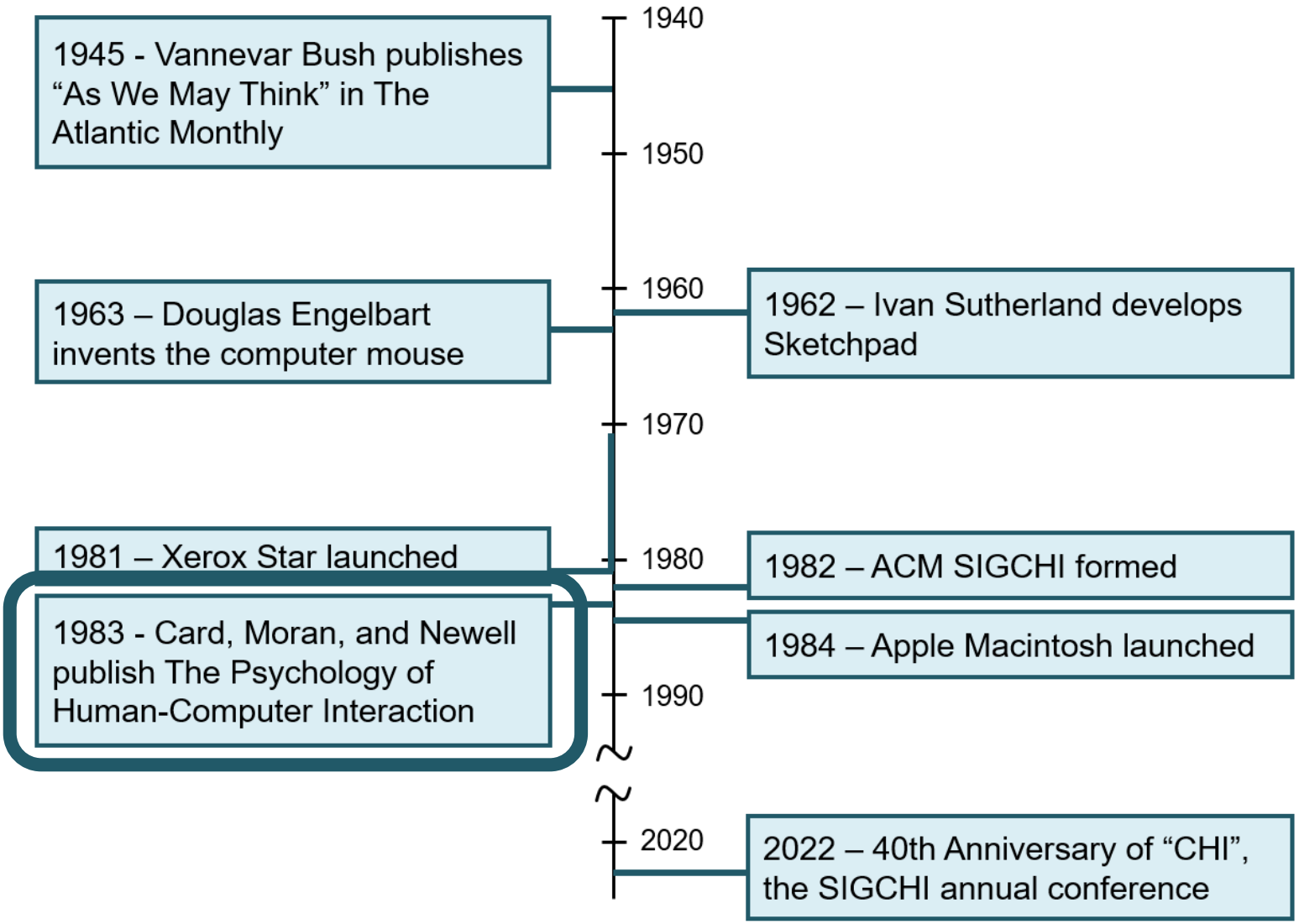
Click here

https://en.wikipedia.org/wiki/SIGCHI

“CHI” Conference Publications



Timeline of Significant Events

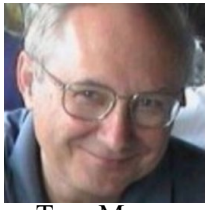


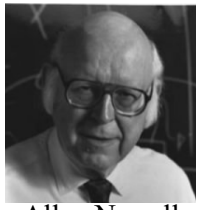
The Psychology of Human-Computer Interaction
Card, Moran, and Newell (1983)

