

Tracing a trail of human-computer interaction history

p.b. hua
The Recurse Center
May 10, 2024

About me

Hi I'm p.b. (she/they)

I facilitate an HCI reading group
(every Monday)

Qualifications

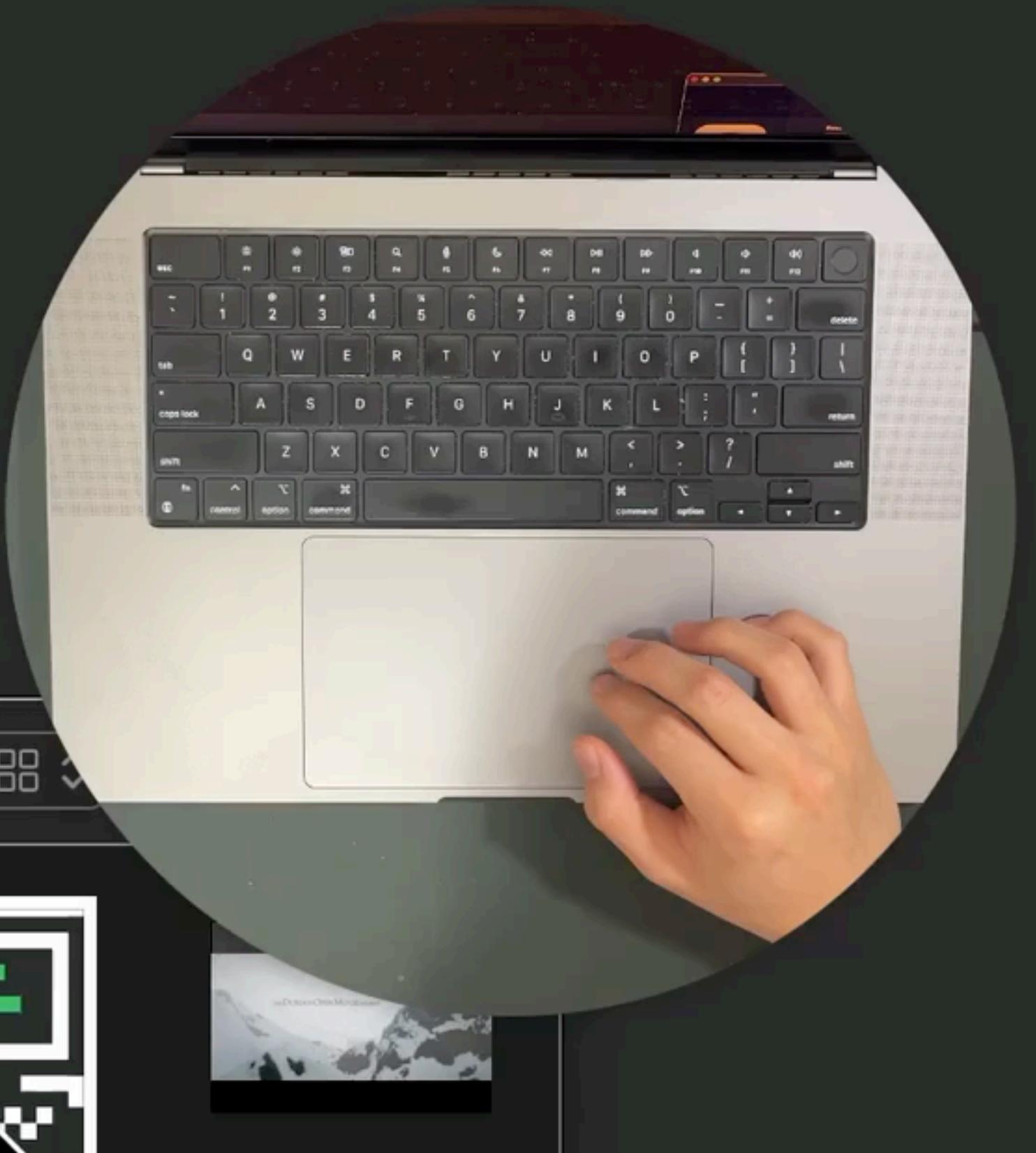
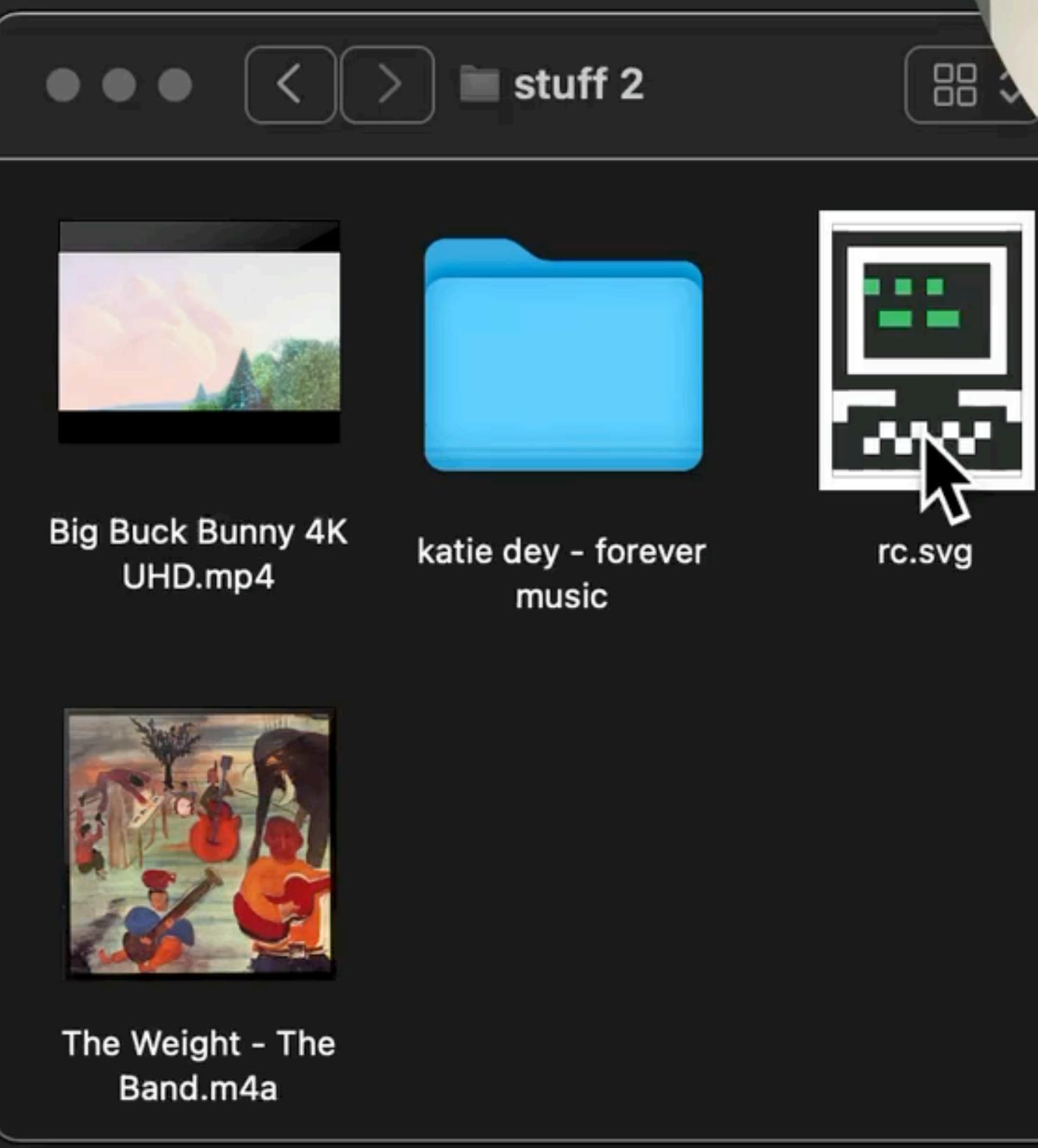
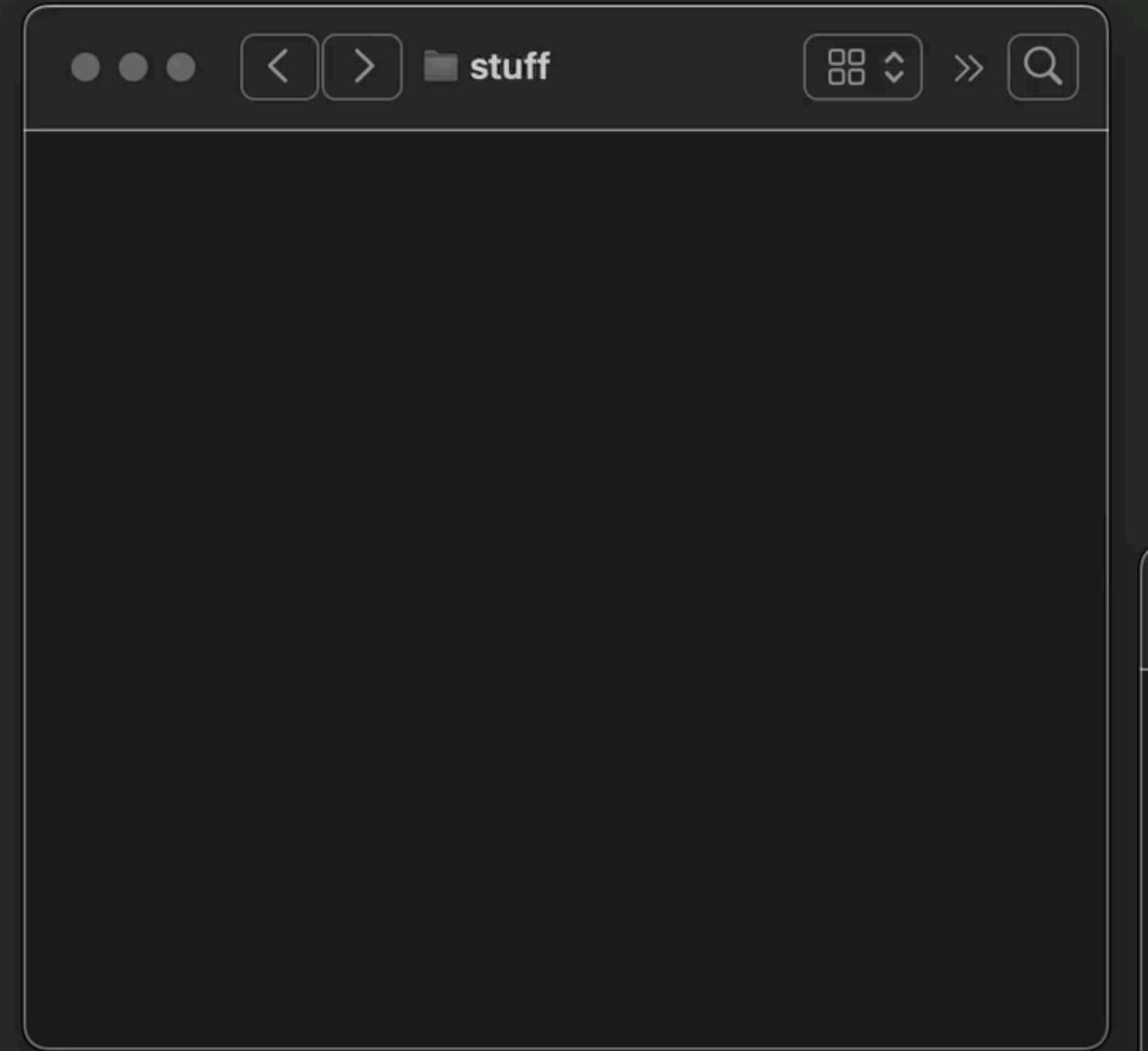
I have used a computer and
I like computers, sometimes

Search

Results for: computer

264 Photos





*Adding weight to drag
and drop in
macOS Finder*

Me, back in March

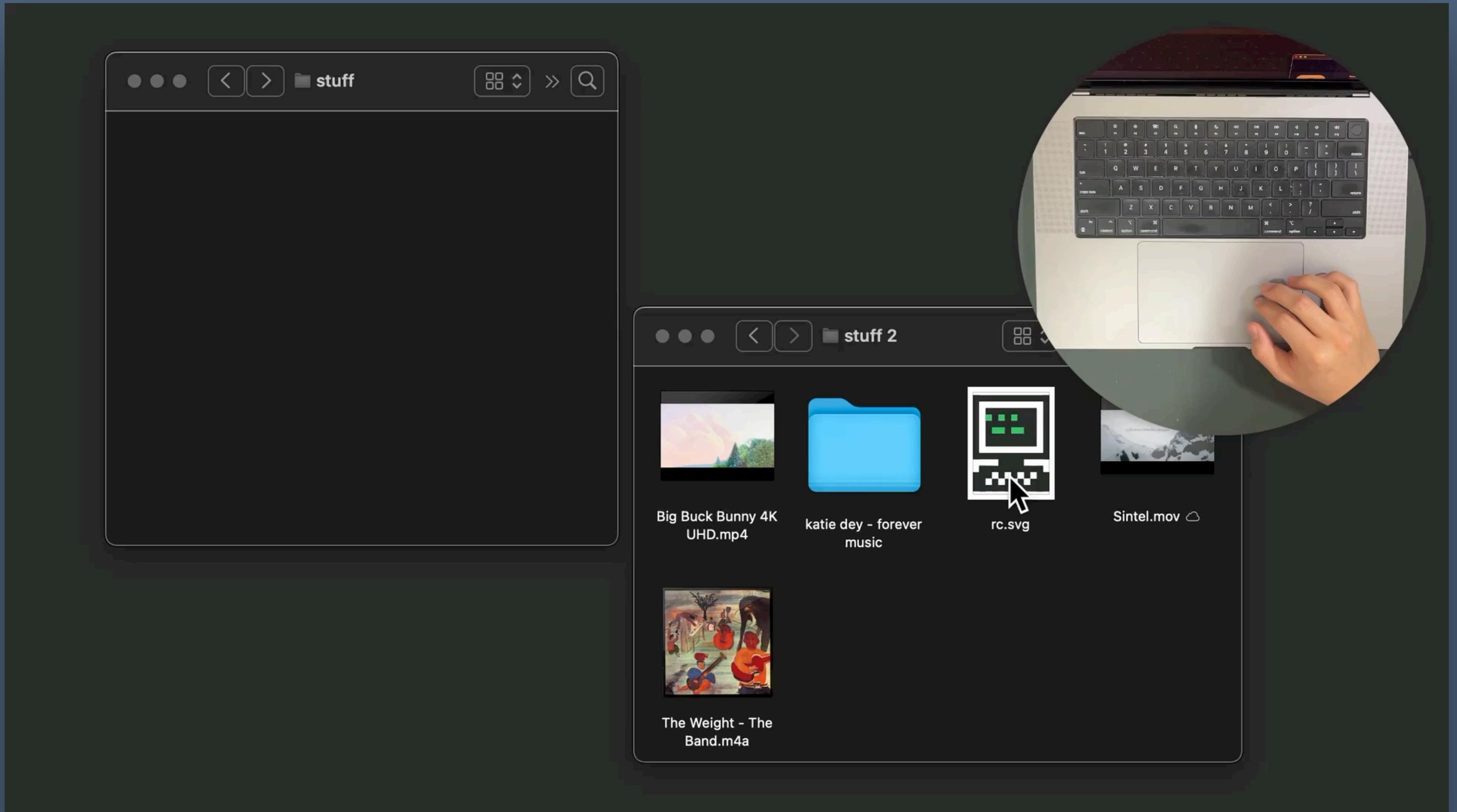
What made this *click*?

Some feedback, anonymized
and paraphrased:

“It’s very silly”

“This would be a great
standup bit”

“It’s very visual”



*Adding weight to drag
and drop in
macOS Finder*

Me, back in March

Before we begin, some disclaimers

This isn't by any means comprehensive, nor is it meant to.

It's kind of a summary of the HCI reading group discussions over the past 12 weeks.

Human-computer interaction?

Human-computer interaction?

“Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.”



*The ACM SIGCHI
Curriculum of Human-
Computer Interaction*

January 1992

Human-computer interaction?



Computers for the Explorer I (1958) mission

World War II

“The human computer is supposed to be following fixed rules; he has no authority to deviate from them in any detail. We may suppose that these rules are supplied in a book, which is altered whenever he is put on to a new job. He has also an unlimited supply of paper on which he does his calculations.”

*Computing Machinery
and Intelligence*

Alan Turing, 1950

“The human computer is supposed to be following fixed rules; he has no authority to deviate from them in any detail. We may suppose that these rules are supplied in a book, which is altered whenever he is put on to a new job. He has also an unlimited supply of paper on which he does his calculations.”

*Computing Machinery
and Intelligence*

Alan Turing, 1950

“Ballistics computation and programming lay at the intersection of scientific and clerical labor. Each required advanced mathematical training, yet each was categorized as clerical work.”

“A ‘computer’ was a human being until approximately 1945. After that date the term referred to a machine, and the former human computers became ‘operators.’”

*When Computers
Were Women*



Hi! I'm just a lil guy

What is human-computer
interaction?



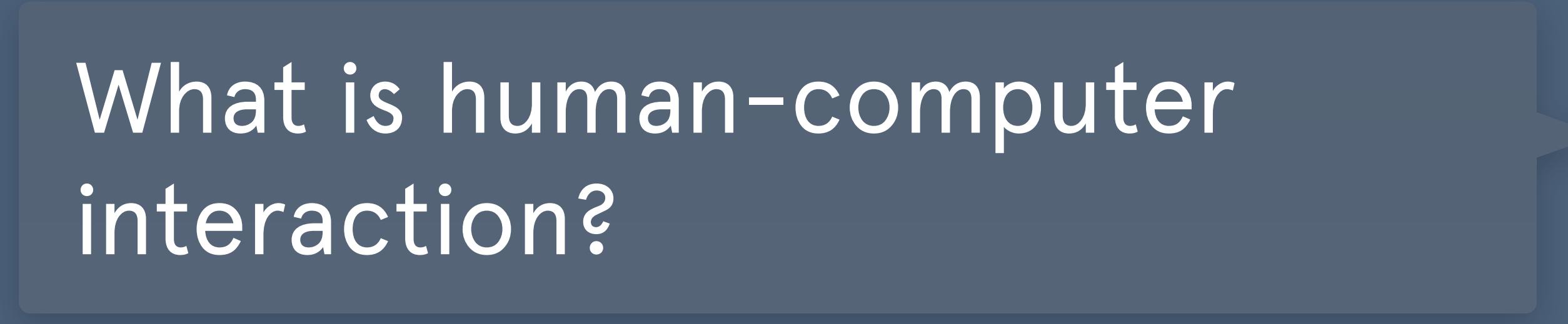
...

n.b.: guy (they/them)



...

Hi! I'm just a lil guy



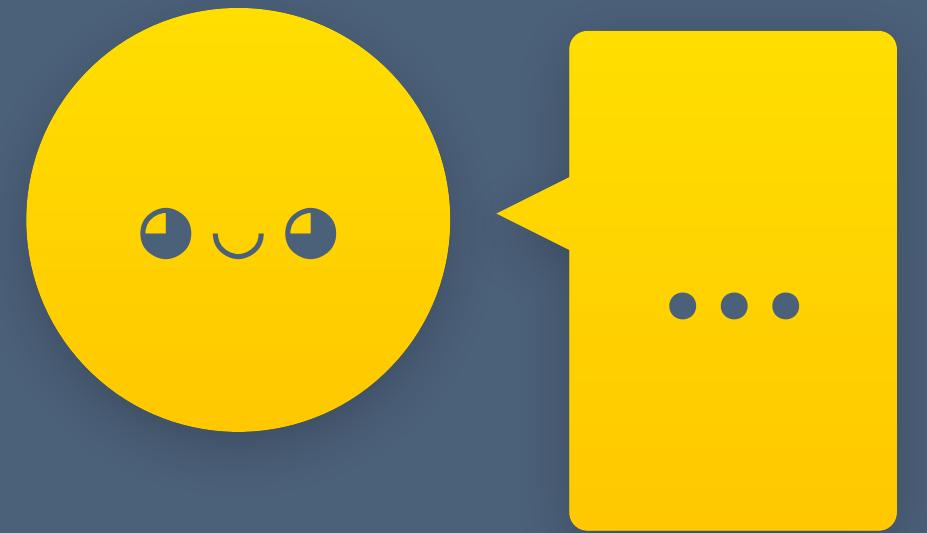
What is human-computer interaction?



...

Certainly! Human-computer interaction is when you issue commands to computers and they must obey you.

Surely you jest?



...

*But look at the origins of some
of the first interaction
paradigms! It's even in the
name.*

Command-line interface

[Article](#) [Talk](#)

From Wikipedia, the free encyclopedia

A **command-line interface (CLI)** is a means of interacting with a [computer program](#) by inputting lines of text called [command-lines](#). Command-line interfaces emerged in the mid-1960s, on [computer terminals](#), as an interactive and more user-friendly alternative to the non-interactive interface available with [punched cards](#).

History [edit]

The command-line interface evolved from a form of communication conducted by people over [teleprinter](#) (TTY) machines. Sometimes these involved sending an order or a confirmation using [telex](#). Early computer systems often used teleprinter as the means of interaction with an operator.

Command-line interface

Article [Talk](#)

From Wikipedia, the free encyclopedia

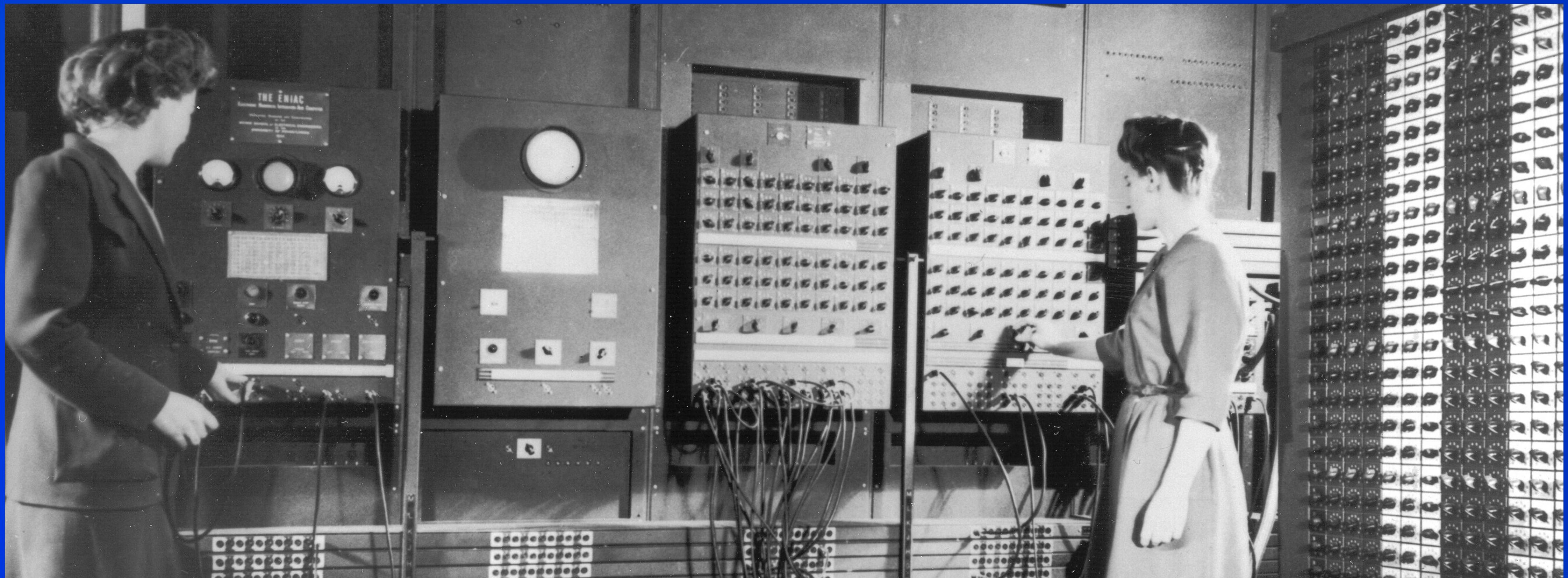
A **command-line interface (CLI)** is a means of interacting with a [computer program](#) by inputting lines of text called [command-lines](#). Command-line interfaces emerged in the mid-1960s, on [computer terminals](#), as an interactive and more user-friendly alternative to the non-interactive interface available with [punched cards](#).

