

History of Human- Computer Interaction

CSI 60: User Interfaces
John Canny

Prehistory

Astrolabe (Middle Ages)

Convenient interface : nested disks.

Allowed calculation of time from sky observations

Sunset/sunrise, moon position

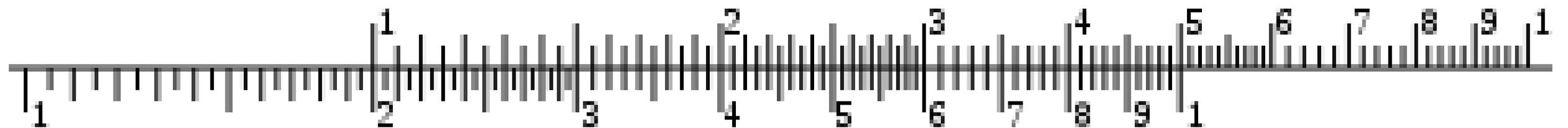
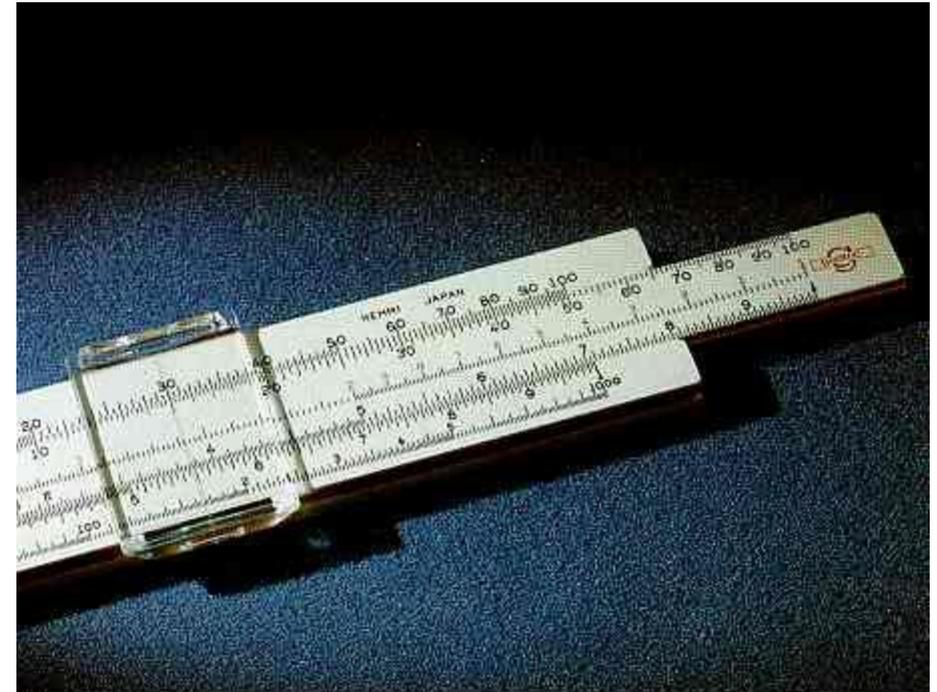
Longitude/latitude



Mechanical Computation

Slides Rules:

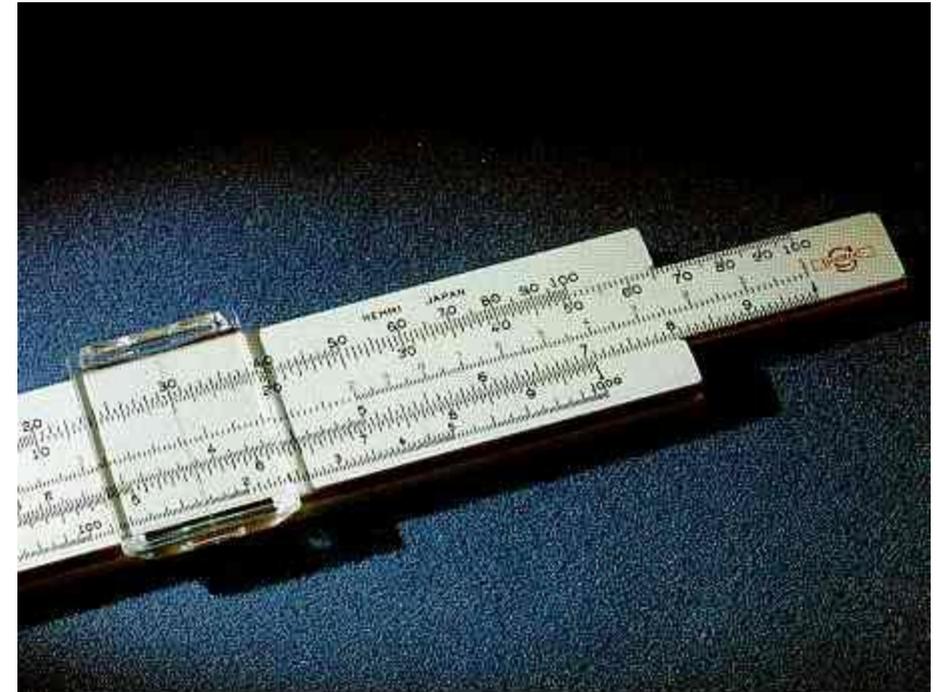
- Analog “rules”!
- Developed in the 1600s after logarithms
- Add log scales to multiply or divide
- Use non-linear scales for other functions (sin, exp, sqrt etc).



Slide Rule Usability

Simple “direct manipulation” UI.

Only computes the significant digits of the result, the order of magnitude is done by hand –
Man-Computer Symbiosis!

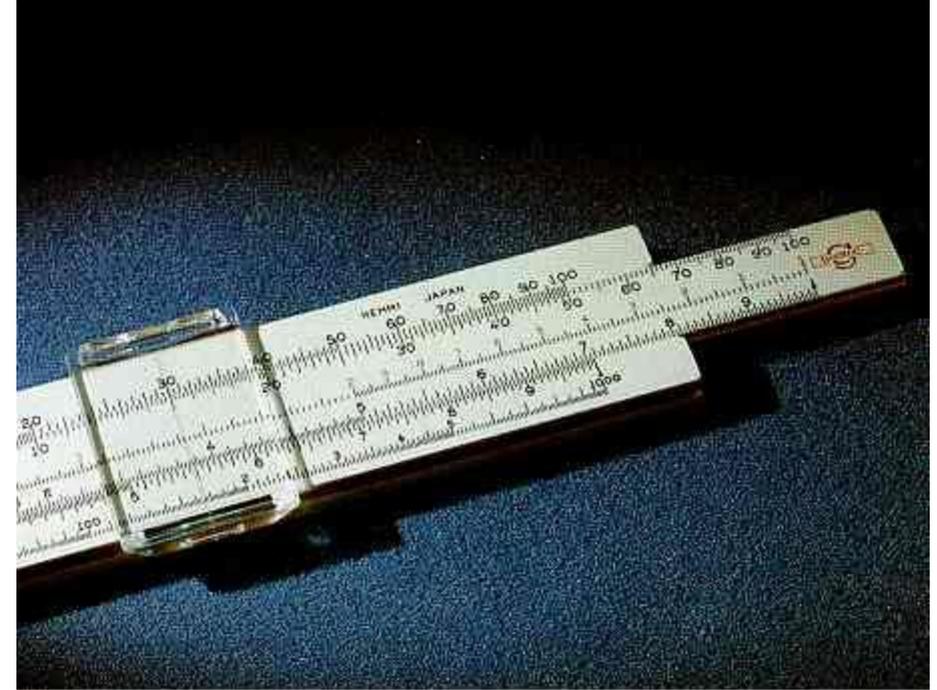


Can make “slips” but not typos.

Seem to be less prone to nonsense results than calculators due to mistyped exponents.

Precision (2-3 digits) is a good match to many engineering problems.

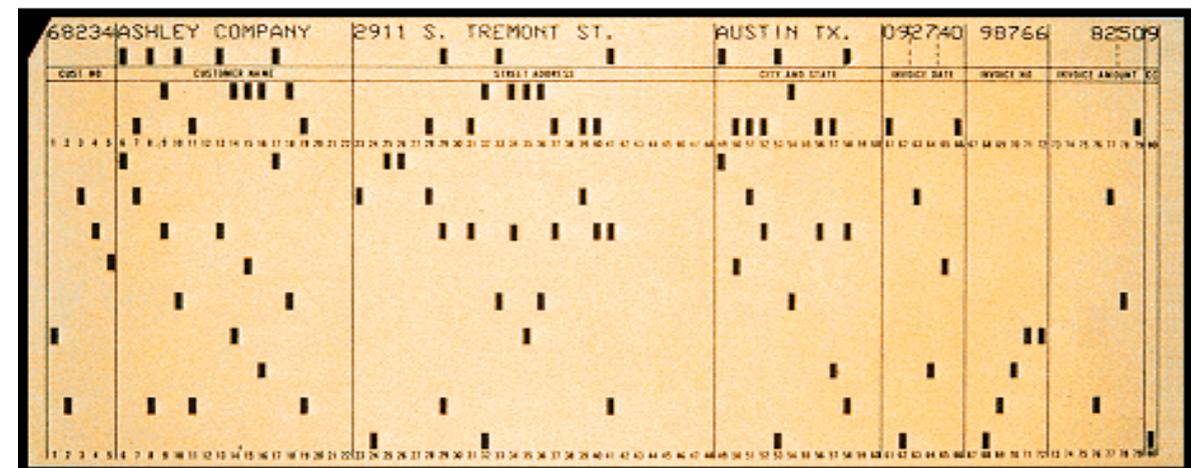
Slide Rule Cons?



Hollerith Punch Cards (1890)



From Computer Desktop Encyclopedia
© 2000 The Computer Language Co. Inc.

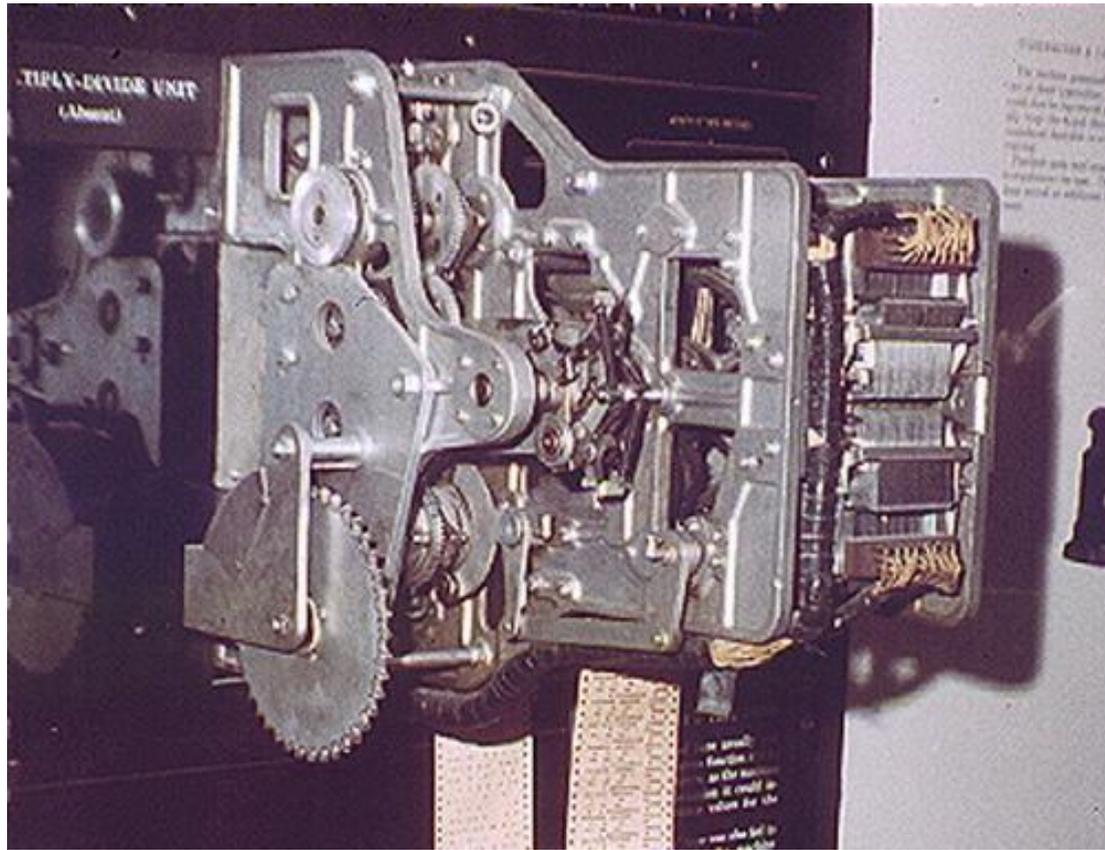


Hollerith Electric Tabulator, US Census Bureau, Washington, DC, 1908,
Photograph by Waldon Fawcett. Library of Congress, LC-USZ62-45687.

