

Human Machine Interaction
based on the lectures by Stefan Kopp
[//www.techfak.uni-bielefeld.de
/~skopp/Lehre/MMI_SS06
/MMI_web.html](http://www.techfak.uni-bielefeld.de/~skopp/Lehre/MMI_SS06/MMI_web.html)

Human & computer are interacting parts of *one system*

□ Human

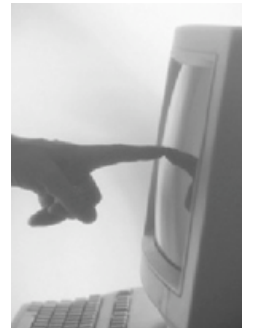
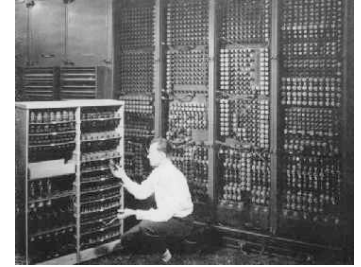
- the end-user of a program
- wants to solve a particular task/problem

□ Computer

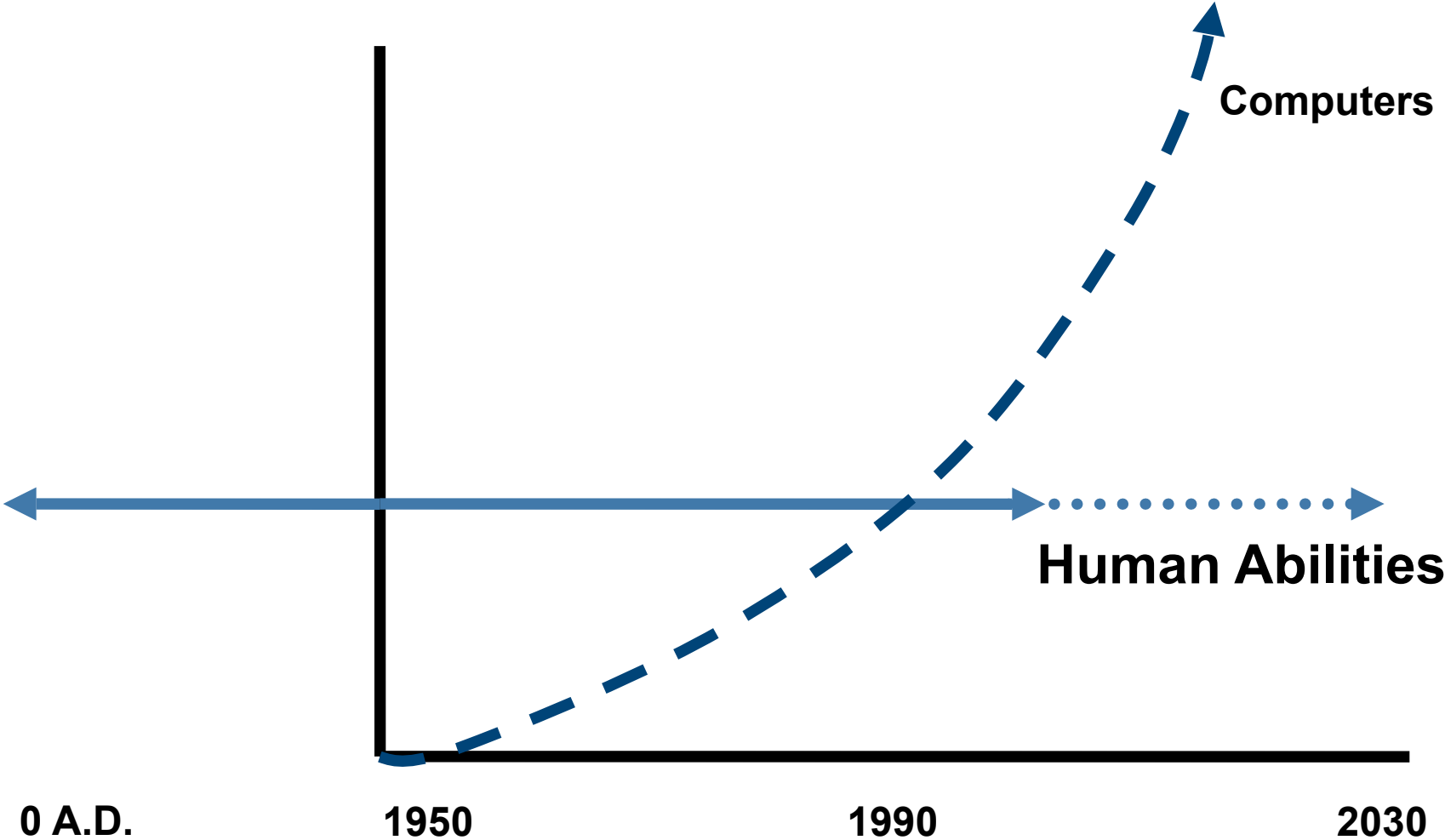
- the program built for accomplishing a certain task
- the machine the program runs on