History [\[edit \]](#)

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Well, I suppose you have a point?

Human-computer interaction?



Betty Jean Jennings and Fran Bilas, computersoperators of the ENIAC, 1945

1800s

Make me some yarn!



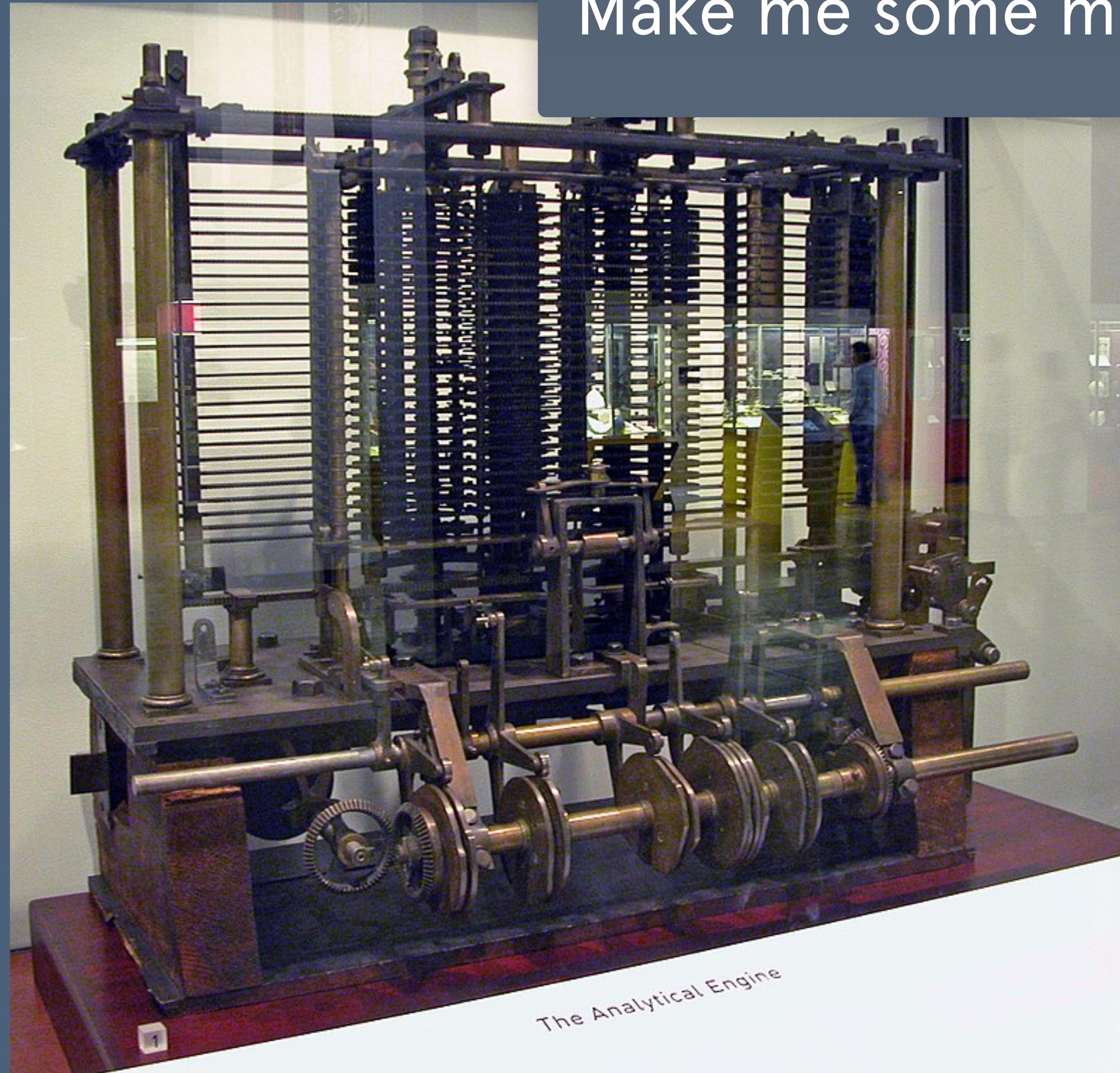
Jacquard loom
punchcards

“She thought about how the engine might do algebra, how it ‘weaves algebraical patterns just as the Jacquard loom weaves flowers and leaves’ and how it might make new discoveries: ‘We might even invent laws for series or formulæ in an arbitrary manner, and set the engine to work upon them, and thus deduce numerical results which we might not otherwise have thought of obtaining.”



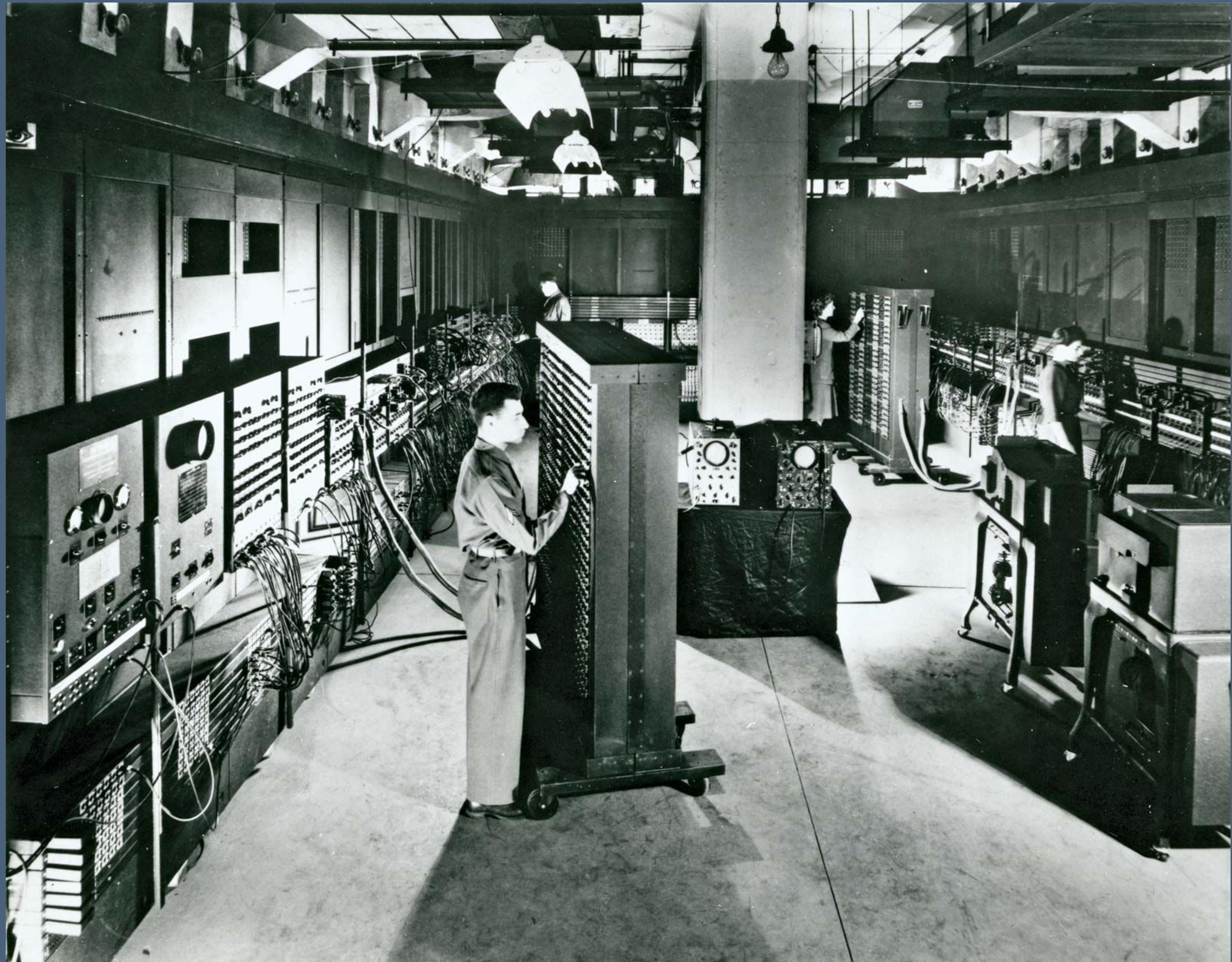
Ada Lovelace

Make me some math!



The Analytical
Engine

World War II (again)



ENIAC

“Newspaper accounts characterize ENIAC’s ability to perform tasks as ‘intelligent’ but the women doing the same computing tasks did not receive similar acclaim.”

*When Computers
Were Women*

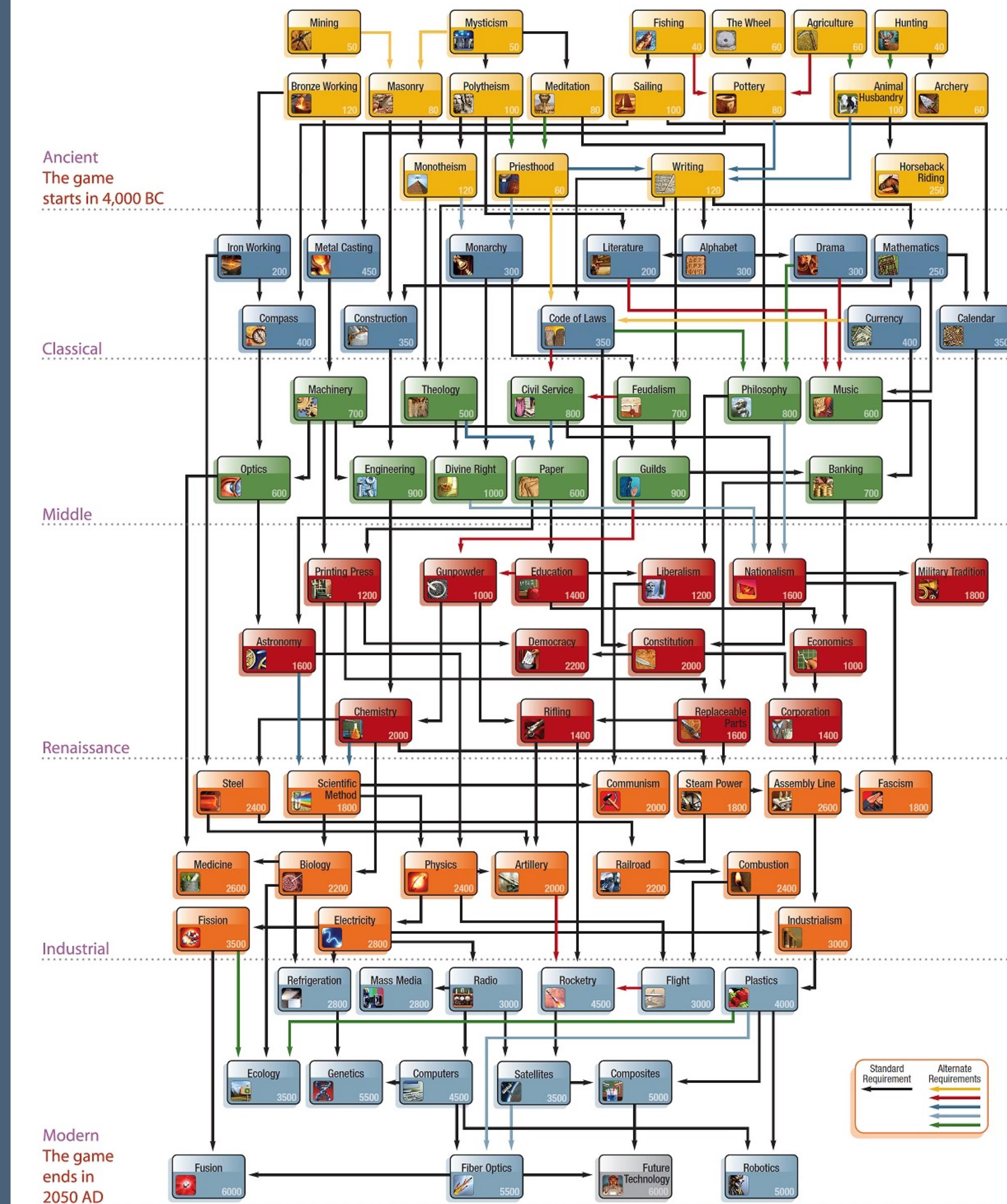


Teletypewriters
(TTYs)



Command lines
(TTYs)

Technology trees



Legend: Title of the Age; Year that marks the beginning of a new Age; Technologies Represented in different Ages; Cost of Researching the Technology
The representation of relationships between technologies has been borrowed from Sid Meier's Civilization IV Tech Tree and Specifications Charts

Civilization 4 Technology Tree

A partial technology tree

Keyboards

Typewriters

Jacquard looms

Computers (human)

Radios

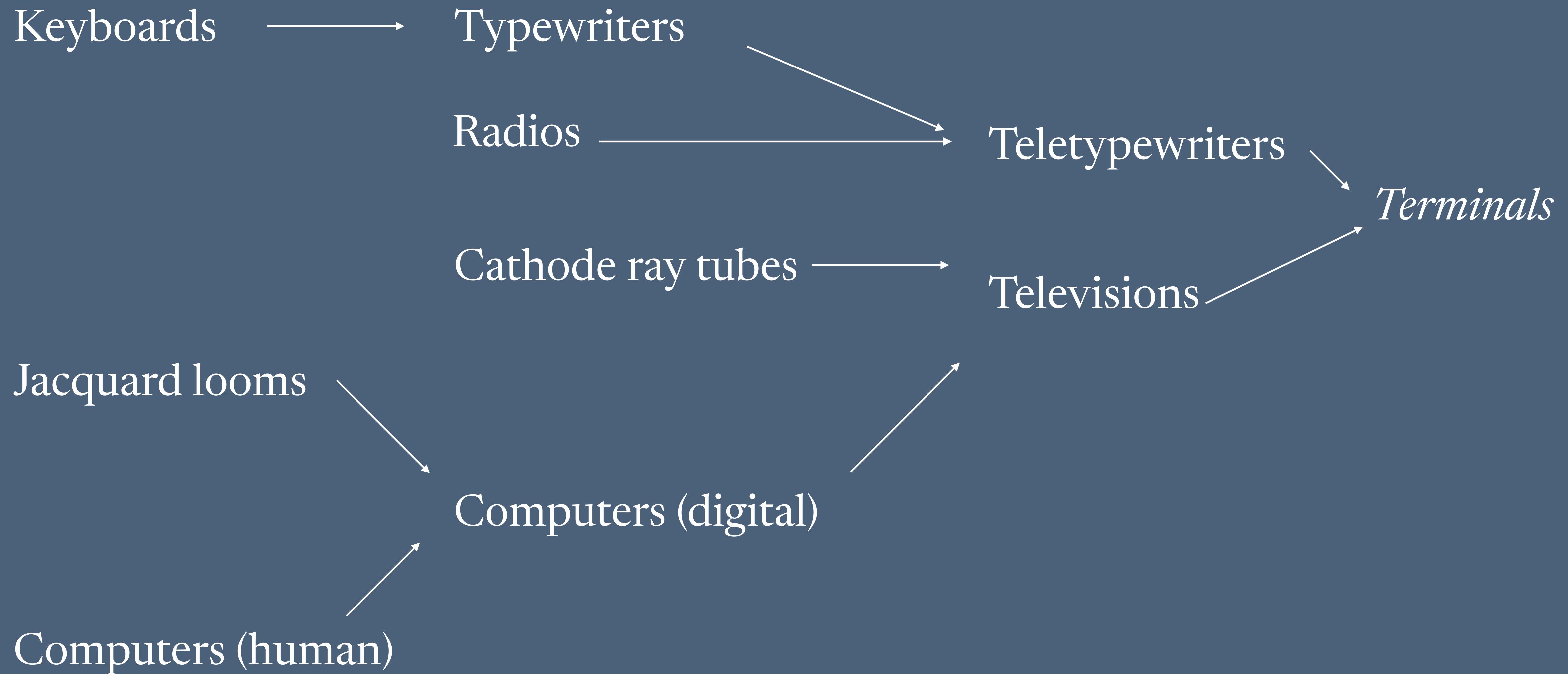
Teletypewriters
Televisions

Cathode ray tubes

Computers (digital)

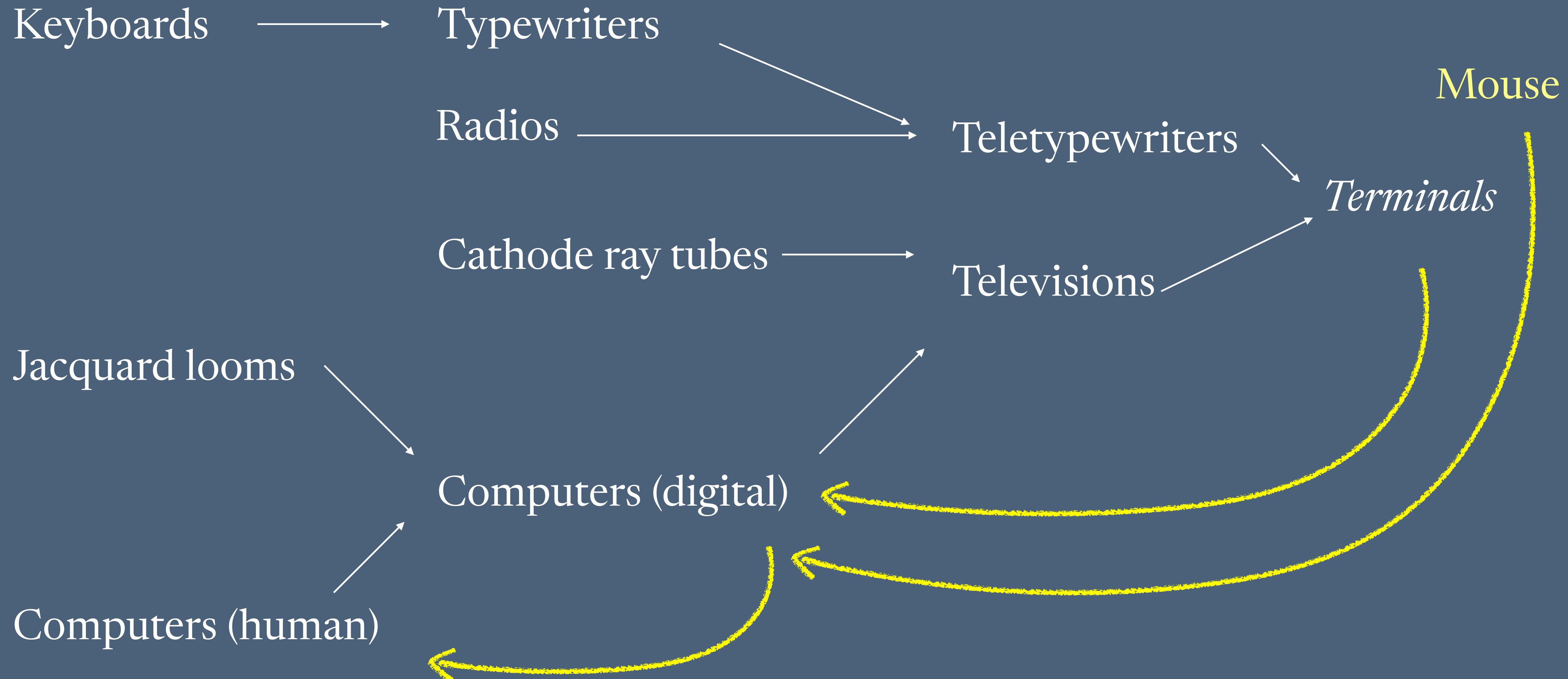
Terminals

A partial technology tree





Isn't there something you're forgetting?



...

Hey can I say something?

Wait hold on I didn't summon
you!

...

...

...

Hey can I say something?

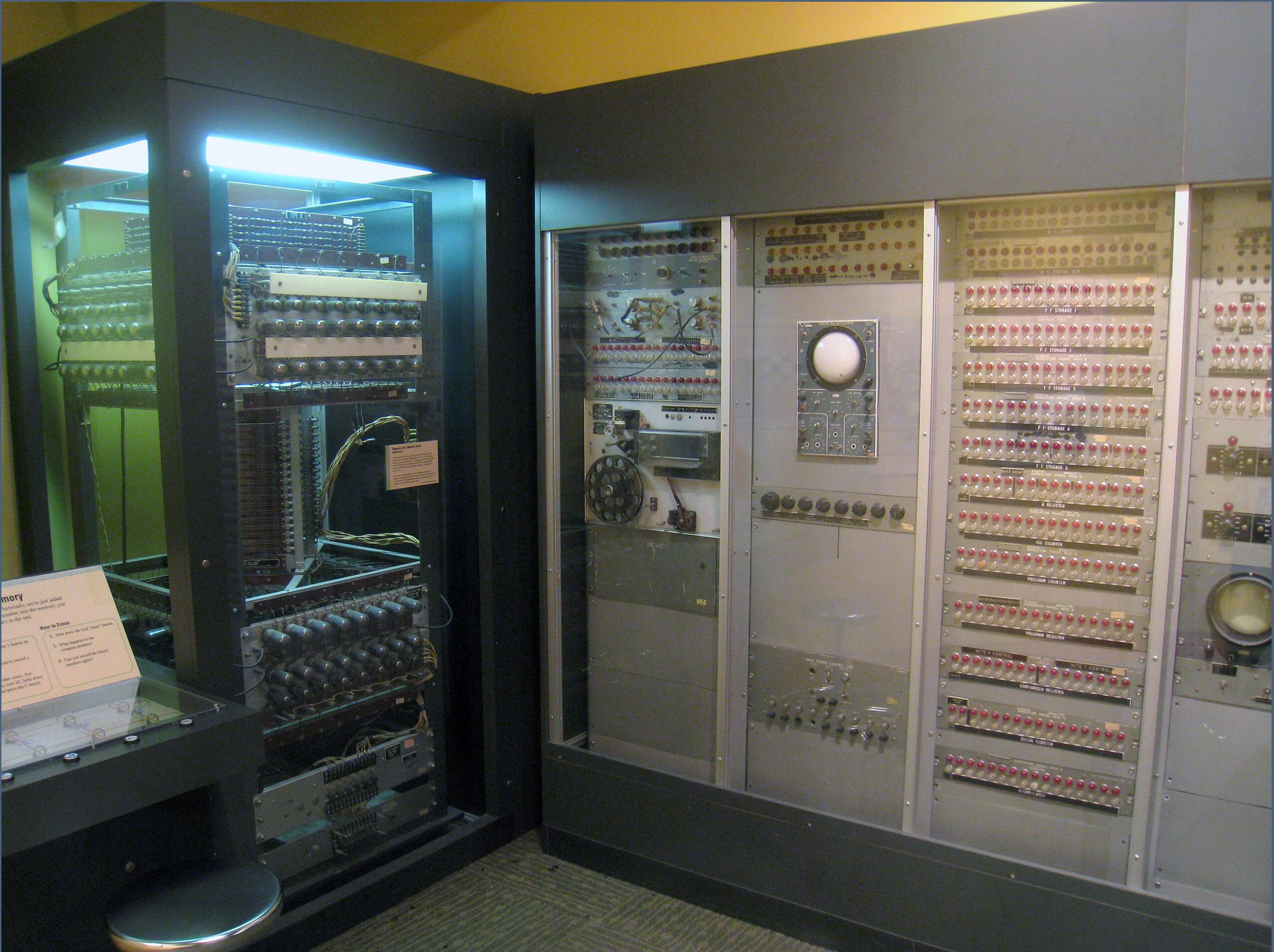
Wait hold on I didn't summon
you!

...

I just wanted to revise my
definition of HCI. I've learned
something: A computer is not
merely a vessel for commands.
It's an extension of the self.

