

# CSCI 1377

# Tools for Thought

# Introduction

“There are many man-machine systems. At present, however, there are no man-computer symbioses.”

— J.C.R. Licklider, 1960



# Vannevar Bush

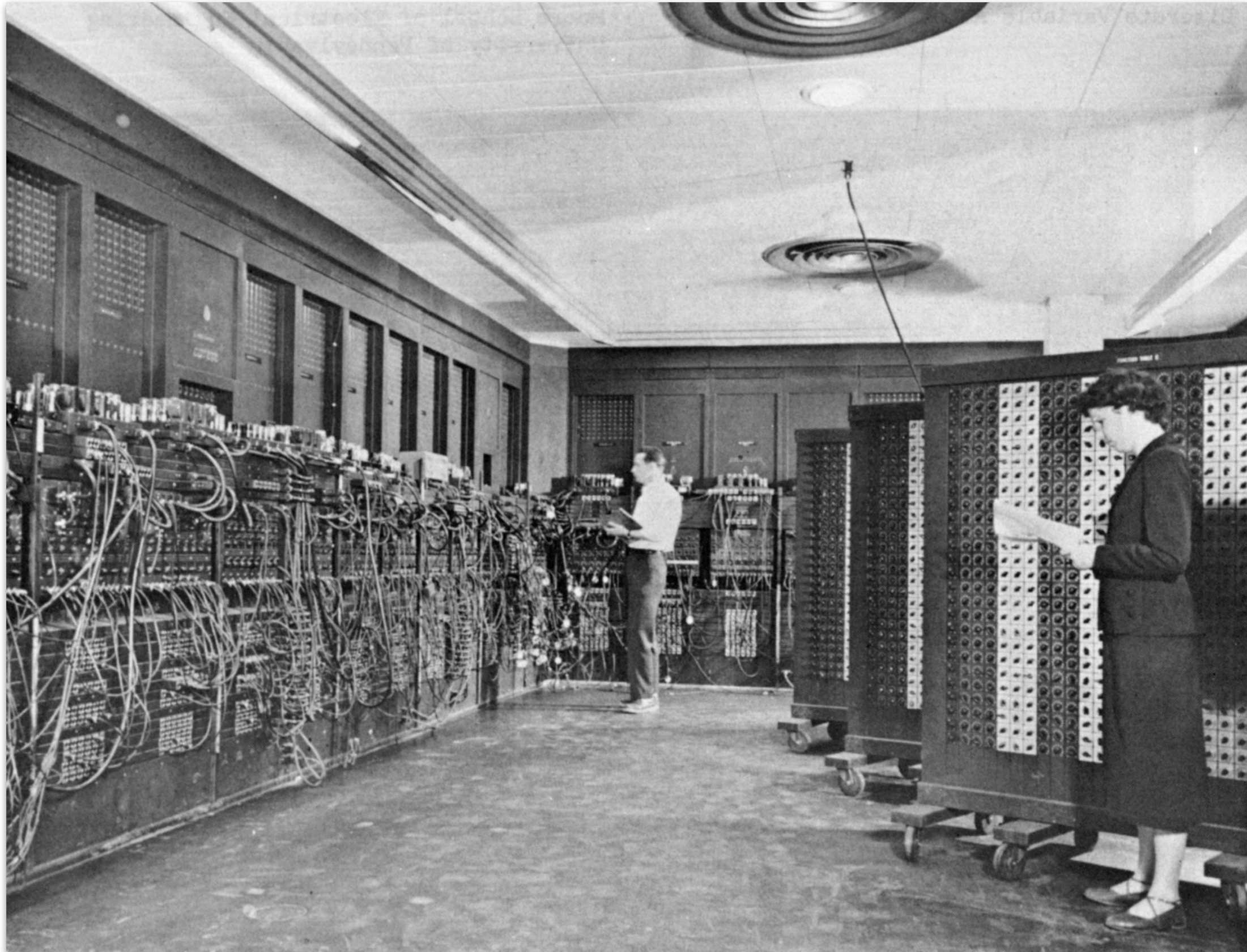
Head of US Office of  
Scientific Research and  
Development during WWII

Early administrator of the  
Manhattan Project

Key proponent of the  
National Science  
Foundation

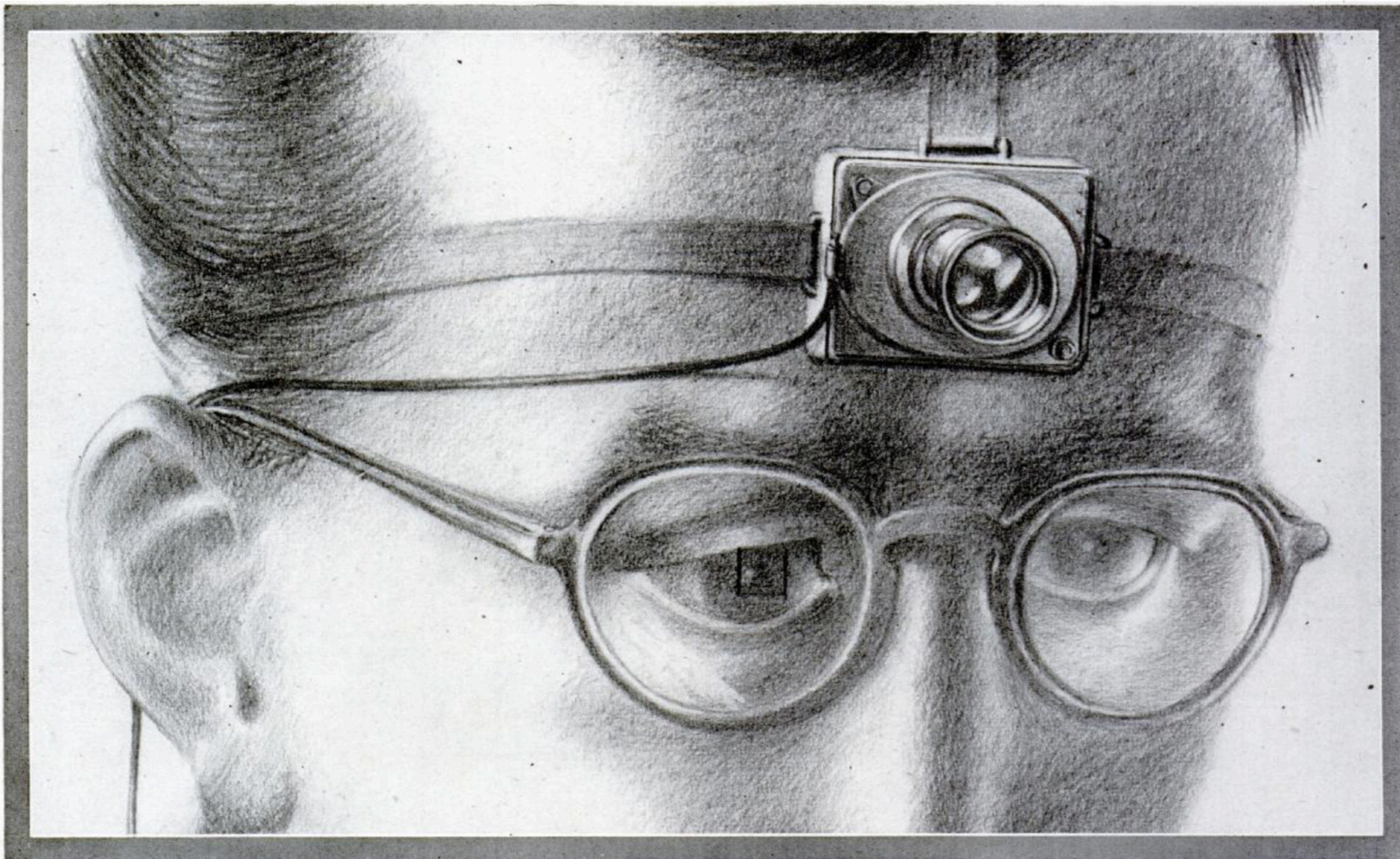
By Harris & Ewing - MIT Museum, GCP-00003581,  
Public Domain, via Wikimedia Commons