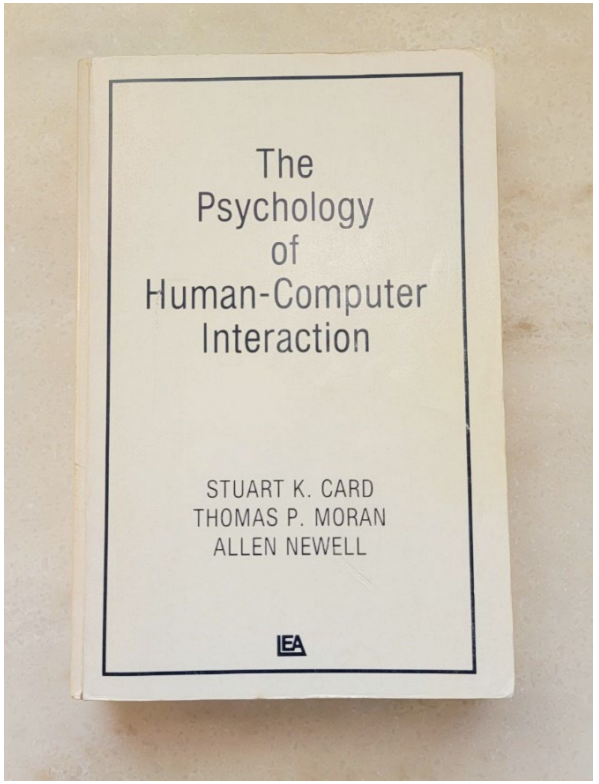
- From work at Xerox PARC (Palo Alto Research Center) in the Applied Information-Processing Psychology Project (AIP)
- AIP mission:

  ... to create an applied psychology of human-computer interaction by conducting requisite basic research within a context of application
- Emphasis on modelling (e.g., via the Keystroke-Level Model)
- Connects low-level human processes in experimental psychology to human interactions with computers


Stuart Card


Tom Moran

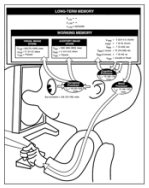

Allen Newell



[1] S.K. Card, T.P. Moran, A. Newell, The Psychology of Human-Computer Interaction, Erlbaum, Hillsdale, NJ, 1983.