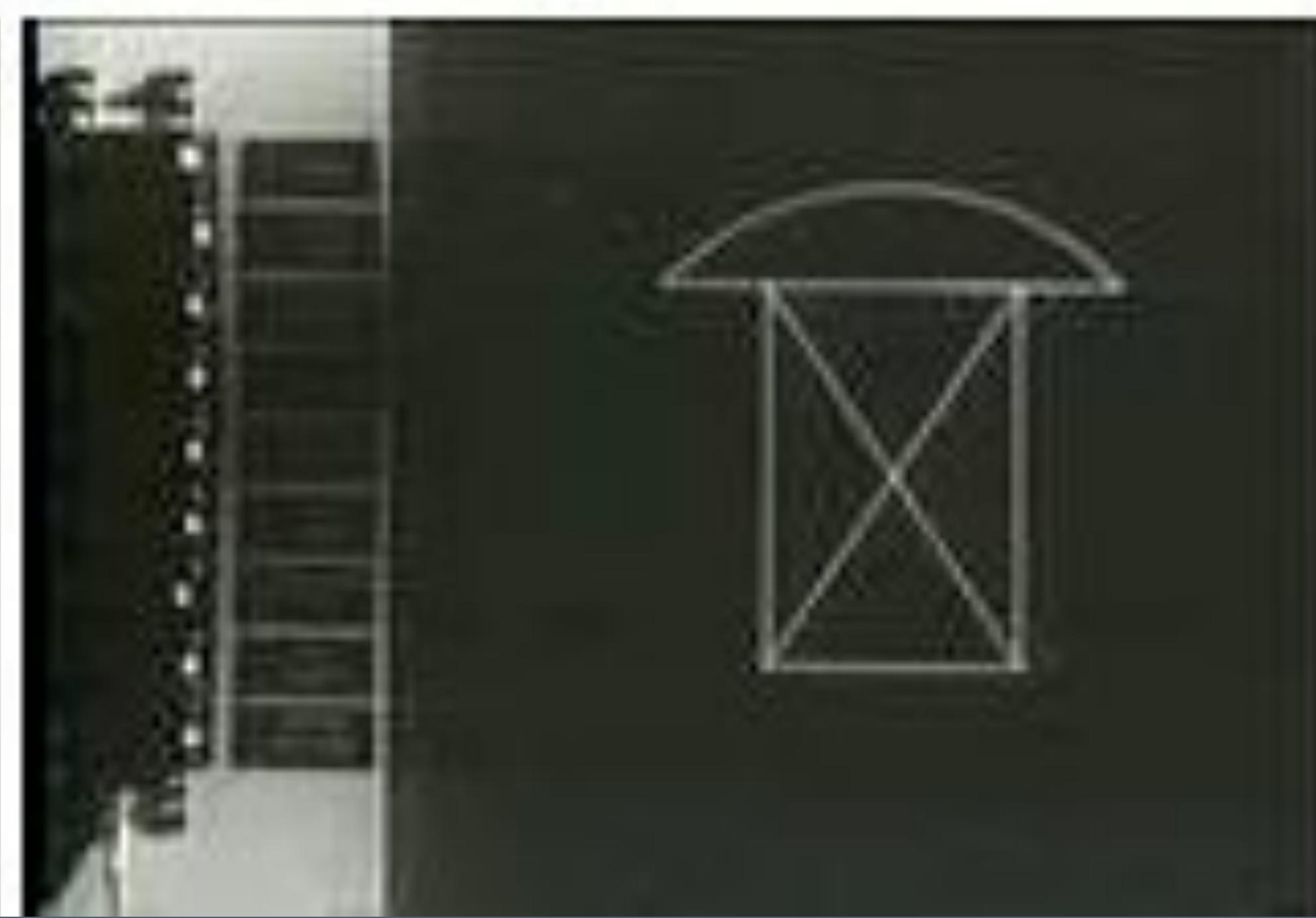
The computer as augment

Just after World War II



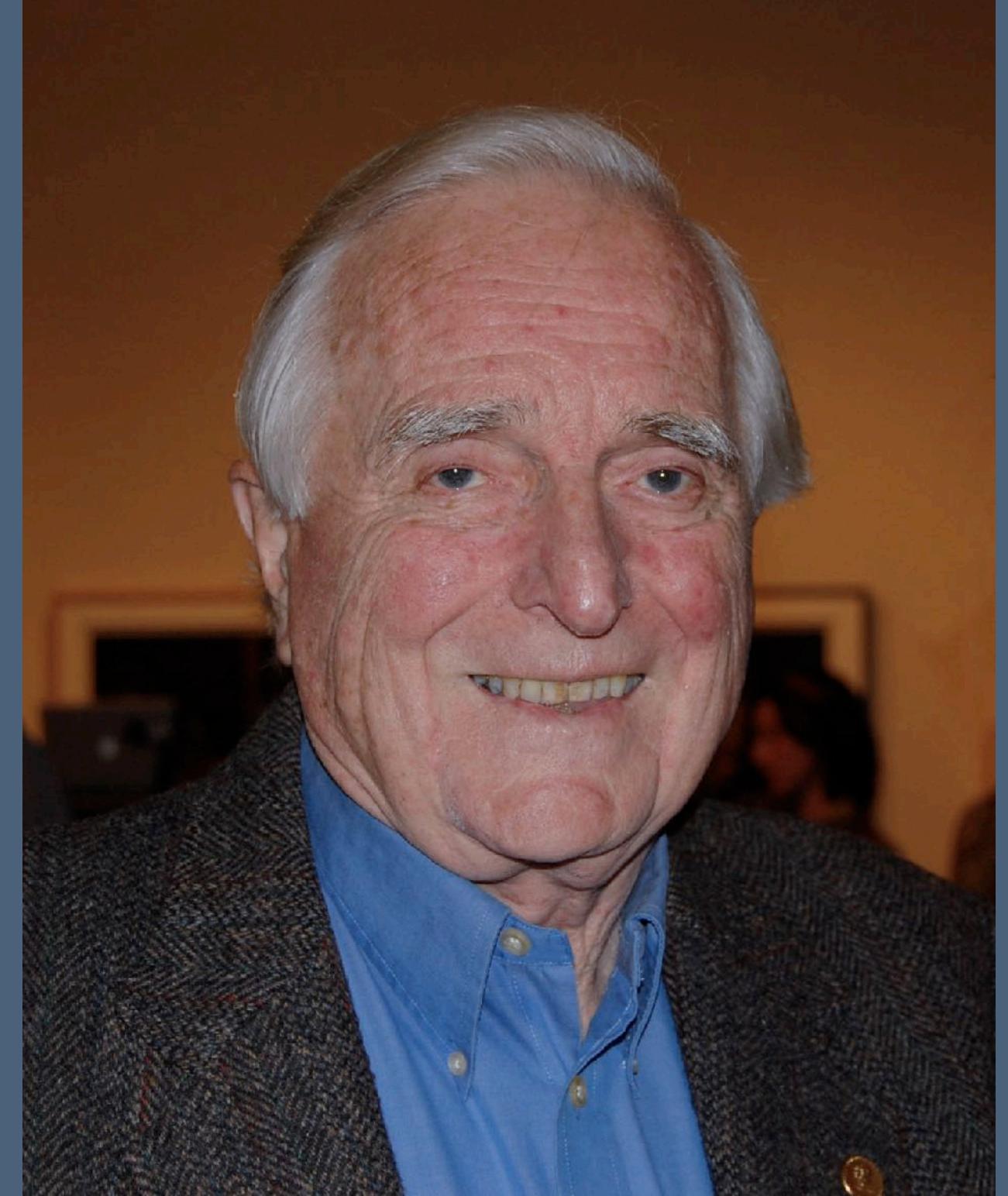
Whirlwind (1951)
The first realtime output computer
(as opposed to a job-based system like on ENIAC)

Sketchpad
(1963)
A light-pen
based
constraint-
satisfying
drawing system

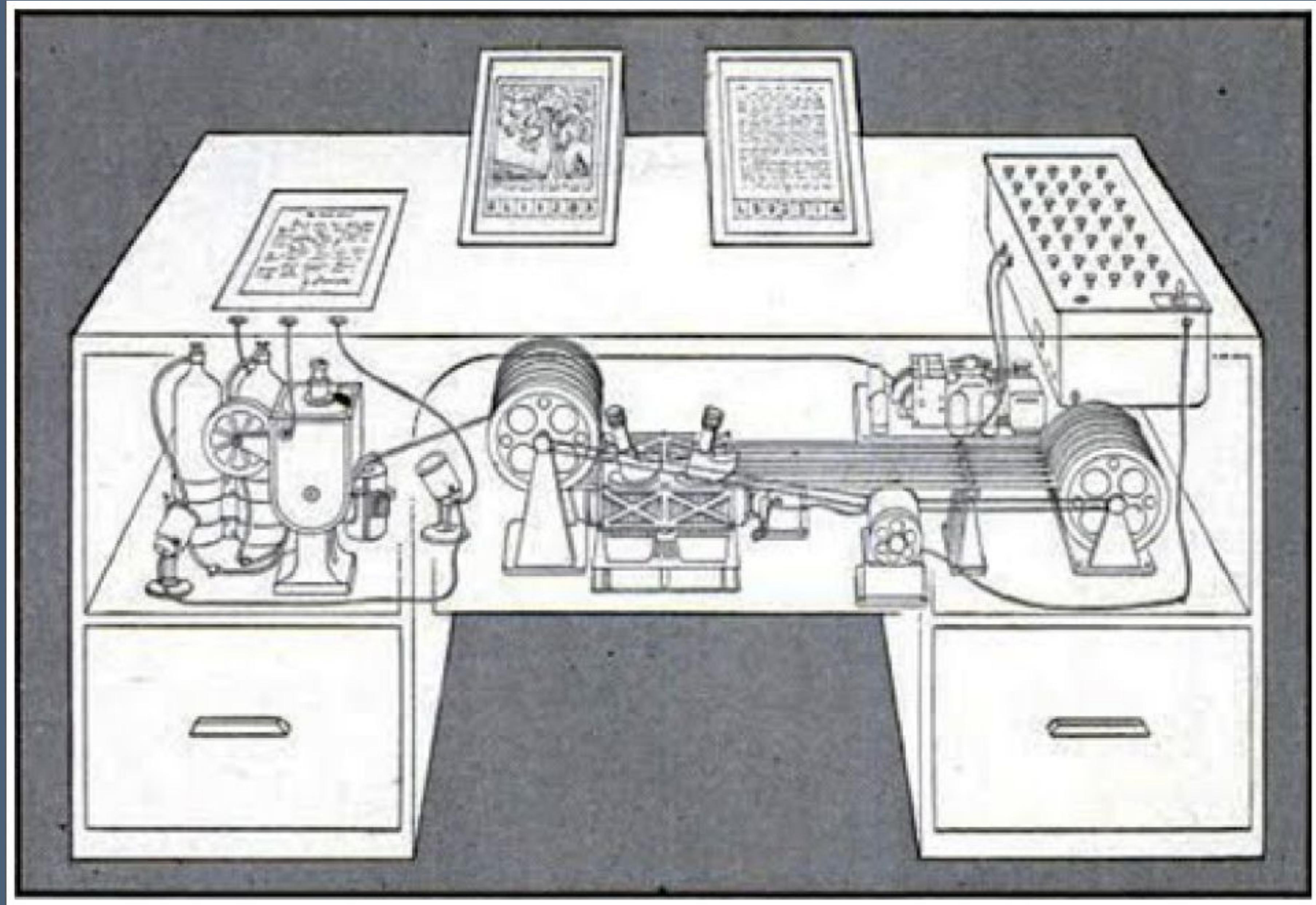


“Man's population and gross product are increasing at a considerable rate, but the complexity of his problems grows still faster...

Augmenting man's intellect [...] would warrant full pursuit by an enlightened society...”



*Augmenting
Human Intellect*
(1962), Douglas
Engelbart



Memex
Vannevar
Bush's
microfilm
information
system

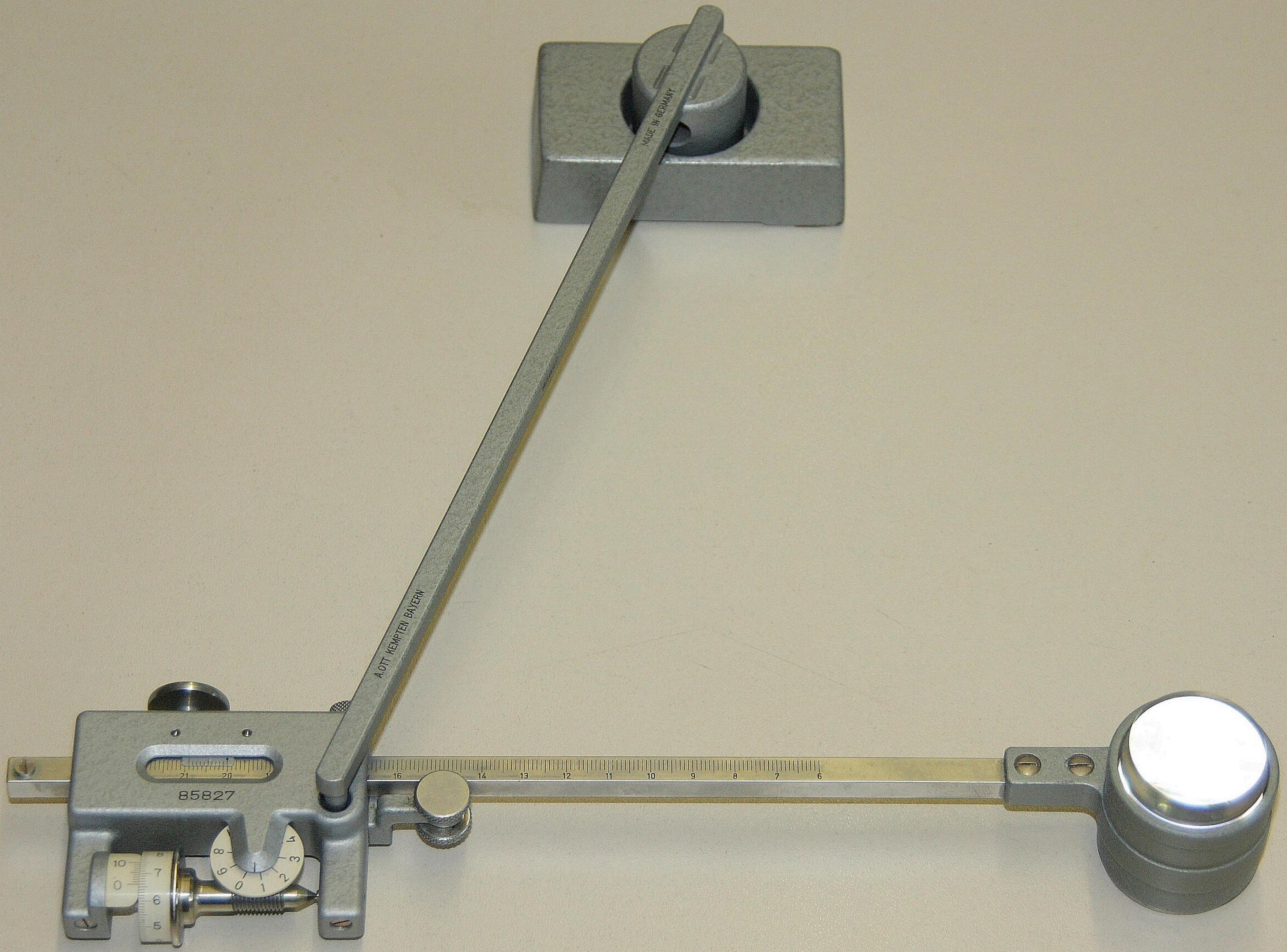
WEEKLY BRANCH

- 1. ORANGES
- 2. APPLES
- 3. BANANAS
- 4. CARROTS
- 5. SOUP
- 6. KETCHUP
- 7. LETTUCE
- 8. FRENCH DRAIS
- 9. BEAN SOUP
- 10. TOMATO SOUP
- 11. PAPER TOWELS
- 12. ASPIRIN
- 13. NOODLES (YELLOW FINED)
- 14. BEANS
- 15. SCOTCH TAPE
- 16. CHAPSTICK
- 17. MILK
- 18. FILM
- 19. BREWER



NLS
(The oN-Line
System)

1962



Planimeter
A device for
determining
the area of a
shape



The first
“mouse”

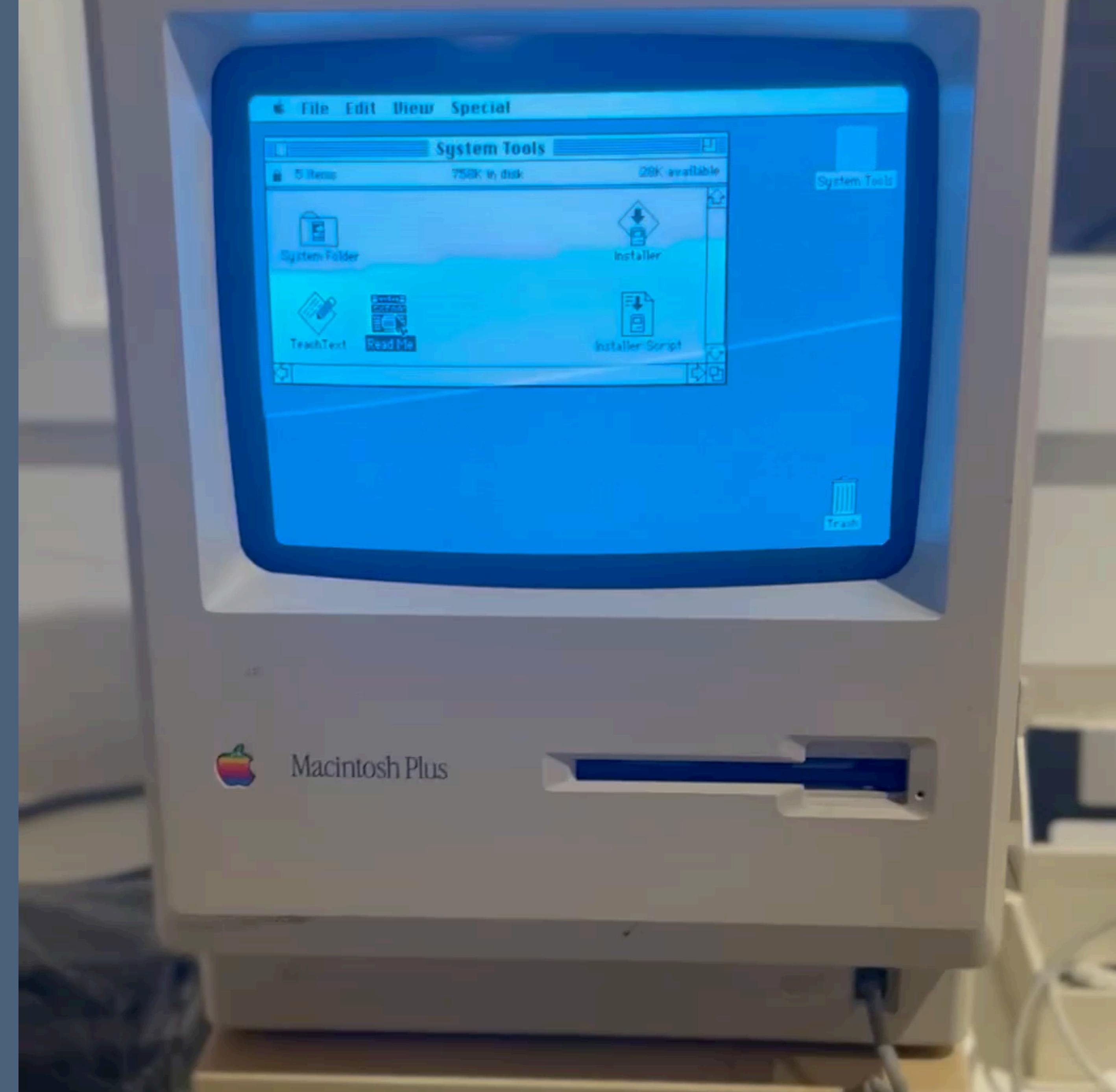


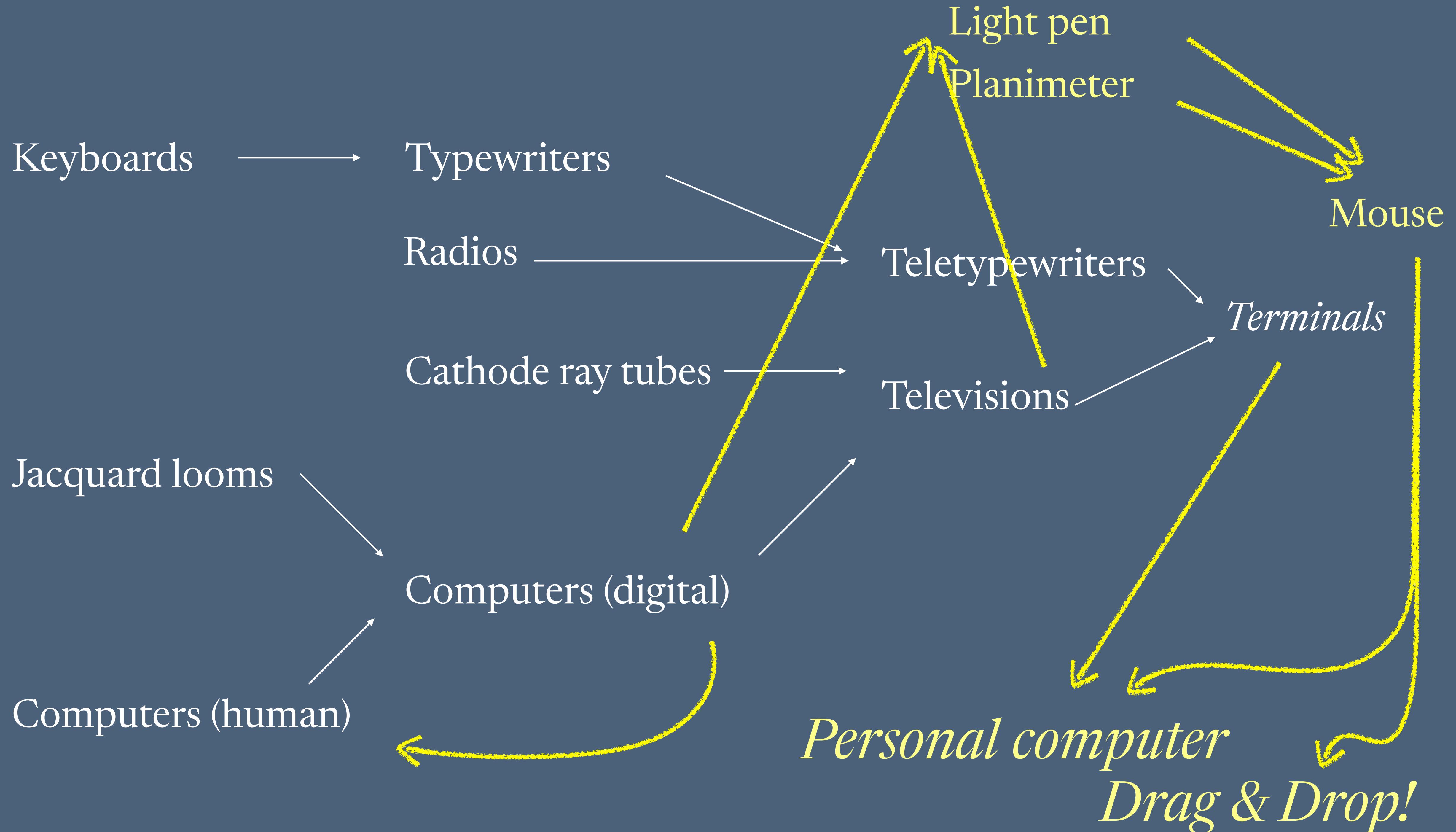
Xerox Alto

“I had observed at PARC, in myself and others, that the three-button mouse was confusing [...] If there's only one button, you can't make any mistakes. So I said, ‘Let's make a mouse with one button.’ But the first thing is, how can you do all the things? [...] So I designed the method of using a one-button mouse, and so invented a lot of methods that are still in use, like click and drag for selecting a region, and for dragging things across the screen.”