Teletype (ca. 1910)



Harvard Mark I (1944)

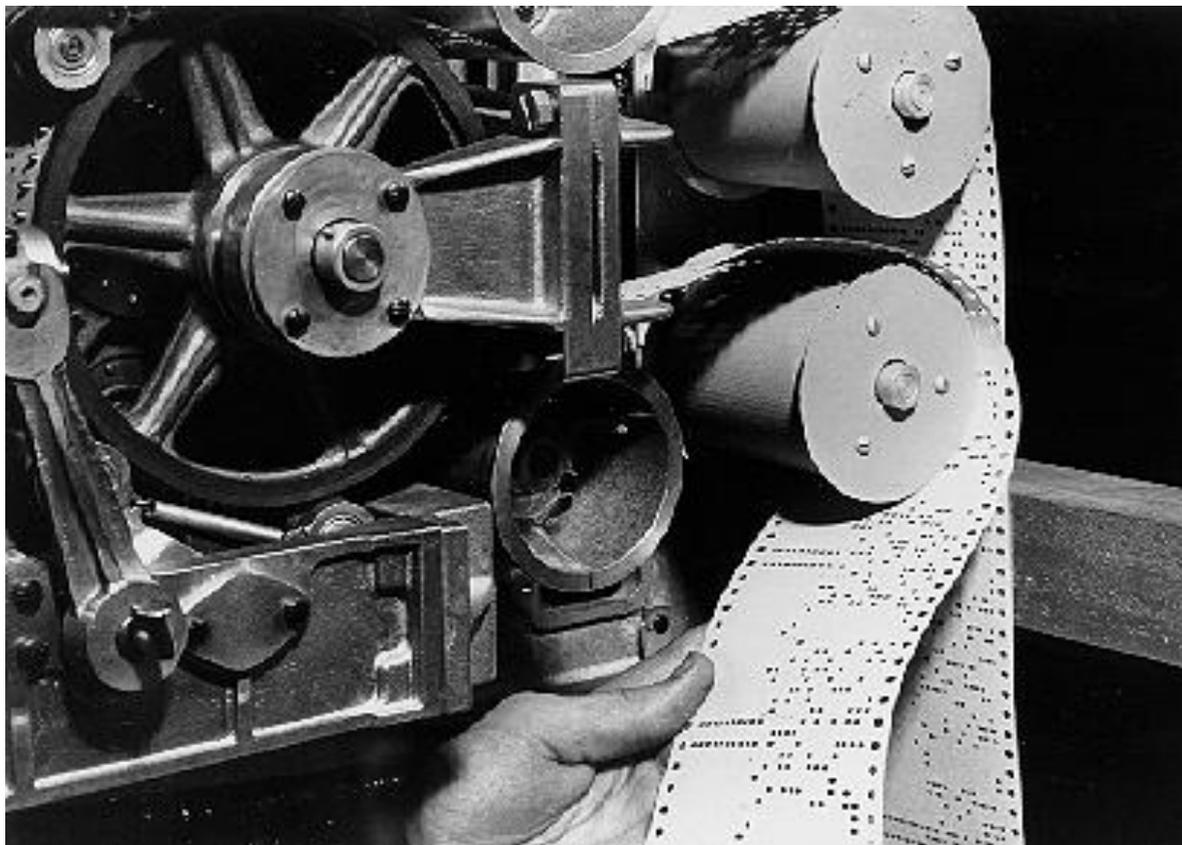


Hardware

- Physical switches
- Paper tape

Uses

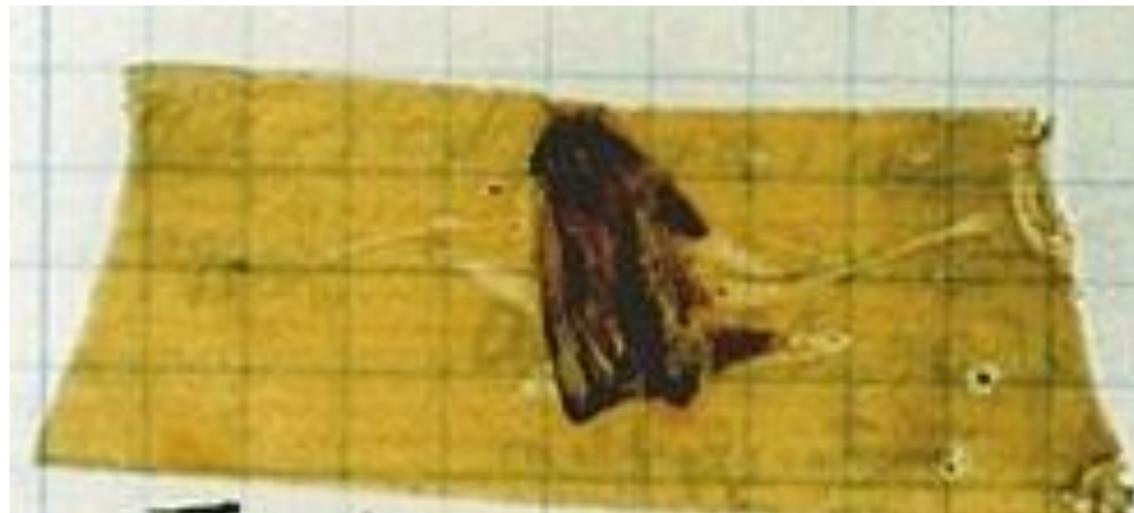
- Ballistics calculations
- Simple arithmetic & fixed calculations (before programs)
- 3 seconds to multiply



Adm. Grace Murray Hopper



First programmer of Mark I

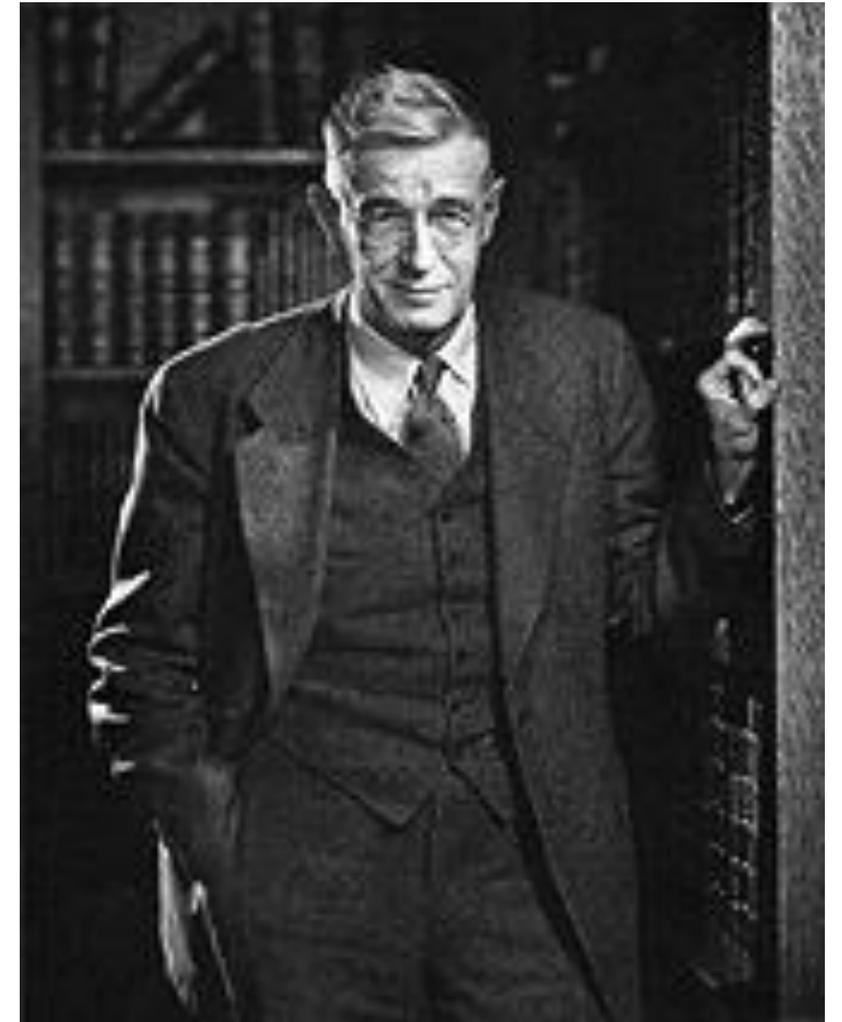


9
0800 Antam started
1000 " stopped - antam ✓ { 1.2700 9.037 847 025
1300 (032) MP-MC 2.130476415 9.037 846 995 correct
(033) PRO 2 2.130476415 4.615925059(-2)
correct 2.130676415
Relays 6-2 in 033 failed special speed test
in relay .. 10.00 test.
Relays changed
1100 Started Cosine Tape (Sine check)
1525 Started Multi Adder Test.
1545  Relay #70 Panel F
(moth) in relay.
First actual case of bug being found.
1700 Antam started.
1700 closed down.