□ Interaction

- the user tells the computer what s/he want
- the computer communicates results
- exchange of meaning via a shared sign system



Human Psychology



A320 crash Bangalore (1990)



“The pilot put the plane into OPEN DESCENT mode without realizing it. This change resulted in the aircraft's speed being controlled by pitch rather than thrust. The throttles went to idle. In that mode, the automation ignores any preprogrammed altitude constraints. To maintain the pilot-selected speed without power, the automation had to use an excessive rate of descent, which led to a crash short of runway.”

Nancy G. Leveson, Safeware Engineering Corp.

Shootdown of an Iranian airliner (July 1988)



Vincennes

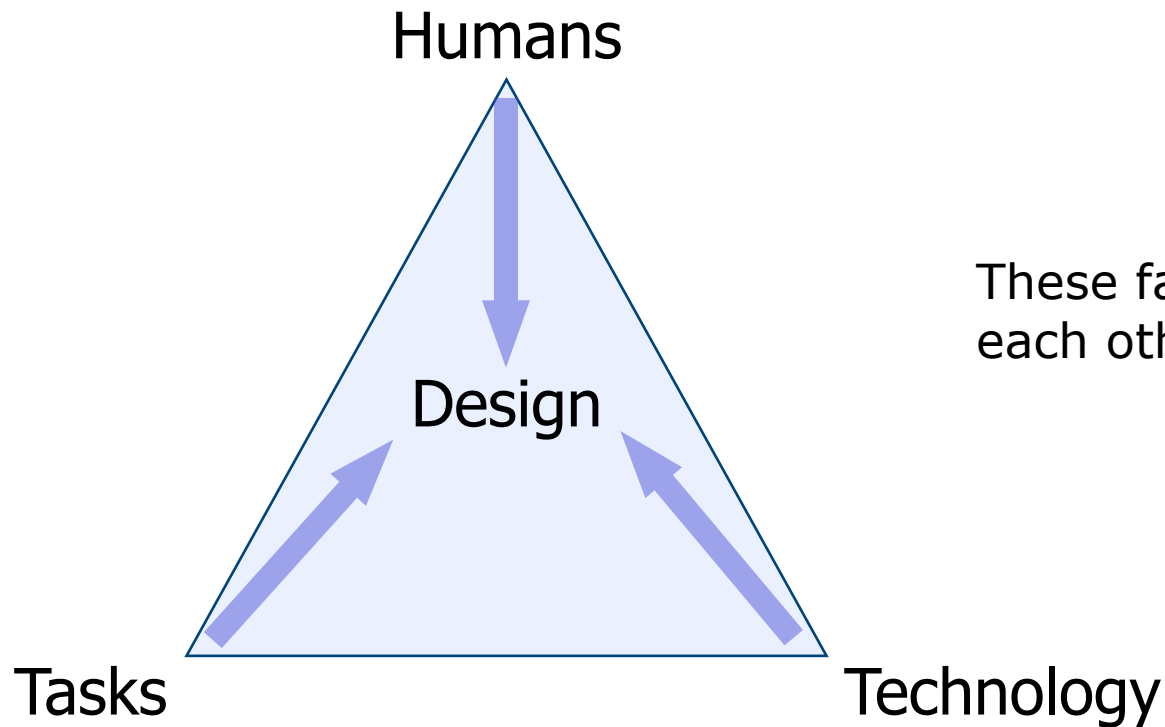
"We have determined that the Aegis radars and computers functioned **correctly** and that the misidentification of an Airbus airliner as an F-14 was **due to human error** induced by combat stress. ... The operator interpreted a display indicating the Airbus was at 12,000 feet and flying level as indicating it was at 7,500 feet and descending toward the ship ... However, we are looking at the **user interface** - what we show on the displays - there may be some room for improvement there, to make it even more user-friendly than it is now..."