# ENIAC computer (1945)



U.S. Army Photo, Public Domain, via Wikimedia Commons

There is a growing mountain of research. But there is increased evidence that we are being bogged down today as specialization extends. The investigator is staggered by the findings and conclusions of thousands of other workers — conclusions which he cannot find time to grasp, much less to remember, as they appear. Yet specialization becomes increasingly necessary for progress, and the effort to bridge between disciplines is correspondingly superficial.



A SCIENTIST OF THE FUTURE RECORDS EXPERIMENTS WITH A TINY CAMERA FITTED WITH UNIVERSAL-FOCUS LENS. THE SMALL SQUARE IN THE EYEGGLASS AT THE LEFT SIGHTS THE OBJECT

# AS WE MAY THINK

A TOP U. S. SCIENTIST FORESEES A POSSIBLE FUTURE WORLD  
IN WHICH MAN-MADE MACHINES WILL START TO THINK

by VANNEVAR BUSH

## WHAT DR. BUSH FORESEES

### **Cyclops Camera**

Worn on forehead, it would photograph anything you see and want to record. Film would be developed at once by dry photography.

### **Microfilm**

It could reduce *Encyclopaedia Britannica* to volume of a match-box. Material cost: 5¢. Thus a whole library could be kept in a desk.

### **Vocoder**

A machine which could type when talked to. But you might have to talk a special phonetic language to this mechanical supersecretary.

