

# Designing Interactive Systems I

## History I – From Abacus to Macintosh

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<http://hci.rwth-aachen.de/dis>



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# Review

- What are the four basic principles of Visual Design?
- How to create contrast using color?
- What font types are there?
  - What are the typical cases for serif types?
- Maximal text line width?



# Radically New Interface



- **No Single Hero:** Even interfaces that seem “radically new” were built on lots of previous iterations (mouse, touch screens,...)

Image: Buxton Collection  
[research.microsoft.com/en-us/um/people/bibuxton/buxtoncollection/](https://research.microsoft.com/en-us/um/people/bibuxton/buxtoncollection/)



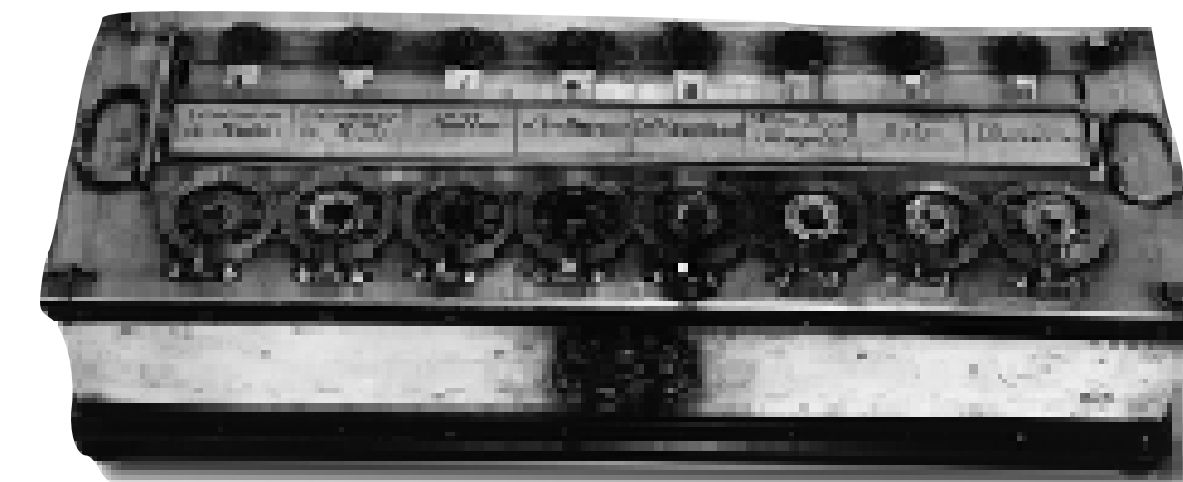
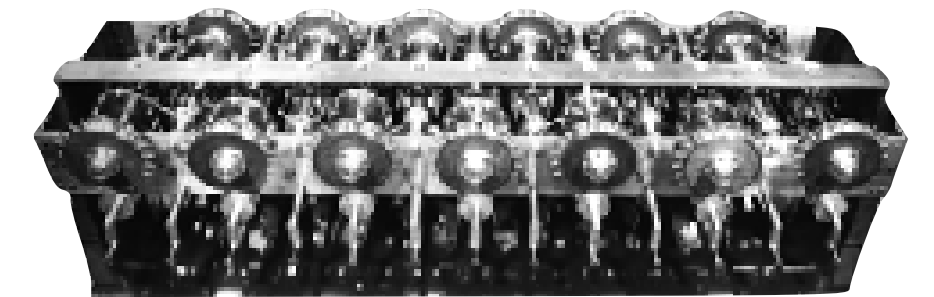
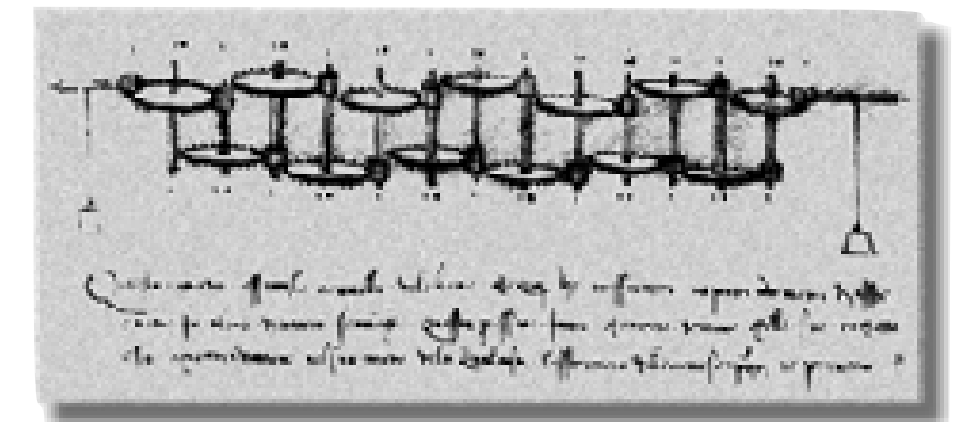
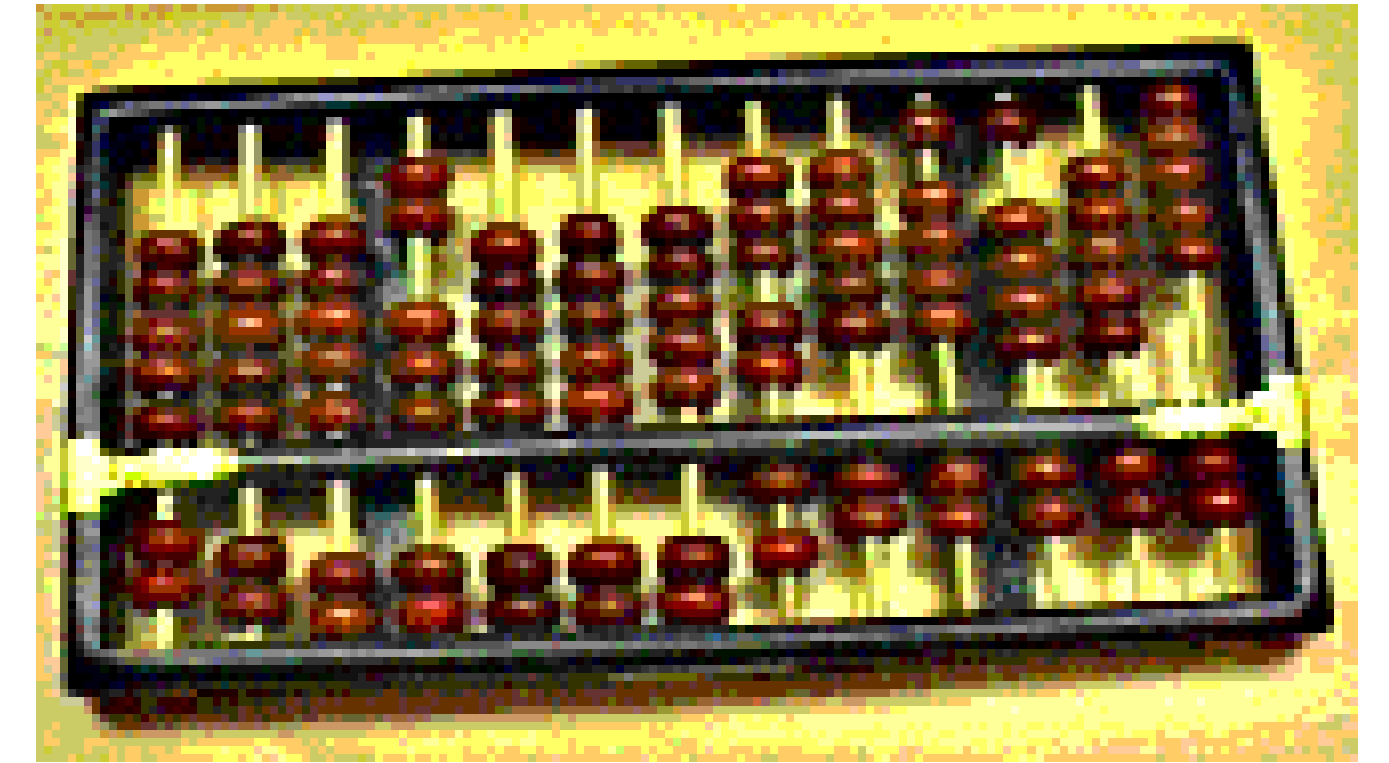
**“Picasso knew everything about art history,  
because he had to know the rules  
before he could break them.”**