Defense secretary Frank Carlucci said that to find range and altitude information of a target on the screen, one must examine a computer readout, which is distracting. "We think it's a good idea to display altitude and range on a large screen," Carlucci said. "I think you could probably even put an arrow on whether it's ascending or descending." ...

"I'm not indicating it wasn't designed correctly," he said, but "as you go through experience with any weapon system you **improve the design**," particularly in combat.

Human-Computer Interaction

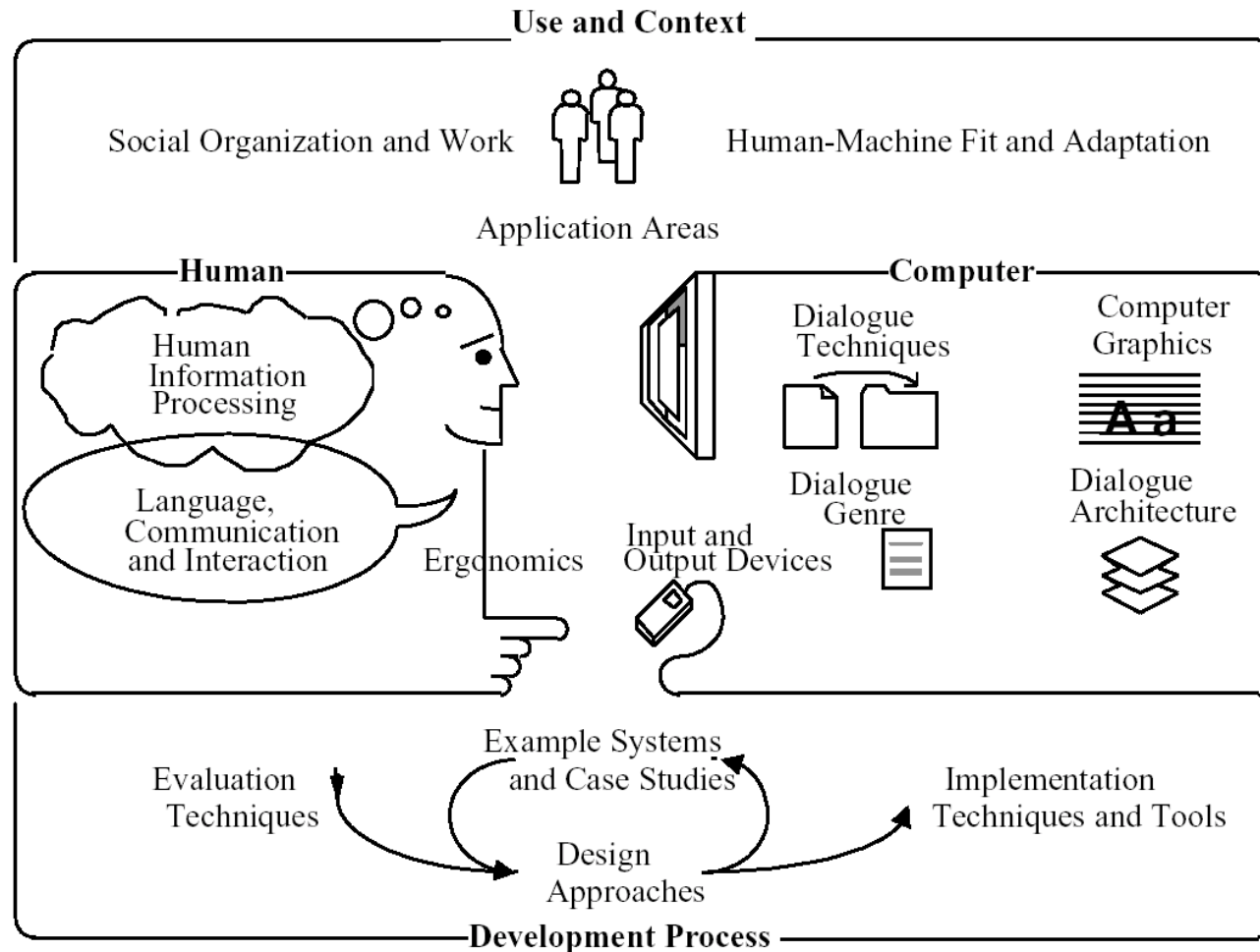
...is concerned with the design, evaluation and implementation of interactive systems for human use.