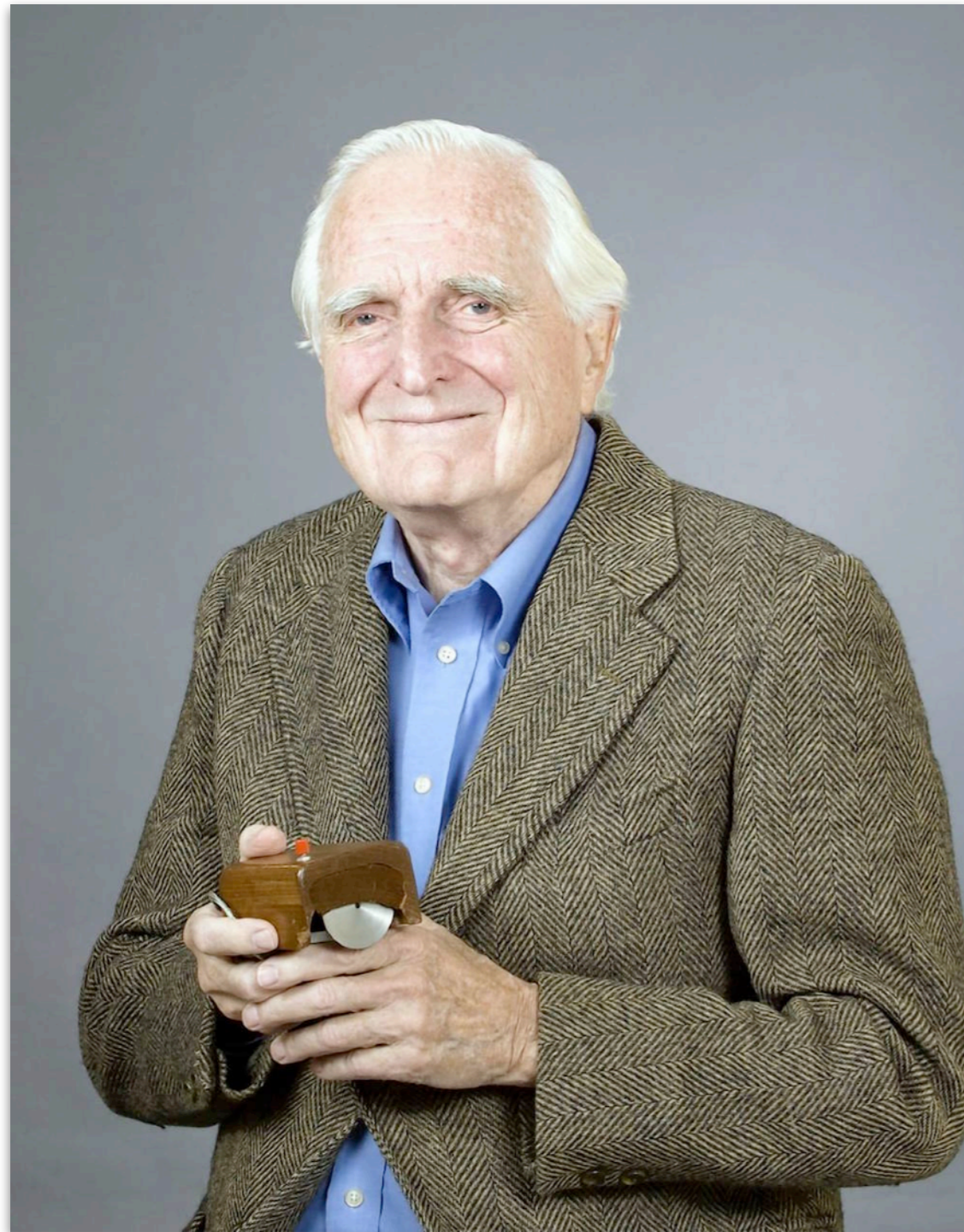
### **Thinking machine**

A development of the mathematical calculator. Give it premises and it would pass out conclusions, all in accordance with logic.

### **Memex**

An aid to memory. Like the brain, Memex would file material by association. Press a key and it would run through a "trail" of facts.

<https://youtu.be/c539cK58ees?t=4>



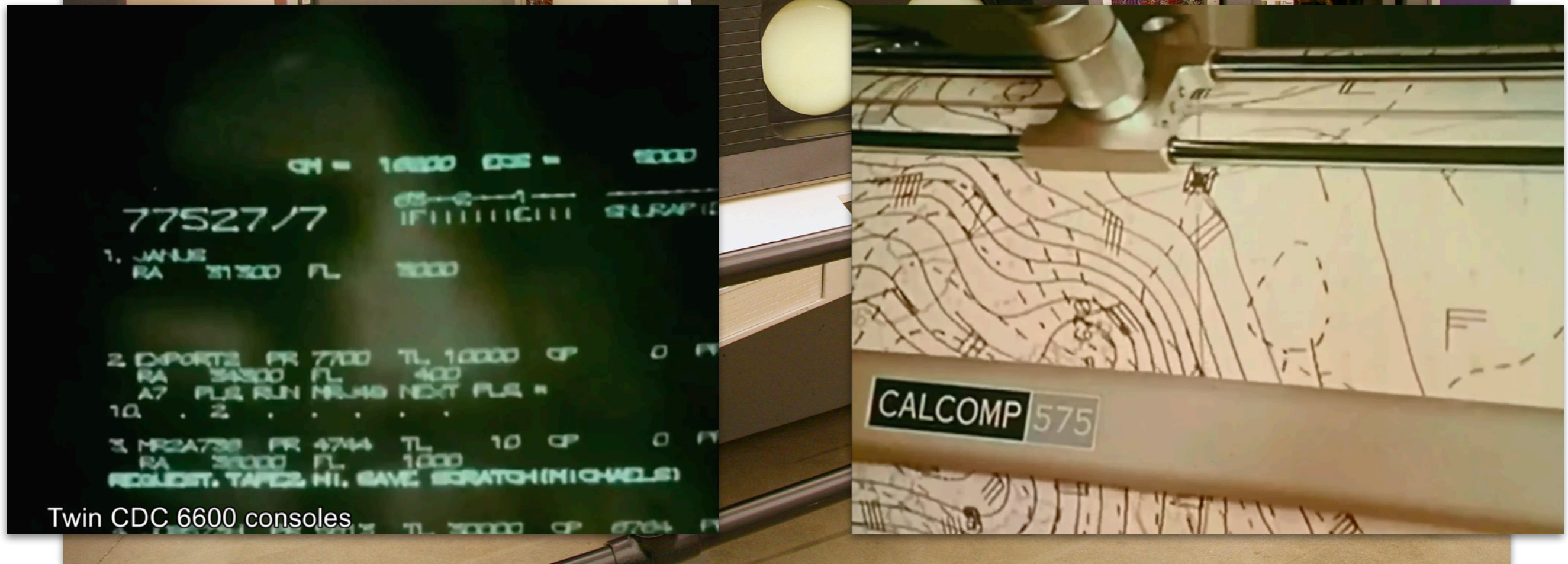
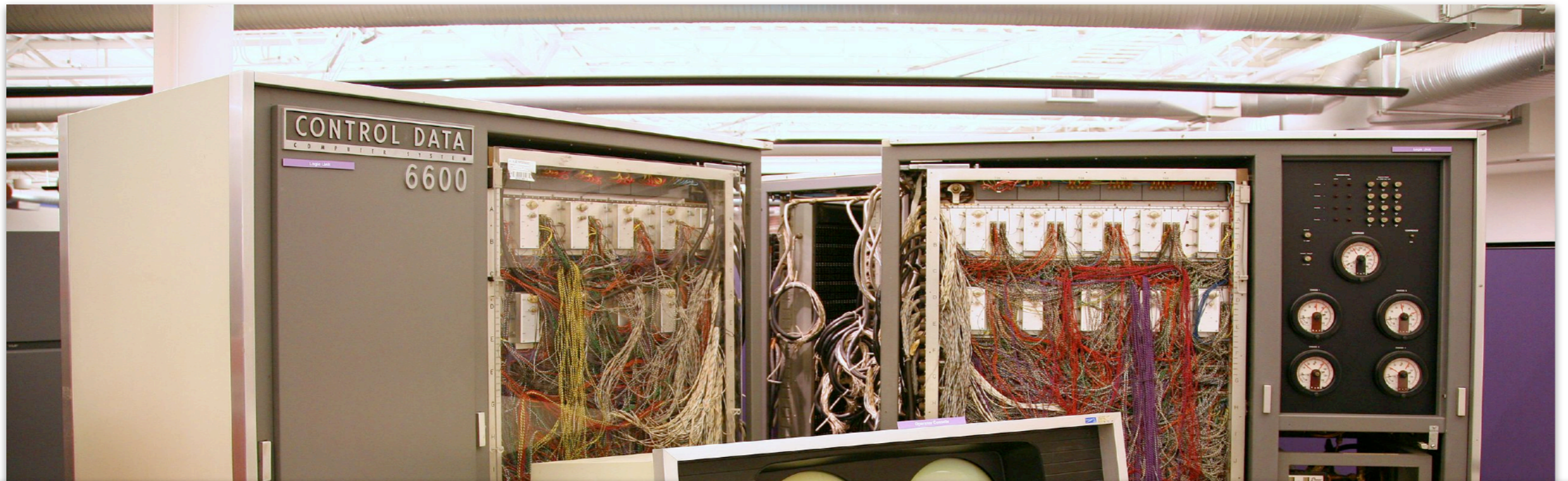
Turing Award portrait via ACM