Filed first bug report

Vannevar Bush (1890-1974)

- Engineer by training (MIT)
- Differential analyzer - 1930
- Led computing research in '30s
- Created military research
 - NDRC '40, OSRD '41-47
- Managed nuclear weapons research throughout the 40's
- Wrote "science - the endless frontier" 1945
- Military consultant through 50's

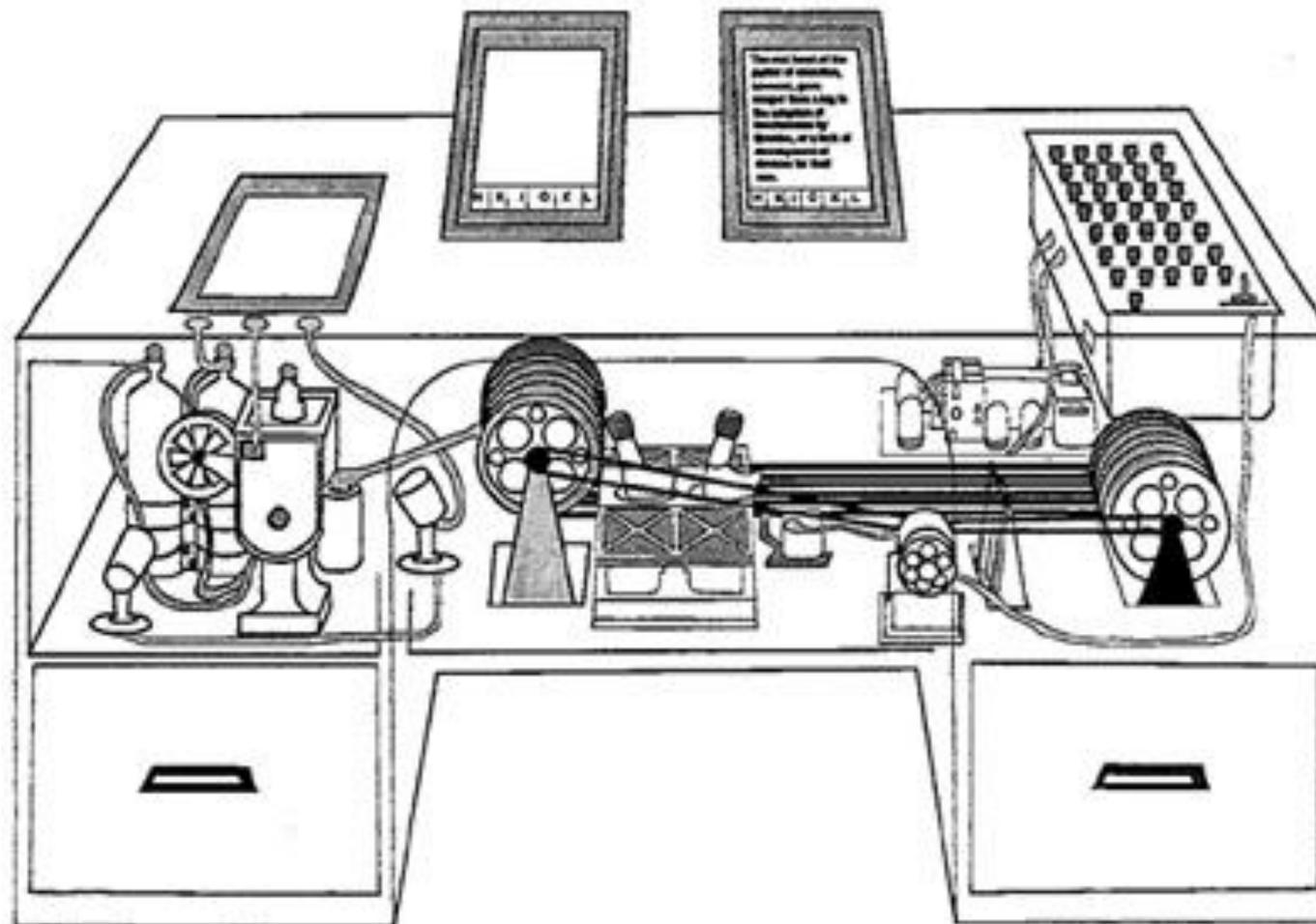


As We May Think

- Published in the *Atlantic Monthly* in 1945!
- What will the computer of the future look like?
 - Wearable cameras for photographic records
 - Encyclopedia Britannica for a nickel
 - Automatic transcripts of speech
 - Memex
 - Trails of discovery
 - Direct capture of nerve impulses

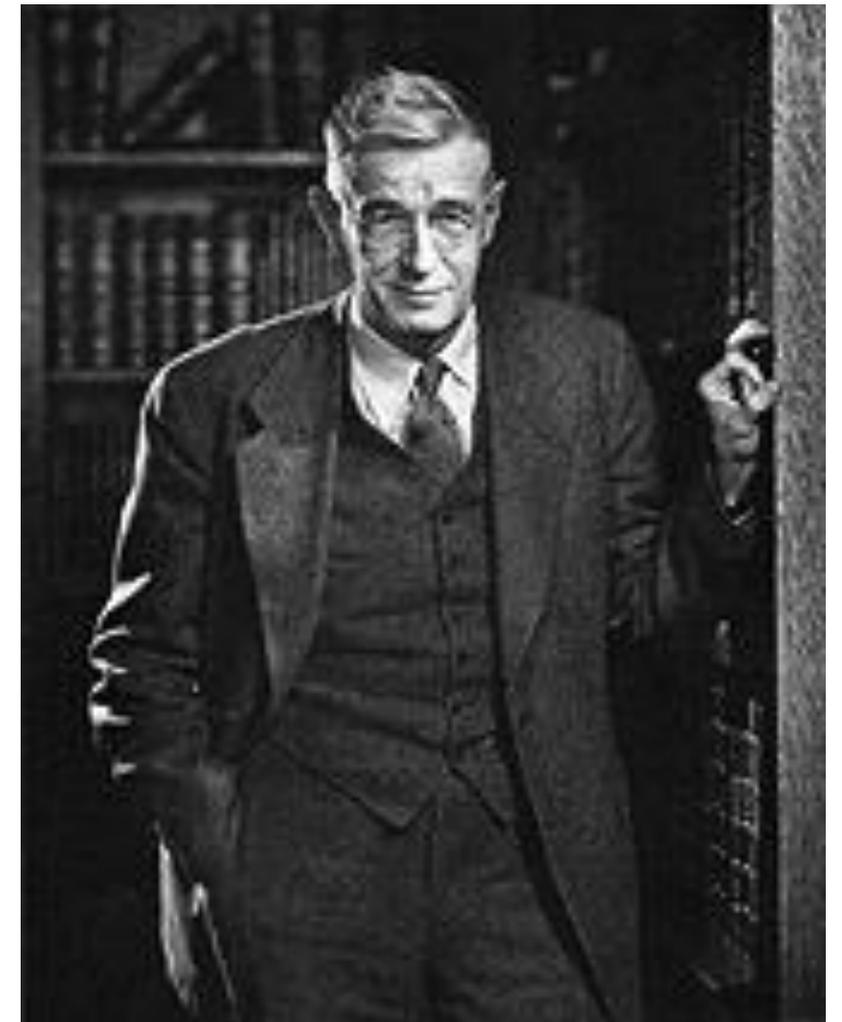
Memex

- Store all personal books, records, communications
- Items retrieved through indexing, keywords, cross references,...
- Can annotate text with margin notes, comments...
- Can construct a trail through the material and save it
- Acts as an external memory



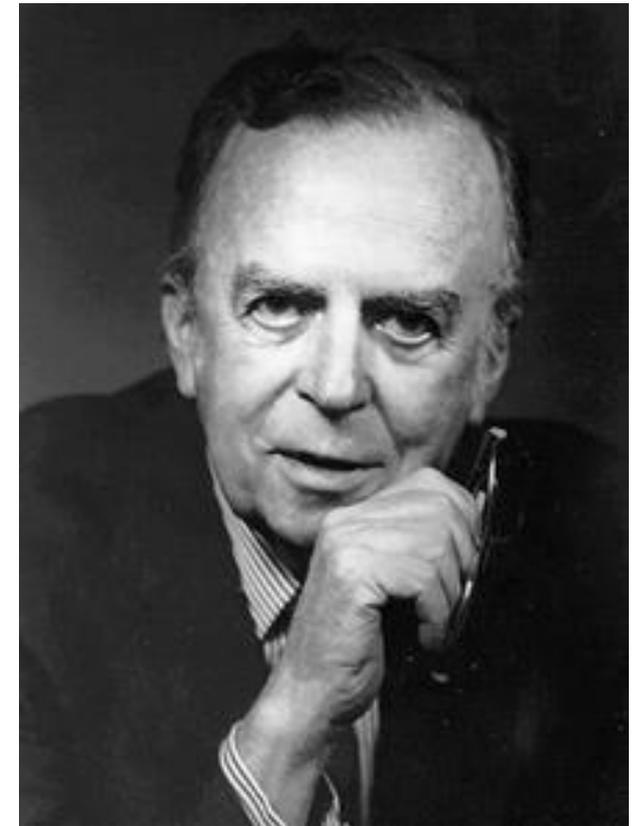
Post-War

- After WWII, Bush continued to push for analog computers (and against digital).
- Building the future is a tough business – you can't get it right all the time, but that's no excuse not to try.
- Not much of what Bush actually built has survived, but his vision inspired generations of engineers.



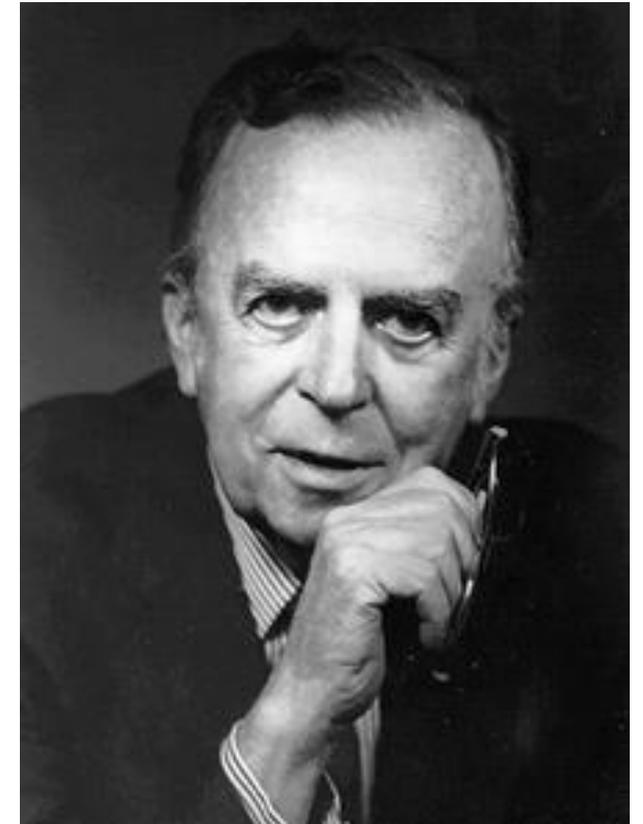
J.C.R. Licklider (1915-1990)

- Ph.D. 1942 Rochester, Psychologist
- Started “Human Engineering group” at MIT’s Lincoln labs in 1951
- Tried to evolve Psychology into a department within Electrical Engineering
- ARPA created in 1958 in response to Sputnik, “Lick” became director in 1962.
- With ARPA sponsorship, the first CS programs were created:
 - MIT, CMU, Berkeley, Stanford



J.C.R. Licklider

- At ARPA, Licklider promoted computing research and sponsored:
 - Time-sharing
 - Networking
 - Engelbart's and Sutherland's online computing work



Articles:

- Man-computer symbiosis – 1960
- Libraries of the future – 1965
- The computer as communication device - 1968

Context - Computing in 1960s

- Transistor (1948)
- PC boards (1950s)
- Punch cards mostly
- Occasionally Teletypes



Vacuum Tube



Transistor

- Computers still primarily for scientists and engineers

Licklider: Man-Computer Symbiosis (1960)

- Did self-observation of his daily work.
 - Observed that much work was mundane and related to accessing and organizing information
- Proposed:
 - Digital libraries
 - Display screens with pen input and character recognition
 - Wall displays for collaborative work
 - Speech recognition and production for HCI