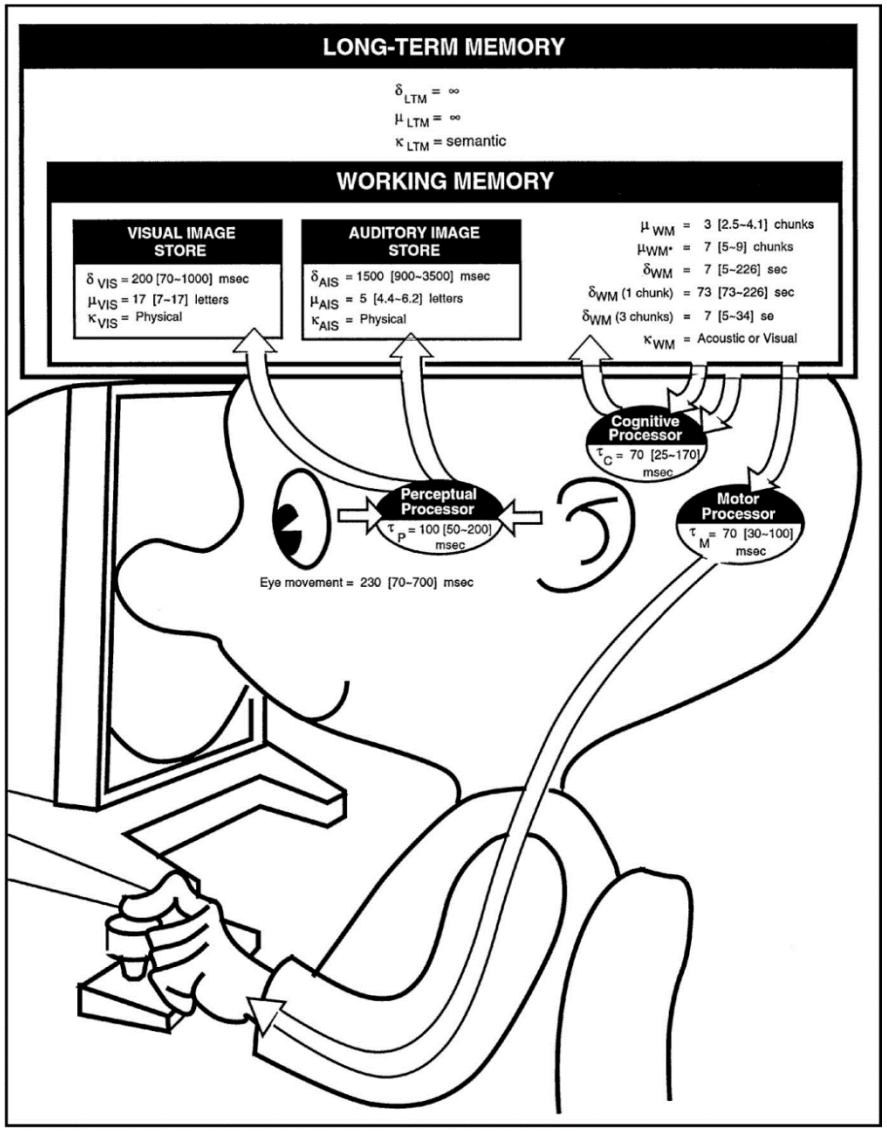
The Model Human Processor

- Framework for analyses: Model Human Processor
  - Eye and ear → sensory input to perceptual processor
  - Brain → with a cognitive processor, short-term memory, long-term memory
  - Arm, hand, and finger → for motor responses
- Schematic:



Next slide

Model Human Processor



Example

- Problem:

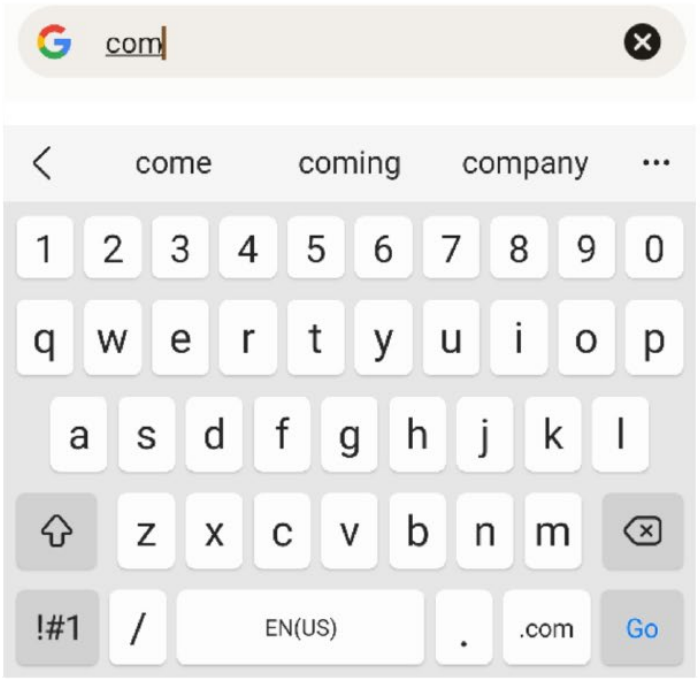
> A user is presented with two symbols, one at a time. If the second symbol is identical to the first, he is to push the key labeled YES. Otherwise he is to push NO. What is the time between signal and response for the YES case?

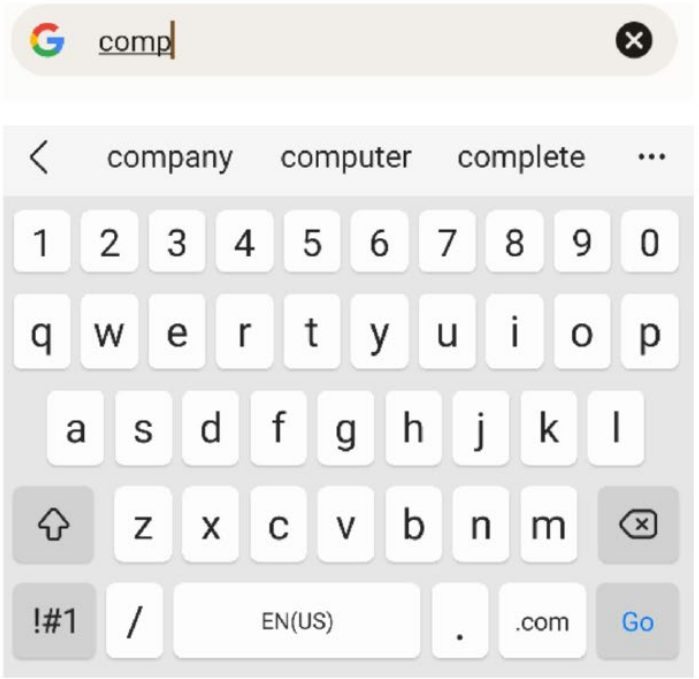
- Solution: (details in chapter 7)