These factors influence each other and design



Human-Computer Interaction - Overview



Graphik: Saul Greenberg



Related terms and disciplines

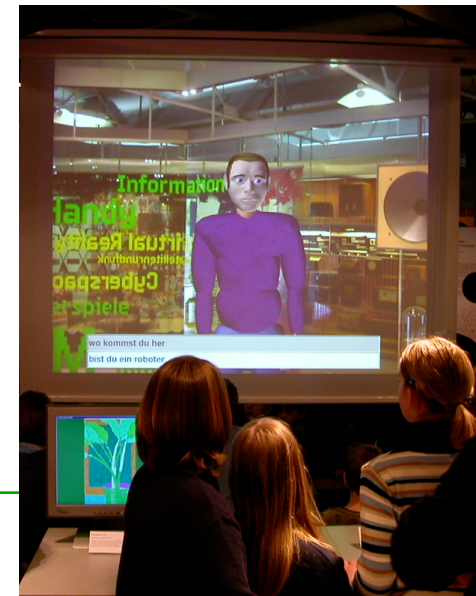
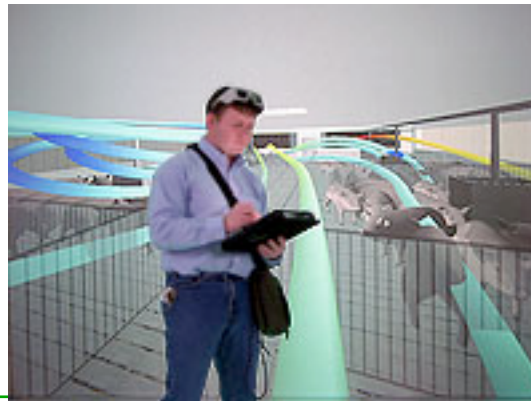
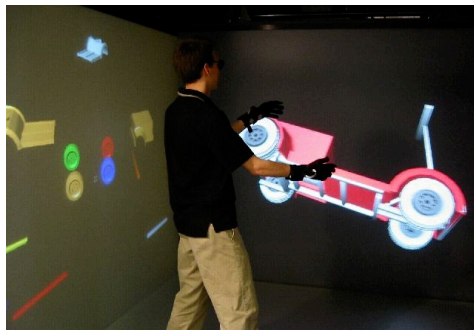
- Software ergonomics
- Human-Computer Communication
- Human-Factors Engineering
- User-centered Design
- Cognitive Engineering
- Usability Design
- Informatics Usability
- User Interface Design
- ...



Why research HCI ??



- To know how it can be improved, and thus to help people using computers, in a systematic way (no *trial-and-error*)
- To understand how people interact with complex artificial systems, and what effects technology has on individuals and society
- To understand principles and mechanisms of communication and cognition by building interactive systems



History of HCI: Pioneers & innovations



Vannevar Bush



- Coordinator of U.S. scientific activities; offered new role for military scientists after WW II

- **„As we may think“ (1945):**
„The summation of human experience is being expanded at a prodigious rate, and the means we use for threading through the consequent maze to the momentarily important item is the same as was used in the days of square-rigged ships“