Licklider: The Computer as a Communication Device - 1968

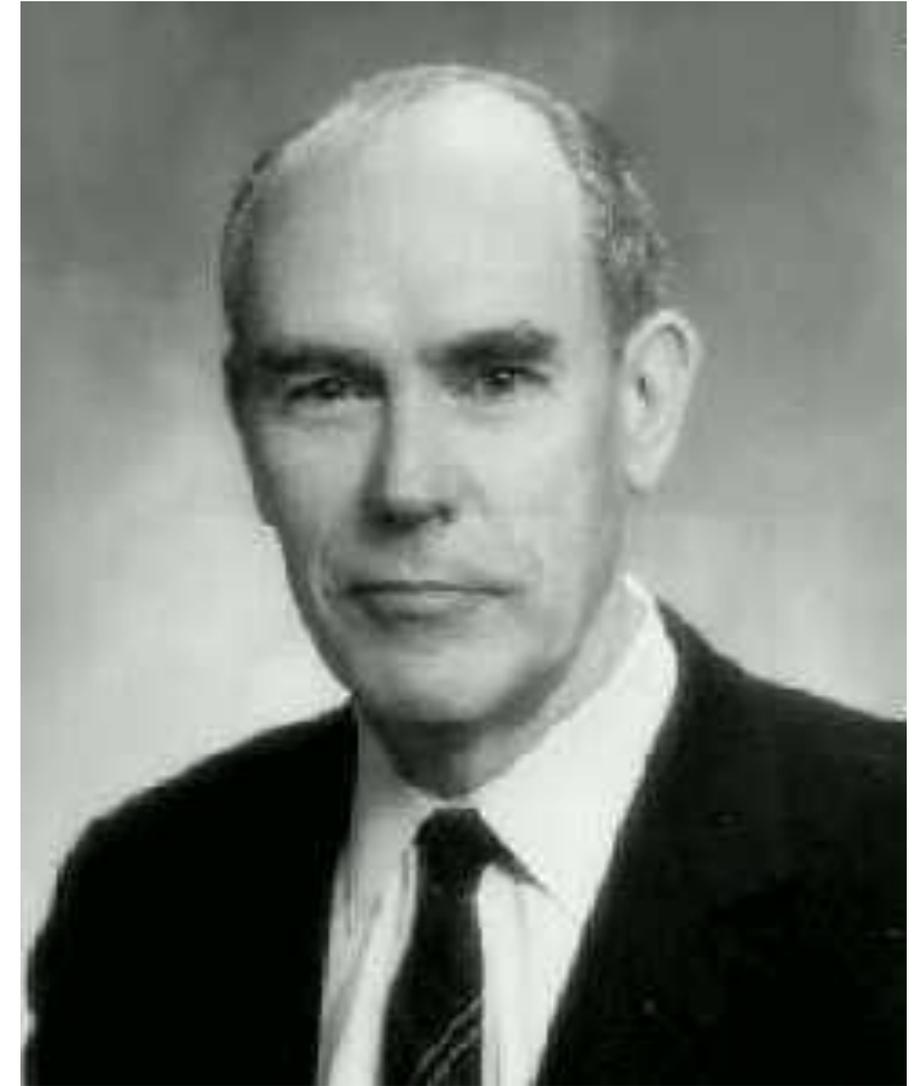
- Cooperative work with shared and individual screens
- Pen chat
- Online communities
- Agents – OLIVERs On-Line Vicarious Expediter and Responder

Networks, Time-sharing

- Much of Licklider's sponsored research was unpopular in the engineering community:
- “Time-sharing is a waste of valuable computer time”
- “Why are we doing this?”
 - BBN engineer about the first computer network

Ivan Sutherland (1938 -)

- Established Computer Graphics
- Started “Evans and Sutherland” in 1968
- Turing award 1988
- Now a fellow at Sun and visiting Professor at Berkeley



Sketchpad (1963)

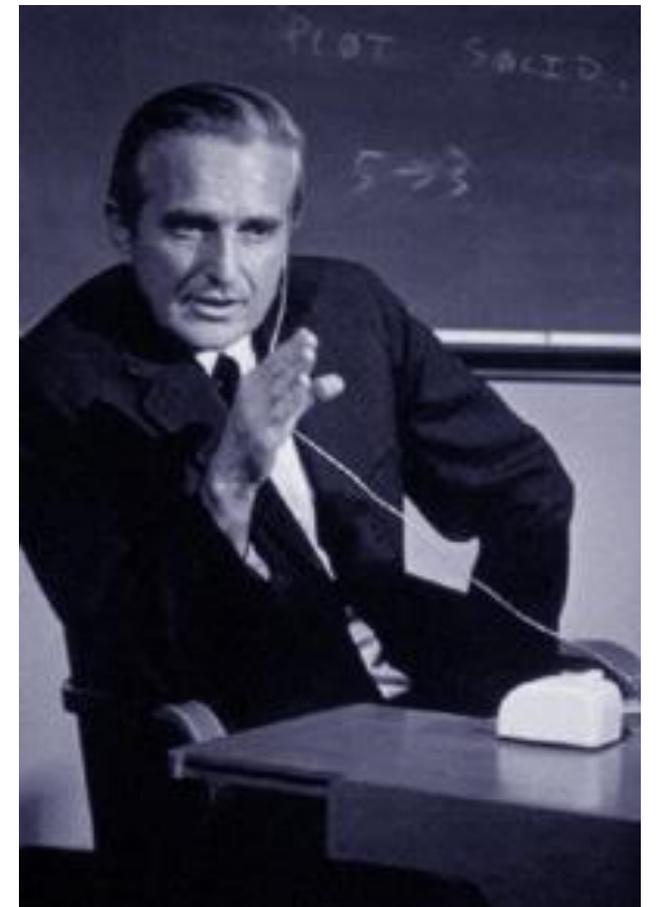
- Ivan E Sutherland's PhD thesis
- Modern pen-based system supporting
 - CAD design
 - 3D modeling
- Key: Interactivity (real-time computing was non-existent)



Video: 4:30 – 9:18

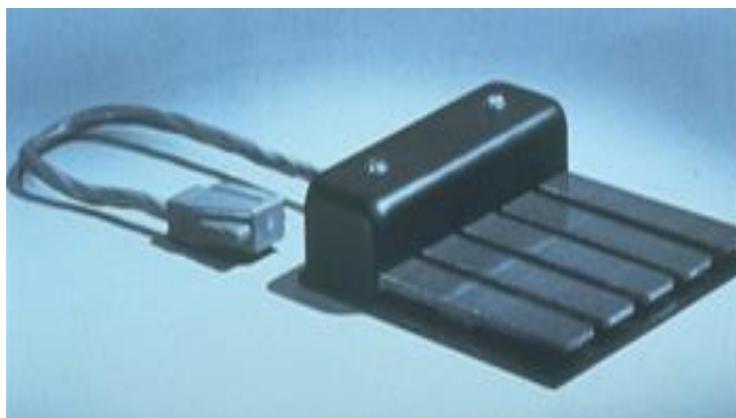
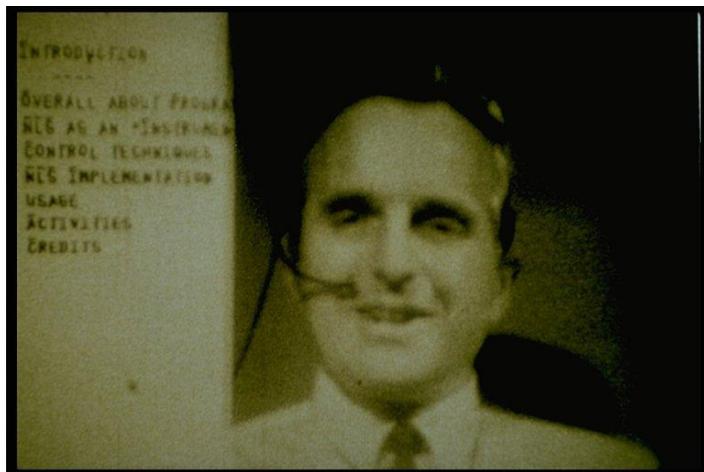
Doug Engelbart 1925 -

- Ph.D. UC Berkeley (EE) in 1955
- Thesis on “plasma digital devices”
- a way into computing
- Strongly influenced by Bush’s article
- Moved to SRI, started formulating human augmentation ideas in 1959
- Funding from ARPA in 1963
- NLS (oNLine System) demo 1968



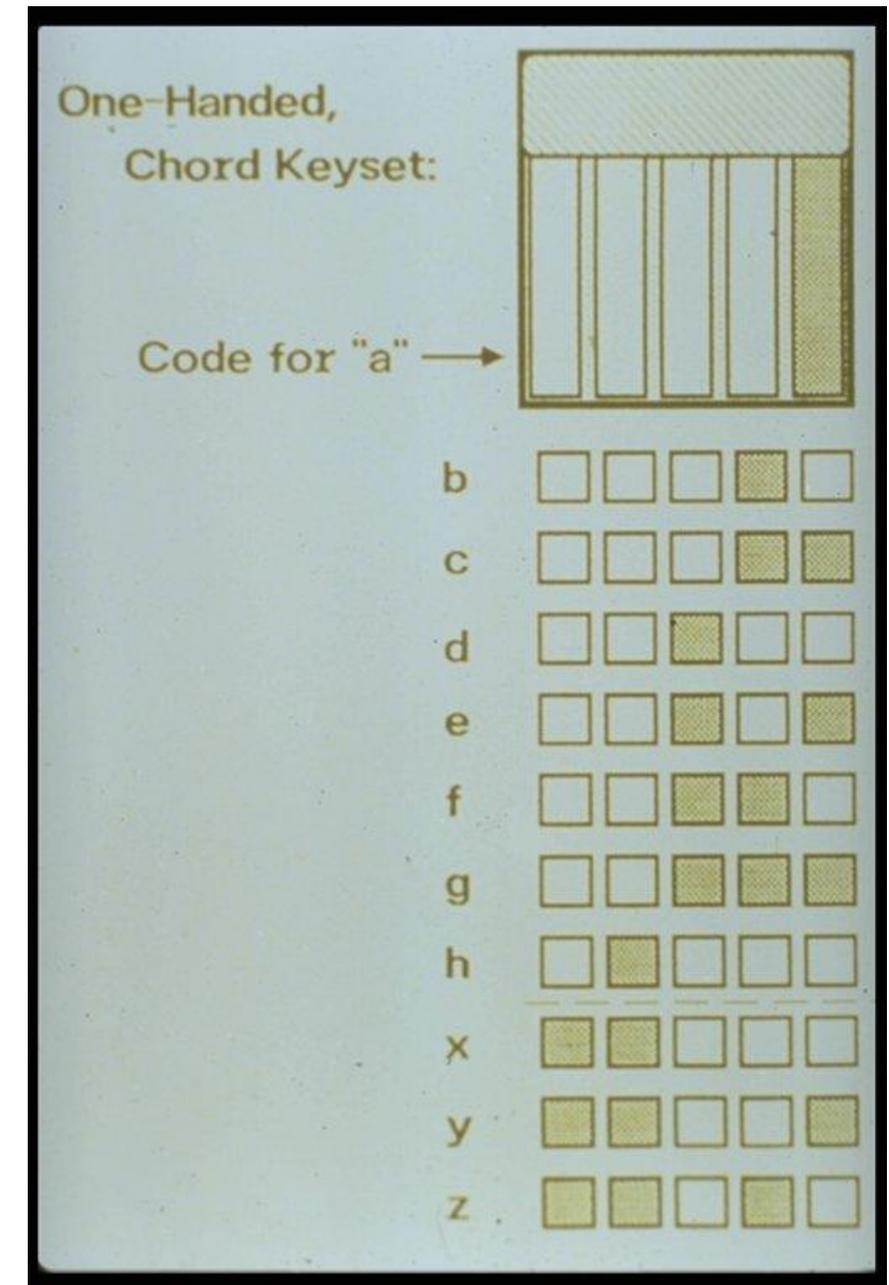
NLS: oNLine System (1968)