$$\begin{aligned} \text{RT} &= t_P + 2 \times t_C + t_M \\ &= 100[30 \sim 200] + 2 \times (70[25 \sim 170]) + 70[30 \sim 100] \\ &= 310[130 \sim 640] \text{ ms} \end{aligned}$$

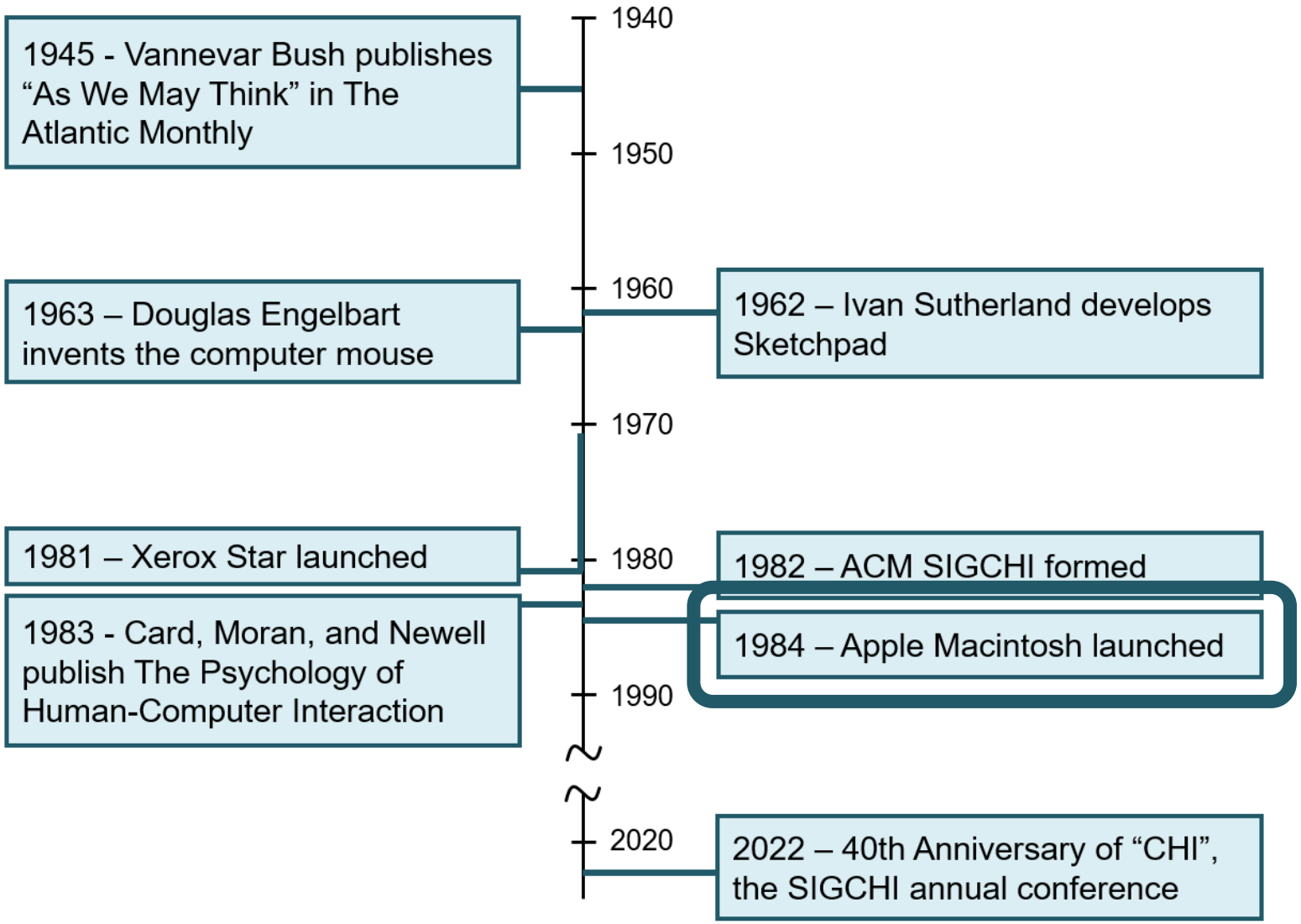
Modern Context

- Problem:
  - How long does it take to enter “computer” on a smartphone with word prediction/completion?