**— Bill Buxton, CHI '11**



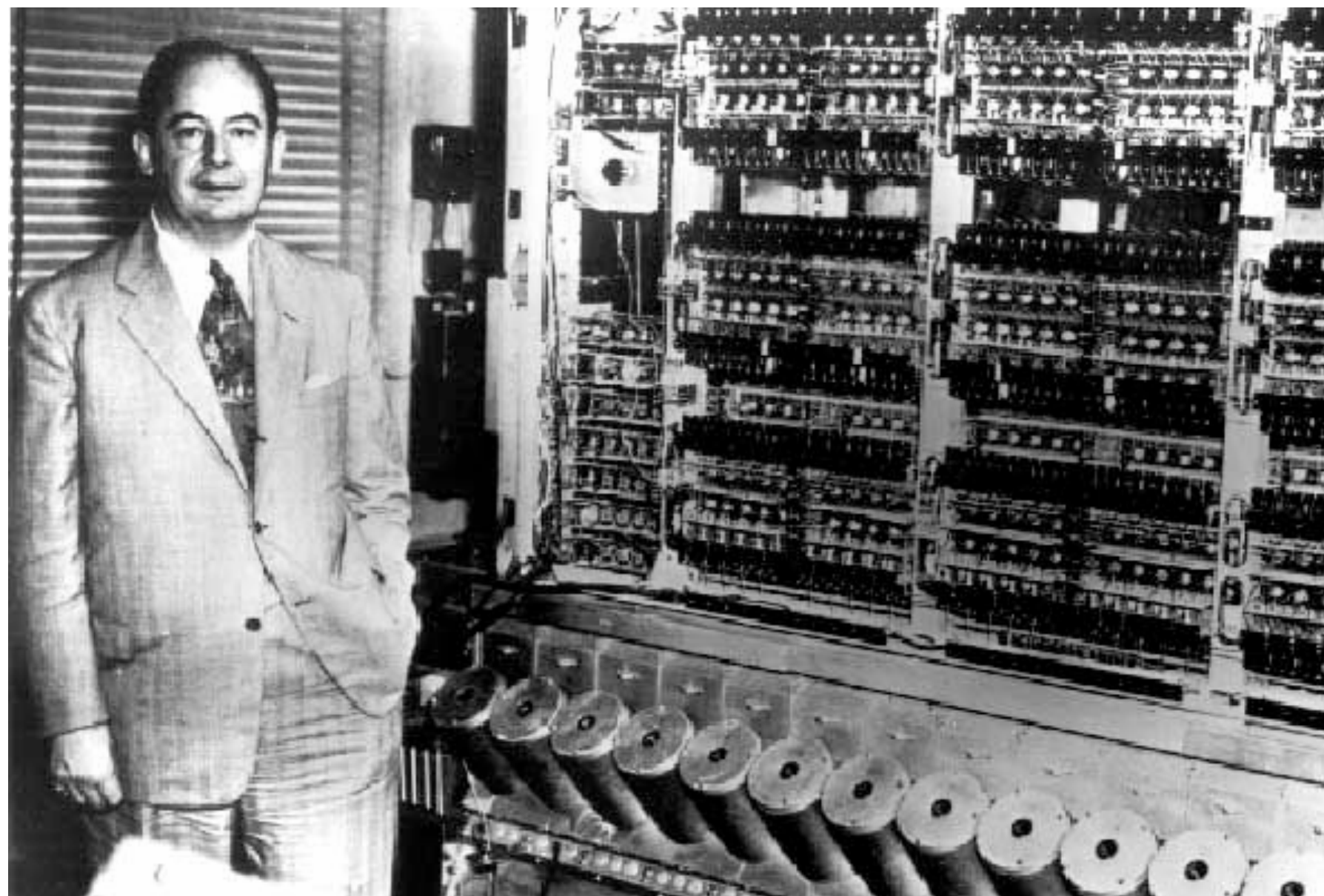
# Pre-Computing

- Abacus (Babylon, ~ 2000 BC): no UI
  - First known mechanical calculating aid
- Da Vinci's mechanical calculator (1500s)
  - First design of mechanical calculator
- Pascal's Arithmetic Machine (1642)
  - First working model, +/-
  - ~ Leibniz, Schickard
- Driving force
  - Early: direct representation of conceptual model
  - Later: increasing level of abstraction



# First Computers

- Plugboards (e.g., ENIAC 1946)
  - Just data, no program memory



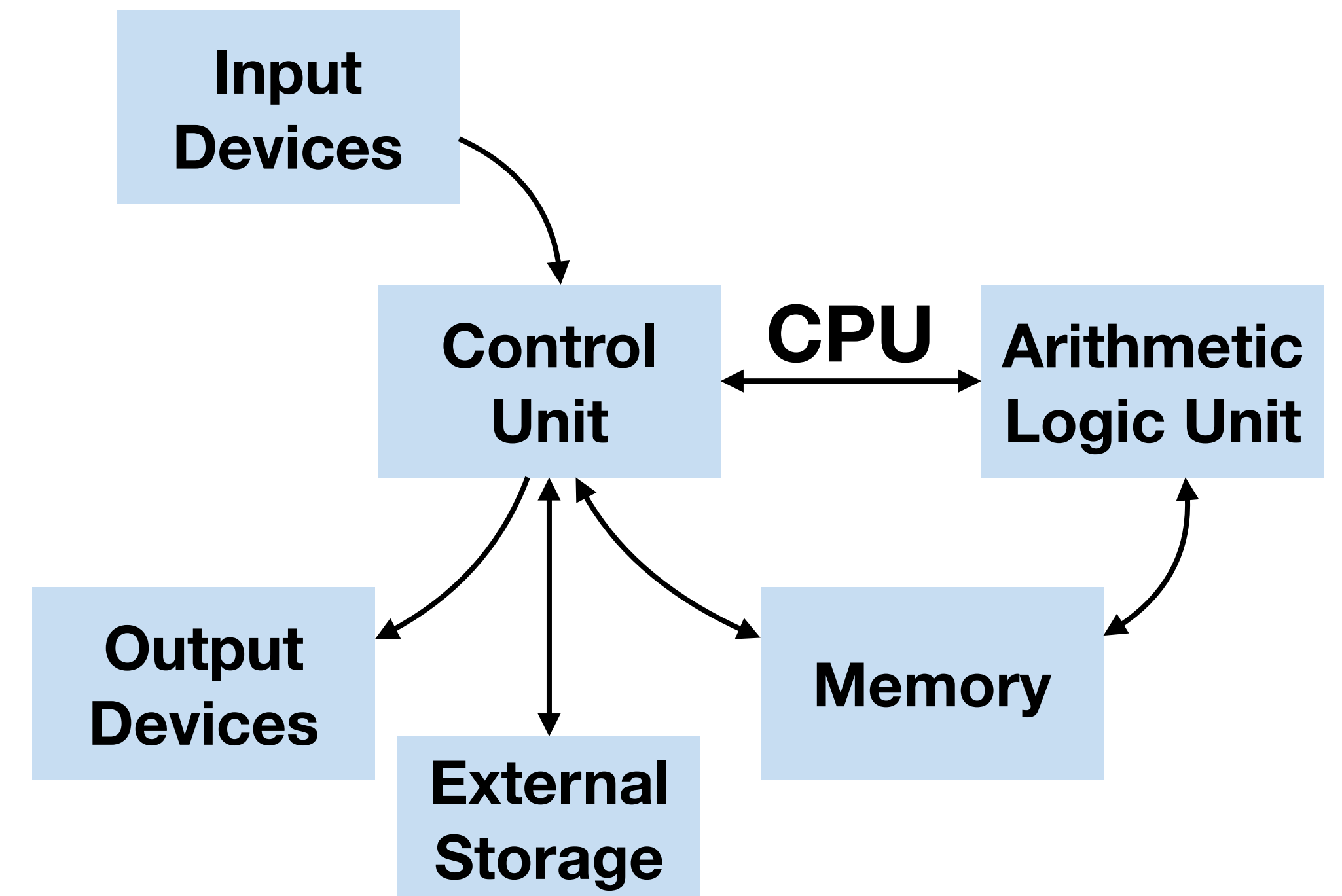
Von Neumann in front of ENIAC, 1946



IBM 557 plugboard and resistor plugs, ca. 1965

# First Computers

- Von Neumann architecture (1945)
- Key advances:
  - Defined basic components of today's computer
  - Storing instructions in memory
- ~ Zuse Z1–Z4 (1936–50)

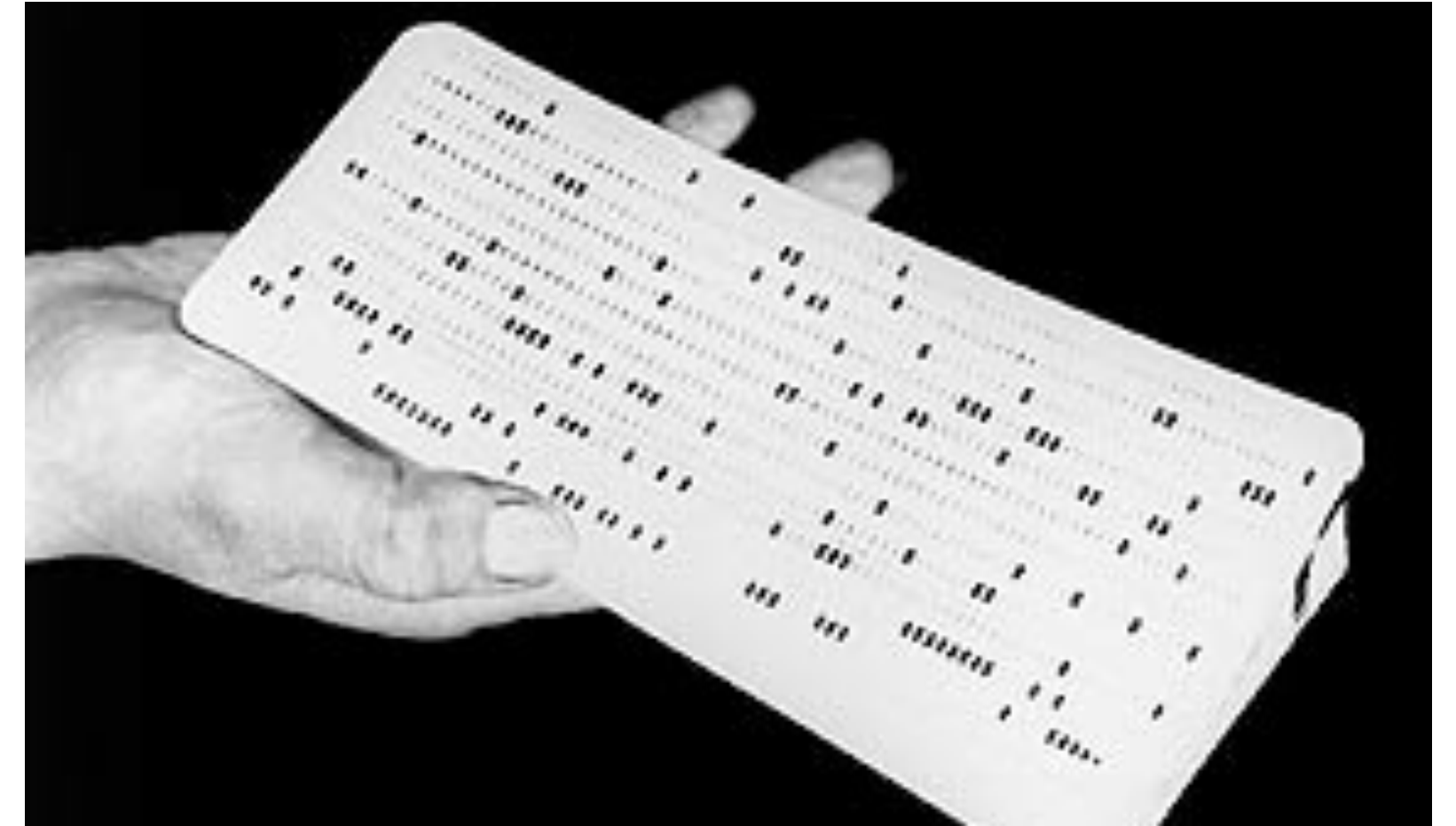


Von Neumann architecture



# Mainframes & Batch Processing

- Prepare data on punch cards—submit—wait for result as printout offline
- Mode of interaction on mainframes of 60's & 70's
- Efficient use of machine; no waiting for human input
- “0-D user interface” [Nielsen'93: Usability Engineering]
  - Single point in time for submission of the batch job as a single unit