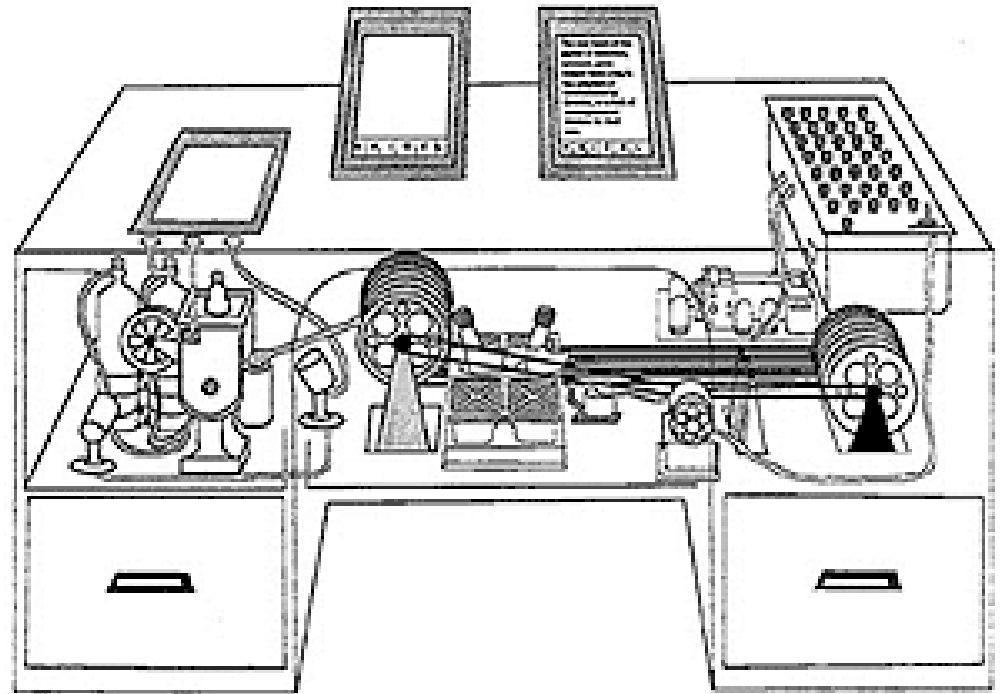
- Problem:
Storing information in a way easy to access later on

Memory Expander (Memex)

Conceiving Hypertext and the World Wide Web

Hypothetical device for information storage & retrieval (1930)

- stores books, communications, photos on microfilm records
- **annotate** text with notes, comments, ...
- can construct a **trail** (a chain of links) through the material and **save** it
- acts as an external memory



Joseph C.R. Licklider



- Great impact on development of graphical user interfaces and world-wide networks; conception of what became the internet later on in 1962, coined term "Netizen" (1968)
- 1962-1964 Director of ARPA Information Processing Technology Office

- **„Man-Computer Symbiosis" (1960):**
"The hope is that, in not too many years, human brains and computing machines will be coupled together very tightly and that the resulting partnership will think as no human brain has ever thought and process data in a way not approached by the information-handling machines we know today."

Joseph C.R. Licklider - *visions*

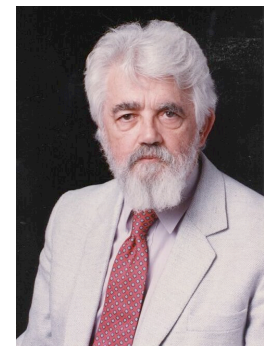
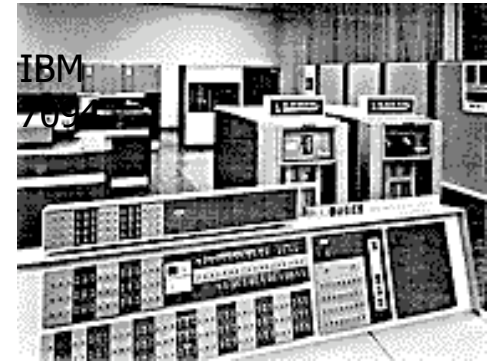
- Short-term goals:
 - Time-sharing among multiple user
 - Input/Output of symbolic and pictorial information
 - Interactive real-time systems
 - Storage & retrieval of large data sets
- Mid-term goals:
 - Facilitation of human cooperation in design and programming of large software systems
 - combined speech recognition, hand-printed character recognition & light-pen editing
- Long-term goals:
 - Natural language understanding
 - Speaker-independent speech recognition
 - Heuristic programming (= Artificial Intelligence)

Time-Sharing

Bob Bemer, John McCarthy (Mid '60s)

- ❑ Before: batches of jobs, scheduled by operator
- ❑ Now: multiple users can use a computer at the same time; every user has the illusion that they are on their own personal machine
- ❑ Afforded **interactive** systems and languages
- ❑ Foundations of, e.g., current word processors

Led to immediate need for support in human-computer interaction !!