# Doug Engelbart

Director of Augmentation  
Research Center at SRI

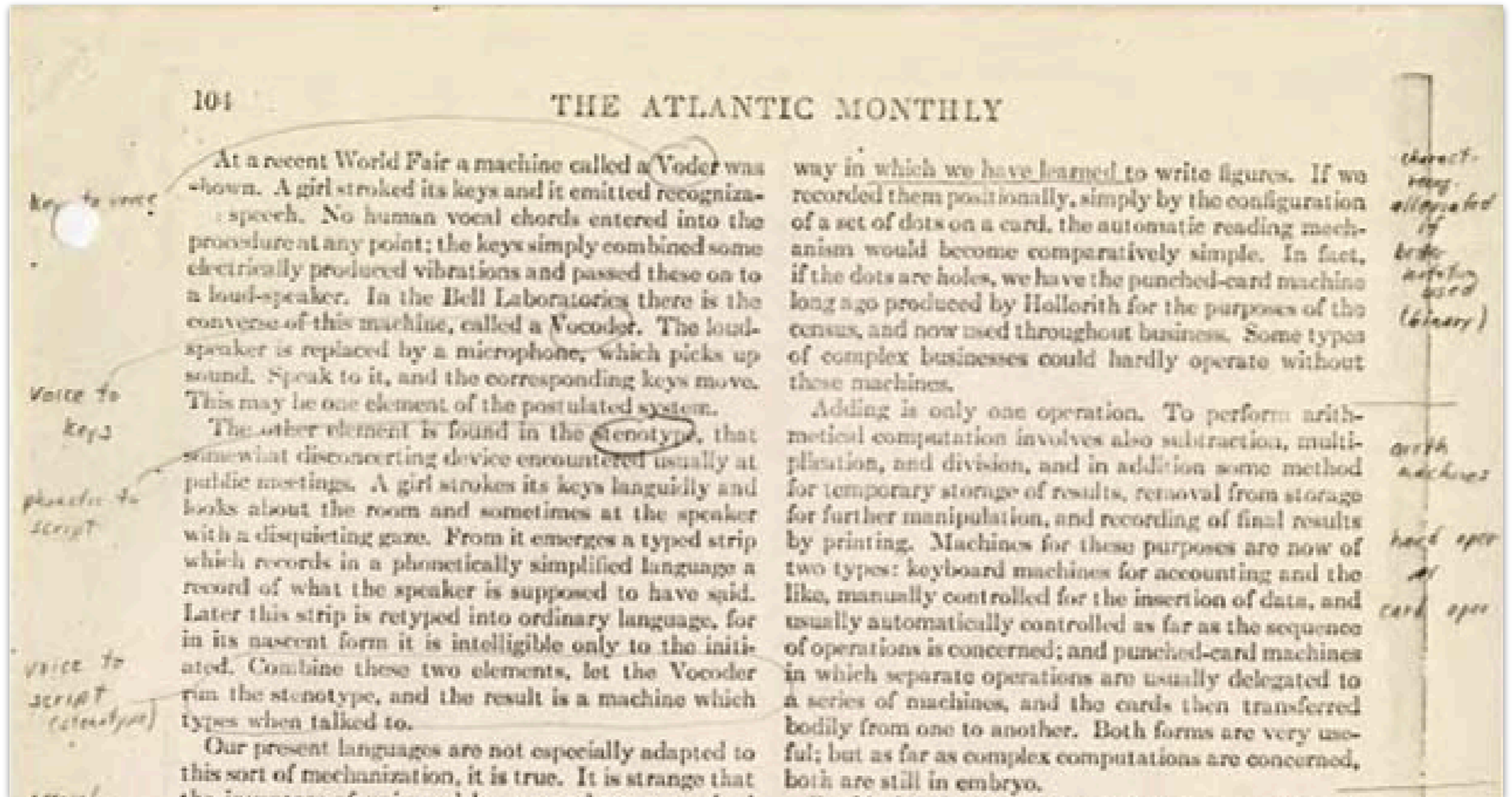
Contributed to the  
invention of the **personal  
computer**: mouse, GUIs,  
word processing, and  
hypertext