**Machine for punching cards**

# Transaction Systems

- SABRE system (1960)
- IBM 3270 (1971)
- Key advances: Immediate response for lots of users from distant terminals (for a special-purpose application)

```
VM/ESA ONLINE

      VV      VV MM      MM
      VV      VV MMM     MMM
      VV      VV MM M     M MM
      VV      VV MM M     M MM
      VV      VV MM M     M MM
      VV      VV MM M     M MM
      VV      VV MM M     M MM
EEEEEEEEEEEE SSSSSSSSSS MAAAAA
EE      VV SS      MM SS      AA      AA
EE      VVSS      MM      AAM      AA
EE      VSS      MM      AAMM     AA
EEEEEEEEEEEE SSSSSSSSSS AAAAAAAAAA
EE      SS      SS AA      AA
EE      SS      SS AA      AA
EE      SS      SS AA      AA
EEEEEEEEEEEE SSSSSSSSSS AA      AA

Fill in your USERID and PASSWORD and press ENTER
(Your password will not appear when you type it)
USERID   ==> █
PASSWORD ==>
COMMAND ==>
```



# Time Sharing

- Key advances: Provide general purpose interactive response efficiently to many users simultaneously with one computer
  - MIT CTSS/ITS/Unix etc.
  - First teletypes, then glass teletypes
  - Addressable character Terminals
  - Command-line interfaces
- “1-D interfaces” [Nielsen’93: Usability Engineering]
  - Enter and edit one command line, then hit SEND key



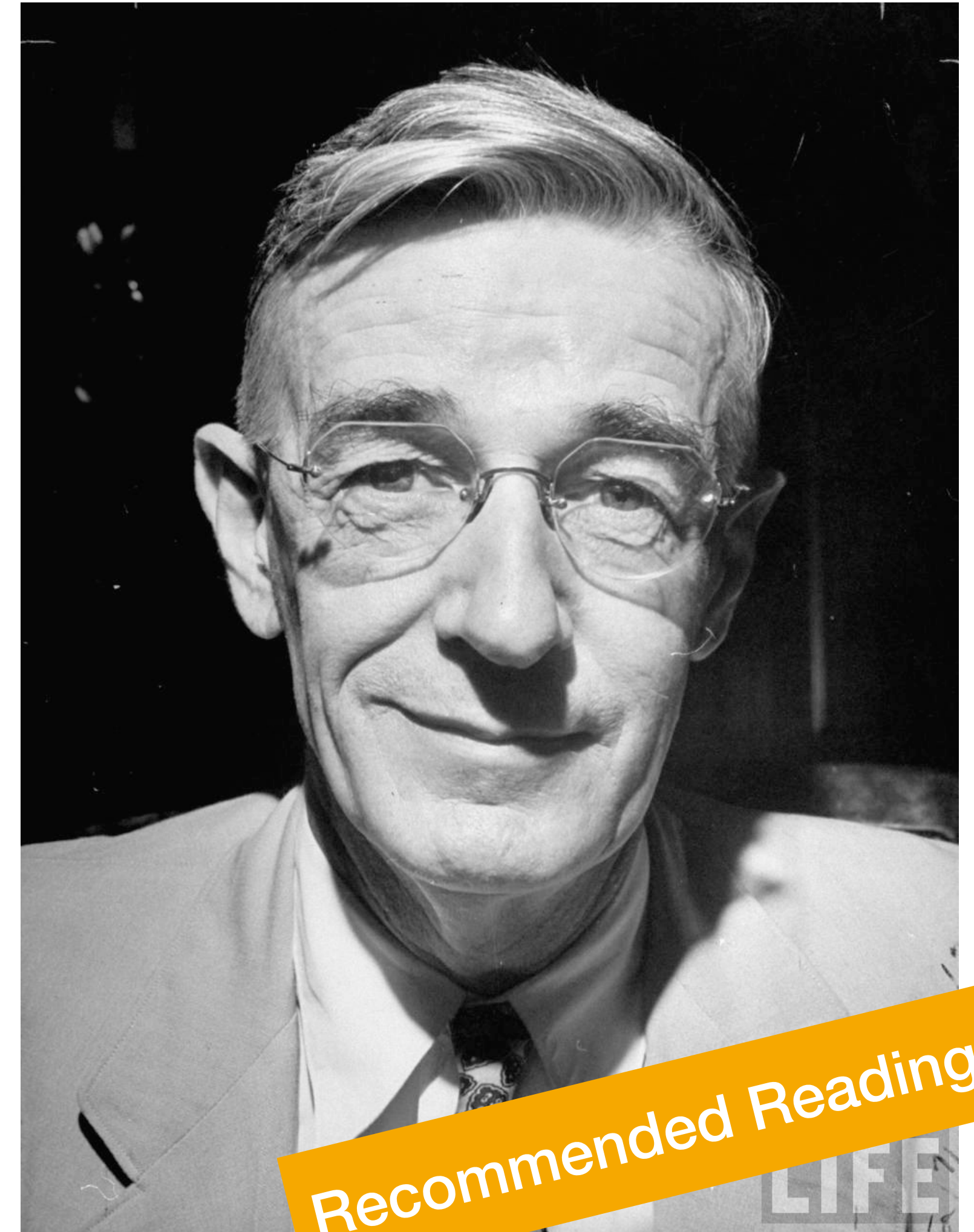
Teletype





# Memex: A Vision of Computing

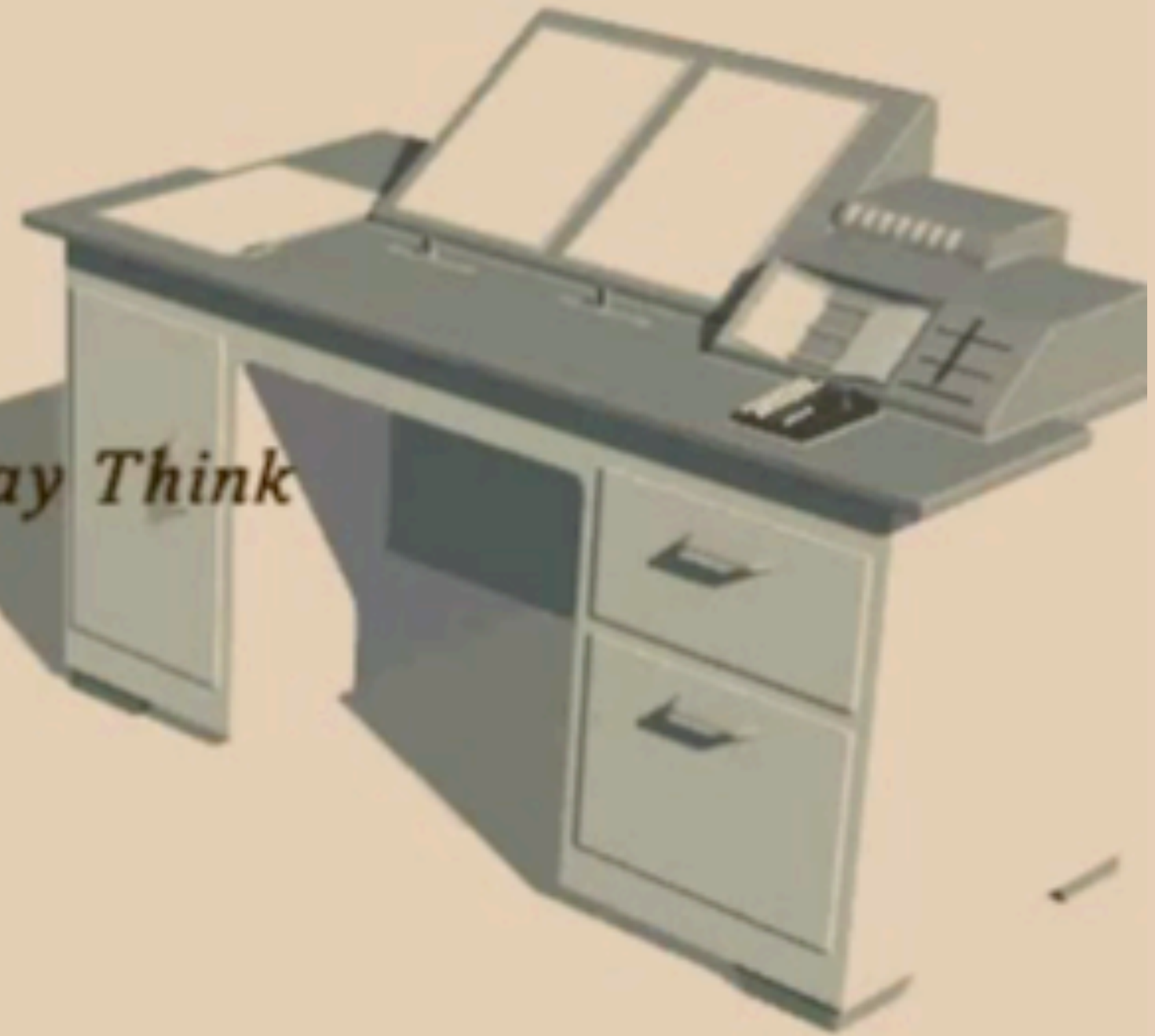
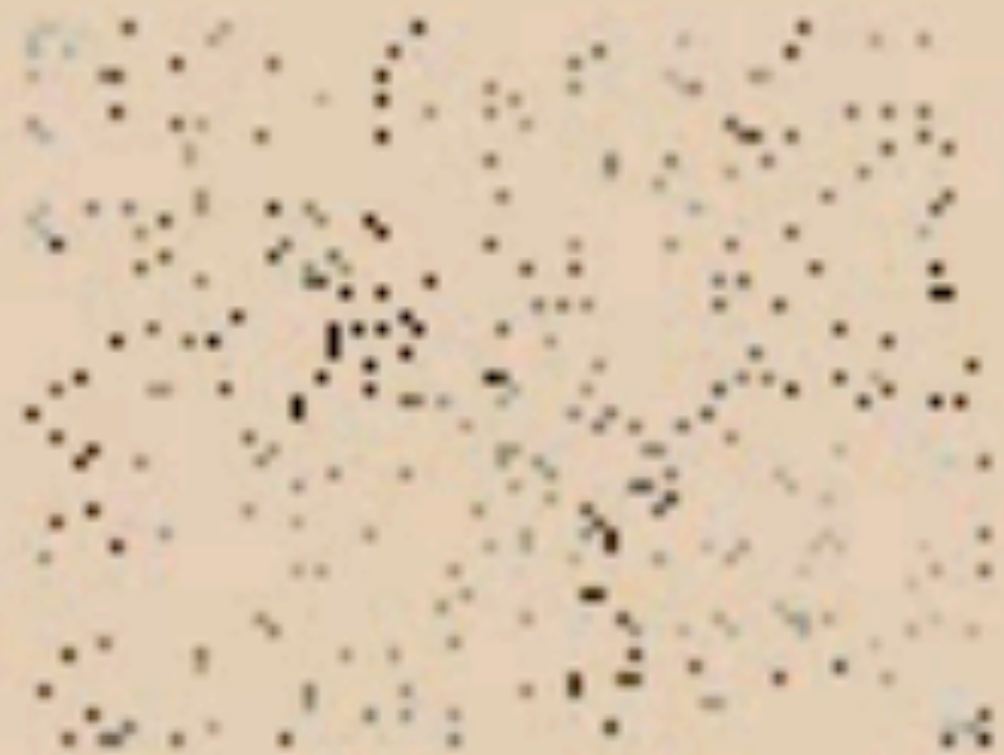
- Vannevar Bush: “As We May Think”, The Atlantic Monthly, July 1945
- The **Memex** is a device storing all of an individual’s books, records, and communications
- Information may be consulted with exceeding speed and flexibility
- Predicted: Hypertext, PC, internet, WWW, speech recognition, online encyclopaedias