Timeline of Significant Events



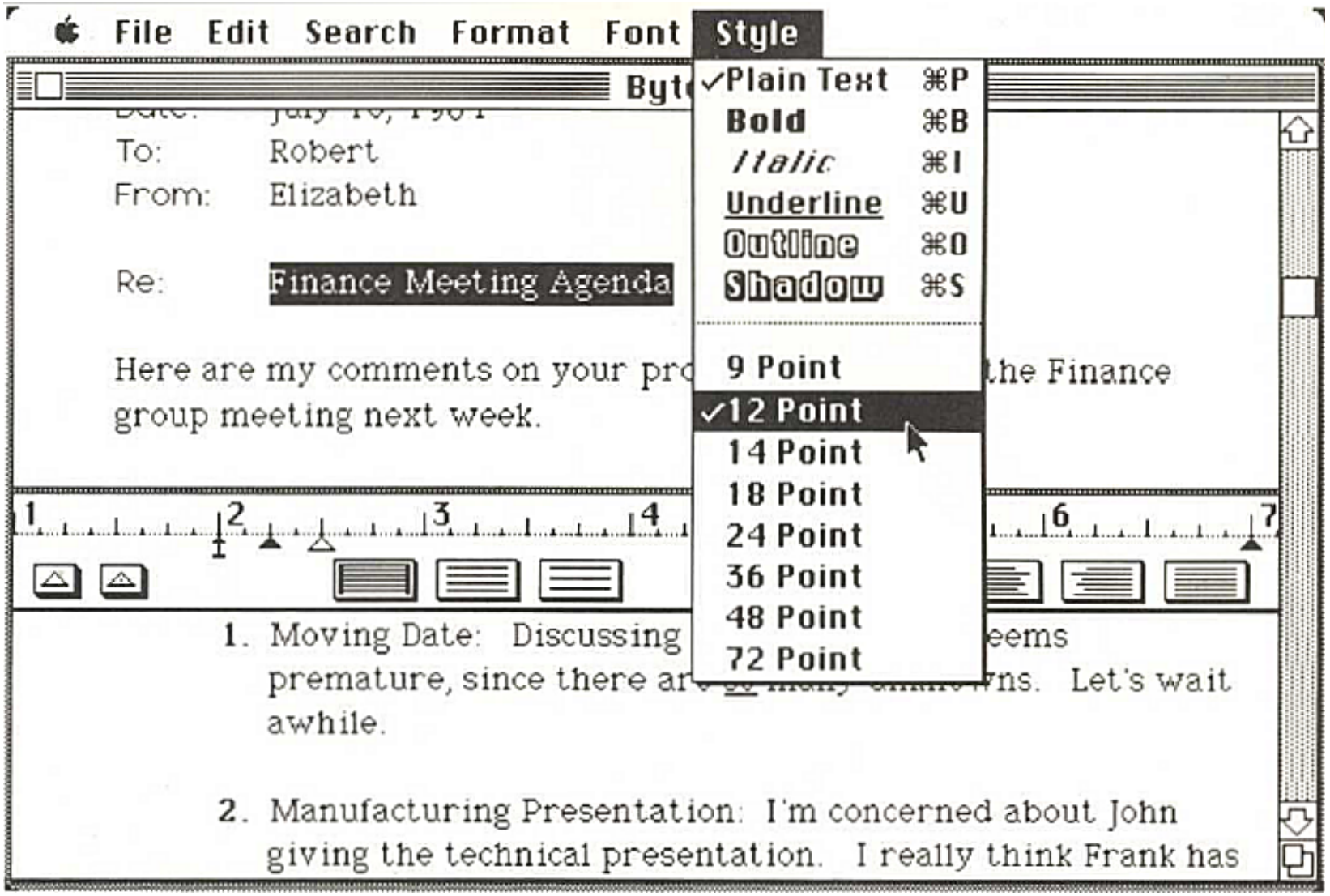
Apple *Macintosh* (1984)

- Introduced on January 22, 1984, in a 60-second commercial aired during the 3rd quarter of Super Bowl XVIII[1]
- The first *successful* system with a graphical user interface (GUI) and point-select interaction
- Inspired and influenced by the Xerox Star following Apple designers' attendance at the NCC in 1981 where they witnessed the revolutionary ideas in the Star
- The first "Mac":  Next slide

[1] The "Super Bowl" is the annual championship game of the National Football League in the U.S.