# Cray CDC 6600 (1964)



Twin CDC 6600 consoles

# Engelbart read "As We May Think" in 1945...

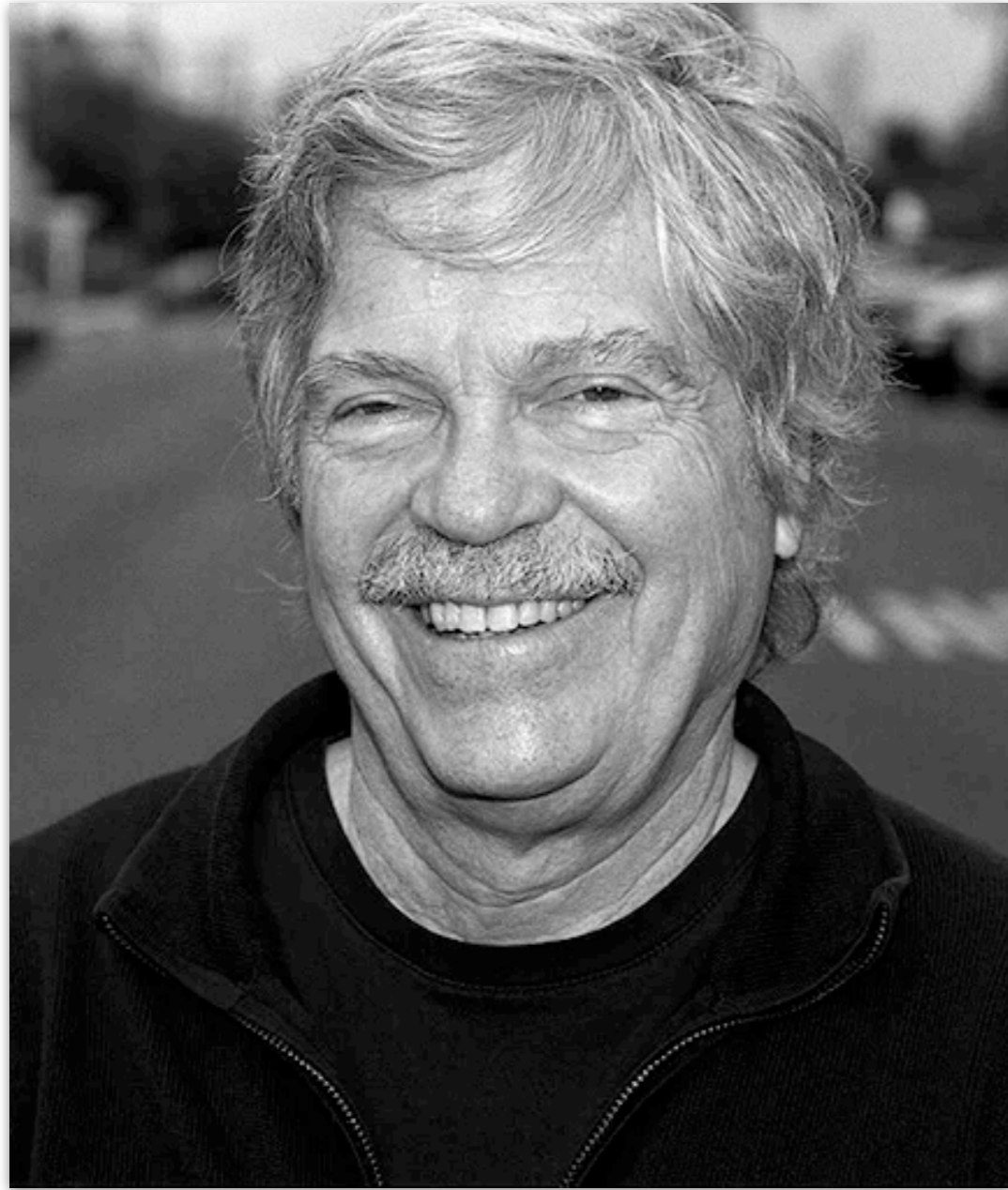


**...20 years later...**

**“The objective of this study is [...]:**

- (1) to find the factors that limit the effectiveness of the individual's basic information-handling capabilities in meeting the various needs of society for problem solving in its most general sense; and**
- (2) to develop new techniques, procedures, and systems that will better match these basic capabilities to the needs' problems, and progress of society.”**

**<https://youtu.be/B6rKUf9DWRI>**



via Heidelberg Laureate Forum

# Alan Kay

While researcher at Xerox PARC, key contributor to:

- SmallTalk, and object-oriented programming
- Windowed GUIs
- Tablet computers

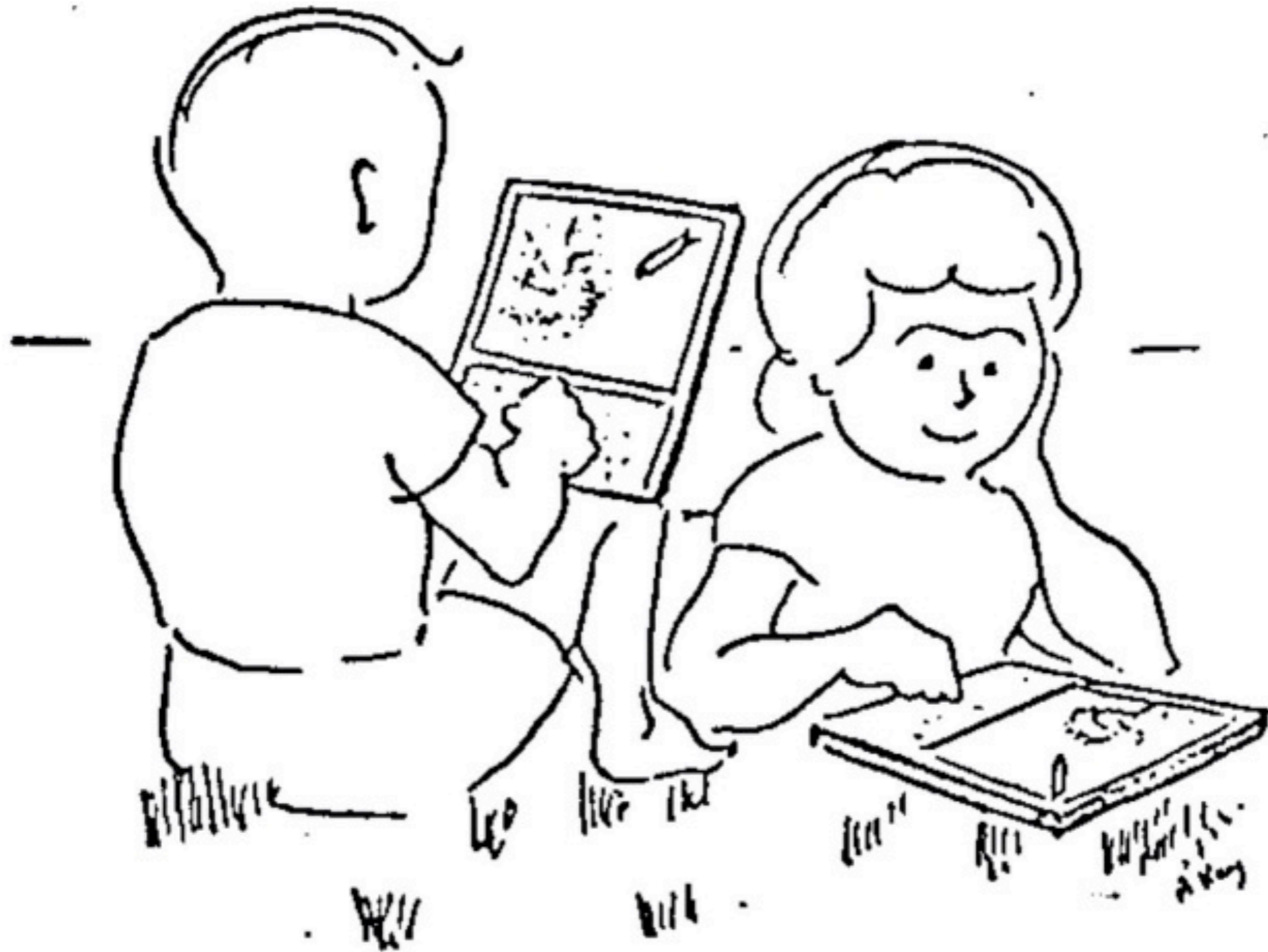
On Engelbart's demo: "It was one of the greatest experiences in my life"