- 1968 Fall Joint Computer Conference (SF)
- Demonstrated NLS to 1000 computer scientists
 - Video screen, chording keyboard, mouse, videoconferencing, hyperlinking, word processing, email,
 - User testing
 - Extremely influential



Video: 10:54 – 17:00

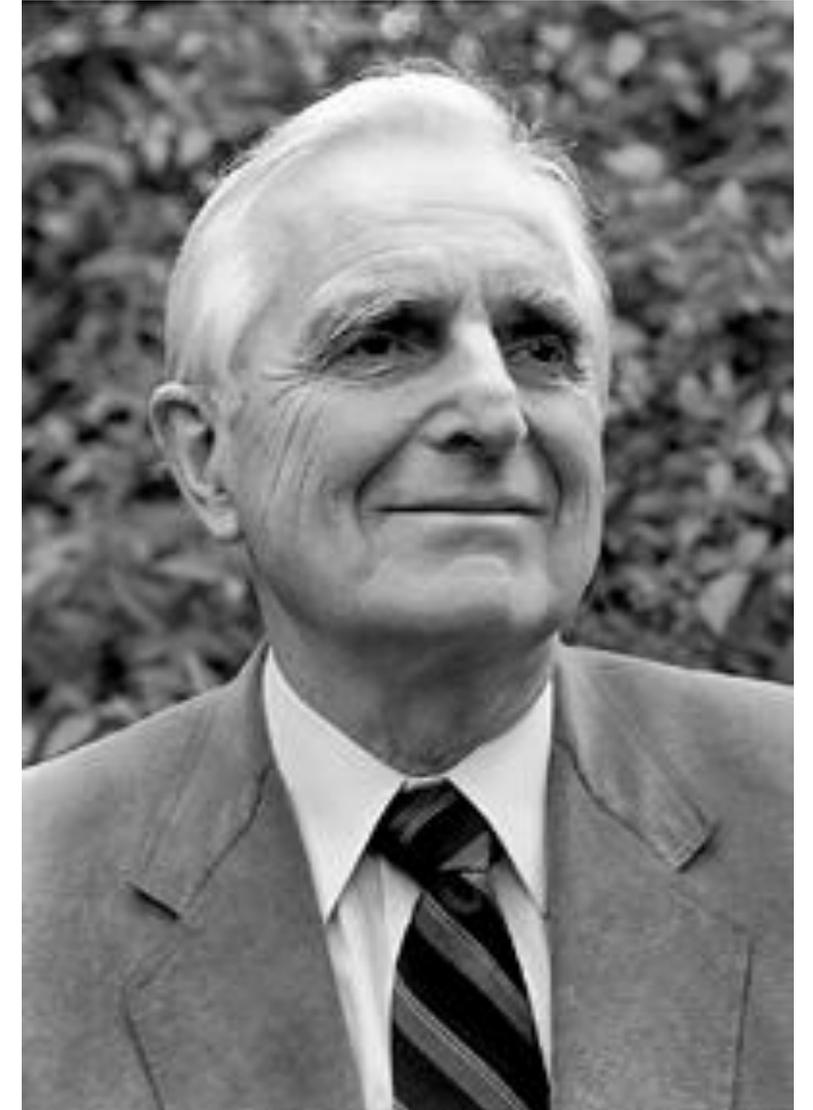
Chording Keyboard and Mouse



Advantages/Disdvantages?

Doug Engelbart

- Funding dwindles in 70's, AI↑ HCI↓
- NLS project sold in 1977 to Tymshare
 - Half of the (~40) NLS engineers moved to Xerox PARC, others to Tymshare
 - Engelbart fired from SRI in '77, moves to Tymshare
- McDonnell-Douglas 1984-1989
 - Worked on open hypertext systems
- Started Bootstrap institute in 1989
- Turing award 1997



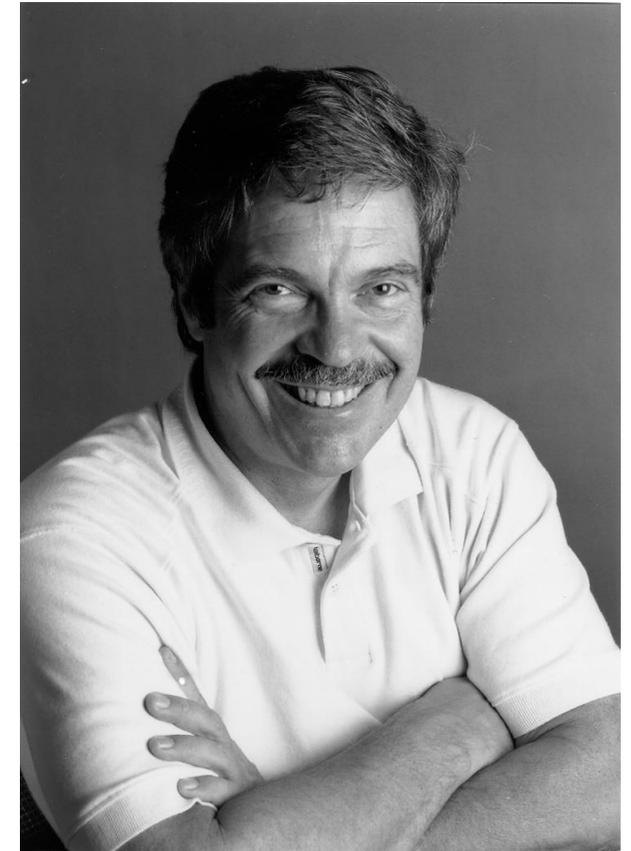
Ted Nelson 1937 -

- M.A. Sociology, Harvard '63
- Coined “hypertext” in 1960
- Worked with Van Dam at Brown on HES – 1967
- Designed Xanadu in 1981
 - Global hypertext
 - Pay-per-view
 - Not funded until 1987
- Hypertext as a more natural medium than linear text for creative writing
- “I build paradigms. I work on complex ideas and make up words for them. It is the only way.”



Alan Kay (1940 -)

- Ph.D. 1969 (Utah) Computer Graphics
- In 1968, met Seymour Papert (LOGO) in the MIT AI Lab.
 - kids can program!
- Moved to Xerox PARC in 1972
- Started developing “Smalltalk”, in the Learning Research Group
- First general OO programming language
- Influenced by Simula
 - Engineers can program!



Alan Kay @ PARC

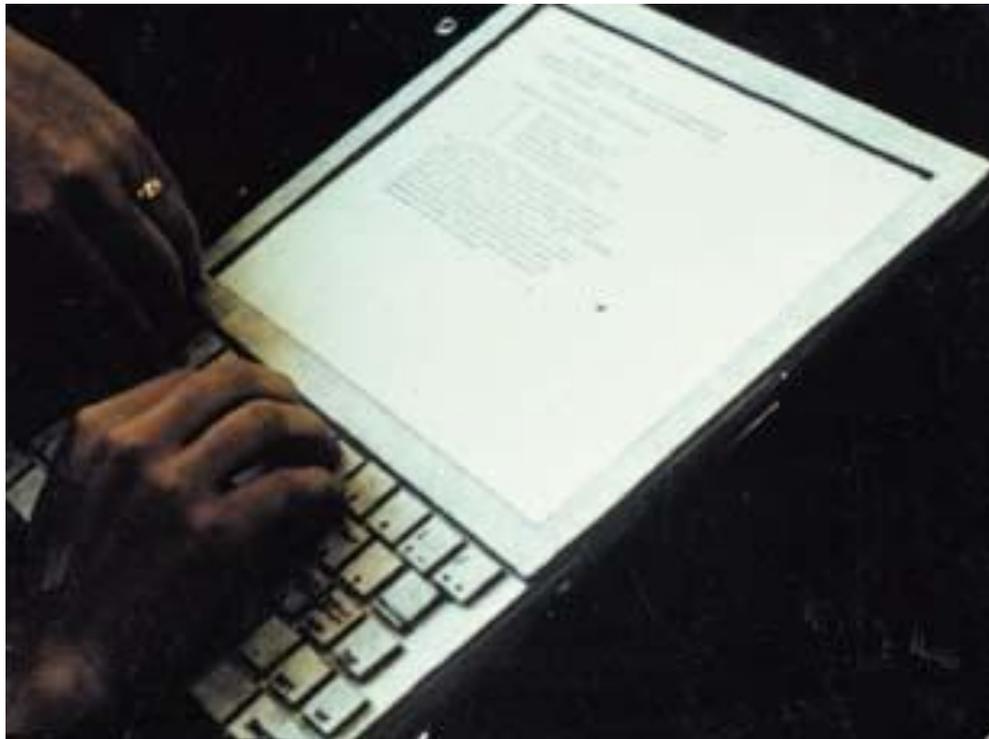
- Dynabook (laptop computer) conceived in 1968, well ahead of its time.
- As interim steps, Kay develops the Xerox Alto (1972) and Star, the first real personal computers.



Xerox Alto

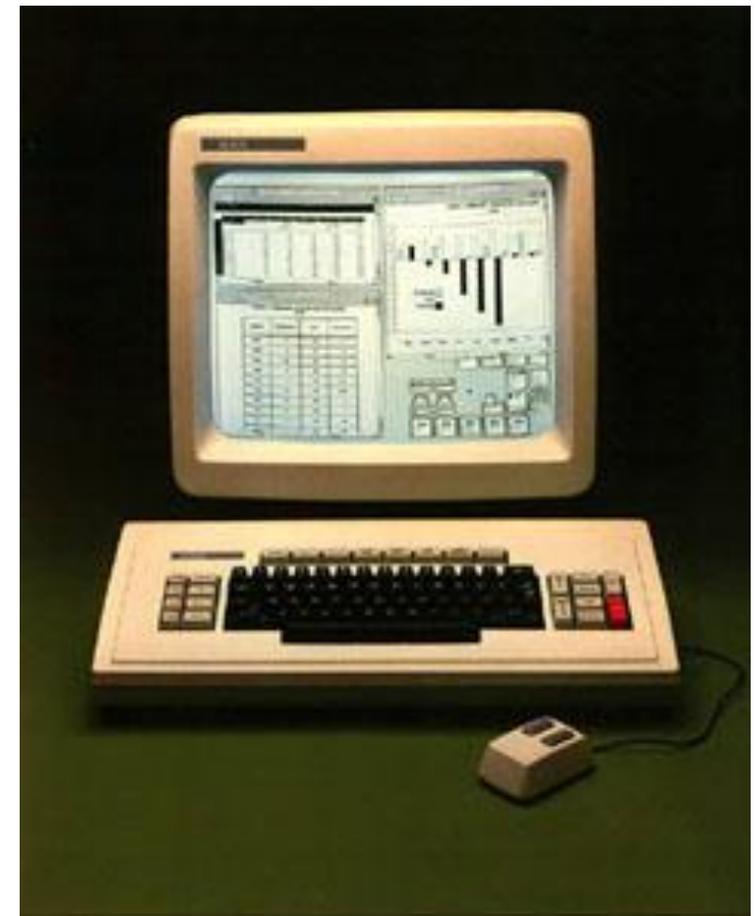
Alan Kay quote

- "Don't worry about what anybody else is going to do... **The best way to predict the future is to invent it.** Really smart people with reasonable funding can do just about anything that doesn't violate too many of Newton's Laws!"