Graphical user interfaces

Whirlwind (MIT, 1951): „real time"-rendering of text and graphics on CRT terminal



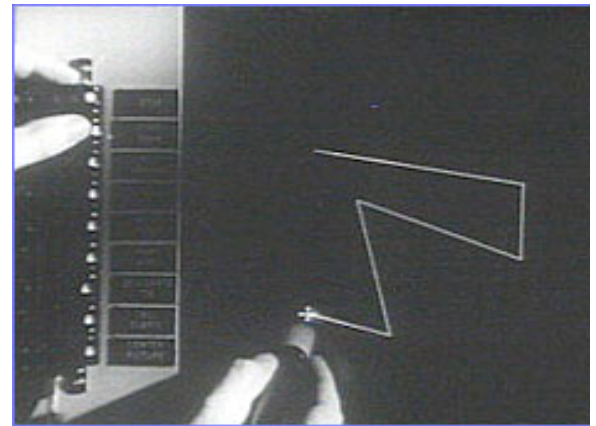
SAGE (Semi-Automatic Ground Environment) project (1963): advancement of Whirlwind for military purposes (radar intelligence)

- **visualization** of large data sets
- „point-and-click“ predecessor with **light pistol**



Sketchpad

- ❑ Ivan Sutherland (1963): *"A Man-machine Graphical Communications System,,* (Ph.D. thesis)
- ❑ First interactive graphics application, sophisticated drawing package
- ❑ Direct manipulation interface
- ❑ Had major impact on HCI and UIs



Douglas C. Engelbart

"...I had the image of sitting at a big CRT screen with all kinds of symbols, new and different symbols, not restricted to our old ones. The computer could be manipulated, and you could be operating all kinds of things to drive the computer

... I also had a clear picture that one's colleagues could be sitting in other rooms with similar work stations, tied to the same computer complex, and could be sharing and working and collaborating very closely." (~ 50s)



oNLine System (NLS, ` 60s)

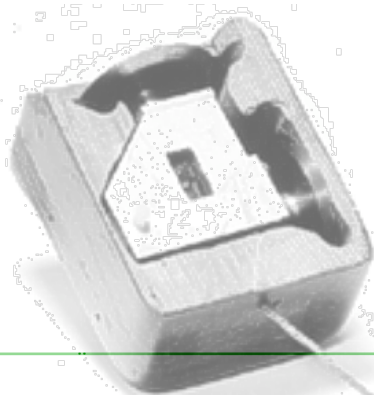
- Two persons edit the same text from different consoles, 2D display editing
- Multiple windows, on-screen teleconferencing
- „Mother of all demos“ (1968)
- Raised need for new input devices



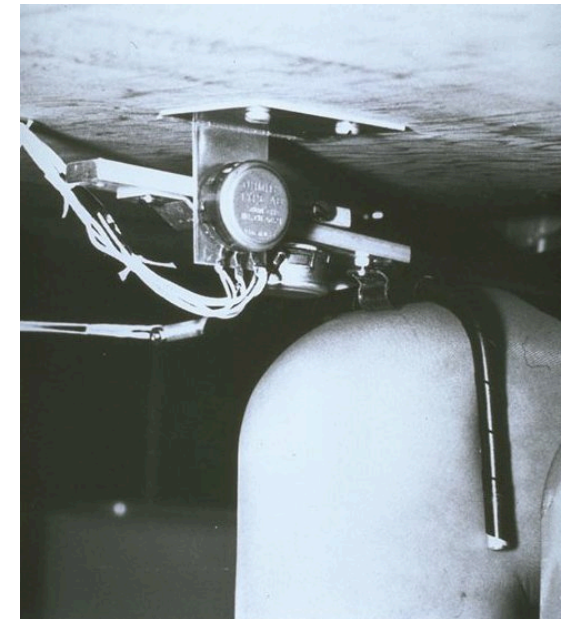
Douglas C. Engelbart

Which device most suitable for CRT display-selection in text-manipulation systems?