# Memex

From Vannevar Bush's Essay *As We May Think*





# Radar Systems

- Example: SAGE Air Defense (MITRE, 1963)
- Key advances: Real-time response for complex (but specific) tasks, including graphics; First GUI (sort-of)



**SAGE control center (1958)**



# Sketchpad (Sutherland, 1963)

- First interactive computer graphics program
- Key advances: Techniques for direct manipulation of graphics on a screen, including constraint satisfaction



# Part 3: Historical Perspective: "Computer Sketchpad"

(not shown  
at CHI'83)

*(Excerpt)*

- \* a classic and beautiful system
- \* first CAD system
- \* introduced constrained input
- \* introduced instantiation



# NLS: oN-Line System (Engelbart, 1968)

- Word processing and linking
- Key advances: Mouse, windows, hyperlinking, video conferencing, revision control, word processing, and collaborative real-time editor
- Focused on enhancing expert performance, not on initial ease of use
  - Failed in user tests because of its complexity
  - Perfect for trained users with 4 hands :)
- But: “Mother Of All Demos” :)



[www.dougenelbart.org](http://www.dougenelbart.org)

TEST STATEMENT

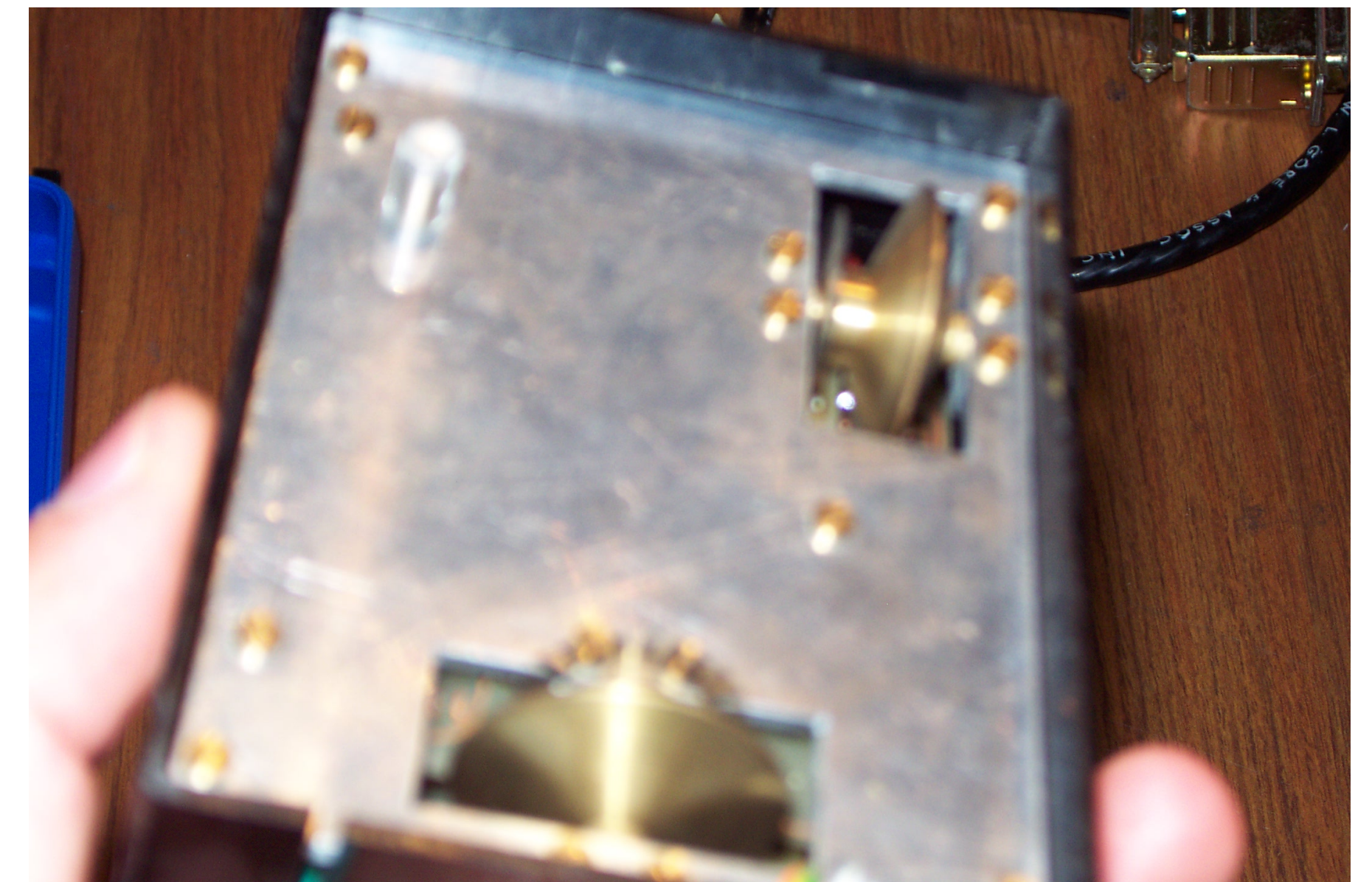
STATEMENT ONE: VOSS VOSS VOSS VOSS ...





# Engelbart's First Mouse (1964)

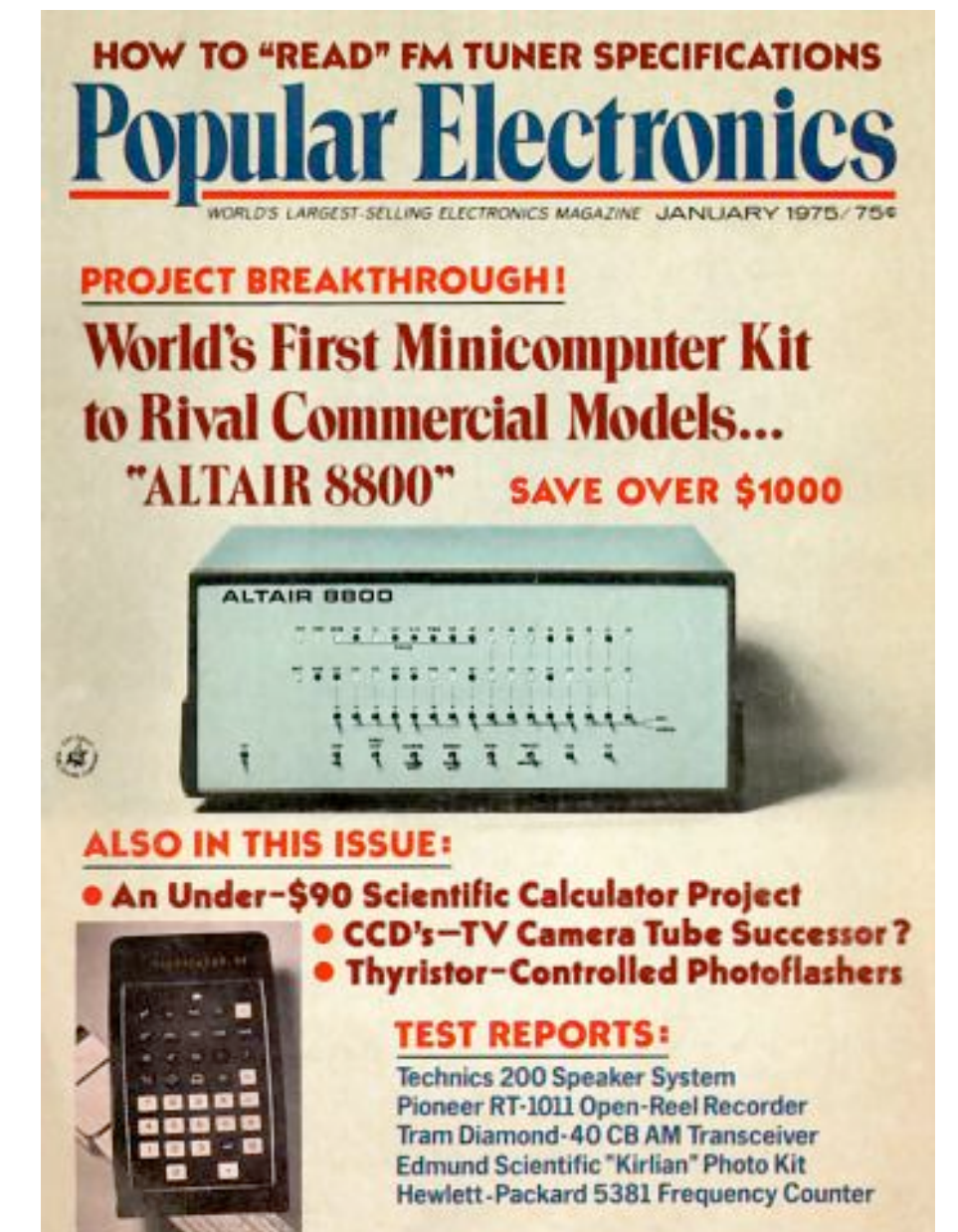
- Two wheels, wire is on the back, one button
- Won the test when comparing with other pointing devices at the time:
  - Light pen, tracking balls, foot-pedal, knee-operated devices, head-operated devices