The Xerox Star

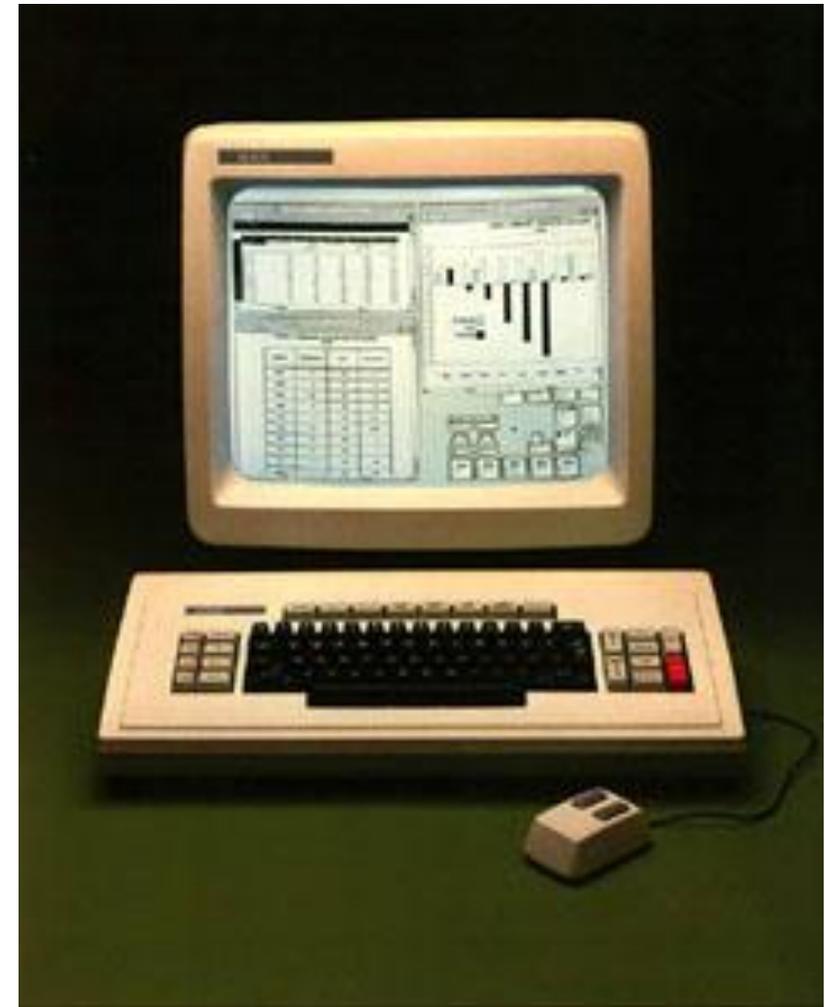
- The Star (1981 and begun in 1975) was developed by Xerox's business unit as an office machine.
- It borrowed heavily from the Alto.
- It had all of the “WIMP” elements we know today.
- The Star was the result of extensive user testing.
- Many design features were better than its successors (e.g. object-oriented editing features)



The Star group

The Star design team developed a new methodology for system design:

- Task analysis
- Wide range of users
- Usage scenarios
- Decomposition of design:
 - display and control interface
 - User's conceptual model
- Many prototyping cycles
- Desktop metaphor, direct manipulation, WYSIWYG



Altair 8800 (1975)



HOW TO "READ" FM TUNER SPECIFICATIONS

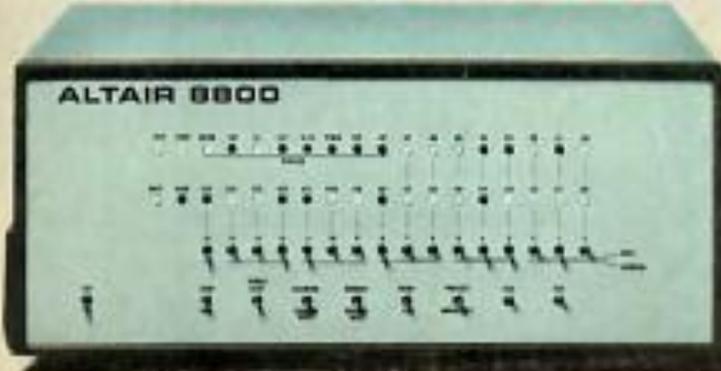
Popular Electronics

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE JANUARY 1975/75¢

PROJECT BREAKTHROUGH!

World's First Minicomputer Kit to Rival Commercial Models...

"ALTAIR 8800" SAVE OVER \$1000



ALSO IN THIS ISSUE:

- An Under-\$90 Scientific Calculator Project
- CCD's—TV Camera Tube Successor?
- Thyristor-Controlled Photoflashers

TEST REPORTS:

- Technics 200 Speaker System
- Pioneer RT-1011 Open-Reel Recorder
- Tram Diamond-40 CB AM Transceiver
- Edmund Scientific "Kirlian" Photo Kit
- Hewlett-Packard 5381 Frequency Counter

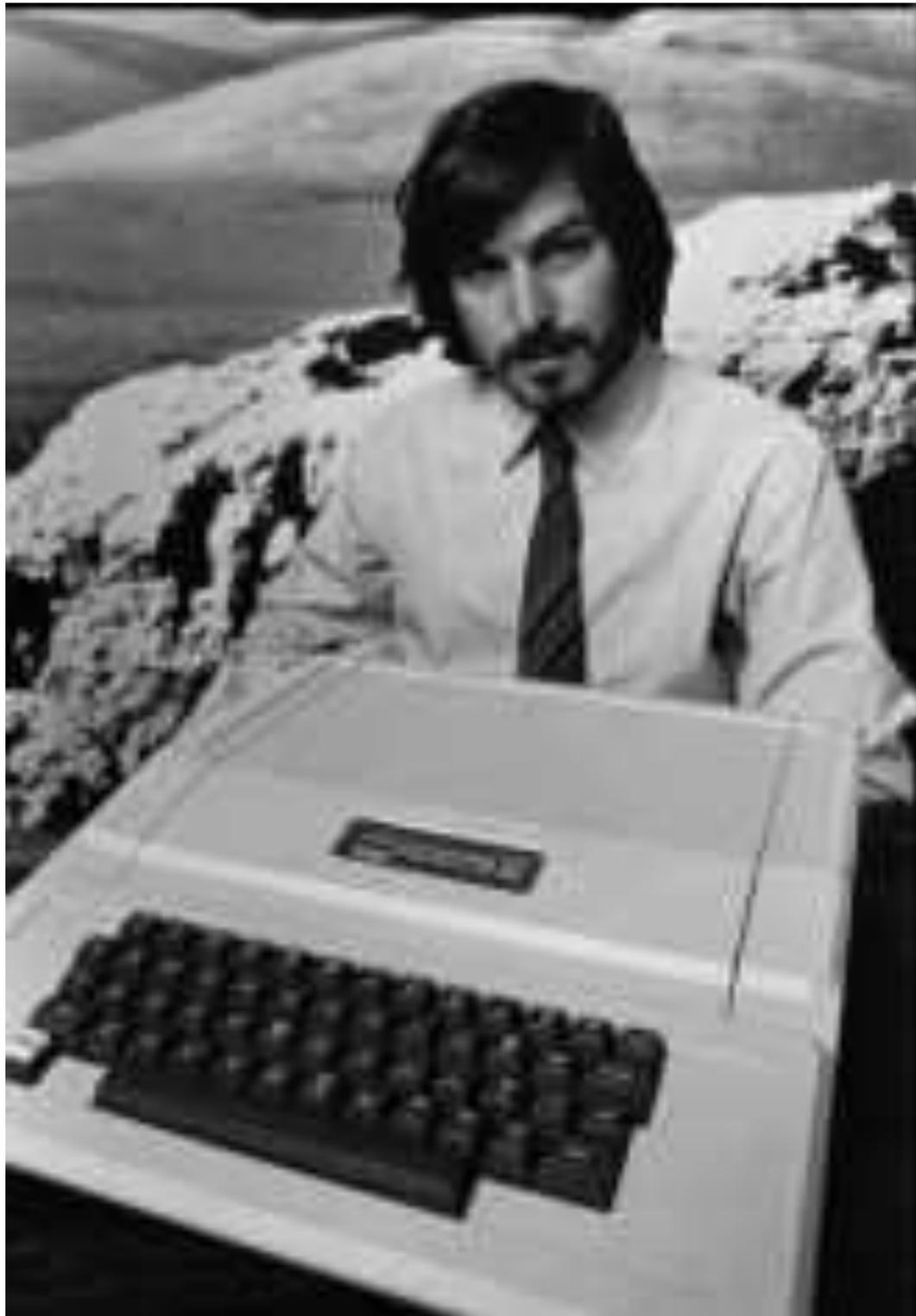


Apple I (1976)

- Steven Wozniak's design, Steven Jobs wanted to sell it.
- Had a keyboard and output video to a monitor.
- Assembled, but no case. About 30-50 still exist.