Apple *Macintosh* (1984)

MacWrite Software



Apple *Macintosh* Commercial (1984)[1]

Click here

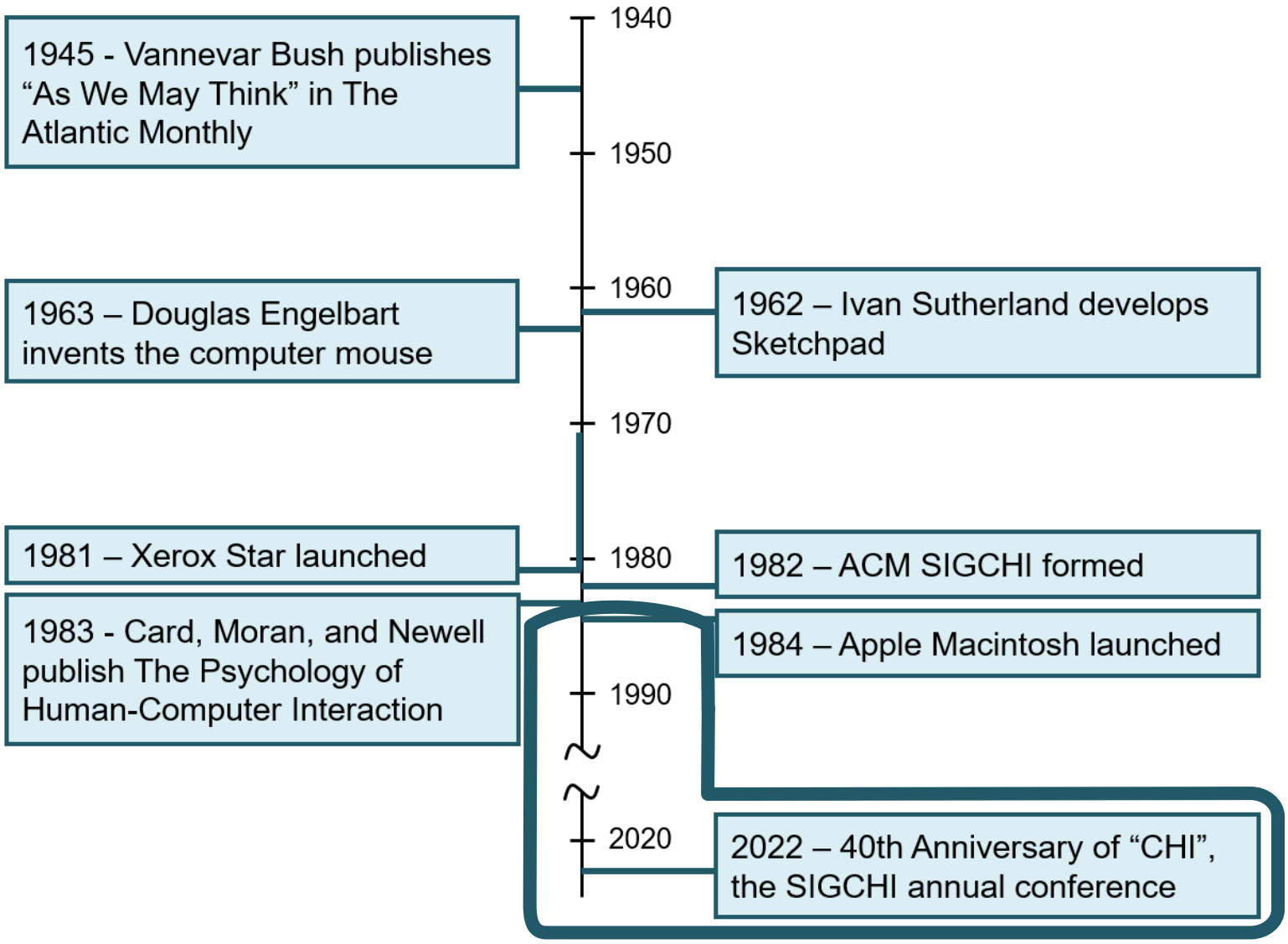
https://www.youtube.com/results?search_query=apple+macintosh+commercial+1984

[1] Directed by Ridley Scott, also known for feature films such as Blade Runner (1982) and Gladiator (2000).