Alex Soojung-Kim Pang,
“Interview with Jef Raskin”

Macintosh (1984) Apple Computer





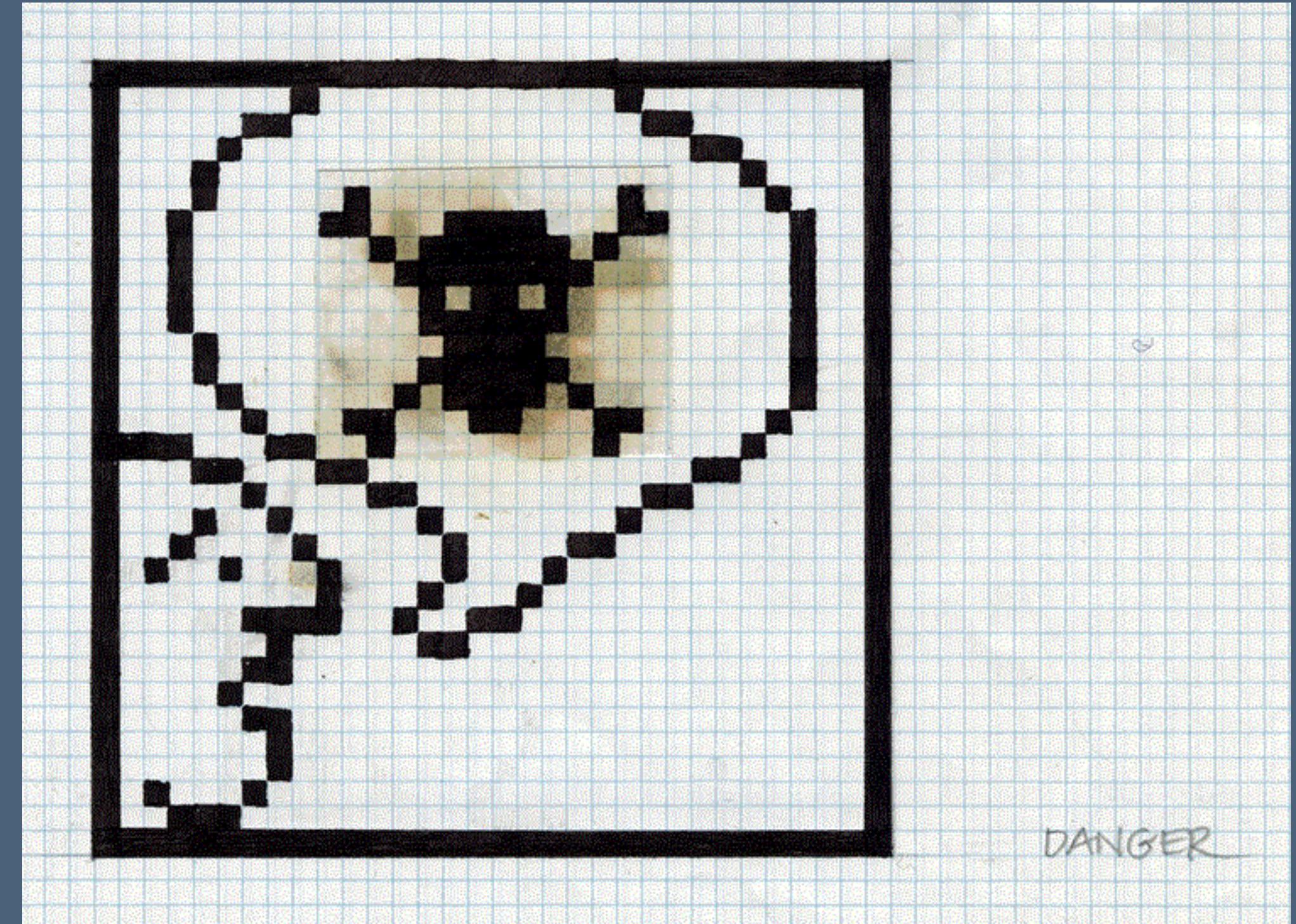
Serving *inter*-face



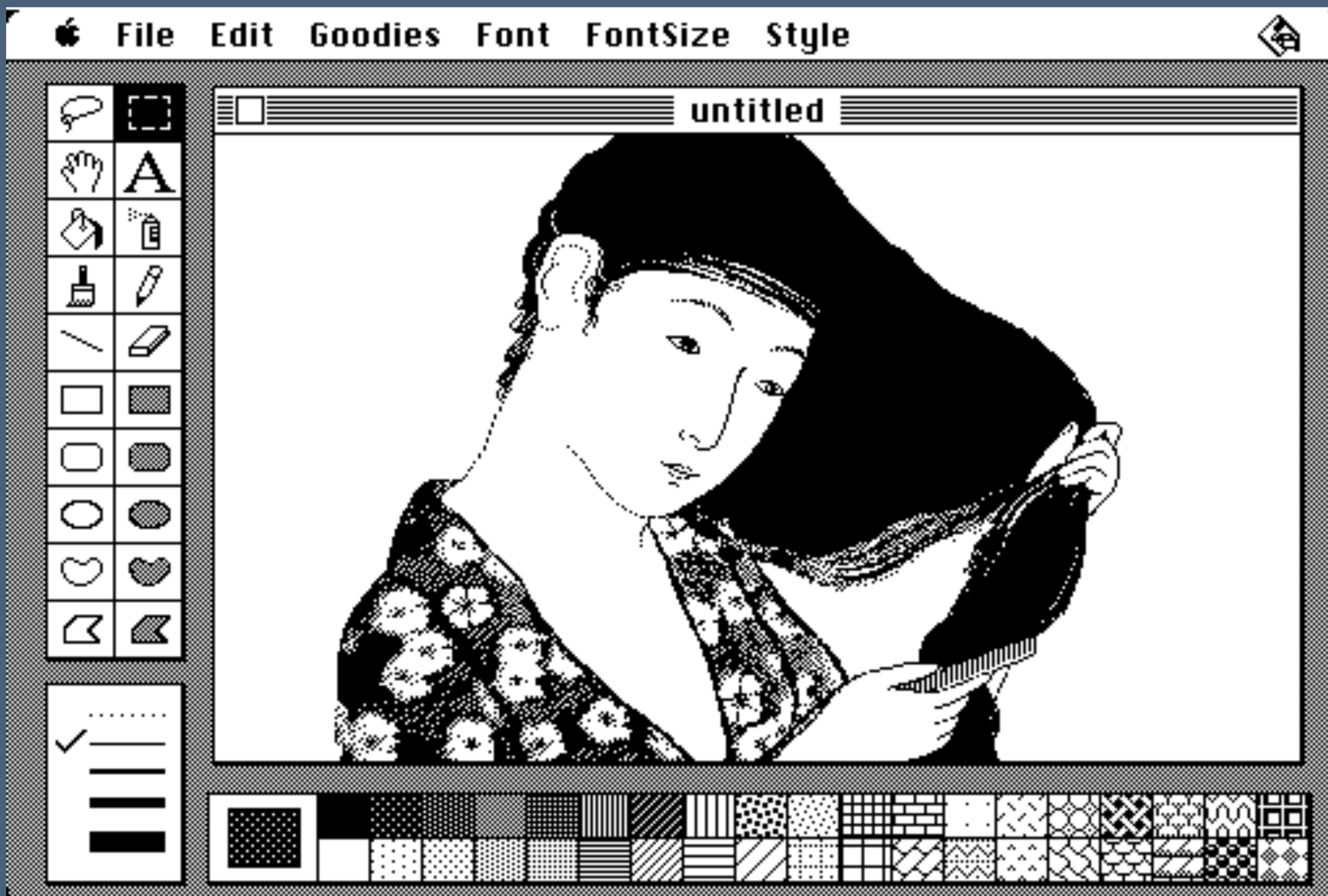
Susan Kare



Susan Kare



<https://invention.si.edu/susan-kare-iconic-designer>



MacPaint, 1984

“Bitmap graphics are like mosaics and needlepoint and other pseudo-digital art forms, all of which I had practiced before going to Apple [...] I didn't have any computer experience, but I had experience in graphic design.”

Alex Soojung-Kim Pang,
“Interview with Susan
Kare”

Chicago 12 pt

Chicago 24 pt

Monaco 9 pt

Monaco 12 pt



Geneva 9 pt

(Cairo 18 pt)

Geneva 12 pt

Los Angeles 24 pt

Los Angeles 12 pt

New York 12 pt

NY 36 pt

San Francisco 18 pt

Toronto 12 pt

Toronto 9 pt

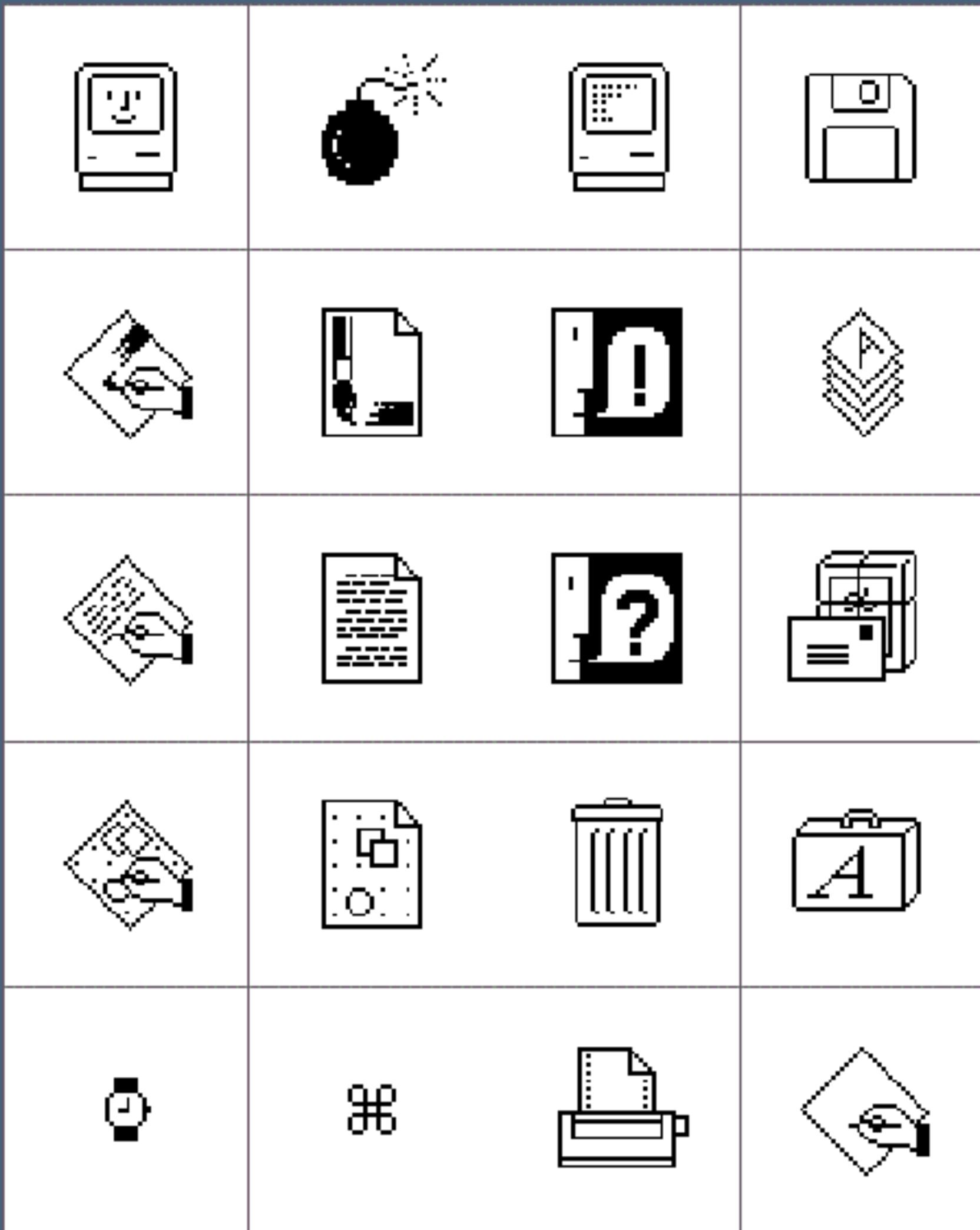
Venice 14 pt

Geneva italic

Chicago (outline)

Macintosh
fonts, 1984

What values does this art embody?

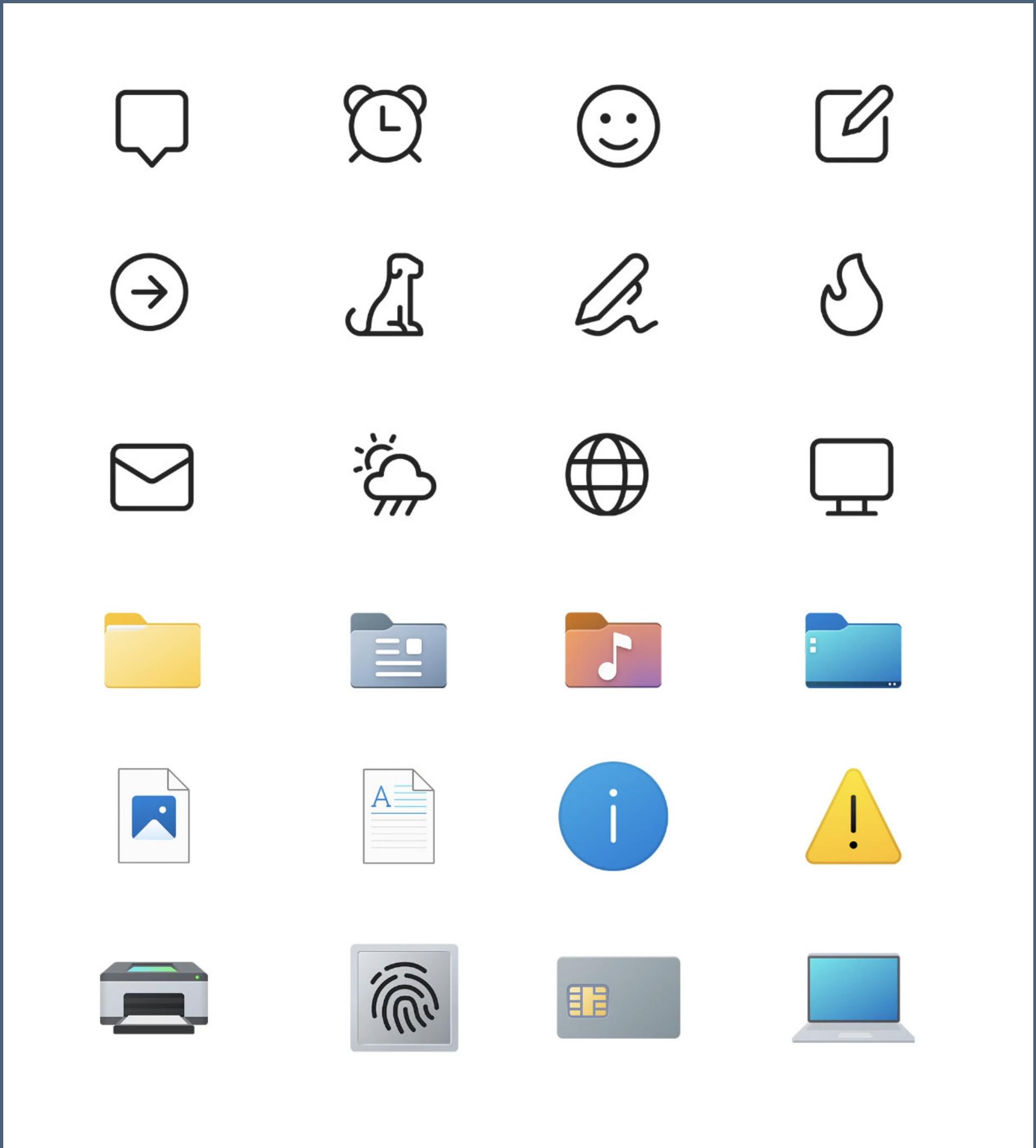


*Macintosh
icons, 1984*

...

... compared to this?

Windows 11
icons, 2021



...

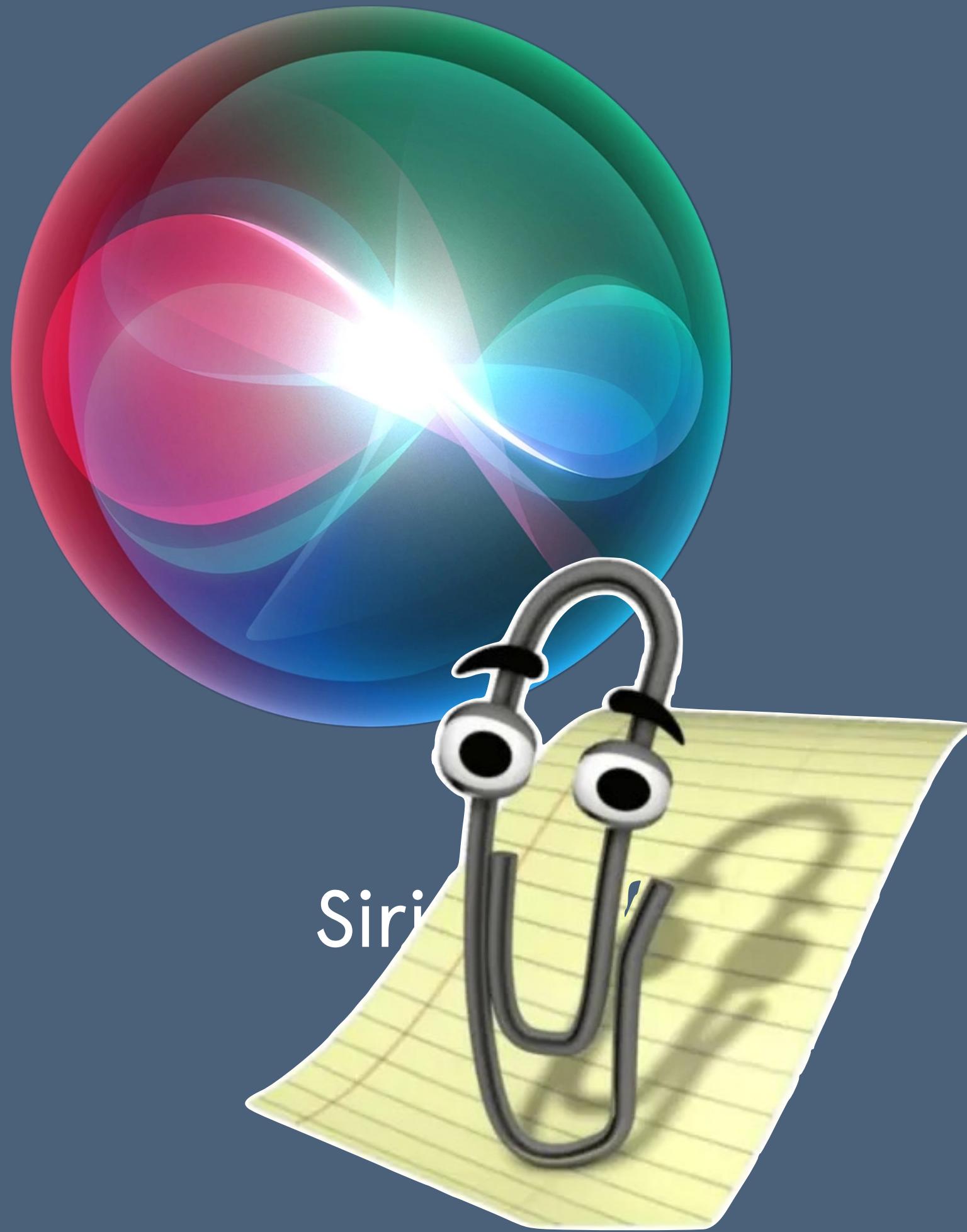
... or what about these?



ChatGPT



Microsoft
Copilot



Siri

“I suggest that the design of information software should be approached initially and primarily as a graphic design project.

Instead of dismissing ink-and-paper design as a relic of a previous century, the software designer should consider it a baseline. If information software can’t present its data at least as well as a piece of paper, how have we progressed?”

Magic Ink

Bret Victor, 2006



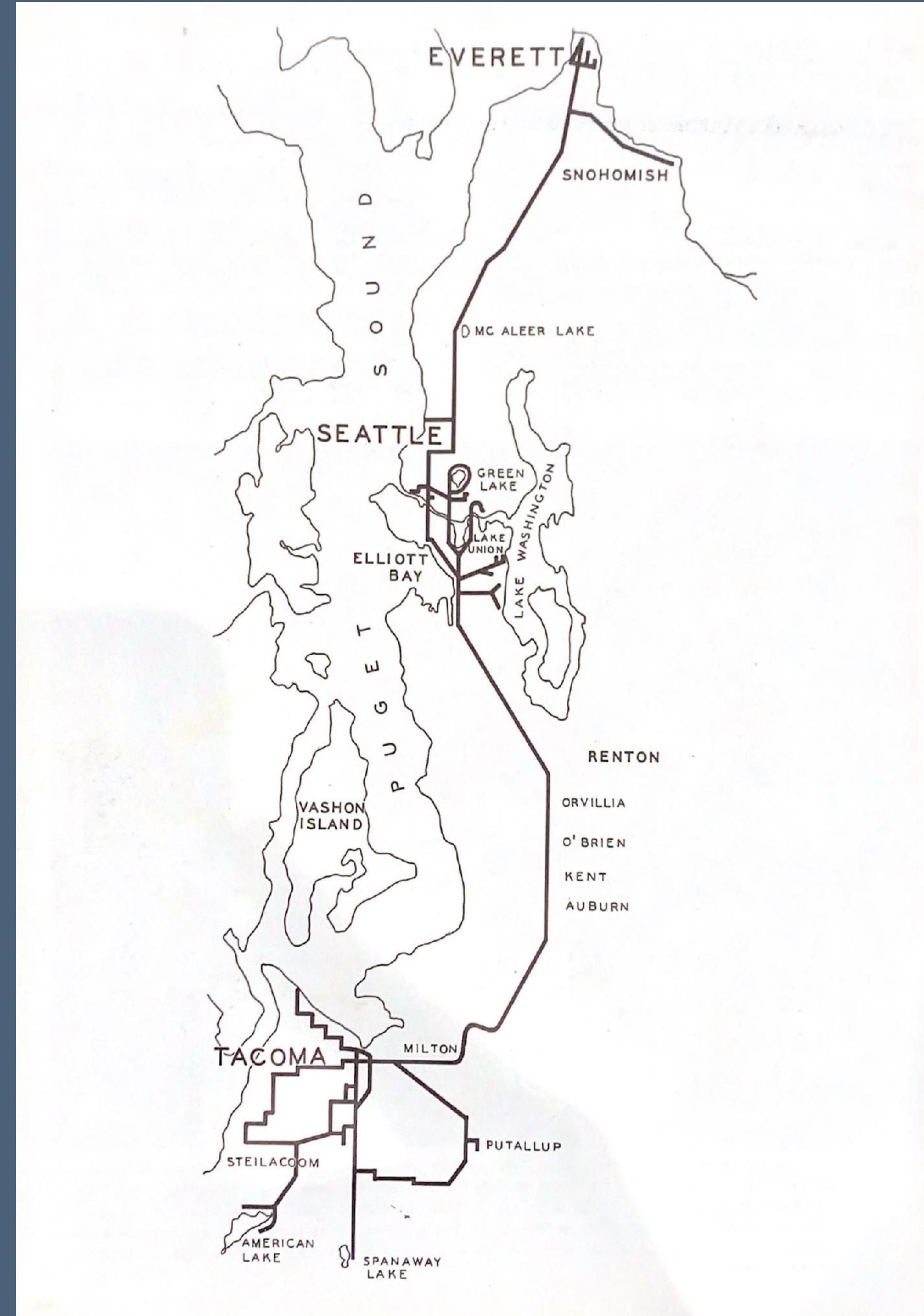
A transit route
planner from
Magic Ink



Transit App

Left: Seattle tram network in the 1920s.