- Light pen
- Joystick
- Knee input device
- The first **mouse**



MMI / SS06



Personal Computer & WIMP

- **Xerox Alto** (1973): *1st personal computer*
 - First **WIMP Interface**: *Windows, Icons, Menus, Pointing*
 - First computer with **regular mouse** (Engelbart's) and ethernet
 - First **WYSIWYG-Editor** *Bravo/BravoX* (*what you see is what you get*), direct predecessor of MS Word
 - \$40.000 - commercial failure

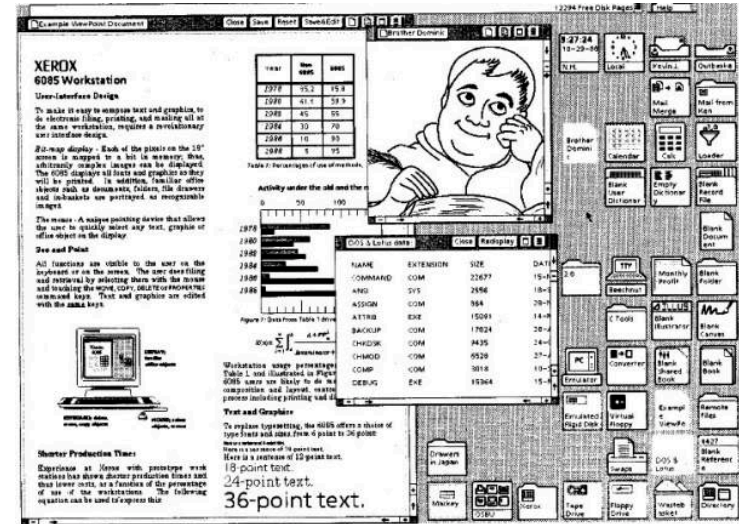


WIMP & Desktop

- **Xerox Star (1981):** Idea of the invisible computer,

Desktop-Metaphor:

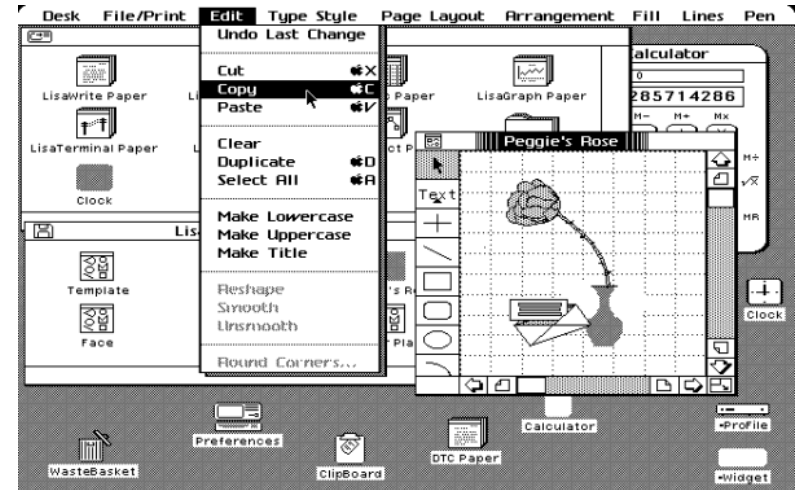
- Windows and menus (*recognition instead of recall*)
- **direct data manipulation** & graphical control (icons)
- no distinction between input & output
- **progressive disclosure:** present common choices to user, while hiding more complex ones (e.g. expanding dialogue box)