Apple *Macintosh* Timeline

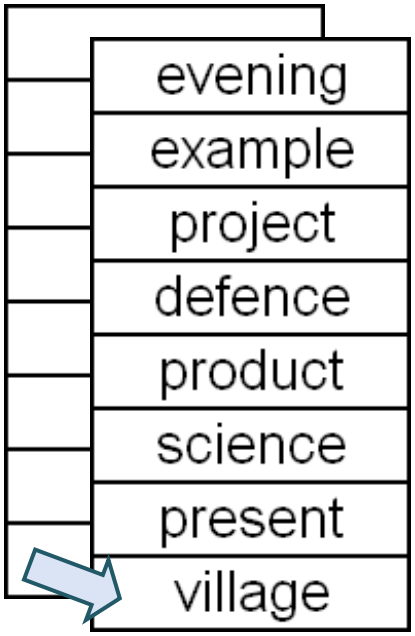
1976	April – Apple Computer Inc. founded in Cupertino, California.
1977	Launch of Apple II. Sells for $1300 U.S. with 4KB RAM. Hugely successful (more than one million units sold). Works with a text-based command-line interface.
1978	*Lisa* project started . Goal of producing a powerful (and expensive!) personal computer.
1979	September – *Macintosh* project started. Goal of producing a low-cost easy-to-use computer for the average consumer. December – Apple and Xerox sign an agreement that allows Xerox to invest in Apple. In return Apple's engineers visit Xerox PARC and see the Xerox *Alto*. The GUI ideas in the *Alto* influence *Lisa* and *Macintosh* development.
1980	December – Apple goes public through initial public offering (IPO) of its stock.
1981	May – Xerox *Star* launched at the National Computer Conference (NCC) in Chicago. Members of the *Lisa* design team are present and see the *Star* demo. They decide to re-vamp the *Lisa* interface to be icon-based. August – IBM PC announced. Highly successful, but embodies traditional text-based command-line interface.
1982	*Lisa* and *Macintosh* development continue. Within Apple, there is an atmosphere of competition between the two projects
1983	January – *Lisa* released. *Lisa* incorporates a GUI and mouse input. Sells for $10,000 U.S. In the end, *Lisa* is a commercial failure. December -- brochures distributed in magazines (e.g., *Time*) pre-announcing the *Macintosh.*
1984	January 22 – *Macintosh* ad plays during Super Bowl XVIII. January 24 – *Macintosh* released. Sells for $2500 U.S.

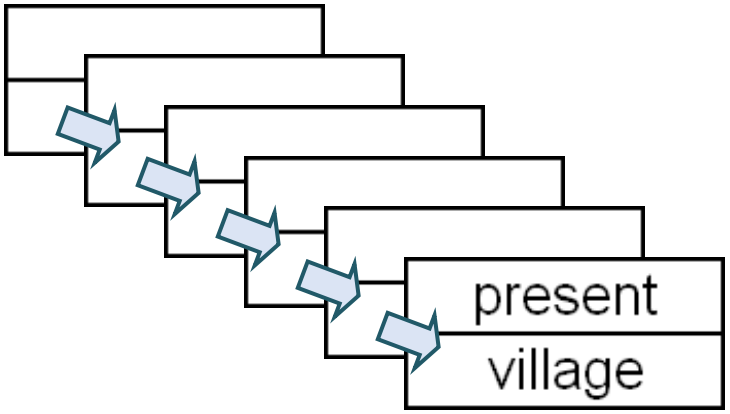
Timeline of Significant Events



Growth of HCI (1983-…)

- Example of an early HCI research topic
  - Breadth vs. depth in menu design



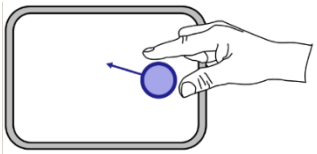
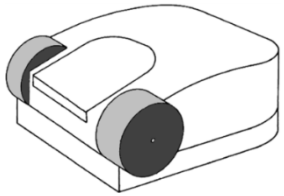
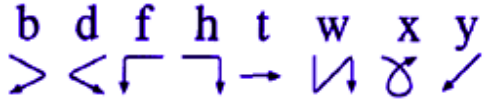