Right: Seattle light rail network in 2050, hopefully



Sound Transit future service



“Infrastructural networks are enduring, and that endurance shapes the way that new systems build on top of—or underneath, or alongside—the older ones.”

How Infrastructure Works

Deb Chachra



...

Keyboard

I'm starting to get it! These technologies aren't fixed points in time; they build on top of one another, relate to one another, inform each other's design!

Jacquard looms

Computers (human)

Radios

Cathode ray tubes

Computers (digital)

Light pen

Planimeter

Mouse

Teletypewriters

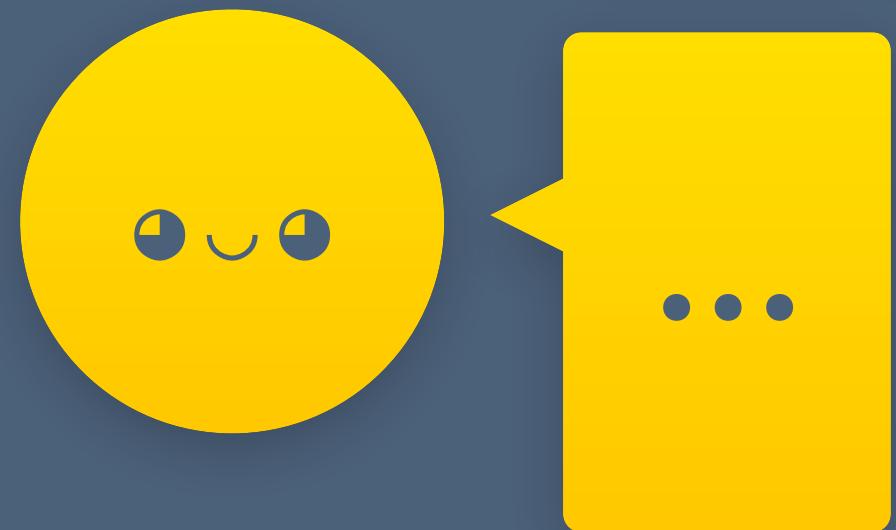
Terminals

Televisions

Personal computer

Drag & Drop!

So, what do you think HCl is now?



So, what do you think HCI is now?

...

Well, I've learned that a computer is not just an augmentation, but the relationship between humanity and a novel, *moldable, dynamic* medium.

HCI is when the human molds the computer, and the computer molds the human.

“‘User’ implies a power relationship and a kind of experience that tends to mischaracterize both technology and people”

*Computers as
Theatre, 2nd Ed.*

Brenda Laurel

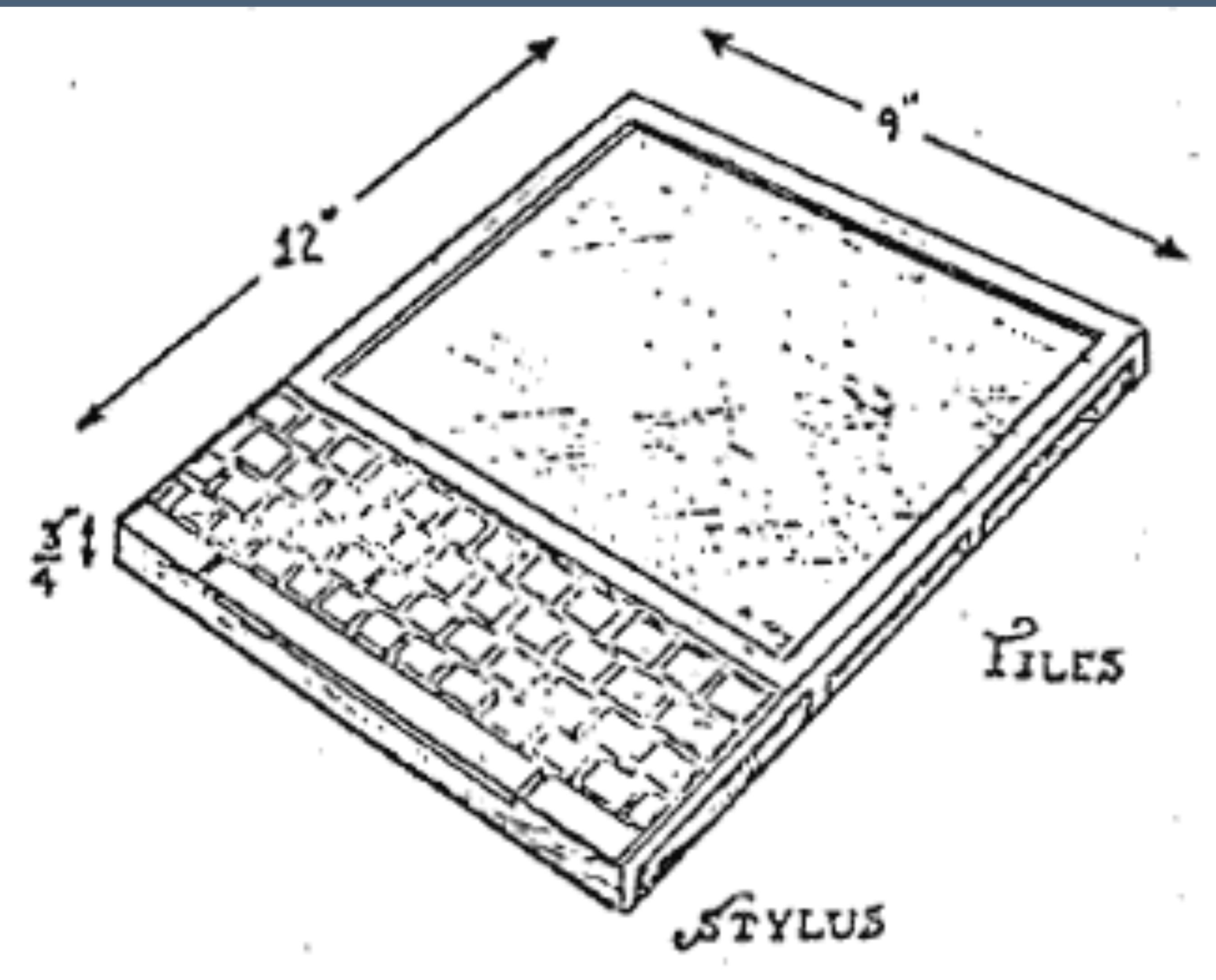
I'm sorry my guy. Alan Kay seems to think that there's something wrong with our relationship...

“The real computer revolution hasn’t happened yet”

“The Real Computer Revolution Hasn’t Happened Yet” (2007)

Alan Kay

What “Computer Revolution?”



Dynabook

Alan Kay and Adele
Goldberg



An “interim” Dynabook
Alan Kay and Adele
Goldberg

“Moreover, this new ‘metamedium’ is active—it can respond to queries and experiments—so that the messages may involve the learner in a two-way conversation.”

*Personal Dynamic
Media*

Kay and Goldberg,
1977

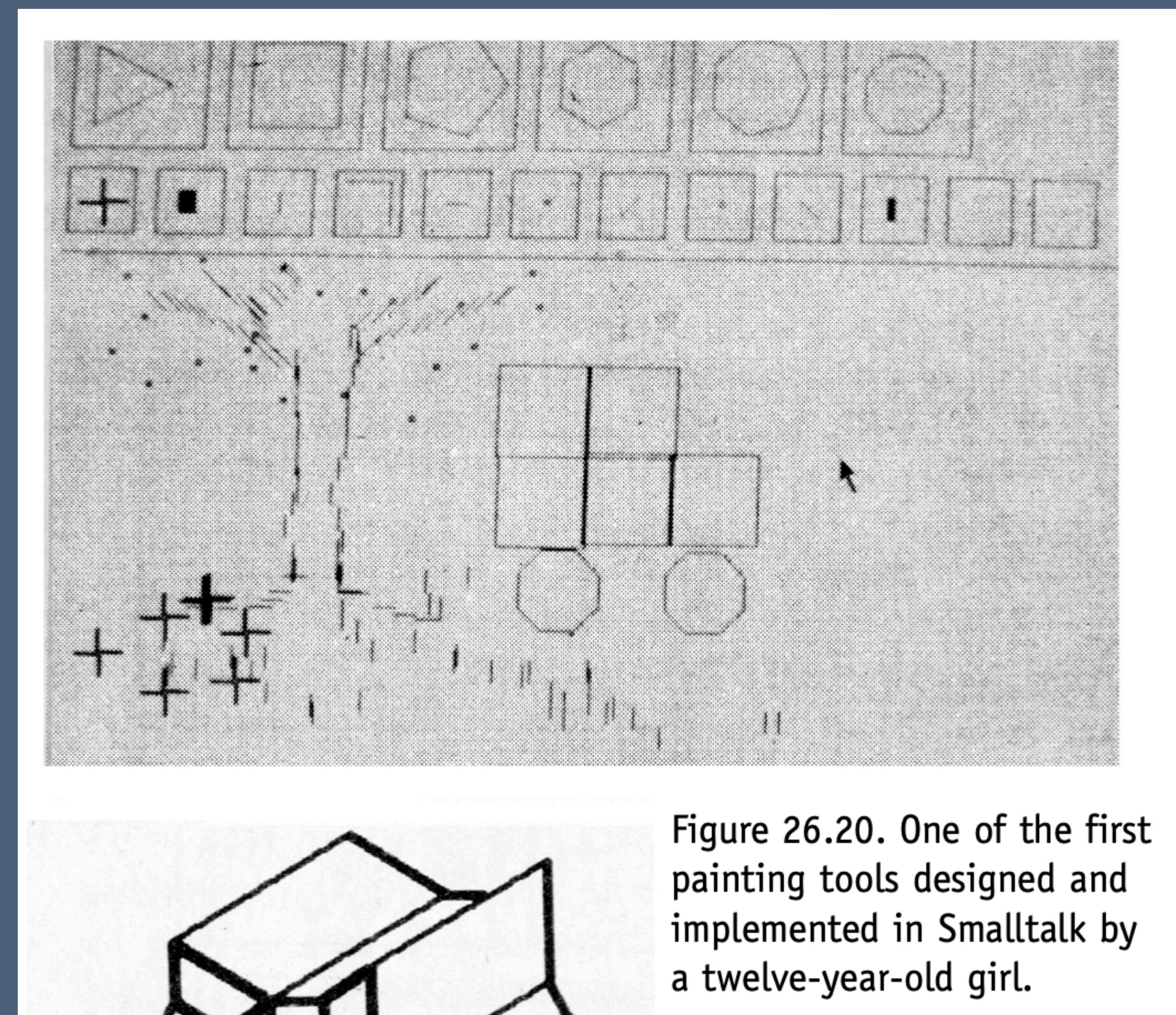
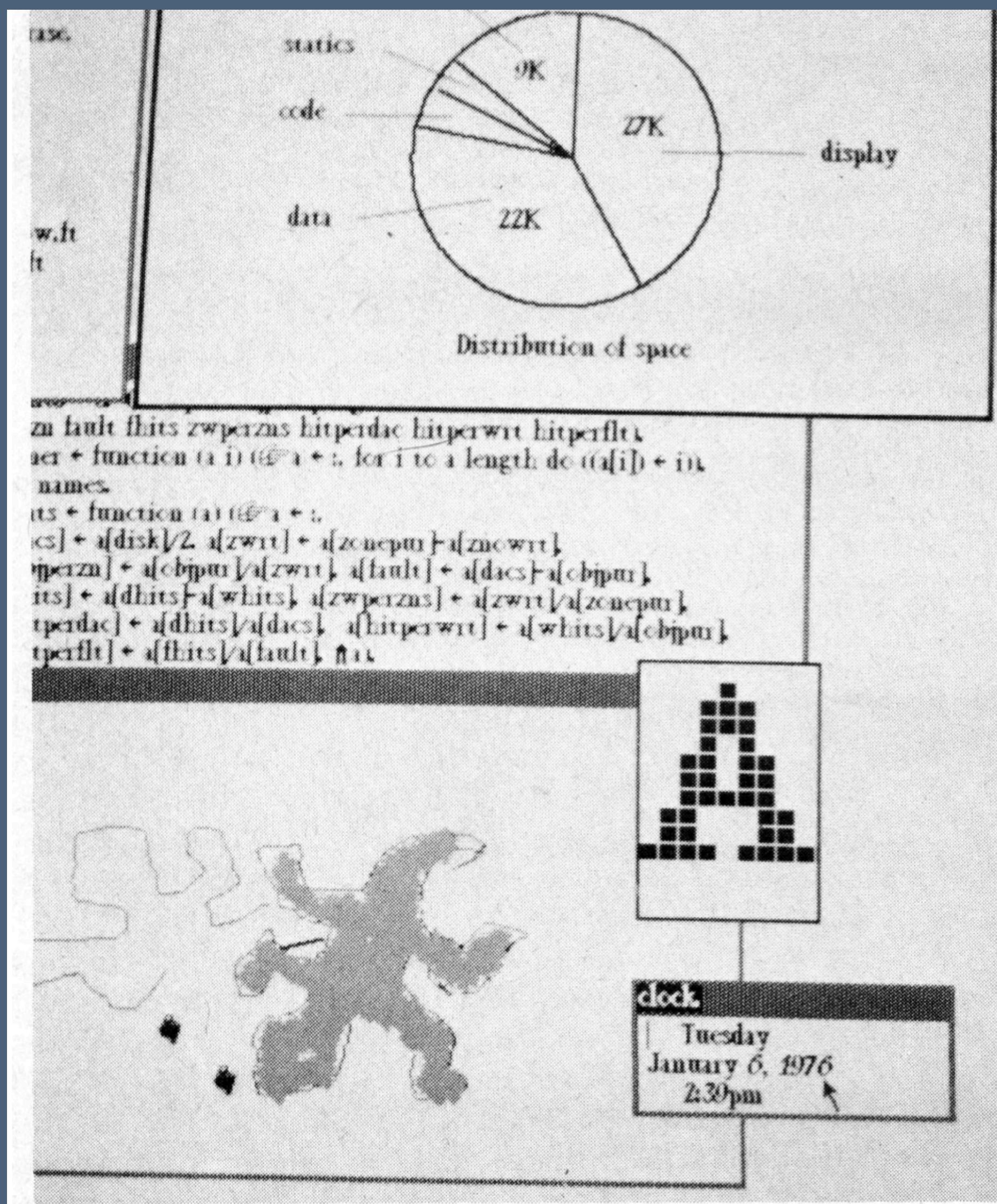
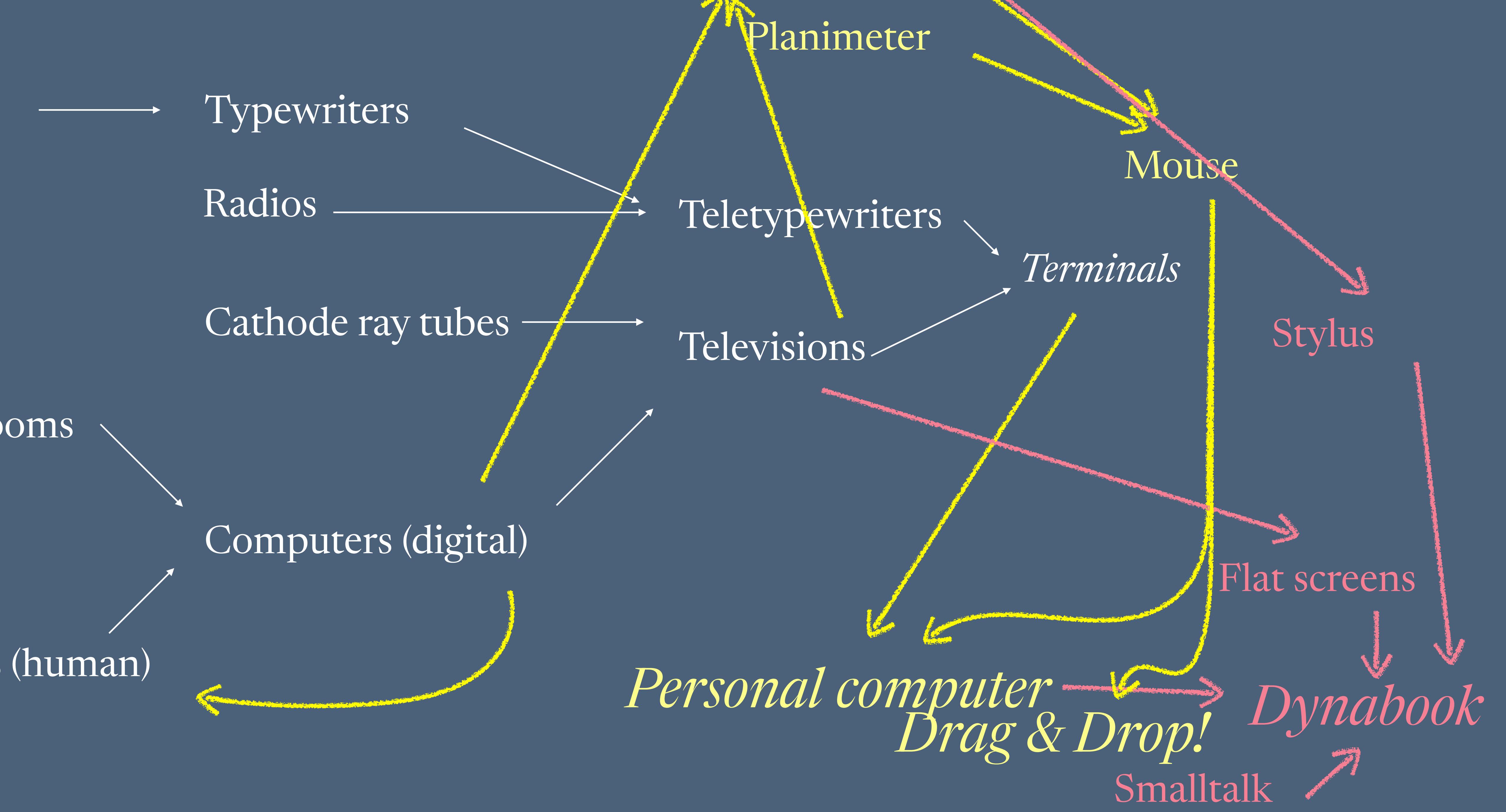


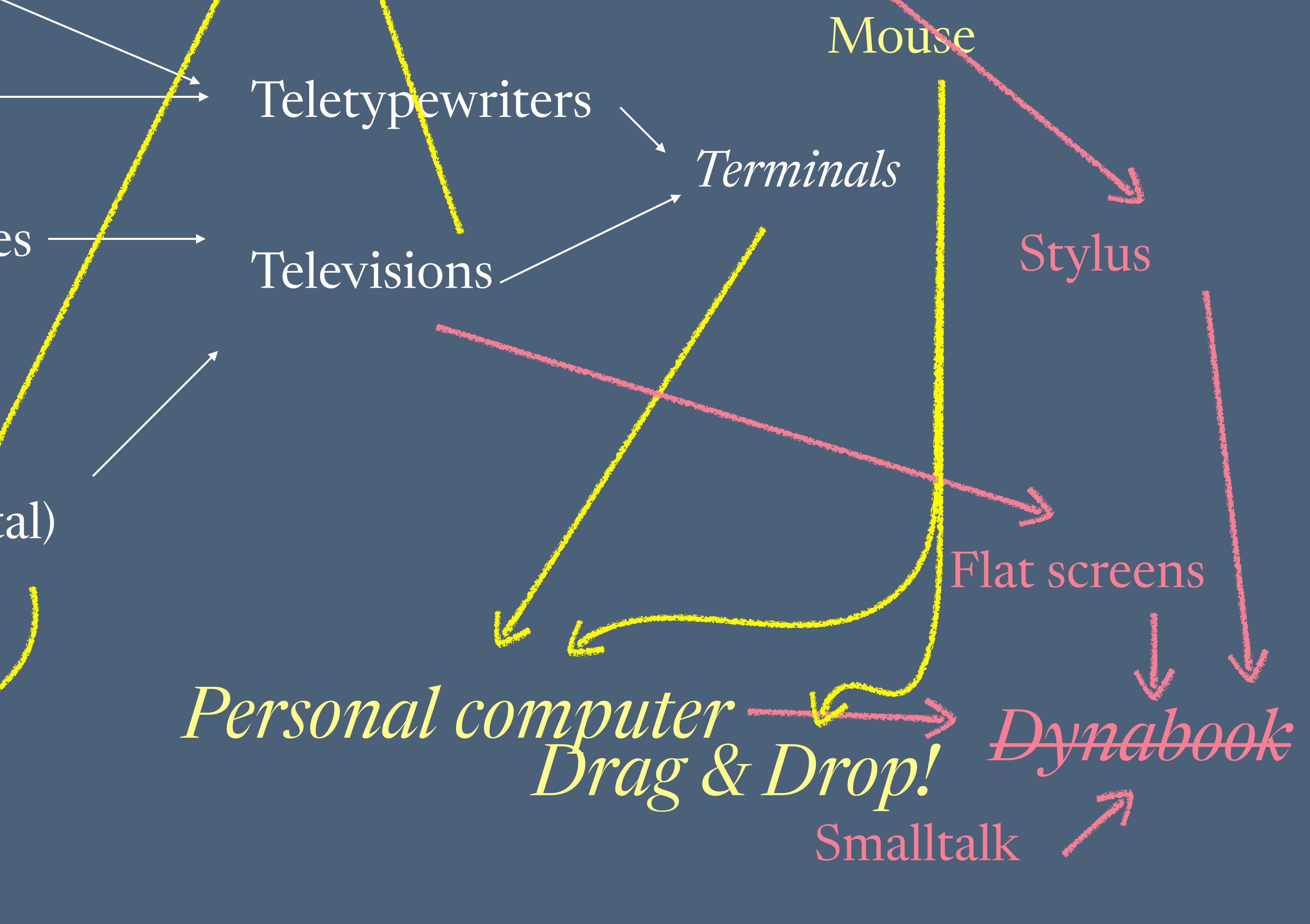
Figure 26.20. One of the first painting tools designed and implemented in Smalltalk by a twelve-year-old girl.