# Early Hobbyist PCs & Games

- Atari PONG (Bushnell, 1972)
- MITS Altair (1975)
- Key advances: Machines cheap enough to be used by someone other than government and big business or research labs



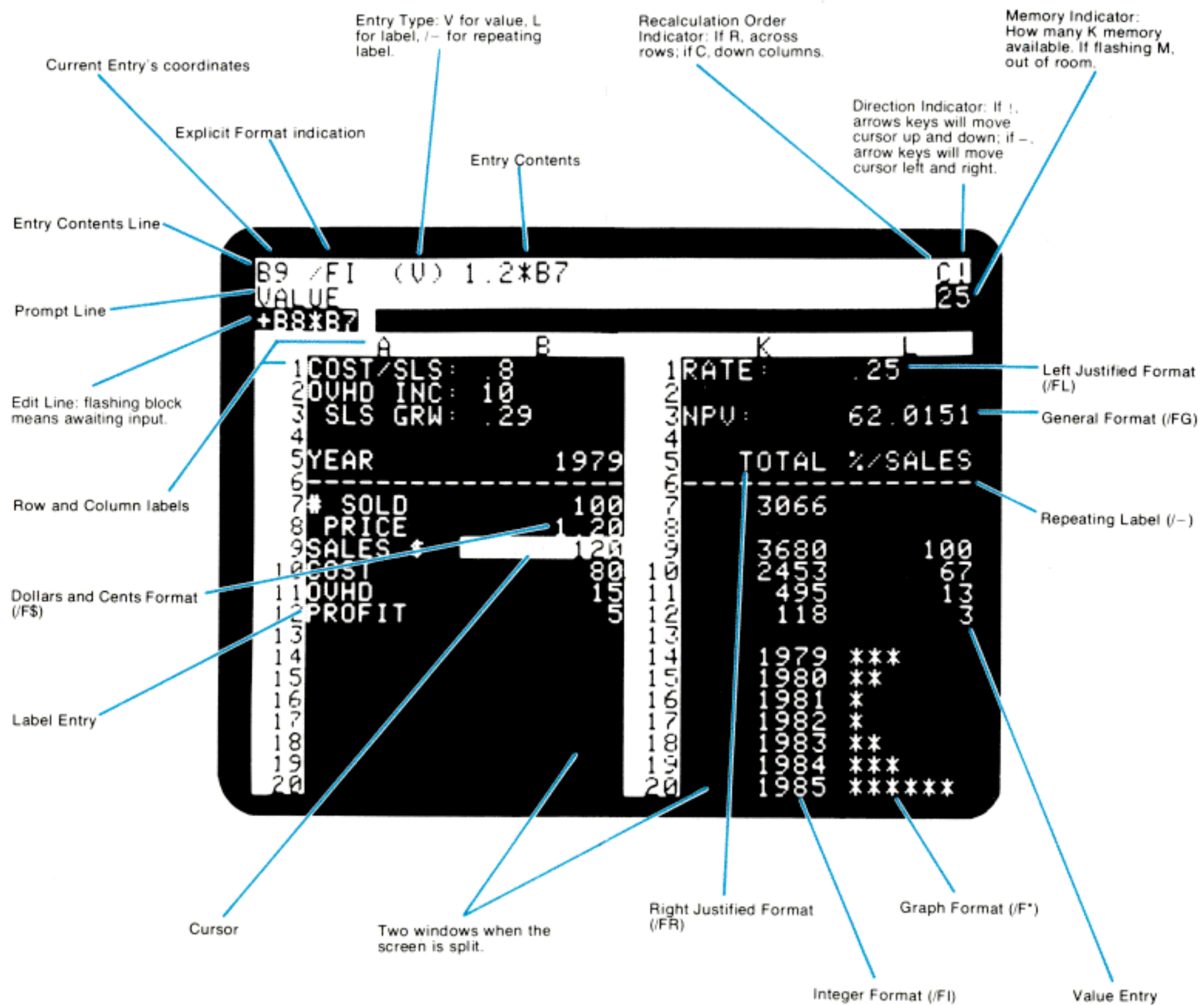


# Early Personal Computers

- Apple II, 1977
  - Key advances: First general purpose personal computer used widely in business (because of VisiCalc)
- IBM PC, 1981
  - Key advances: Making the PC respectable to business in general by putting the IBM label on it
- Features
  - Character terminal
  - Text UI standards (IBM CUA)
  - Graphics: non-standard











# Bitmap Displays and GUIs



# Xerox Alto (PARC, 1973)

- 2.5MB removable HD (pre-floppy), 128-256K RAM, 600x800, mouse, Ethernet, not commercialized
- Smalltalk platform, Bravo WYSIWYG editor, email
- Key advances:
  - Bitmap Display and GUI
  - Menus, windows, pointing, dragging, etc., as we now know them





# Xerox Star (1981)

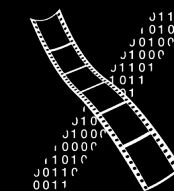
- Introduced window systems commercially, \$17K
- Key advances: Integrated networked document environment, WYSIWYG text editing, icons, property sheets, window management, ...
- Built to improve Alto
- Unique design process (8 years of prototyping)
- “2.5-D interfaces” [Nielsen’93]
  - Interacting with 2D display + overlapping windows



# XEROX

 Part 1

 Part 2





# Xerox Star keyboard and mouse

www.digibarn.com





# Star: Design Lessons

- ✓ Design first, then code
- ✓ Objects & Actions
- ✓ Detail
- ✓ Graphic designers
- ✓ DIA cycle



# But:

- ✗ Industry trends
- ✗ Customer focus
- ✗ Extensibility
- ✗ Responsiveness
- ✗ Metaphor limits
- ✗ Selling radical innovation





# Apple Lisa (1983)

- Apple's first bitmapped-GUI computer
- Inspired by Alto (not Star) —  
One-button mouse
- Key advances: Fixed menu bar (instead of pop-up menus: Fitts' Law)
- But: underpowered, bad marketing (\$10K)