# Wang 2200 desktop computer (1973)



StenSoft, CC BY-SA 3.0, via Wikimedia Commons

# Dynabook (1972)



<https://youtu.be/lwL3yXdupv0?t=3042>

# Notion, “A story of tools and the future of work”



Then something magical happened in the 1970s!

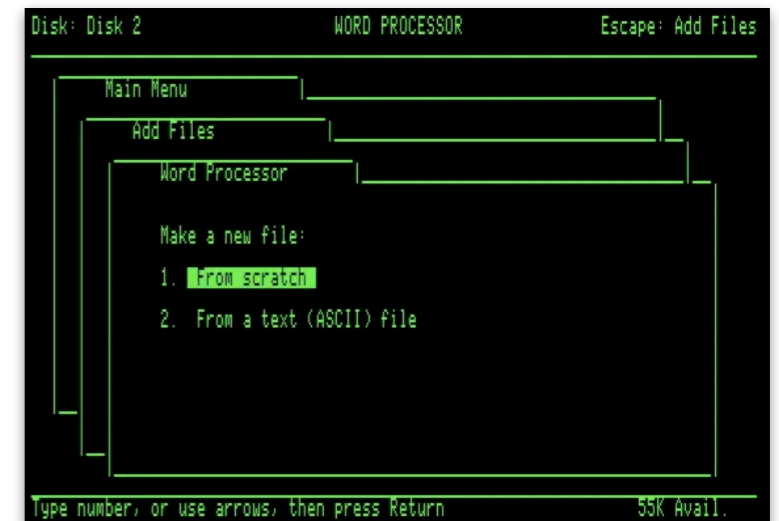
A generation of pioneers saw the computer as something far beyond a number-crunching machine. They dreamt a future where computers could amplify imagination (Alan Kay), augment intellect (Doug Engelbart), and expand our thoughts far beyond text on paper (Ted Nelson).

A tool unlike anything we have seen before.

# VisiCalc

A	B	C	D
ITEM	NO.	UNIT	COST
MUCK RAKE	42	12.95	556.95
BUZZ CUT	150	6.75	1012.50
TOE TONER	250	49.95	12487.50
EYE SNUFF	2	4.95	9.90
SUBTOTAL			13155.50
9.75% TAX			1282.66
TOTAL			14438.16