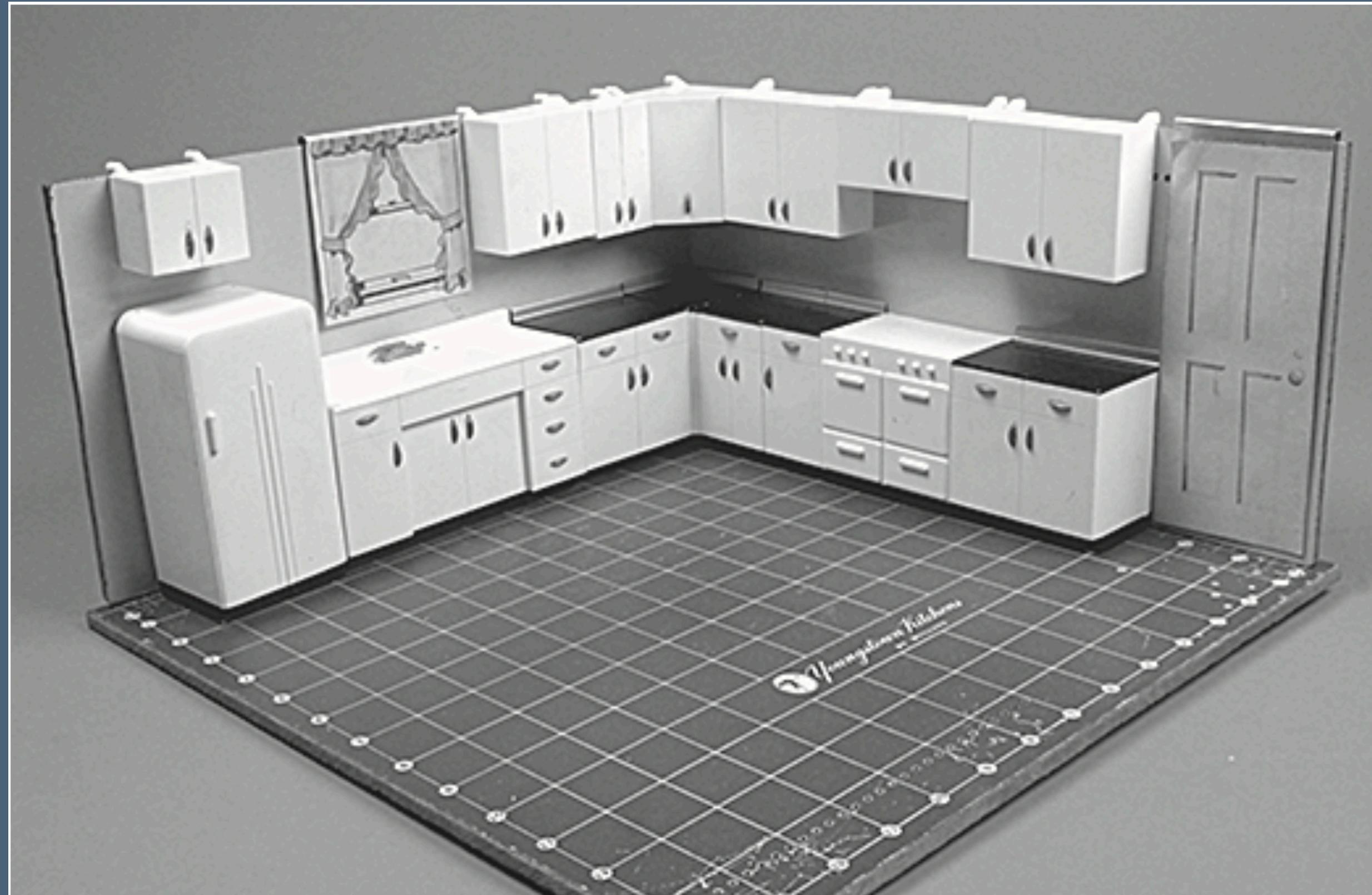
“But it looks as though the actual revolution will take longer than our optimism suggested, largely because the commercial and educational interests in the old media and modes of thought have frozen personal computing pretty much at the ‘imitation of paper, recordings, film and TV’ level.”

“The Real Computer Revolution
Hasn’t Happened Yet” (2007)

Alan Kay



Just after World War II (again)



Youngstown model kitchen, 1952

"Look Who's Designing Kitchens": Personalization, Gender, and Design Authority in the Postwar Remodeled Kitchen

“The kitchen went from a place where labor and laborer were concealed to a personalized showplace ‘around which all household activities revolve[d]:’

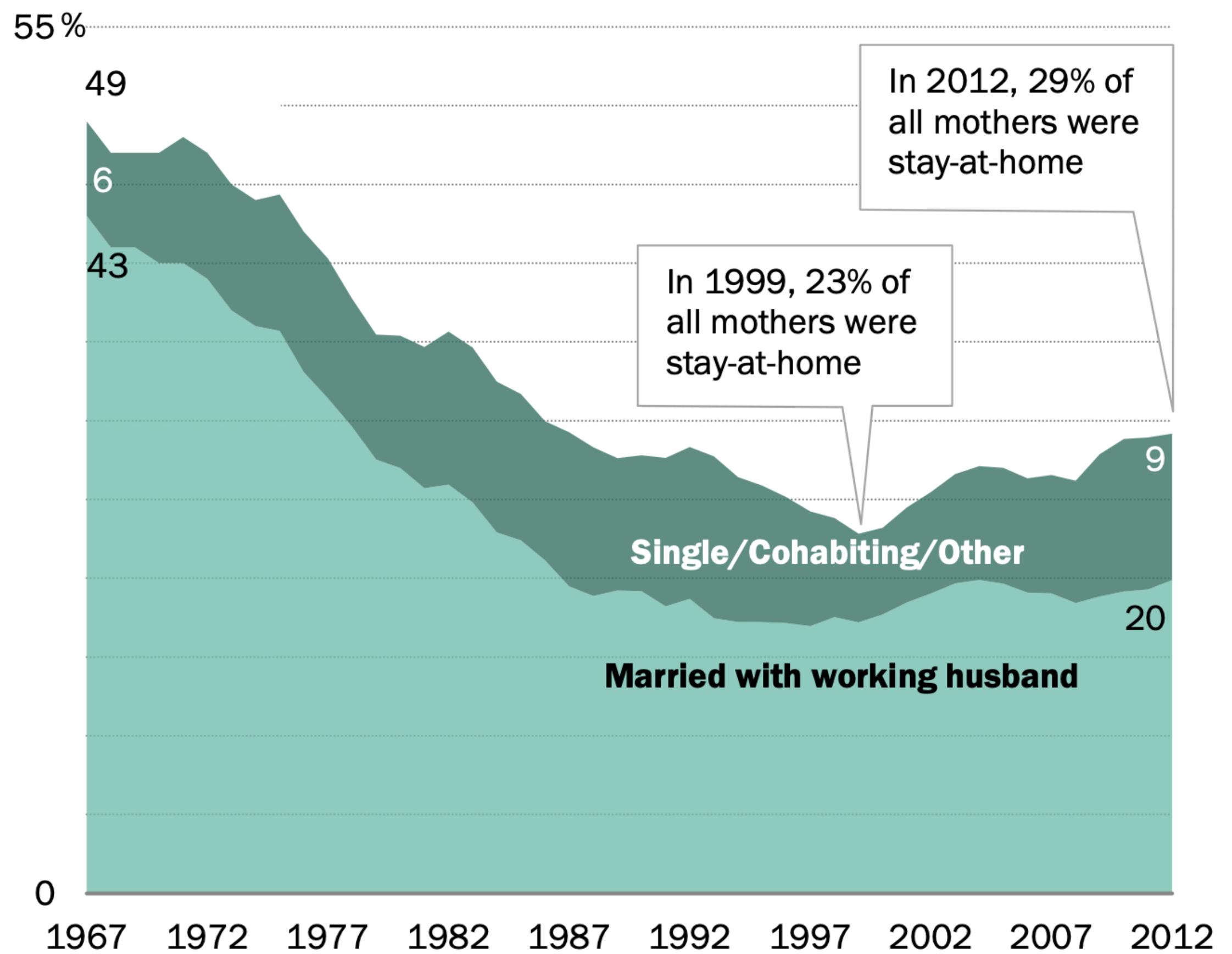
Situating women in the kitchen and presenting remodeling and other forms of consumption as a primary vehicle for ameliorating household labor were parts of a broader domestic revival in the postwar period.”

“Look Who's Designing Kitchens”: Personalization, Gender, and Design Authority in the Postwar Remodeled Kitchen



<https://www.contemporist.com/kitchen-designed-to-hide-behind-a-wall-of-minimalist-cabinets/>

% of mothers with child(ren) younger than 18 who do not work outside the home



Note: Based on mothers ages 18-69 with own child(ren) younger than 18 in the household. Mothers are categorized based on employment status in the year prior to the survey. "Other" stay-at-home mothers are those who are married with a non-working or absent husband.

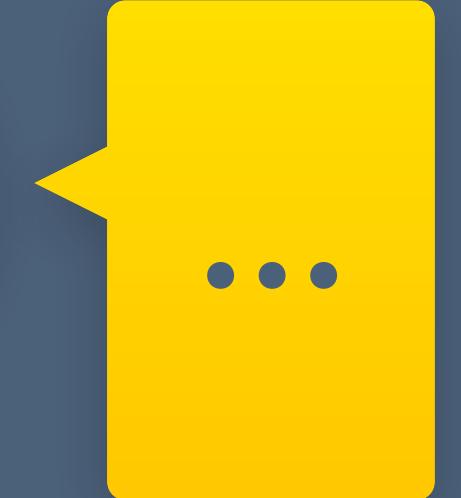
Source: Pew Research Center analysis of March Current Population Surveys Integrated Public Use Microdata Series (IPUMS-CPS), 1968-2013

“By contrast, the contemporary minimalist kitchen is now located within the main living space, and is designed to conceal the multitude of appliances in an attempt to make domestic labour **invisible**.”

“From invisible segregation to the visible heart: what 100 years of kitchens can tell us about domestic labour” (2024)
by Hannah Lewi, University of Melbourne

<https://theconversation.com/from-invisible-segregation-to-the-visible-heart-what-100-years-of-kitchens-can-tell-us-about-domestic-labour-220661>

Wait, kitchens aren't HCl?



Wait, kitchens aren't HCI?

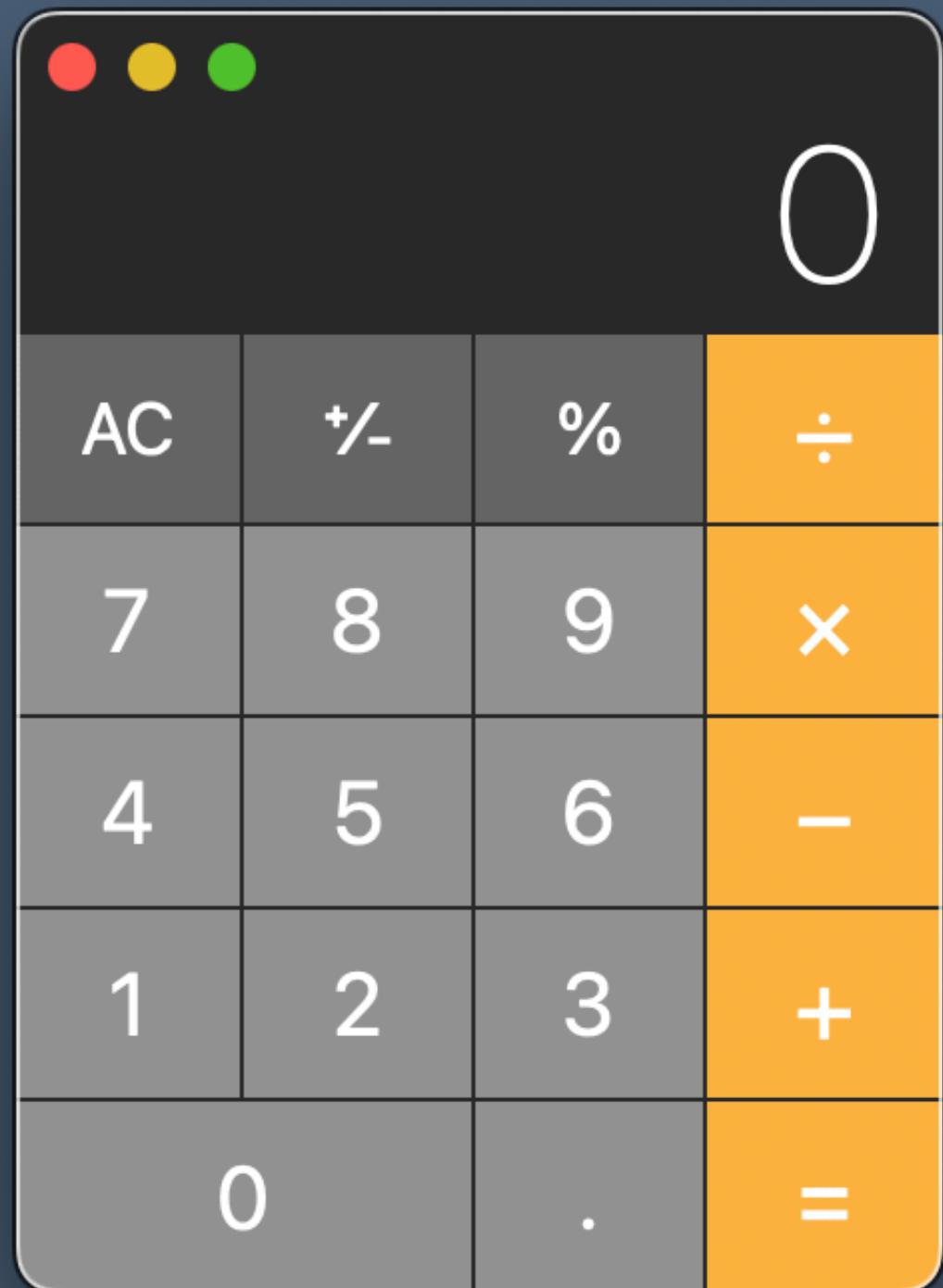
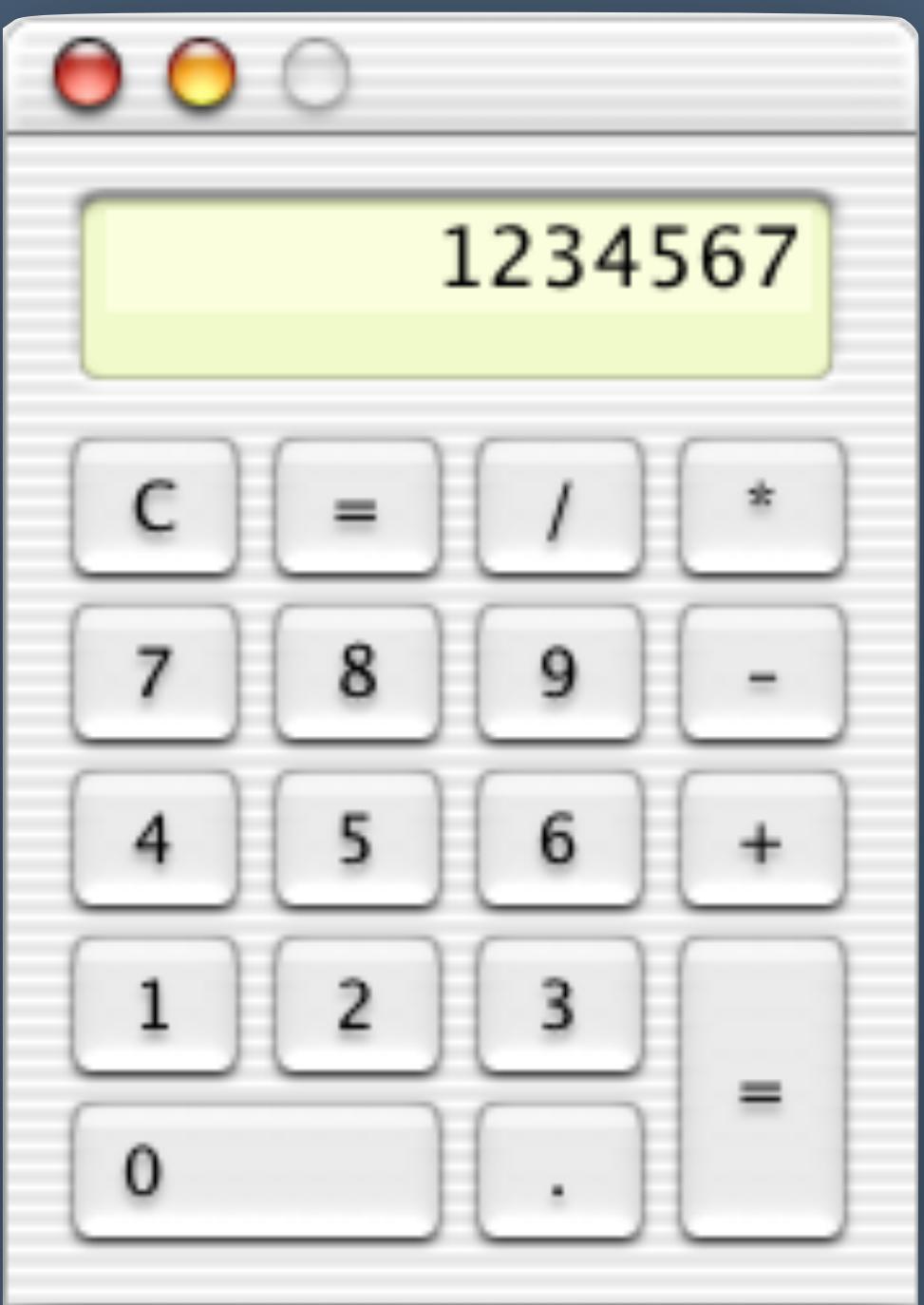
...

It's true. But I think the way that we have interacted with kitchens throughout the decades can be reflected in the way we interact with computers, the way that computers are marketed to us, as they have become intertwined with how we live and do work.

Skeumorphism

“a derivative object that retains
ornamental design cues (attributes)
from structures that were necessary
in the original”

Wikipedia

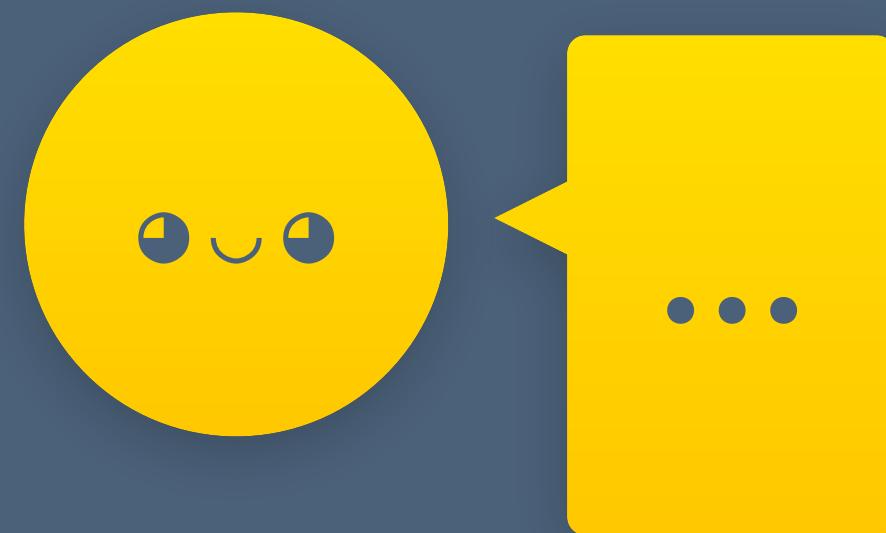
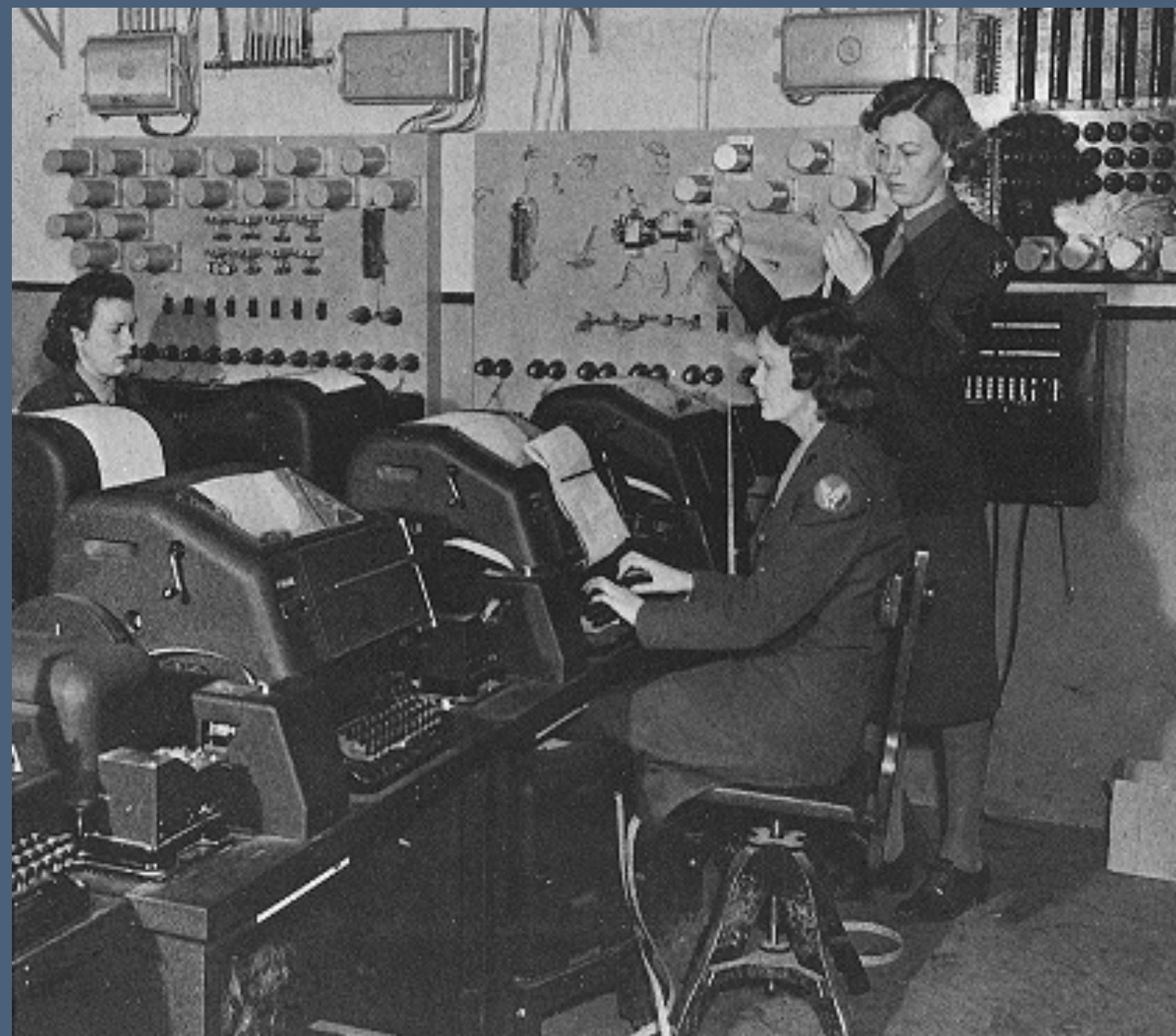


Example:
Calculator.app



LCARS
(from *Star Trek: Voyager*)

Is this also skeumorphism?





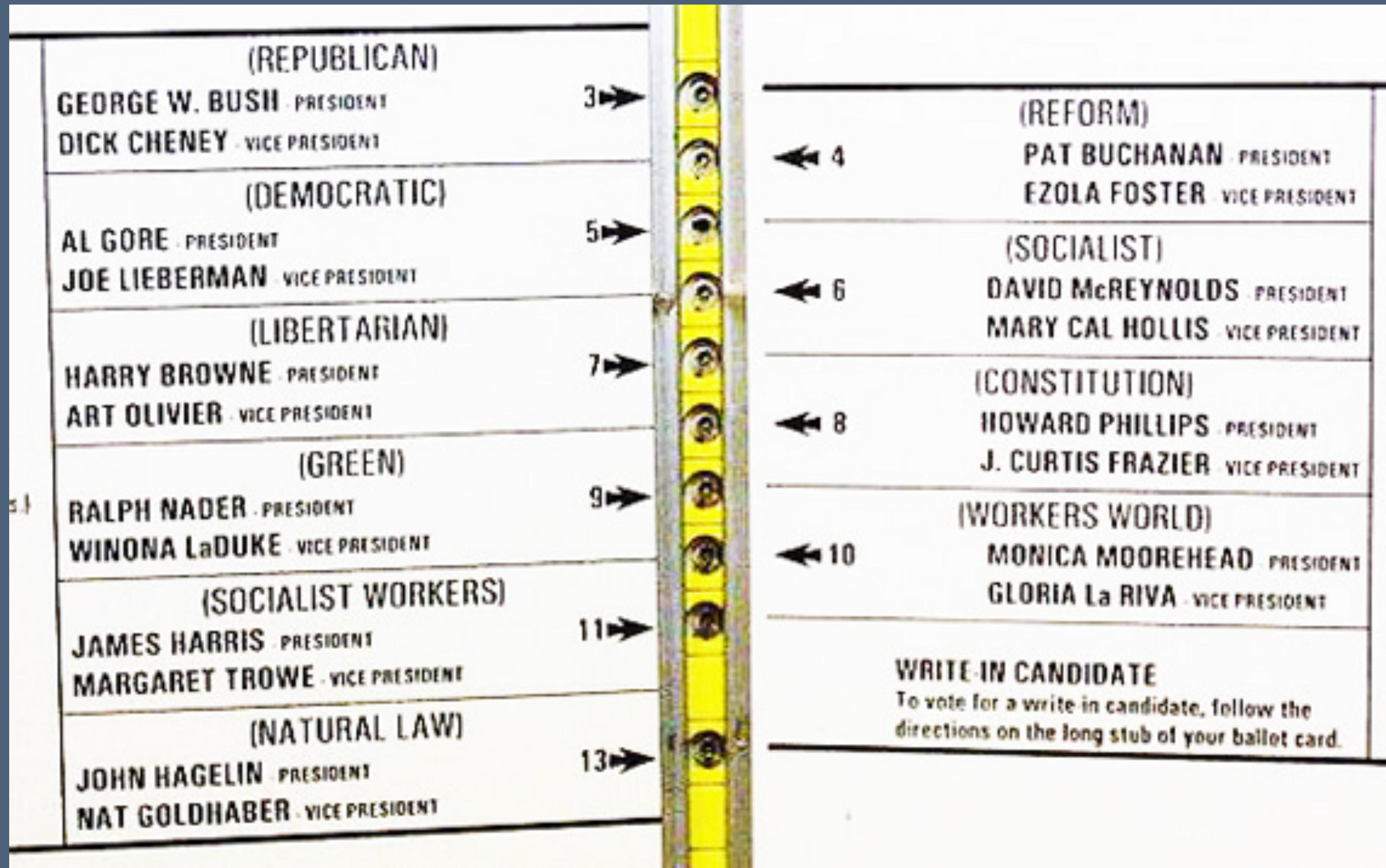
...