**Bill Atkinson**  
**(Night shift: design & code prototypes)**

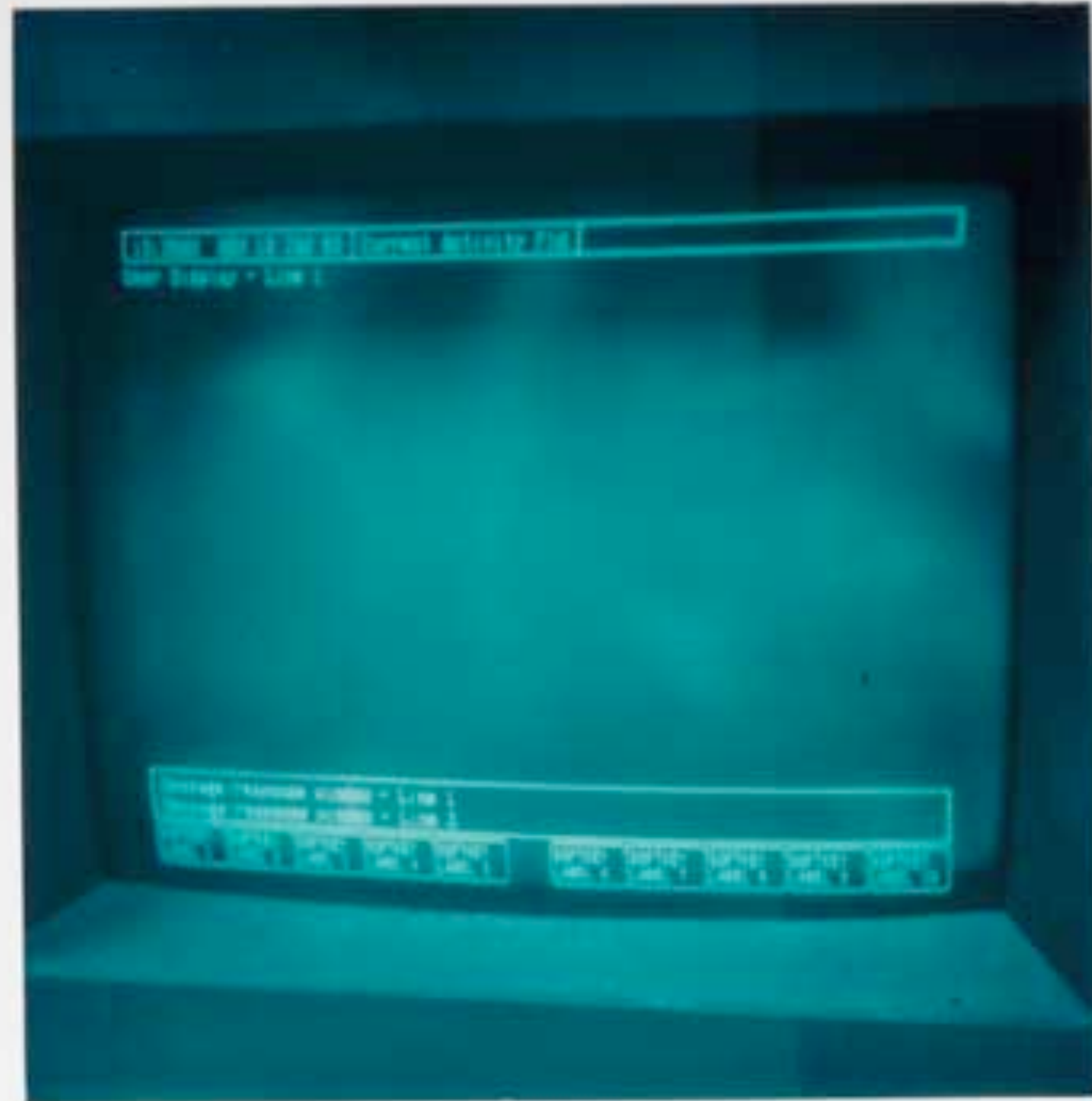


**Larry Tesler**  
**(Day shift: user tests)**



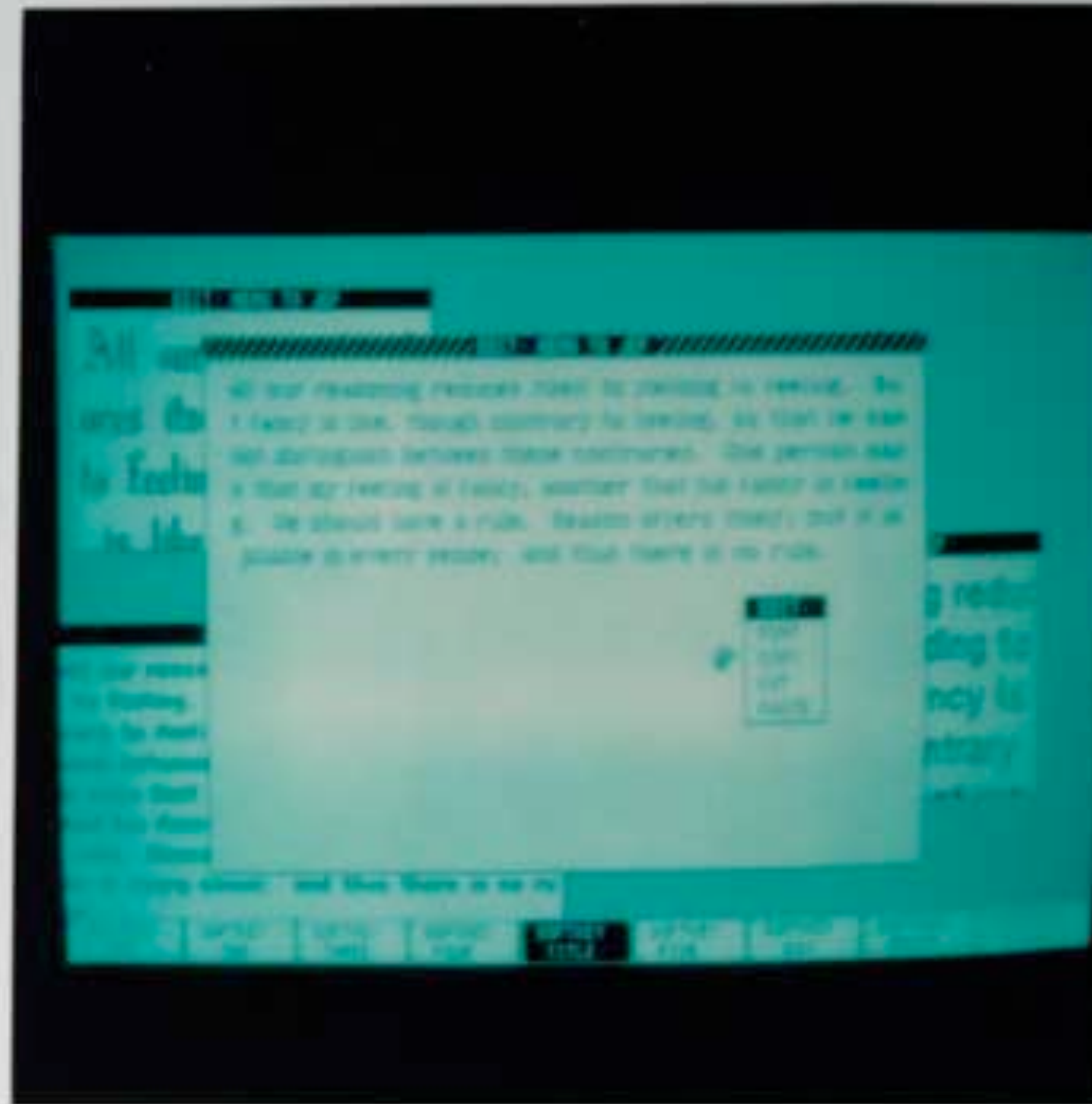
# HP 6845C Soft-key menus



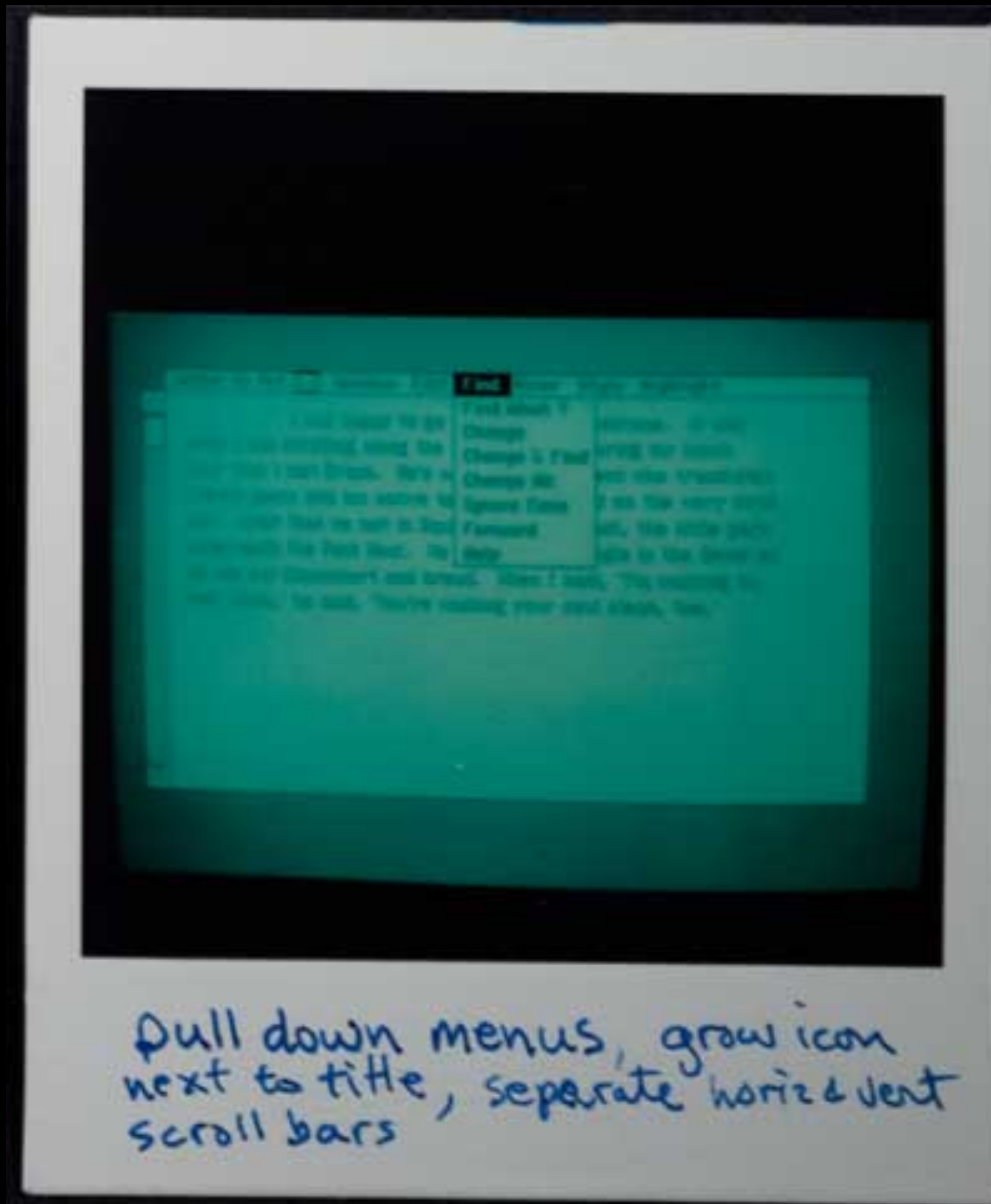


Initial Lisa  
User Interface





windows + soft keys  
Pop-up menus





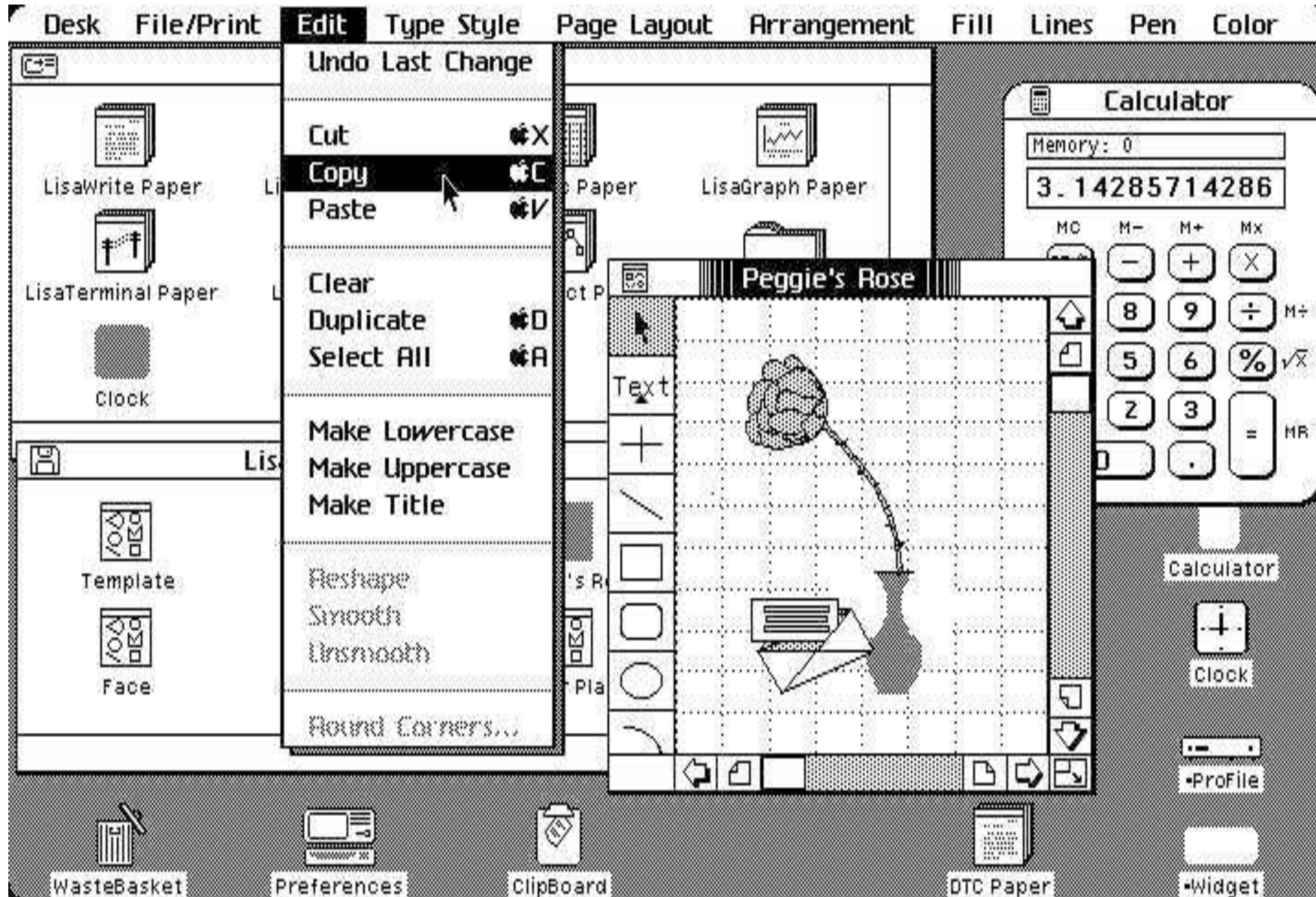


Menus moved to top.  
Grow icon in bottom right.  
Both scroll bars required



# Lisa User Interface

[Craig, 1993]

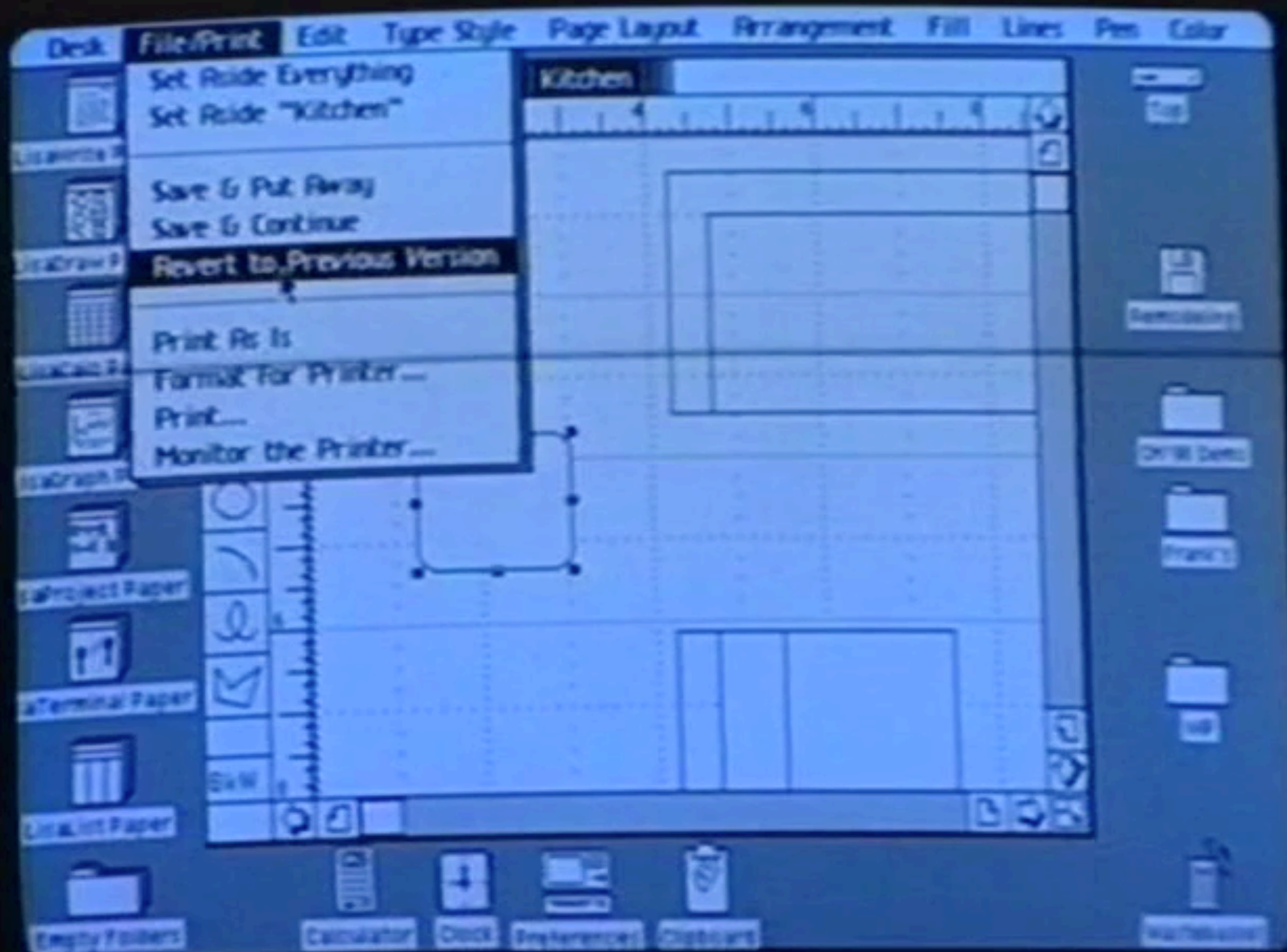