# AppleWorks

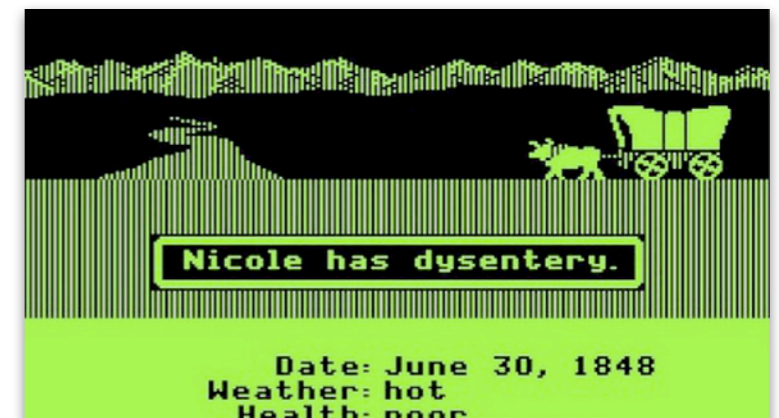


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Wikimedia Commons



<https://youtu.be/welKoeoK6zI>

# Oregon Trail

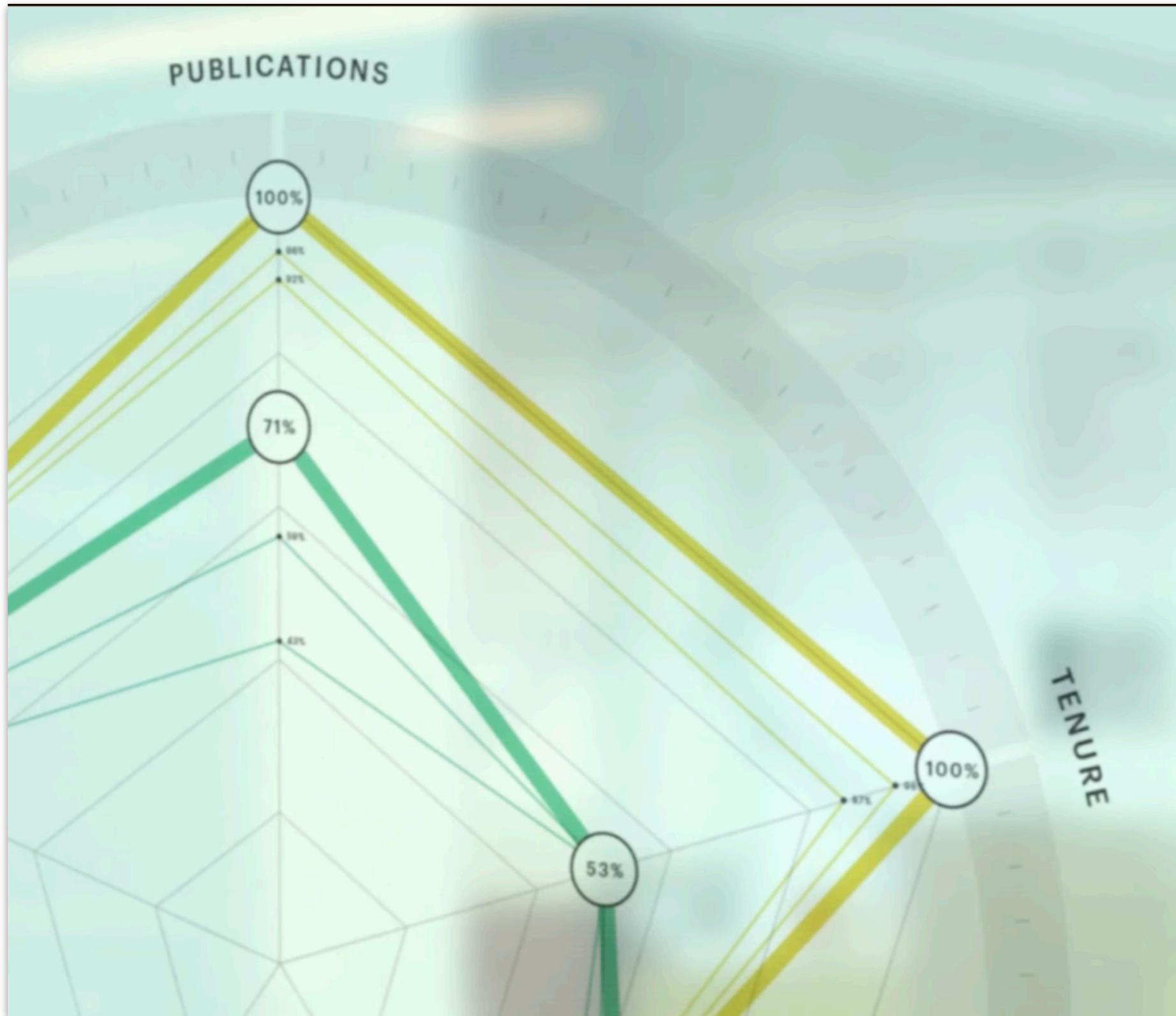


“A future-generation Macintosh, which we should have early in the twenty-first century, might well be a wonderful fantasy machine called the Knowledge Navigator, a discoverer of worlds, a tool as galvanizing as the printing press.”

Sculley and Byrne. *Odyssey: Pepsi to Apple*. 1987

“These pieces were marketing materials. They supported the sale of computers by suggesting that a company making them has a plan for the future. They were not inventing new interface ideas. (The production cycles didn’t allow for that.) Instead, they were about visualizing existing ideas—and pulling many of them together into a reasonably coherent environment and scenario of use.”

Hugh Dubberly, “The Making of Knowledge Navigator” in Bill Buxton, *Sketching User Experiences*. 2007



<https://youtu.be/w-tFdreZB94>



<https://youtu.be/PixPSNRDNMU?t=108>

# This course will cover a curated range of systems for knowledge work

## Spaced repetition systems



## Software tutors



## Reading augmentation systems



## Spreadsheets



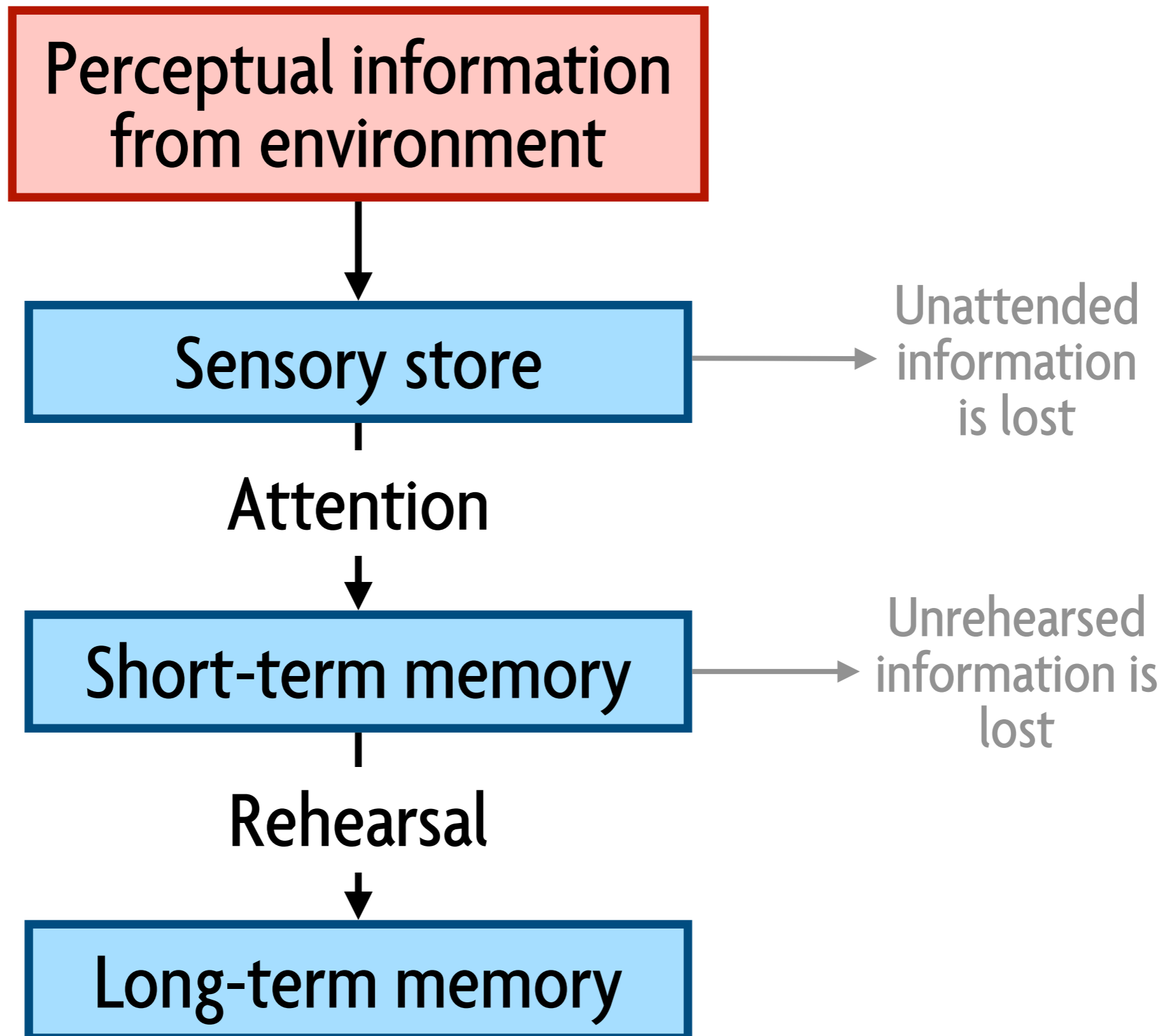
## Hypertext systems



## Computational notebooks



# A basic model of memory



# Primitives of an SRS: cards and decks

Card is a question + answer, deck is a collection of cards

说

---

请你再说一遍。

说

shuō

speak

verb

---

请你再说一遍。

Qǐng nǐ zài shuō yī biàn.