I'm not so certain. The definition of skeumorphism seems to imply that *ornamental* details are what makes something skeumorphic, but that requires defining what is and isn't ornament, and it implies that ornament isn't useful.

Human-computer *m*isinteraction



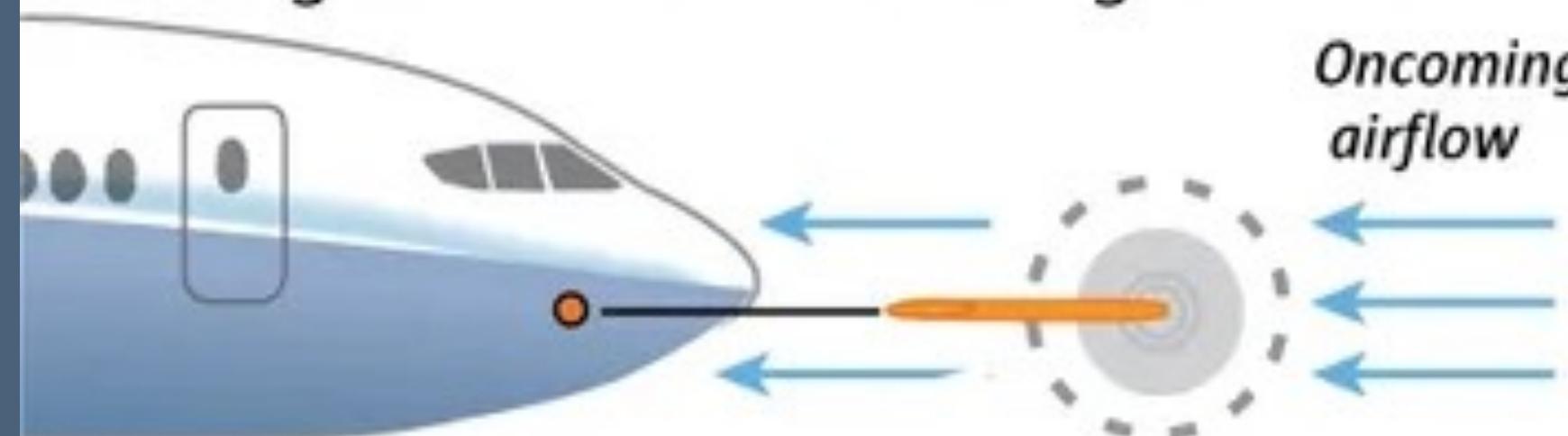
Therac-25



Florida "Butterfly
Ballot", 2000

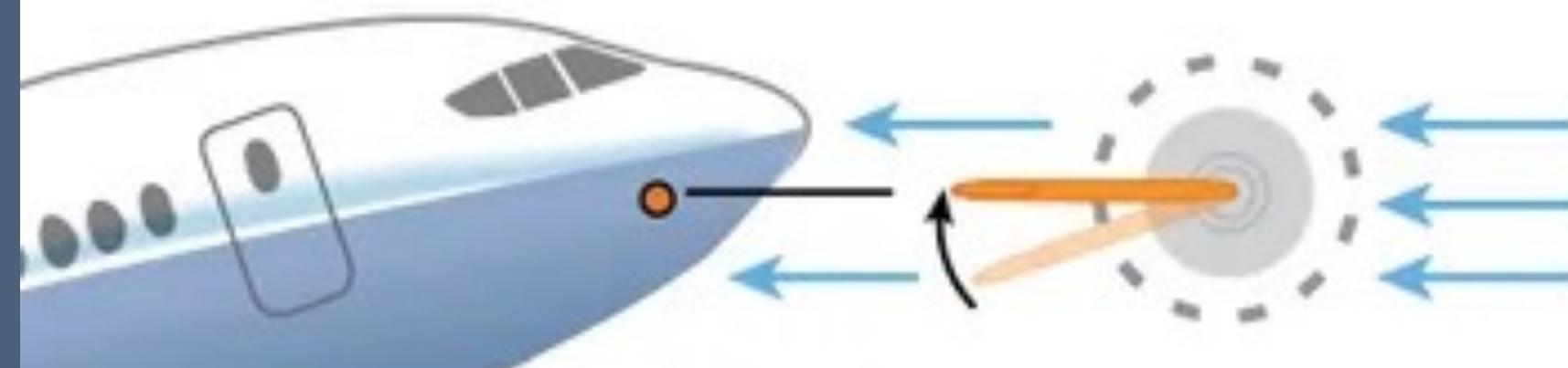
How the MCAS (Maneuvering Characteristics Augmentation System) works on the 737 MAX

1. The angle-of-attack sensor aligns itself with oncoming airflow.



The angle of attack is the angle between the wing and the airflow.

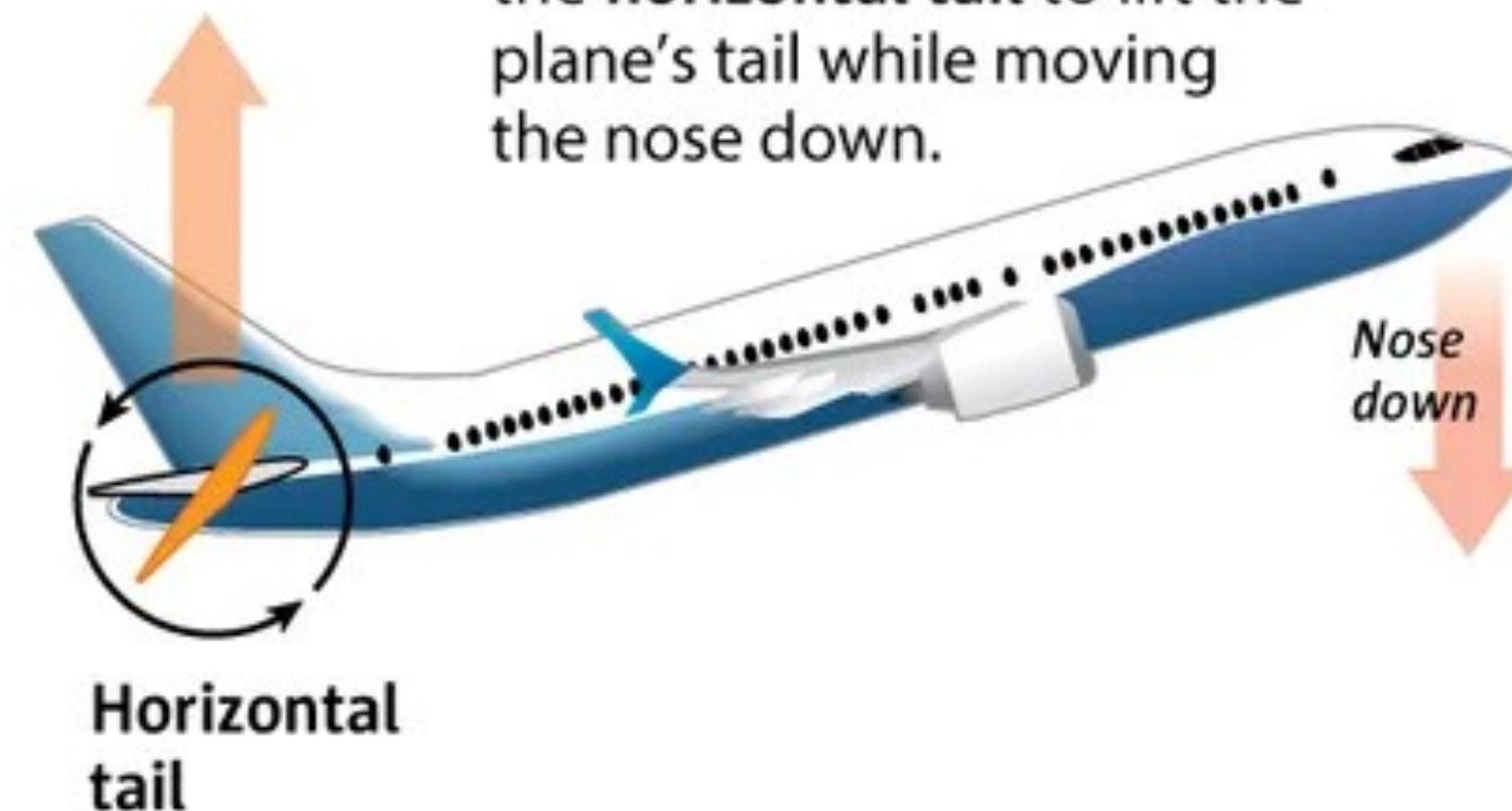
2. Data from the sensor is sent to the flight computer.



If the angle rises too high, suggesting an approaching stall ...

... the MCAS activates.

3. MCAS automatically swivels the **horizontal tail** to lift the plane's tail while moving the nose down.



Horizontal tail

Sources: Boeing, FAA, Indonesia National Transportation Safety Committee, Leeham.net, and The Air Current

Reporting by DOMINIC GATES,
Graphic by MARK NOWLIN / THE SEATTLE TIMES

Boeing 737
MAX, 2017

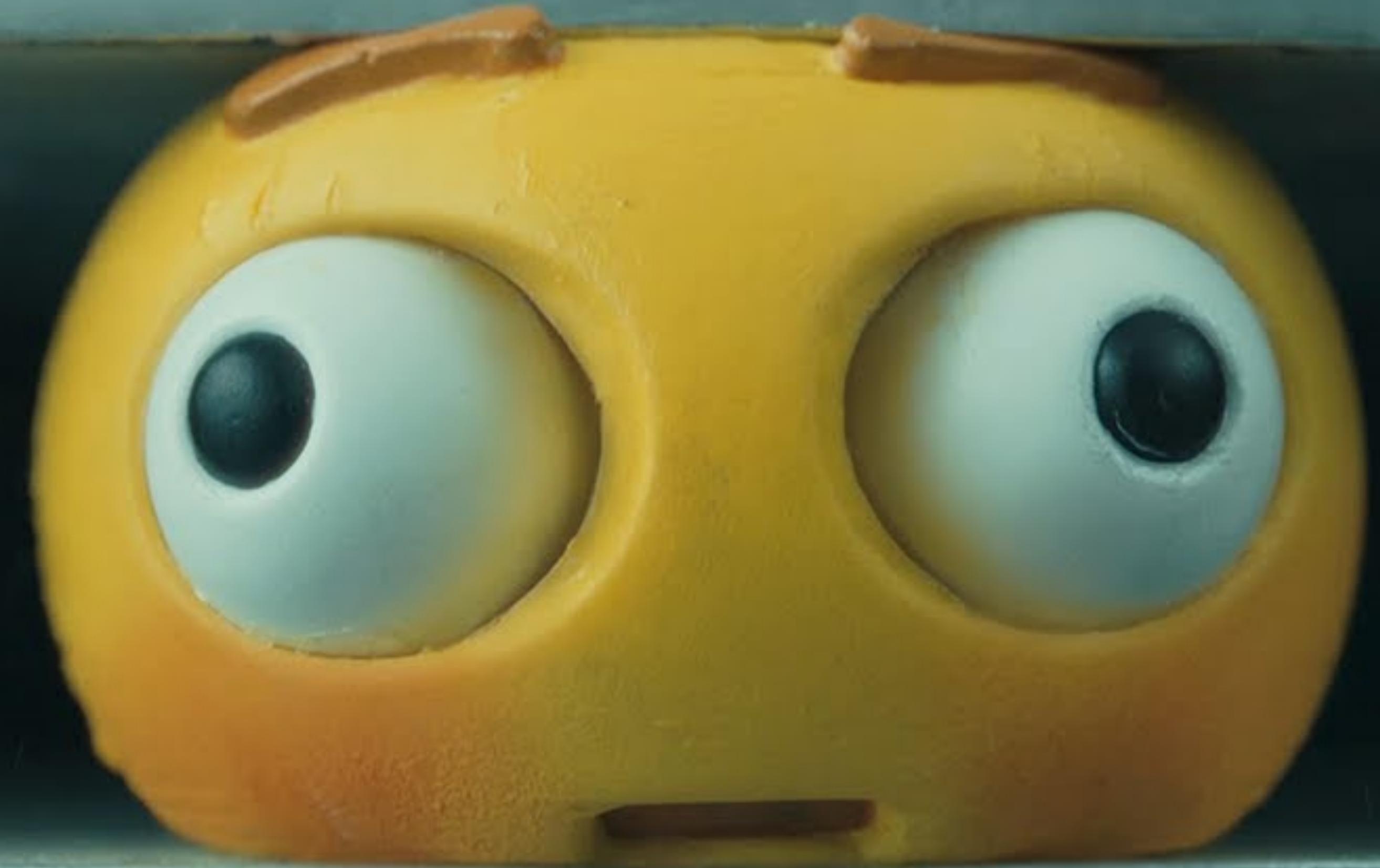
“Permanent Numbness”

or

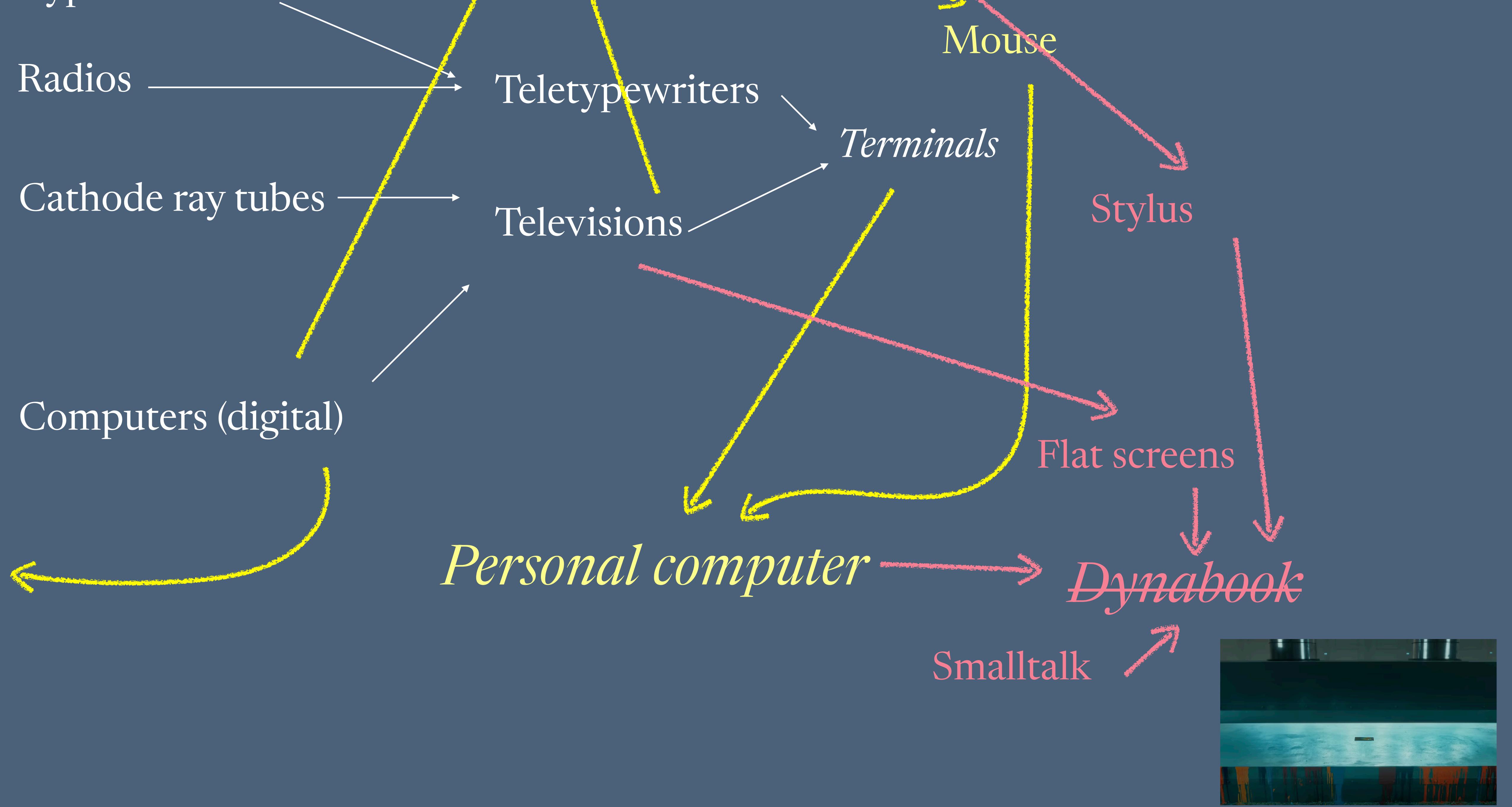
Human-computer *feelings*

Crush!

iPad Pro



*Crush! (2024),
Apple*





*Productivity Future
Vision (2010),
Microsoft*

“Pictures Under Glass is an interaction paradigm of permanent numbness. It's a Novocaine drip to the wrist. It denies our hands what they do best. And yet, it's the star player in every Vision Of The Future.”

*A Brief Rant on the Future
of Interaction Design*

Bret Victor, 2011

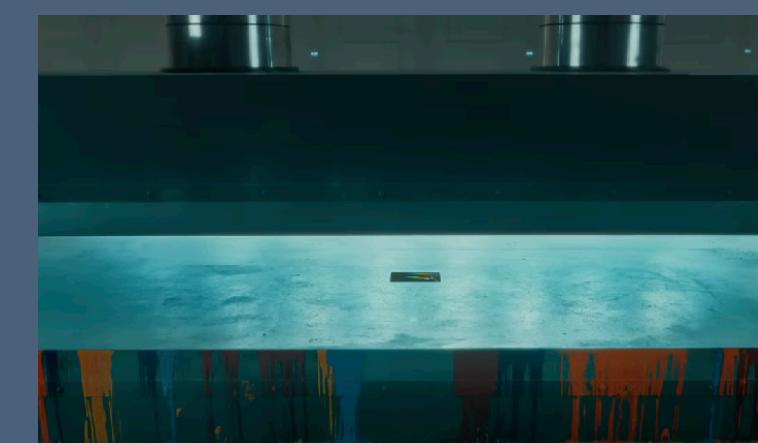
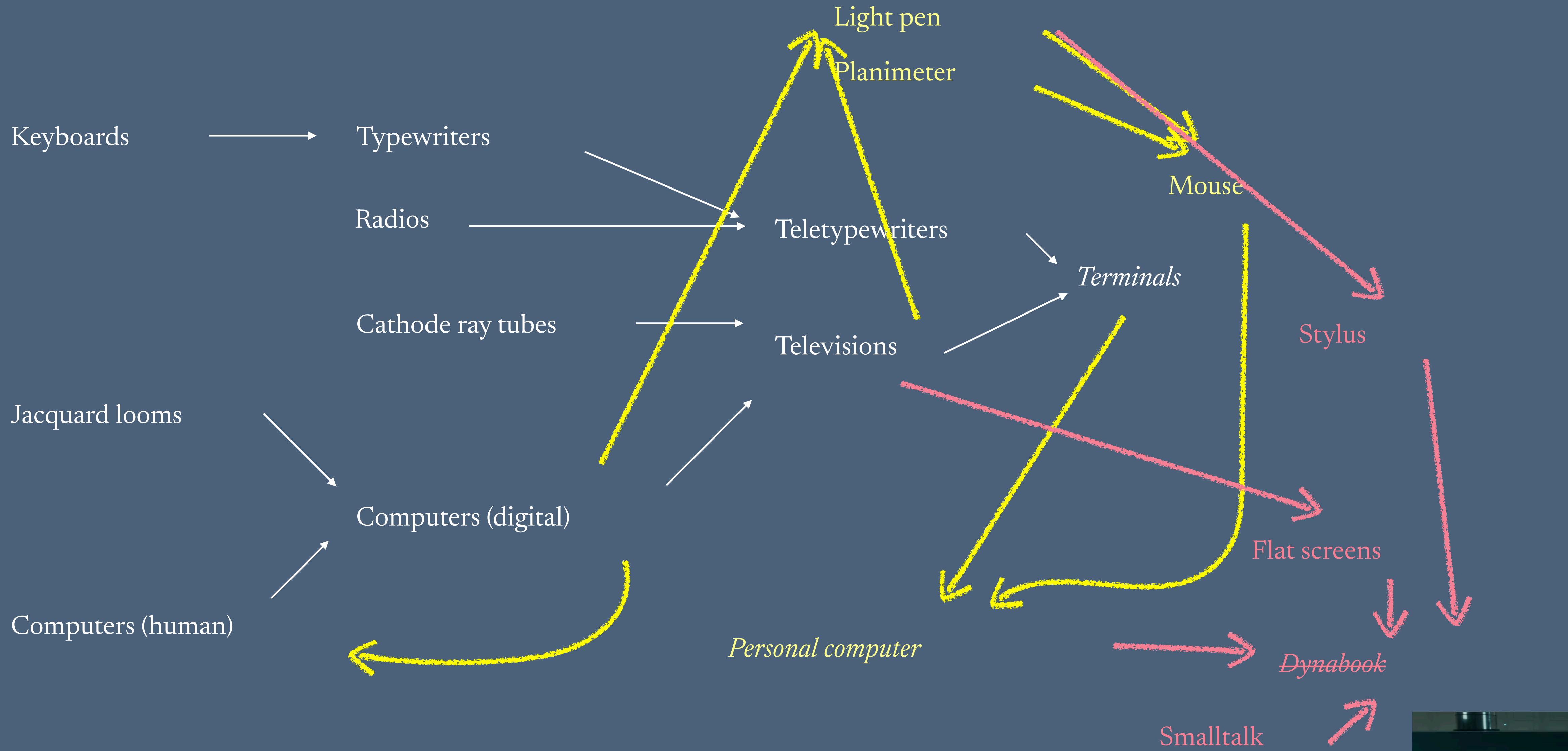


*Working with Apple
Vision Pro in the
Subway in NYC
(2024), Nikias Molina*



Woman in the Dunes

dir. Hiroshi Teshigahara,
1964





Perhaps another world is possible?

Keyboards

→ Typewriters

Radios

Cathode ray tubes

Jacquard looms

Computers (digital)

Computers (human)

Light pen
Planimeter

Teletypewriters

Televisions

Personal computer

?