# Auto Save in Lion (2011)



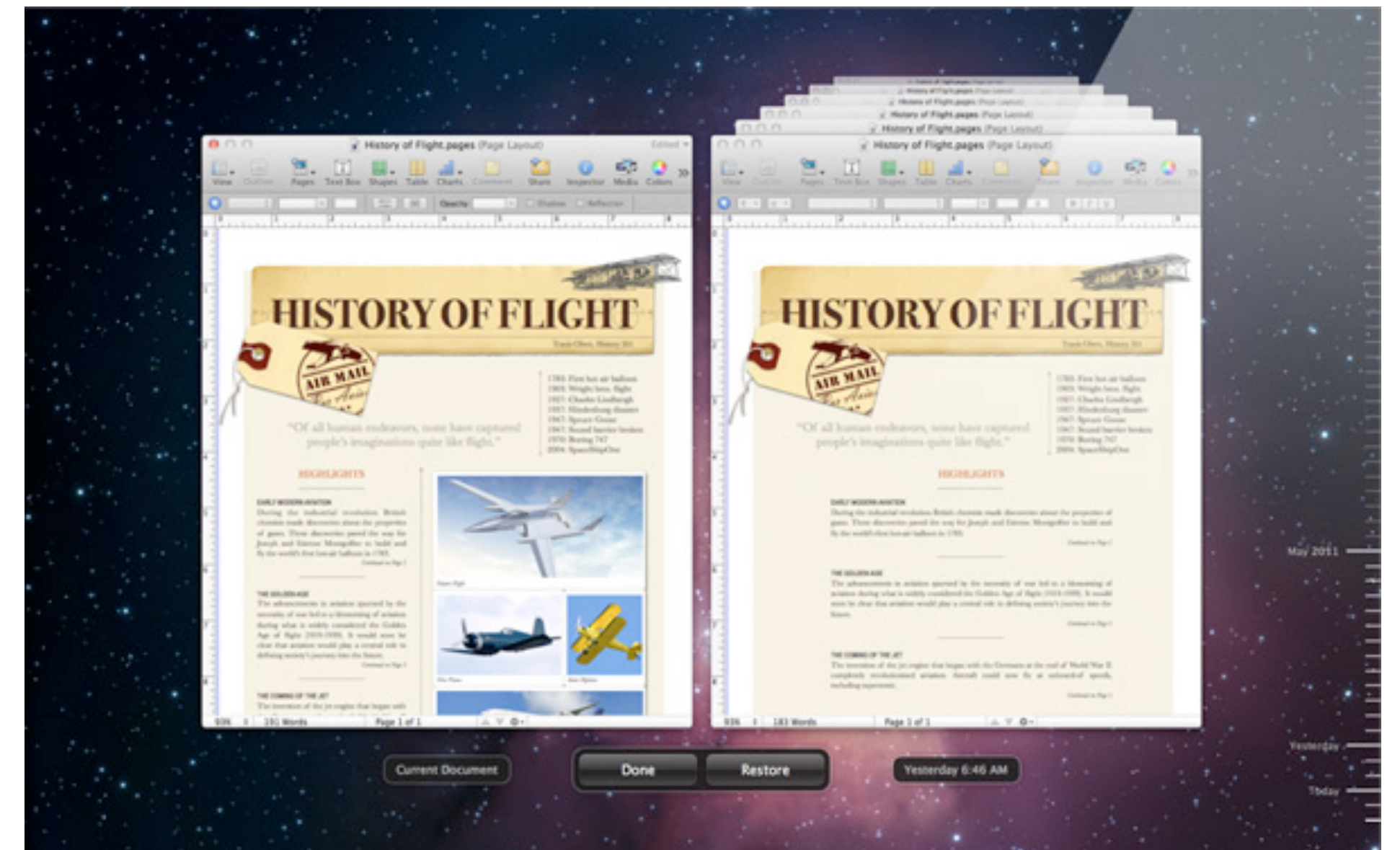






# No Need To Save: Why History Matters

- Apple, 2011: “New feature: Documents are saved automatically and continuously—only need to save explicitly for checkpoints!”
- Relaunching an application brings back all open documents in their last state
- Guess what? Lisa had these features in 1983!
  - Got lost with Mac due to hardware/software performance limitations at the time
- History tends to repeat itself — although 2011 adds better versioning UI