WIMP & Desktop

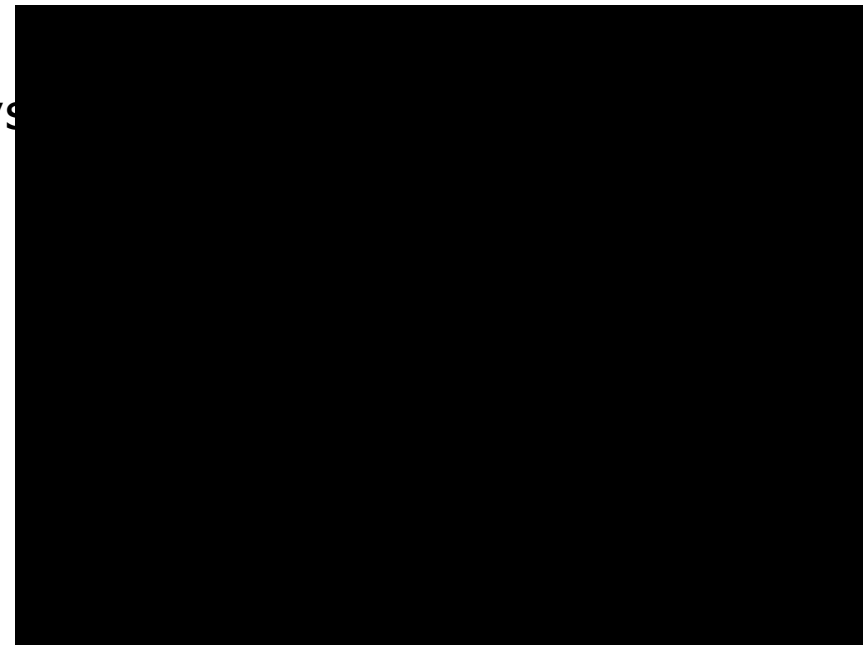
□ Apple Lisa (1979)

- Logical Integrated Softw. Arch.
 - Document-centered view
- Lisa 2 → Macintosh XL



□ Apple Macintosh (1984)

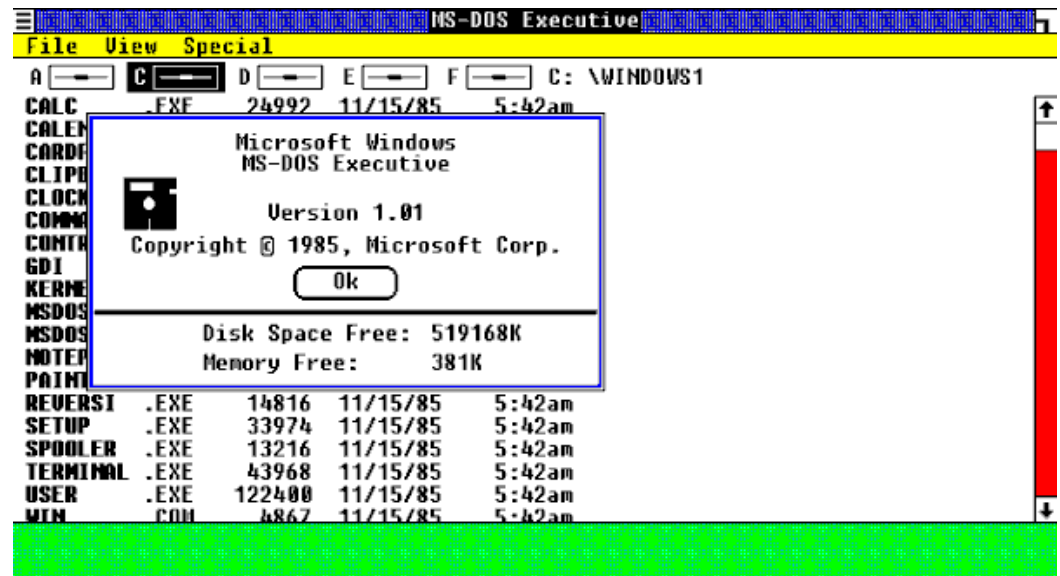
- Consequent GUI, no cursor keys
- \$2495 – commercial success
- Killer apps: Finder, MacDraw, MacWrite, DTP, MS Word



WIMP & Desktop

□ Windows

- 1983: Apple CEO Sculley signed agreement allowing Microsoft to use Mac OS technology in exchange for further development of MS software for Mac
- 1987: Windows 1.01 - unusable
- 1988: Windows 2.03
- Windows 3.1, 95 & 98, NT, 2000, XP, ...



Since then...

- MIT Architecture Machine Group, MIT Media Lab (1969-1980+): many innovative inventions, including
 - wall sized displays
 - use of video disks
 - use of artificial intelligence in interfaces (idea of agents)
 - speech recognition merged with pointing
 - speech production
 - multimedia hypertext
 - affective chairs
 -

- ACM SIGCHI (1982) and HCI Journals (1st Man-Machine-Systems, 1969)

- Mobility
- Ambient & ubiquitous intelligence