Personal Computers



Apple II 1977



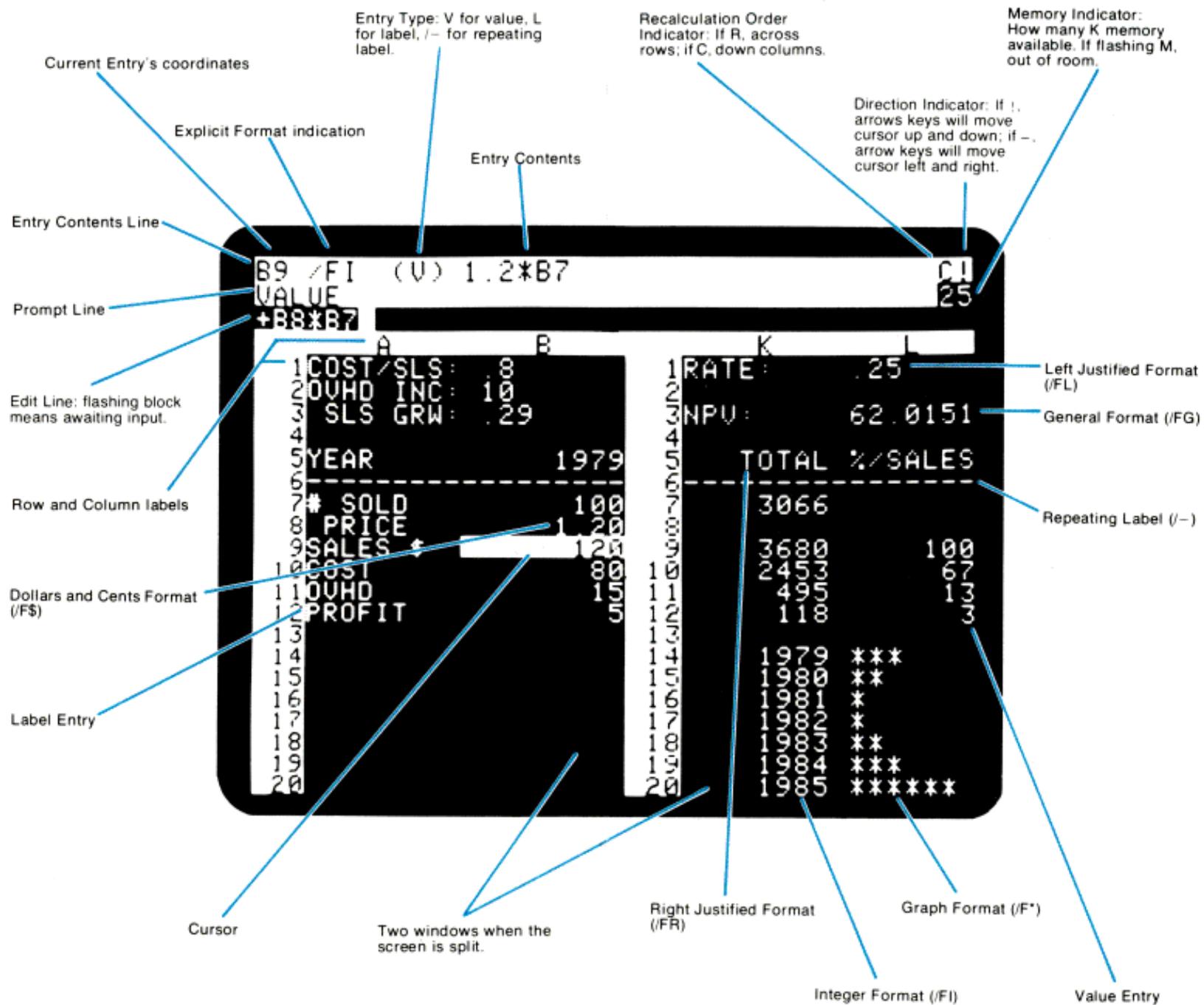
IBM PC 1981

VisiCalc (Bricklin, 1979)

9

10

A VISICALC™ Screen:



Xerox Star → Mac

The Star was expensive and slow (\$25k).

Steve Jobs visits PARC in 1979

- Sees Alto (precursor to Star)

Jobs gets moved from Lisa to

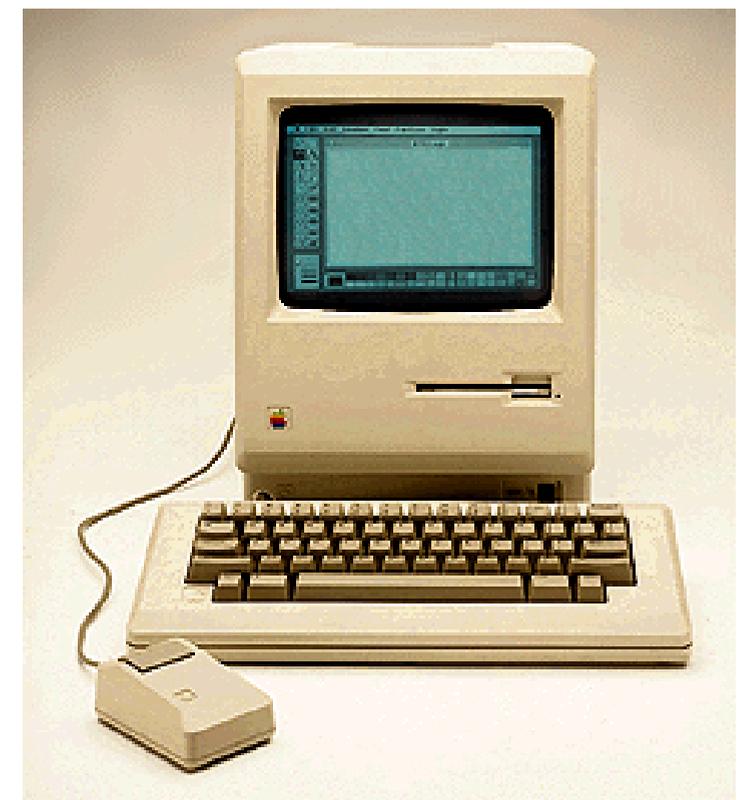
Macintosh project

- Lisa ships in 1983 at \$10,000,
- Fails in marketplace

Macintosh ships in 1984 at \$2500

- Most consistent WIMP UI
- Look and feel guidelines

Defined personal computing



What's next: Tablet PCs?

Excellent writing surface,
pen, digital ink.

Compromise on:

Keyboard

Weight

Battery life

Still trying to be a PC.

Many formats, will natural
selection choose a winner?

Price now competitive with penless laptops



Small Devices

The Apple Newton was the first “PDA” (1993) but didn’t succeed commercially.

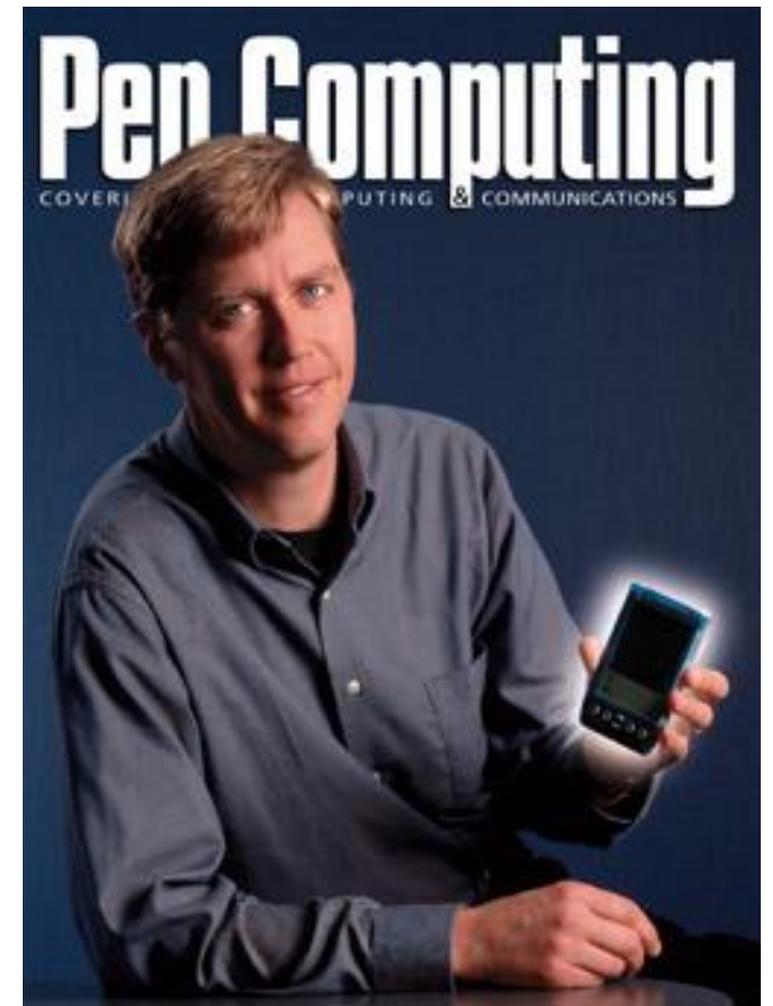
Still popular, though out of production.

Has achieved cult status.



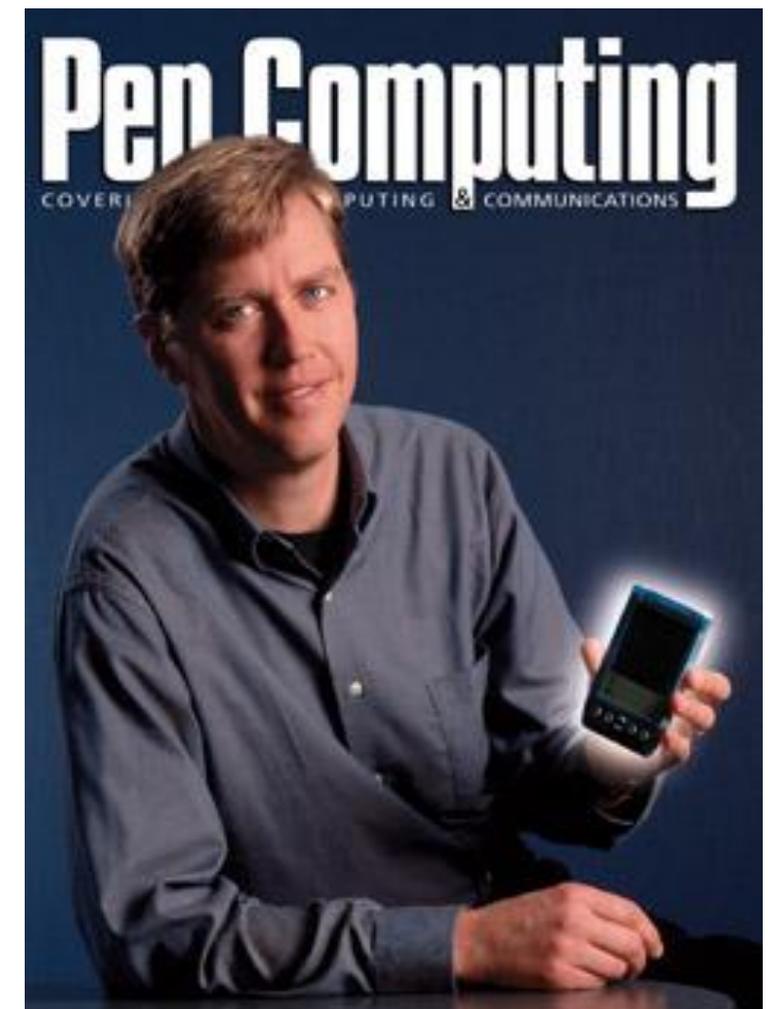
Palm Pilot

- Jeff Hawkins was an EE with an interest in cognitive science and the brain.
- Worked at GRiD (first laptop)
- Wrote Ph.D. proposal at Berkeley in Biophysics in 1987 - rejected.
- Back to GRiDPad - first pen computer?
- Developed a handwriting recognizer based on his interests in the Brain.



Palm Pilot

- Next try “Zoomer” 1993 - a failure commercially
- Intensive studies of Zoomer users began in 1994.
- Decided the PDA should be a paper replacement, not a PC replacement.
- Switched to graffiti.
- Shrunk to pocket size.
- Unveiled the Palm Pilot in 1994.