# Apple Macintosh (1984)

- Lisa follow-up
- Key advances:
  - First commercially successful WIMP system, \$2500
  - GUI affordable to huge new user community
  - Targeted at hobbyists, not just office use
  - Most consistent commercial WIMP UI
    - Macintosh Human Interface Guidelines
    - Apple Evangelists
- MacPaint & Quickdraw now open source
  - (<http://www.computerhistory.org/highlights/macpaint/>)





# Macintosh System 1.1

Hello System 1.1  
|

Puzzle

|    |    |    |   |
|----|----|----|---|
|    | 8  | 11 | 3 |
| 14 | 10 | 9  | 6 |
| 1  | 5  | 15 | 2 |
| 4  | 13 | 12 | 7 |



Calculator

0

|   |   |   |   |
|---|---|---|---|
| C | E | = | * |
| 7 | 8 | 9 | / |
| 4 | 5 | 6 | - |
| 1 | 2 | 3 |   |
| 0 | . | + |   |

Control Panel

1/11/12      2:53:26

0 1 2 3

0 1 2 3 4

0 1 2 3 4

1 2 3

1 2 3

Trash

More in DIS2









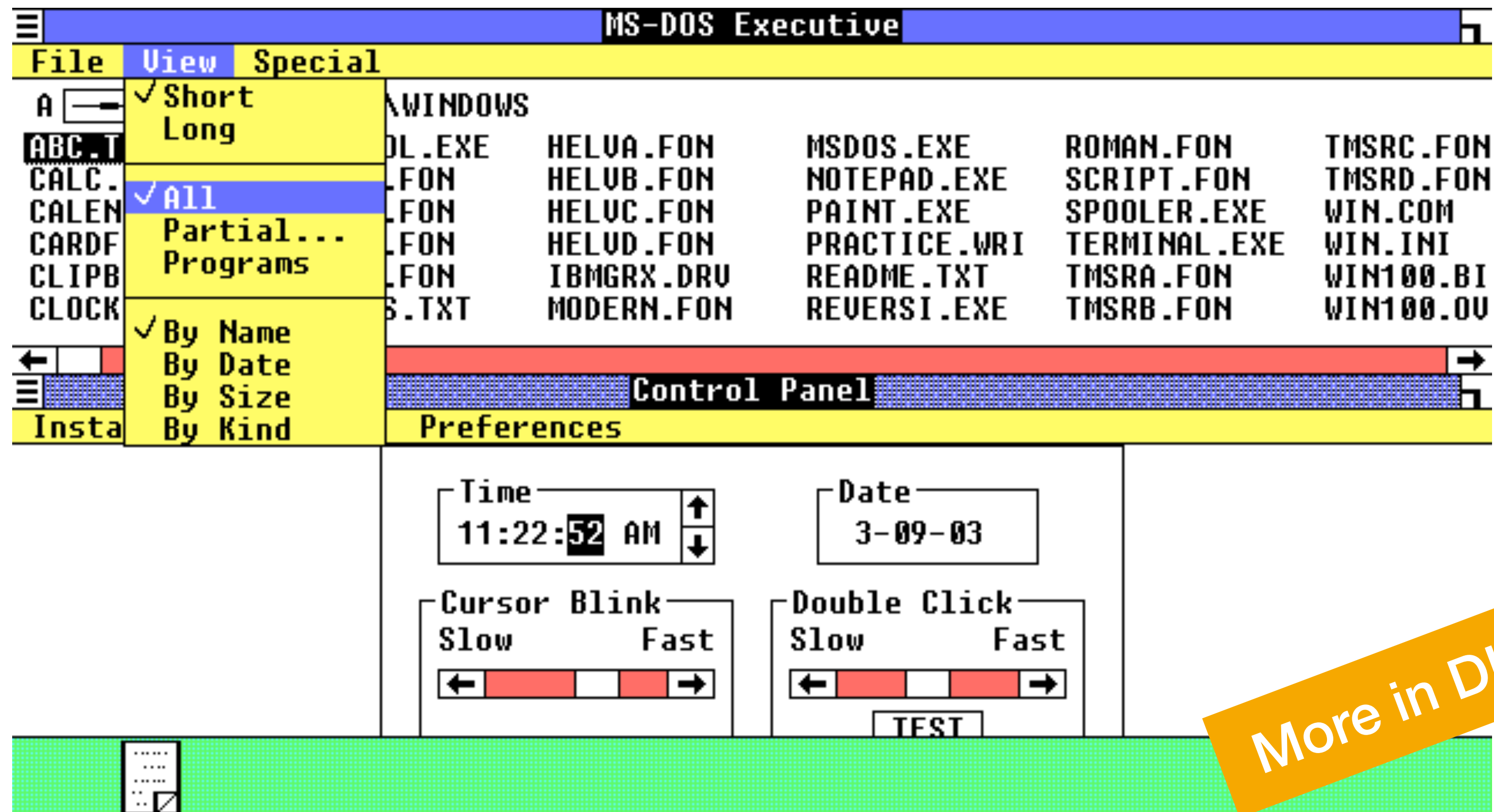
**elRellano.com**

 **Link**



# Microsoft Windows (1985)

- Key advances: Bringing Alto/Star/Mac interaction style to huge populations of DOS and Unix computers



More in DIS2

www.guidebookgallery.org





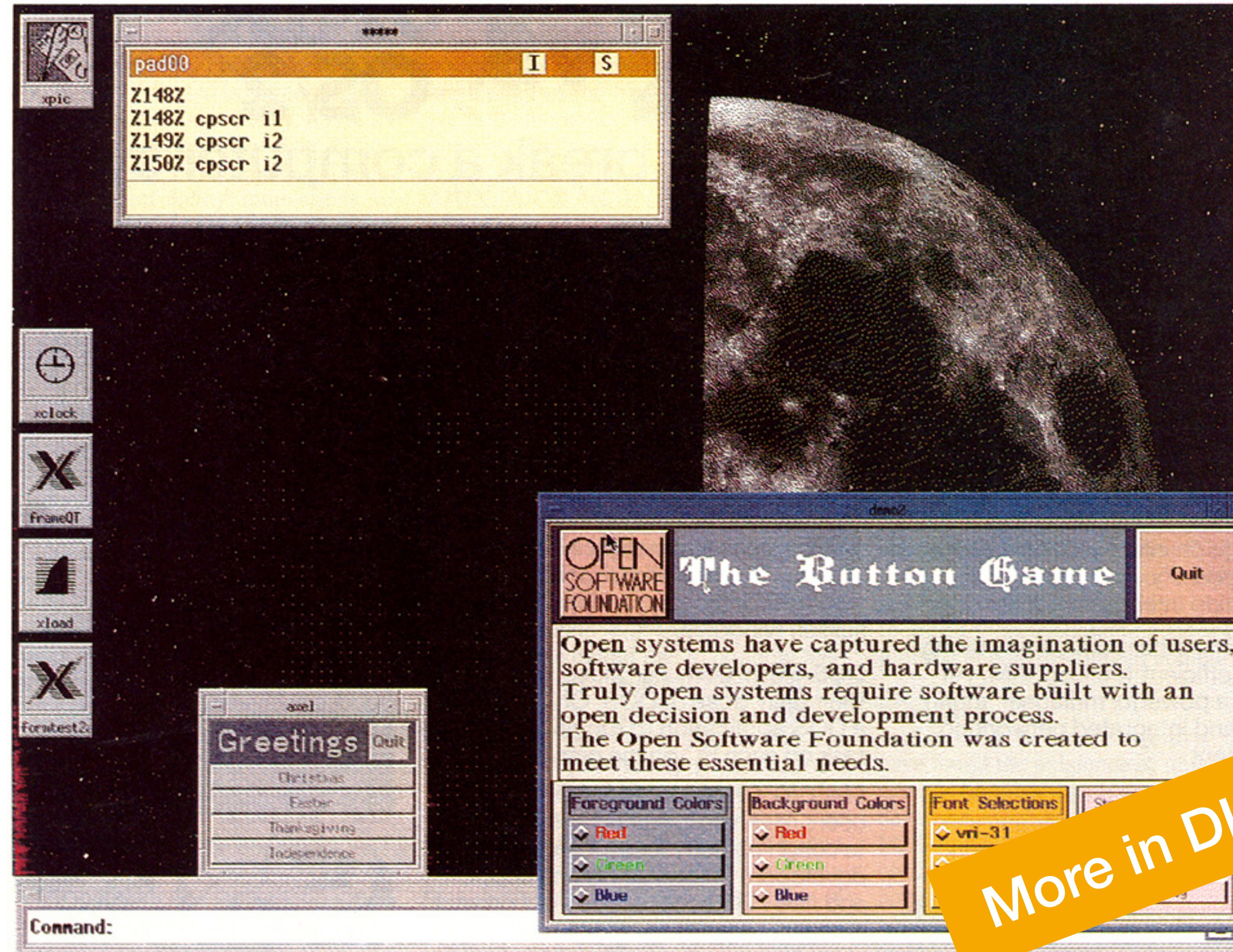


Microsoft  
WMI



# OSF/Motif (1980's)

- Key advances: OO toolkit architecture (simpler dev.)



[www.guidebookgallery.org](http://www.guidebookgallery.org)



# Lineage of Visual Computing Systems (2000)