SIGCHI-sponsored Conferences

First Year	In Short	Full Name
1983	CHI	Human Factors in Computing Systems
1988	UIST	User Interface Software and Technology
1988	CSCW	Computer-Supported Cooperative Work and Social Computing
1993	IUI	Intelligent User Interfaces
1994	VRST	Virtual Reality Software and Technology
1995	DIS	Designing Interactive Systems
1997	GROUP	Supporting Group Work
1999	C&C	Creativity and Cognition
2000	ETRA	Eye Tracking Research & Applications
2003	ICMI	Multimodal Interaction
2006	HRI	Human-Robot Interaction
2007	RECSYS	Recommender Systems
2009	EICS	Engineering Interactive Computing Systems
2009	ISS	Interactive Surfaces and Spaces
2009	UBICOMP	Pervasive and Ubiquitous Computing
2010	TEI	Tangible and Embedded Interaction
2012	MobileHCI	Human-Computer Interaction with Mobile Devices and Services
2013	SUI	Spatial User Interfaces
2014	IMX	Interactive Media Experiences
2014	CHI PLAY	Computer-Human Interaction in Play
2015	IDC	Interaction Design and Children
2017	AUTOMOTIVE	Automotive User Interfaces and Interactive Vehicular Applications
2018	CI	Collective Intelligence
2022	COMPASS	Computing and Sustainable Societies
2022	CUI	Conversational User Interfaces

HCI Research

- Research precedes products
- Consider…
  - Two-finger gestures (Apple *iPhone*, 2007)
  - Acceleration-sensing (Nintendo *Wiimote*, 2005)
  - Wheel mouse (Microsoft *Intellimouse*, 1996)
  - Single-stroke text input (Palm's *Graffiti*, 1995)
- Were these ideas born out of engineering or design brilliance? Not really…

- Two-finger gestures: ~~2007?~~  **1978**[1]
- Acceleration-sensing: ~~2005?~~  **1998**[2]
- Wheel mouse: ~~1996?~~  **1993**[3]
- Single-stroke text input: ~~1995?~~  **1993**[4]

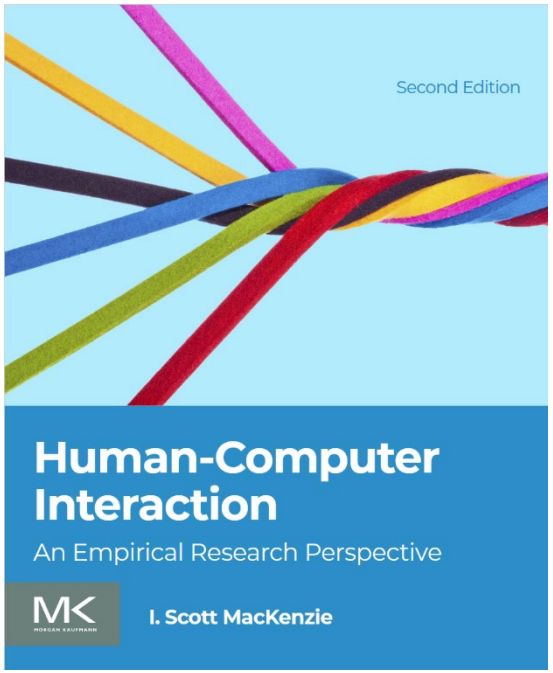
More on the distinction between research, engineering, and design in Chapter 4

[1] C.F. Herot, G. Weinzapfel, One-point touch input of vector information for computer displays, in: Proc SIGGRAPH '78, ACM, New York, 1978, pp. 210–216.
[2] B. Harrison, K.P. Fishkin, A. Gujar, C. Mochon, R.Want, Squeeze me, hold me, tilt me! An exploration of manipulative user interfaces, in: Proc CHI '98, ACM, New York, 1998, pp. 17–24.
[3] D. Venolia, Facile 3D manipulation, in: Proc INTERCHI '93, ACM, New York, 1993, pp. 31–36.
[4] D. Goldberg, C. Richardson, Touch-typing with a stylus, in: Proc INTERCHI '93, ACM, New York, 1993, pp. 80–87.

Resources

Google Scholar:	`http://scholar.google.ca/`
ACM Digital Library:	`http://portal.acm.org/`
HCI Bibliography:	`http://hcibib.org/`
Wikipedia:	`http://en.wikipedia.org/`
Book web site:	`http://www.yorku.ca/mack/HCIbook2e`

Thank You



https://www.yorku.ca/mack/HCIbook2e/