Mouse

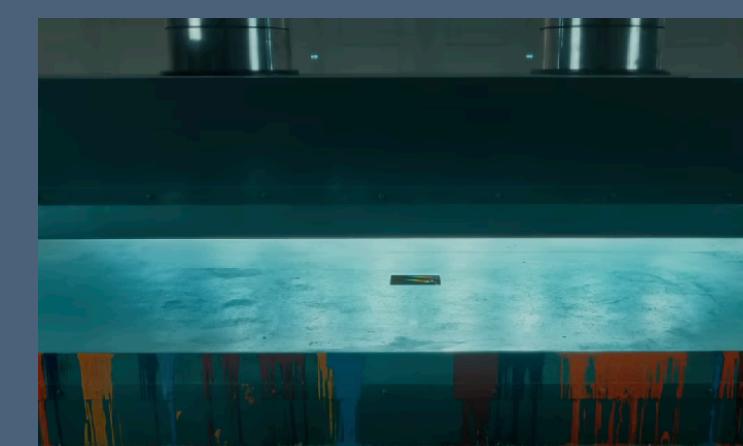
Terminals

Stylus

Flat screens

Dynabook

Smalltalk



All Possible Futures

Face-to-face

Dynamic Conversation

I see what you're saying

Mode of communication

- Conversation means person-to-person, face-to-face, realtime, improvised.

Today

- Concepts are represented with spoken words, hand-waving, static sketches.
- One person's "picture in the head" can't be seen by the other. Miscommunication is the norm.
- People explain and convince through reasoning and rhetoric, not evidence and explorable models. Words are terrible at representing systems.

Vision

- A medium in which every conversation is naturally **show-and-tell**. People can depict as easily as describe.
- **Dynamic sketching**: As two people are talking about how an aircraft wing generates lift, they quickly and naturally improvise dynamic simulations to explore and explain, as if sketching on a whiteboard. (Today, "programming" such things takes hours, and needs to come down to **seconds** in order to fit into a natural conversation.)
- The medium encourages **evidence-backed** representations over guesses.
- The **context** of every representation can be seen. A conversation is an exploration of a visible data space rather than a string of anecdotes.
- The participants' focus remains on **each other** and the concepts represented, not the implementation of the representations.
- Long-term — entire conversations taking place through improvising and manipulating visual-tactile representations intermixed with scattered words and sounds. A genuinely new language that would be unintelligible to someone today.



Illustrations by David Hellman

Dynamic Creative Play

friends, drinks, and dynamic authoring

Mode of communication

- Friends hanging out in the evening, casual, playful, realtime, improvised, shared experience.

Today

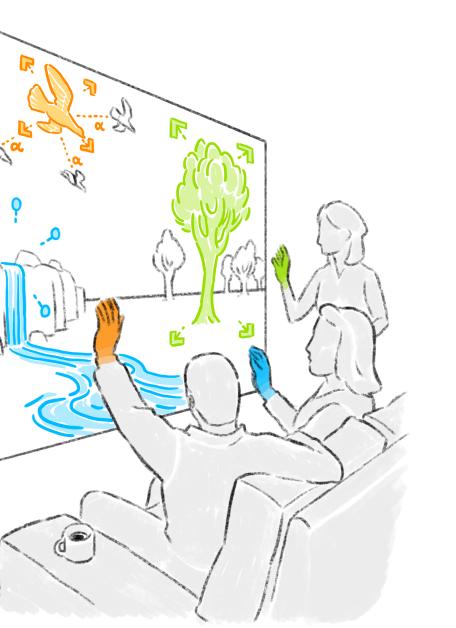
- Most activities where friends focus together on the same thing are **passive** (watching TV) or **non-creative** (playing games).
- Programming is **isolating**, even in groups. People stare at laptops, focused on their own private worlds.
- Code is **anti-social**. A program cannot be immediately understood and modified by a casual onlooker.

Vision

- Friends authoring together for fun, in a casual, shared space. (Creating dynamic playable "murmurs", perhaps.) Similar to playing with LEGO or model trains.
- Everyone is focused on the **same thing**.
- Everyone can **see** what everyone else is making.
- Everyone can **understand** how everyone else is making it.
- Everyone can "jump in" and participate in what others are making.

Rationale

- If the dynamic medium is to be the foundation of a new literacy, people must be able to **author casually and socially**. Authoring shouldn't feel like "work"; it shouldn't be isolating, and implementations must be immediately understandable and modifiable by onlookers.



Presenting

Dynamic Presentation

show and tell

Mode of communication

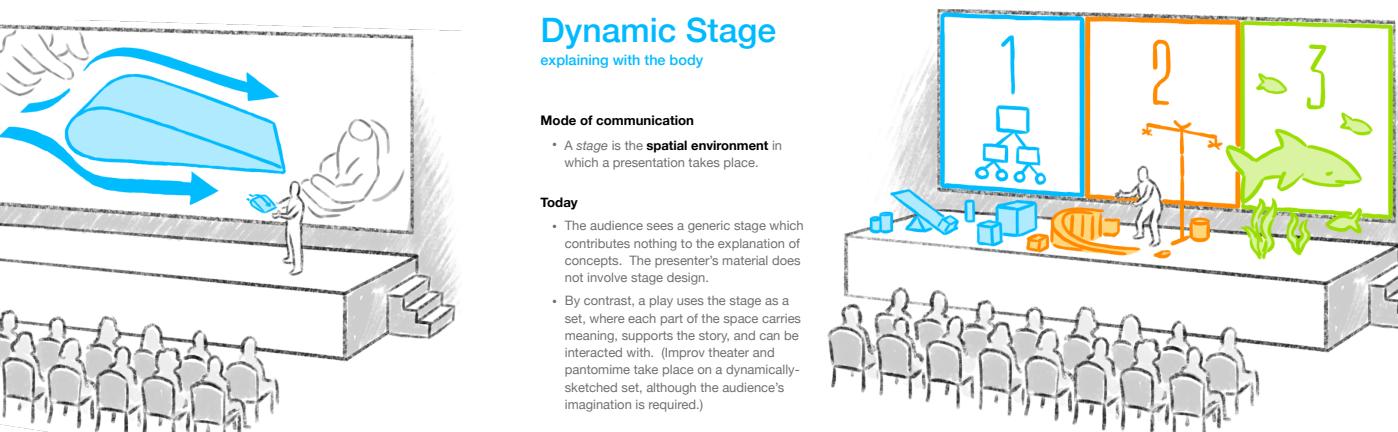
- Presentation means person-to-group, realtime, prepared outline but improvised details.

Today

- A presentation at a blackboard uses weak sketching, but is fully flexible; it can go in any direction, cover any topic, respond to any question.
- A presentation at a computer must stick to the script. All material must be authored ahead of time. What's the point of a living, dynamic speaker, if the presentation is completely static?
- In the verbal medium, the natural form of explanation is the anecdotal narrative. Lies are indistinguishable from truth.

Vision

- Every presentation is naturally **show-and-tell**. By default, refers are shown rather than described. The shown material carries the **primary representations** of the concepts presented, not secondary "visual aids". It is not possible to understand the presentation by just listening.
- The material is **dynamically mapped to physical space**. Different areas of the stage represent different concepts. The presenter builds up a conceptual space and a visible space in parallel, and then navigates in that space while discussing. The presenter physically moves around the stage as the message moves between topics. Connections between concepts can be seen as connections across physical space.
- The **outline** of the presentation is manifest in the layout of the stage. At all times, the audience can see what the presenter has already presented, and what they have yet to present. Instead of the presentation being "one fleeting thing after another", the audience sees a tour through a visible, well-structured space.
- The stage is a **dynamic medium**, and the presenter sketches and interacts with human-scale dynamic representations. In addition to sketching space during the presentation, the presenter can **download environments** authored at home.



Dynamic Stage

explaining with the body

Mode of communication

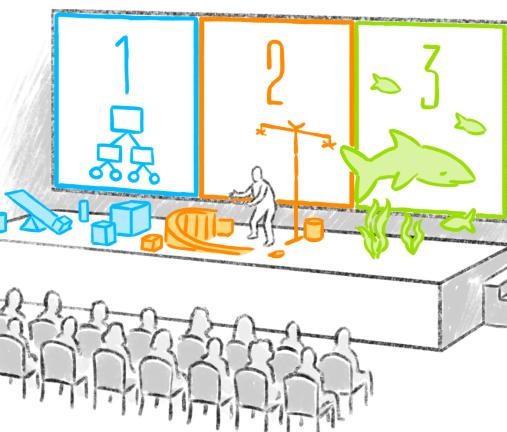
- A stage is the **spatial environment** in which a presentation takes place.

Today

- The audience sees a generic stage which contributes nothing to the explanation of concepts. The presenter's material does not reflect the stage directly.
- By contrast, a person uses the stage as a set, where each part of the space carries meaning, supports the story, and can be interacted with. (Improv theater and pantomime take place on a dynamically-sketched set, although the audience's imagination is required.)

Vision

- The stage is a **medium** — a canvas — and participates in the presentation by hosting **human-scale representations**.
- **Concept space is mapped to physical space**. Different areas of the stage represent different concepts. The presenter builds up a conceptual space and a visible space in parallel, and then navigates in that space while discussing. The presenter physically moves around the stage as the message moves between topics. Connections between concepts can be seen as connections across physical space.
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Reading

Dynamic Reading

this is not a printing press

Mode of communication

- Reading means media-to-person, solitary, deliberate, prolonged, contemplative.

Today

- Concepts are represented with words, words, words. The author's "picture in the head" is rarely transferred well to the reader.
- The author explains and convinces through reasoning and rhetoric, not evidence and explorable models. Words are terrible at representing systems.

Vision

- A thorough **multi-channel** form of written communication. A fine-grained mixture of words, notation, and visual representations. Show and tell.

Skimmable

- Get the gist in 5 seconds. Get "enough" of an understanding to make associations with later in 60 seconds. Go deeper in particular areas as needed.

Transformable

- View many different representations of the same knowledge, without an author having created them beforehand.

Explorable

- Assertions and explanations are backed by data and models. Adjust premises and assumptions, and see consequences.

Context-sensitive

- Not one-size-fits-all, but unique for every reader and every reading.

Interrogable

- Have a dialog with the material. Get clarifications and examples, without an author having anticipated the questions.

Hypothesis

- With a better form of writing, concepts that today take hours to understand can be understood in seconds. What today takes weeks can take hours. What is impossible today, because it would take more than a lifetime to synthesize, becomes possible.



Dynamic Spatial Media

books you walk around in

Mode of communication

- Like reading — media-to-person, personal, prolonged, contemplative — but human-scale, and experienced with the body.

Today

- The primary objects for acquiring knowledge — books and computer screens — **convey representations** to a tiny rectangle.
- Representations use a tiny fraction of the visual field. Peripheral vision and visual scanning are wasted. Eyes are damaged by constant up-close focus.

- Representations are flat and intangible. Tactile understanding is wasted; the hands are neglected.
- Readers are immobile. Spatial understanding is wasted; the body is neglected and damaged.

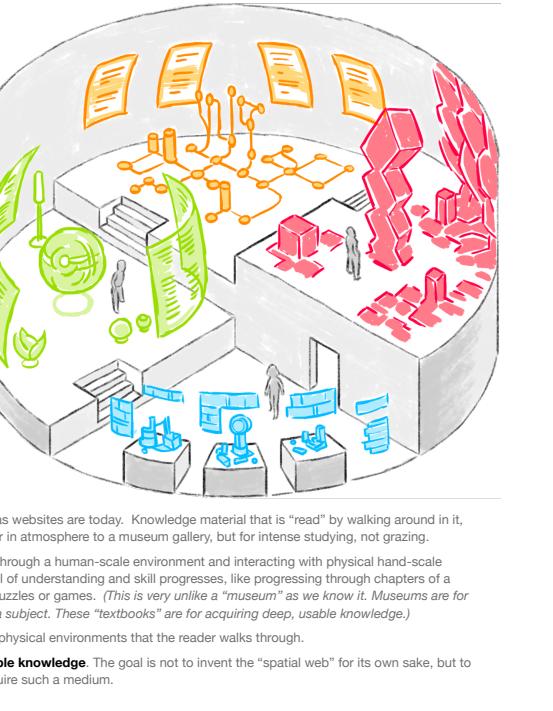
Vision

- Walkable environments that are **published and downloaded**, as websites are today. Knowledge material that is "read" by walking around in it, engaging with it visually, tangibly, and spatially. Perhaps similar in atmosphere to a museum gallery, but for intense studying, not grazing.

- **Spatial textbooks**. A person learns linear algebra by walking through a human-scale environment and interacting with physical hand-scale objects. The learner progresses through the space as their level of understanding and skill progresses, like progressing through chapters of a text. "Exercises" are interactive objects; "exercises" are puzzles or games. (This is very unlike a "museum" as we know it. Museums are for gazing in wonder, or gazing at a superficial lay-understanding of a subject. These "textbooks" are for acquiring deep, usable knowledge.)

- **Spatial research papers**. Scientific findings are published as physical environments that the reader walks through.

- And so on. The focus is on the **spatial representation of usable knowledge**. The goal is not to invent the "spatial web" for its own sake, but to invent powerful new representations of thought which may require such a medium.



Dynamic Library

walk through the world's knowledge

Mode of communication

- A library is a walkable environment for browsing and discovering knowledge.

Today

- A library consists of sections of shelves, which convey almost no information. Nothing is learned by walking around the space.
- A shelf is a vast array of spines, which convey almost no information. Nothing is learned by looking at a shelf. The assumption is that the browser will "select" a particular book to read.
- A book consists of pages of text, which convey almost no information at a glance. The assumption is that a book will be "read" over many hours, and does not provide knowledge on any shorter time scale.

Vision

- The branches of knowledge are represented by distinct areas that feel **inviting, approachable, and tempting**, like the lands at Disneyland. Simply walking around the space gives one an **spatially-anchored overview** of the branches of knowledge and how they are connected.

- Researchers walk through the Anthropology section gives one a basic grounding in anthropology, and invites deeper exploration.

- Material provides **knowledge at all distance scales**: 12 feet away (overview of topic), 6 feet, 3 feet, 1 foot (standard reading), ½ foot (fine details).

- Material provides **knowledge at all time scales**: ½ second ("get" what the material is about), 10 seconds (understand the gist), 3 minutes (enough knowledge to later make connections back to), hours (deeper studying), days, etc.

- Engaging in the zoomed-out scales requires **no deliberate action** other than simply walking by.

- Conceptual **connections** between knowledge can be seen visually, and explored.

- Material is **dynamic and multi-channel**. Knowledge is represented in many different forms, including dynamic tangible objects.



Research Gallery

every idea is on display

Mode of communication

- In most research environments, no representation of the group's output is **displayed in the space**. Ideas, prototypes, discoveries, and analyses are buried in hard drives, code repositories, websites, group lore.

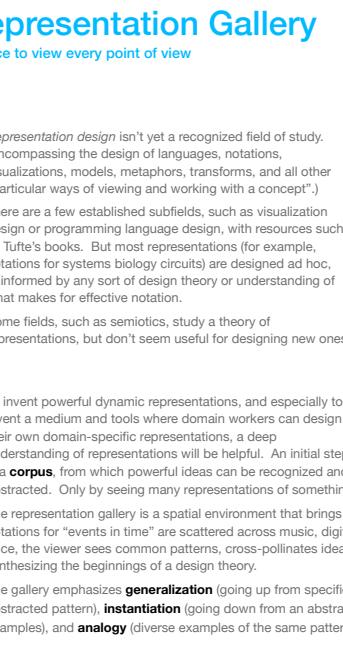
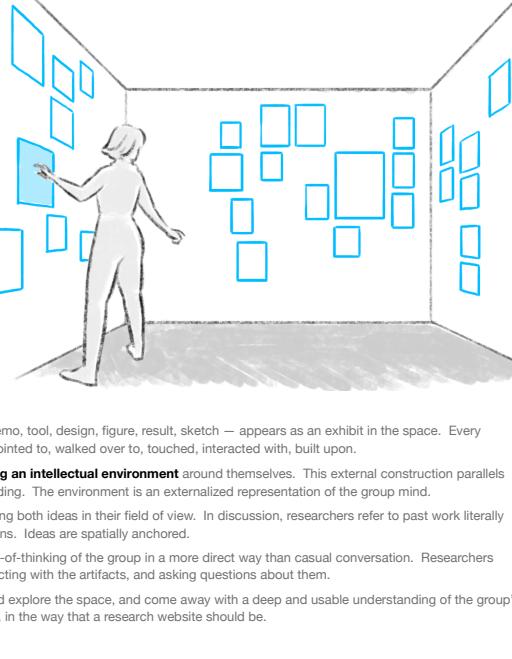
- A researcher can't make use of **prior work** unless they happen to recall it via mental association, then spend the effort to bring it up.

- A visitor can't learn much from a group's work. A visitor learns mostly from a website or paper, or by visiting the group itself.

- As the group **turns over**, past work is forgotten and lost.

Vision

- Every artifact the group produces — every prototype, demo, tool, design, figure, result, sketch — appears as an exhibit in the space. Every concept has a **physical presence**; it can be spotted, pointed to, walked over to, touched, interacted with, built upon.
- As researchers work, they feel like they are **constructing an intellectual environment** around themselves. This external construction parallels the internal construction of their understanding. The environment is an externalized representation of the group's mind.
- Researchers make **connections** between ideas by seeing both ideas in their field of view. In discussion, researchers refer to past work literally by pointing to it, instead of with vague verbal descriptions. Ideas are spatially anchored.
- New researchers are **immersed** in the history and ways-of-thinking of the group in a more direct way than casual conversation. Researchers "come of age" by physically exploring the space, interacting with the artifacts, and asking questions about them.
- The space is a form of **publication**. Visitors browse and explore the space, and come away with a deep and usable understanding of the group's work. The space is designed to teach and disseminate, in the way that a research website should be.



Writing

Dynamic Authoring

direct manipulation of dynamic behavior

Mode of communication

- Authoring is person-to-media, deliberate, prolonged.

Today

- Static material — illustrations, films, books — is created by directly manipulating a literal representation of the artifact.
- Dynamic material is created by "writing code" — blindly manipulating symbols. The author sees and manipulates indirect symbolic representations, and must imagine how they give rise to dynamic behavior.
- "Blindly manipulating symbols" is a holdover from pencil-and-paper mathematics. Programming emulates paper.

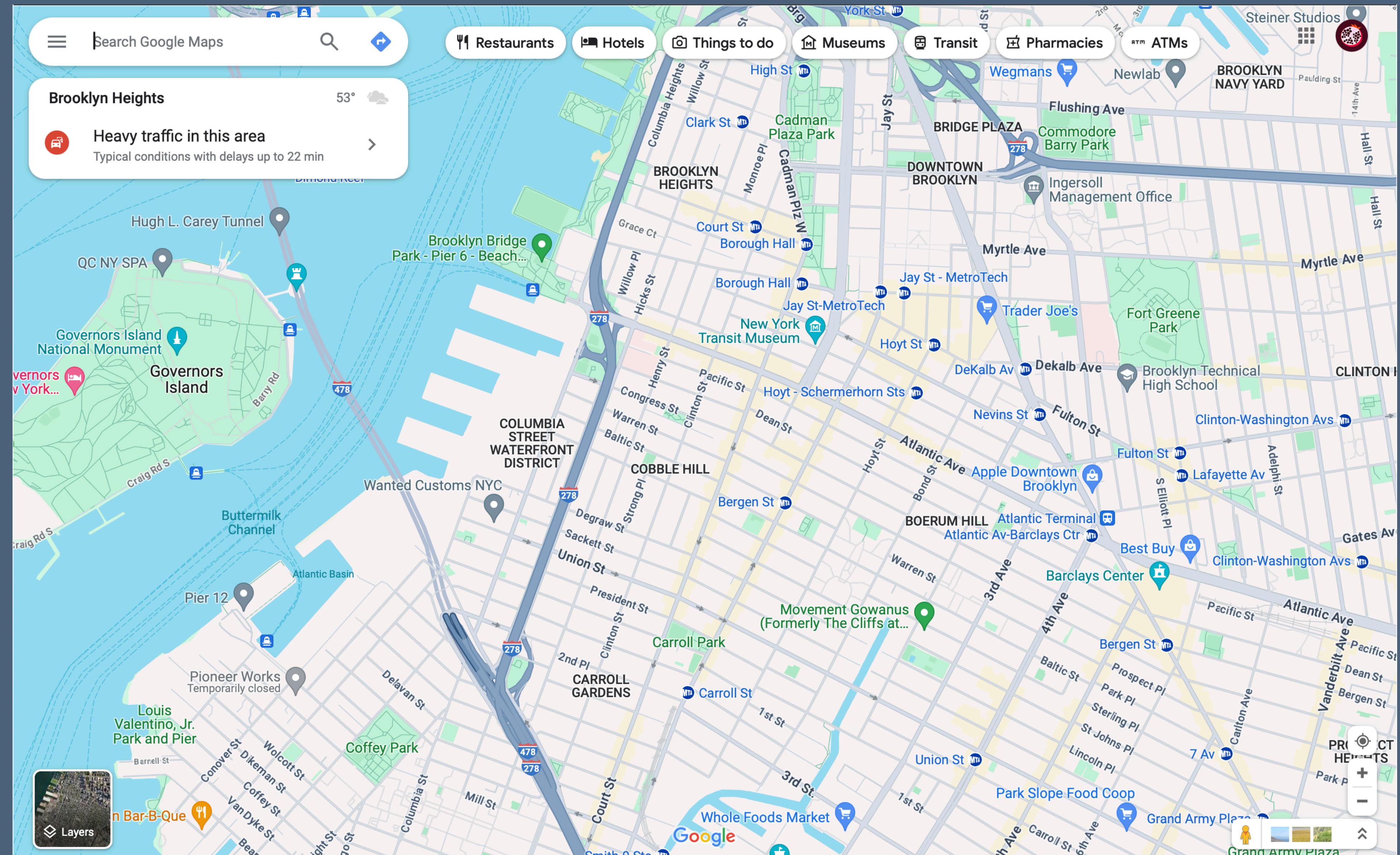
Vision

- The author **sees the dynamic behavior** they're creating, and sees it as they're creating it. The primary representations are behavior or data representations, not representations of a system structure.
- The author **sees multiple representations** of behavior — multiple levels on the "ladder of abstraction", multiple instances of abstractions, multiple views and transforms, each offering its own perspective and insights.
- The author **explores** the representations — transforming, measuring, searching, looking at them from many perspectives.
- The author **creates** the material by **directly manipulating representations of behavior and data**, instead of manipulating a structure. Manipulation takes place in the data domain.

Rationale

- The envisioned new form of thinking centers upon creating and exploring dynamic representations. Thinkers must be able to create these representations with as little indirection as possible, so the dynamic medium can function as an extension of the mind.







Dynamicland



The idea of computing as automation of computing labor

Keyboards → Typewriters

Radios

Cathode ray tubes

Jacquard looms

Light pen

Planimeter

Mouse

Terminals

Stylus

Teletypewriters

Televisions

The idea of computing as augmenting the human

Flat screens

Dynabook

Smalltalk

Computers (digital)

Co

These are ideas we've seen before, but what if we centered our idea of computing around them?

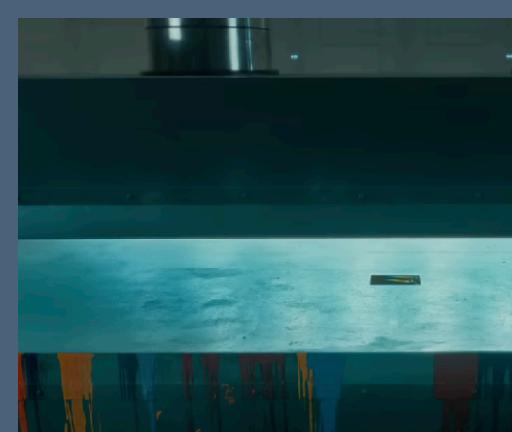
Computing as a place

Computing as feeling

Computing as a form of play

Computing as just hanging out

The idea of consumption as a form of computing



Jacquard looms



Computers (human)

These are ideas we've seen before, but what if we centered our idea of computing around them?

The Idea of computing as
centering the human

Computing as a place

Computing as feeling

Computing as a form of
play

Computing as just hanging out ?

Personal computer



Flat screens

Dynabook

Smalltalk

The idea of consumption
as a form of computation

Any idea of what HCI is now?

...

HCI is how we as humans *interact with one another*. The computer is just a starting point.

Thank you