Smart phones

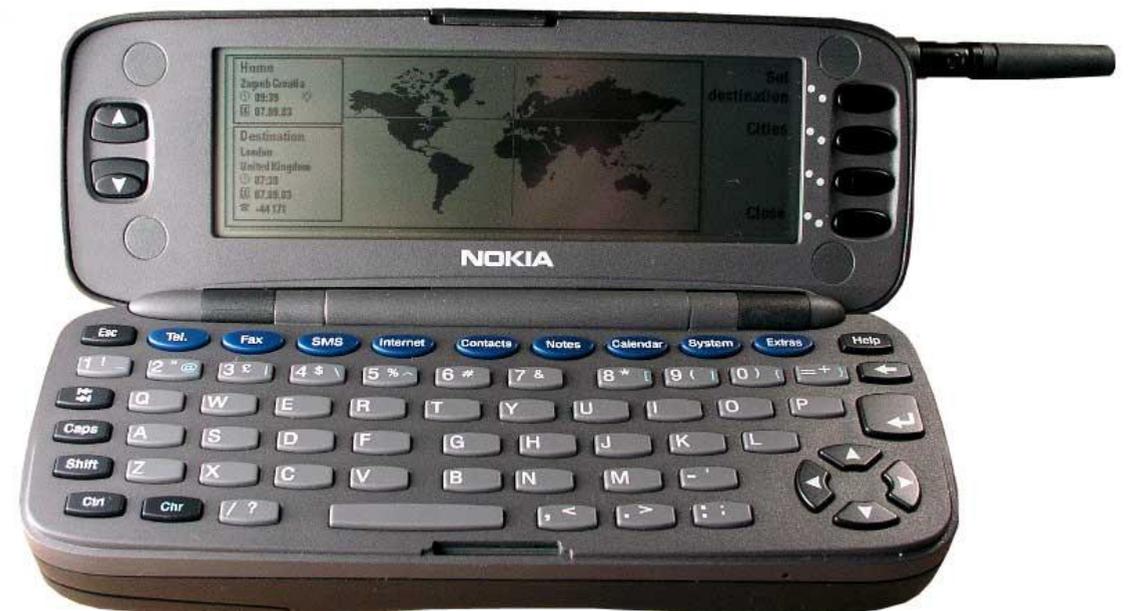
IBM's Simon (1992)

- no keypad! touch/pen screen



Nokia 9000 Communicator (1996)

- Alphanumeric + shortcut keys



Symbian devices retain 50% of
phone OS market share

Smart phones

Windows Mobile for Smartphone (2002)

- Almost-Win32 API, developers dream



RIM Blackberry (2002) , highly usable device

- 19M subscribers



Smart phones

Apple iPhone, keyless multi-touch screen.

- Design principles?
- Fast graphics, open platform
- Online application store
- Gaming
- iPhone 3G was biggest seller Q3 2008.



Smart phones

Google Android

- Cross platform set of APIs
- Excellent service integration
- Java VM
- Devices shipping now (T-Mobile G1)



Mark Lennihan / AP

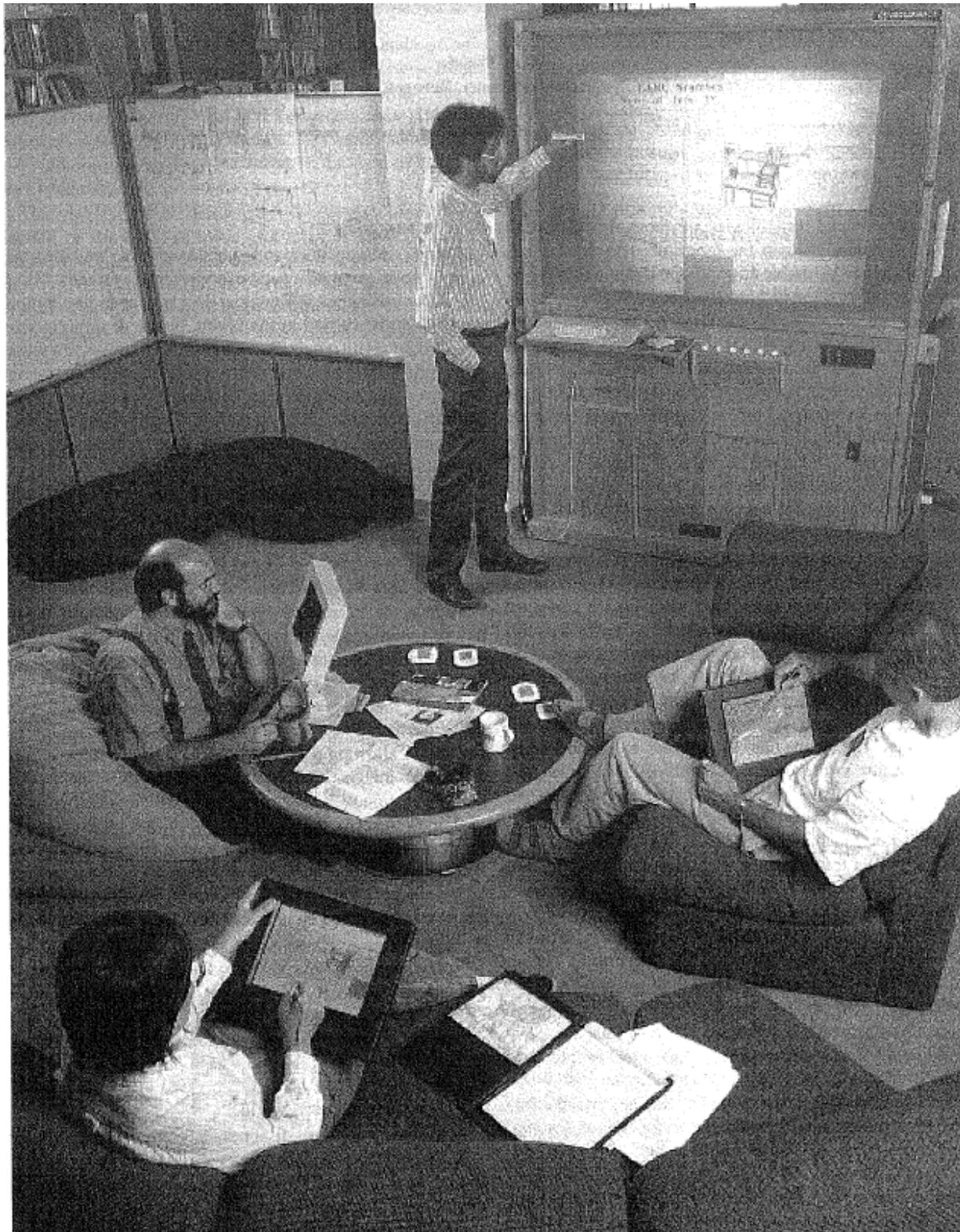
Marc Weiser (1952 – 1999)

- Ph.D Univ. of Michigan 1979
- Prof at Univ. of Maryland 79-87
- Joined Xerox PARC 1987
 - Head of Computer Science Lab 1988

Coined term “ubiquitous computing” in 1988

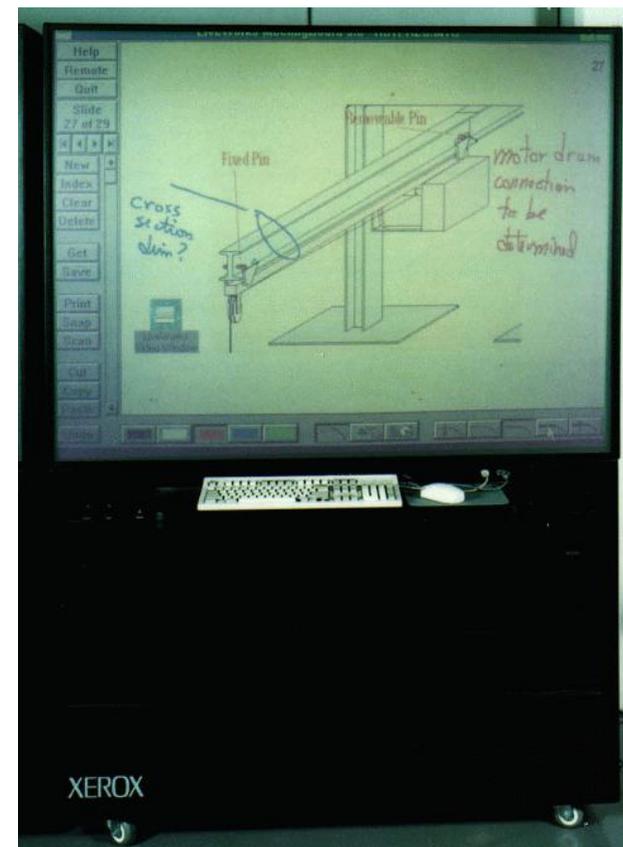


Ubiquitous Computing (1988)



Marc Weiser's vision

- 100s of computers work together
- Will disappear (invisible)



Liveboard
(Yard scale)



PARC tab
(Inch scale)



PARC pad
(Foot scale)

What happened to UbiComp?

- ?

Atari

- Created in 1970 by Nolan Bushnell (Atari is Japanese for “score”).
- Al Alcorn hired in 1972, creates “Pong” the first video game.
- Other games “Battlestar,” “Asteroids” and “Space Invaders” (1980)



Atari

- Atari created the first success home consoles as well: the Atari 2600, in 1977.
- The 2600 supported new games through plug-in cartridges.
- Mostly bought to run the home version of “Space Invaders”



Atari

Atari peaked as a \$0.5 billion company, but started losing market share in the early 1990s to Sega and Sony.

In the meantime, Atari assembled the most impressive set of researchers outside of Xerox PARC:

- Alan Kay
- Scott Fisher
- Brenda Laurel
- Jay Miner, Jack Tramiel

Researchers explored multi-player virtual reality games, holographic displays, learning games etc.

Early Multiplayer Games

- MUDs: Multiple-User Dungeons (U. Essex 1978).
These were the first multiplayer, networked games. The games were text-based RPGs. Comuserve ran dialup servers to support Essex-style MUDs.
- Monster and TinyMUD (1988) were MUDs that supported end-user programming and extension of the game world.

Multiuser VR Worlds

- Habitat (1985) built by Lucasfilm Games and Quantum Computer Services (introduced avatars).
- Ran on Commodore 64 computers.
- Alphaworld (1995): realistic 3D universe.
- User extensible, 3D avatars.
- Est. 900,000 users.



Multiuser VR Worlds

Whyville (1999): Kids educational virtual world

2.5D graphics-rich experience.

Many awards, 1.4M users.



Second Life (2003)

High-profile, extensible VR world

Simplest building UI, open design

Probably the largest VR world

User-Generated Content

Weblogs: Glen Barry's "Forest Protection Blog" (1993).

- Blogs were initially manually-updated web sites.

Open Diary was launched in 1998, and spread quickly.

Many variants exist now, including video-blogging and micro-blogging.

Micro-blogging (e.g. Twitter) supports very short, regular updates, usually to a very small audience.

Wikis

From the Hawaiian for “fast”

Ward Cunningham developed “WikiWikiWeb” in 1994.

Wikis are designed for easy editing from any web browser.

Link creation is streamlined to encourage extension.

Wiki’s ideally have a “work in progress” look and feel to encourage updates.

Social Networking Sites

The first site to make social networks explicit was SixDegrees.com in 1997. It closed in 2000.

Friendster was launched in 2002 as an extension of Match.com. It grew rapidly (and bumpily) and currently claims 85M members.

The success and struggles of Friendster inspired a torrent of competitors in the next few years.

Social Networking Sites

The next round of innovators were Myspace.com, which supported full customization of home pages,



and...

Facebook. Tapped users' alma mater network and introduced “viral apps” as a new form of user-generated content.



What's Next?

- Smart rooms, cars & homes
- Wearable computers
- Embodied interactive characters
- Tangible interfaces



Summary

- Computing began with programming – minimal interaction
- Bush, Licklider, Engelbart had a vision of computers as knowledge tools that augment human abilities.
- Personal computing required a nexus of price/performance, apps, and usability.
- We have more devices now, but hopefully more consistent experiences across them.
- Over time, the most successful apps have moved from:
 - Work and productivity
 - Recreation/games
 - Communicating and socializing