Sandhi: Qíng nǐ zài shuō yí biàn.

Can you please say it again.



# Leitner spacing algorithm, roughly

**input:** user grade  $q$ , interval  $I$

**output:** updated interval  $I$

**if**  $q = 1$  (correct) **then**

$I \leftarrow$  **case**  $I$

| 1  $\rightarrow$  2

| 2  $\rightarrow$  7

| 7  $\rightarrow$  30

| 30  $\rightarrow$  365

**else** (incorrect)

$I \leftarrow 0$

**end**

T: 0            1            2            3            4            5            ...            12            ...

$q=1$   
 $I=1 \rightarrow 2$

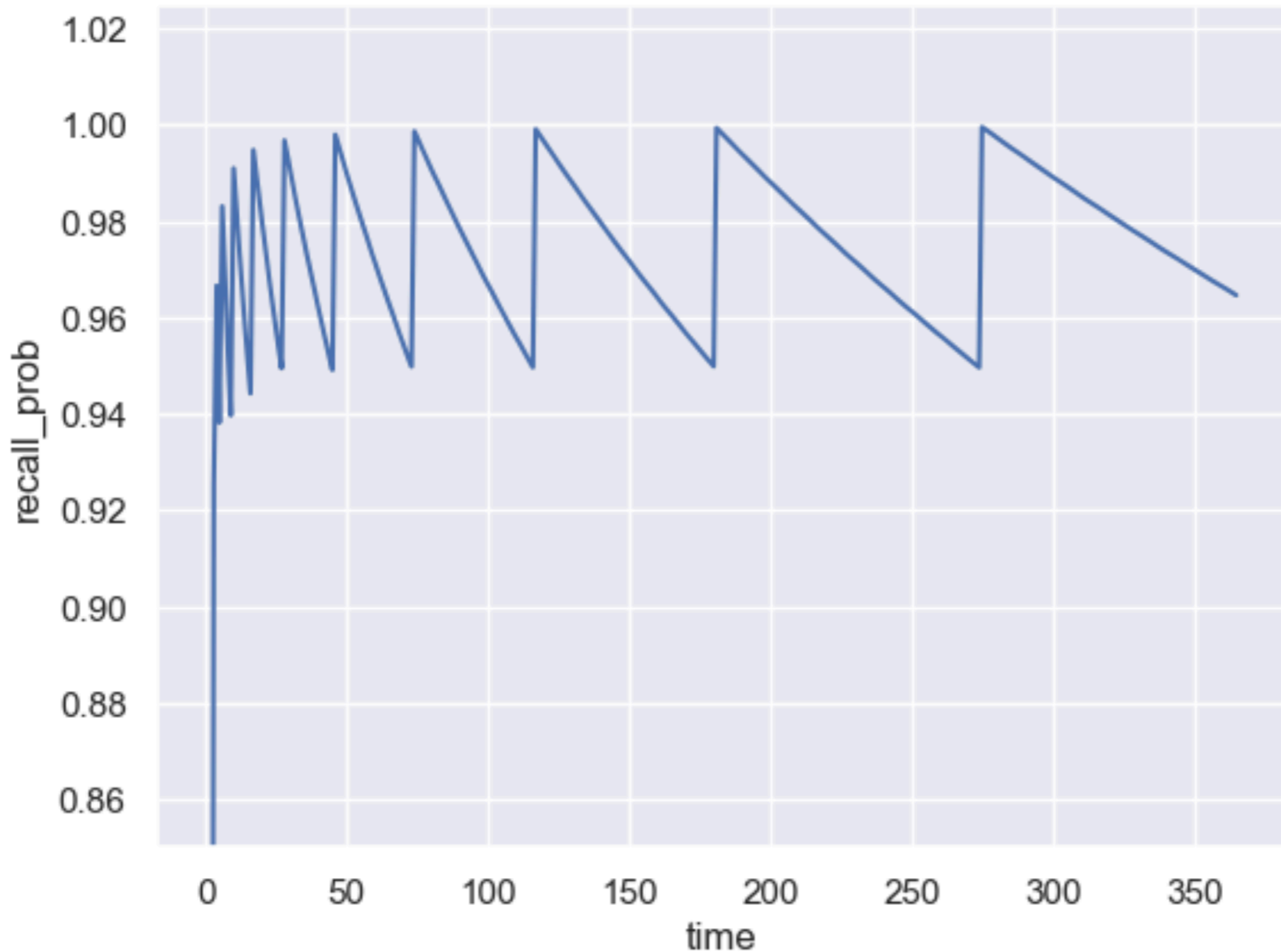
$q=0$   
 $I=2 \rightarrow 1$

$q=1$   
 $I=1 \rightarrow 2$

$q=1$   
 $I=2 \rightarrow 7$

$q=1$   
 $I=7 \rightarrow 30$

```
[22]: data = simulations.cheating_simulate(ThresholdSchedule, seed=0x1337BEEF)
ax = sns.lineplot(data, x="time", y="recall_prob", errorbar=("pi", 75))
_ = ax.set_ylim([0.85, 1.025]) # note the change in y-axis limits
```



# Other course notes

- **Overrides:** apply using the link on the website, overrides given starting Monday
- **Midterm:** will have a midterm on conceptual content
  - We will distribute an Anki deck with review cards for lecture material!
- **Final project:** four weeks at the end of the semester
- **Attendance:** no textbook or lecture notes, so engaging with lecture is important
  - Given the recent tragedy, physical attendance will not be required, do what is best for you
  - All lectures will be recorded and posted online

# My wonderful course staff



**Eleanor Park**



**Charlene Chen**



**Jinho Lee**