Methoden der Mensch-Maschine-Interaktion

1. Termin: Einführung & Historie

Administrivia

Dr. Stefan Kopp

- skopp@techfak.uni-bielefeld.de
- Sprechstunde: Fr 14-15, M4-128
- Tel: (106) 2921

- Semesterapparat (in den nächsten Tagen)
  - Uni Bib, FB 10, "Wachsmuth, Latoschik, Kopp„
- Webseite (ab heute):
  - *www.techfak.uni-bielefeld.de/~skopp/Lehre/MMI_web.html*

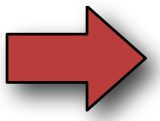
Scheine/Leistungspunkte

- Regelmäßige Teilnahme an der VL
- Übungen: Erfolgreiches Bearbeiten der **beiden** Miniprojekte im Laufe des Semesters
  - in Kleingruppen von 3 Personen
  - mit kurzer schriftlicher Ausarbeitung und evtl. Vorstellung in der Vorlesung
- Teilnahme an der Klausur: letzte VL, 13.7.

→ 5 Leistungspunkte und eine benotete Einzelleistung

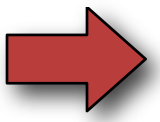
Course structure

- **Human - Cognitive Science**
  - Perception & Attention
  - Cognition & Acting & Reacting
- **Computer & Interaction**
  - Models & task analysis
  - User-centered design
  - Evaluation



1st student project: usability study

  - Interface design & paradigms
- **Interfaces**
  - WIMP
  - Language & Dialogue



2nd student project: interface design

  - Multimodality
  - VR & smartrooms
  - Interface agents
  - Embodied Conversational Agents and Social Companions

Literature

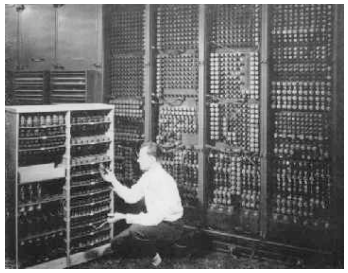
- Dix et al.: Human-Computer Interaction (3. Aufl.). London: Prentice Hall, 2003.
- Shneiderman: Designing the User Interface - Strategies for Effective Human-Computer Interaction (3. Aufl.). Addison Wesley, 1998.
- Johnson: GUI Bloopers - Don'ts and Do's for Software Developers and Web Designers. San Diego: Academic Press, 2000.
- Jurafsky & Martin: Speech and Language Processing, Prentice Hall, 2000.
- Cassell et al.: Embodied Conversational Agents, MIT Press, 2000.
- Reed: Cognition (5. Aufl.), Wadsworth, 1999.

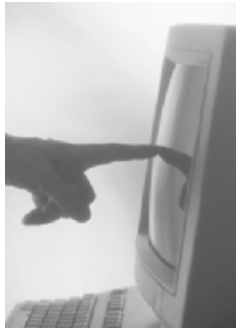
What is HCI and why should I learn about it?

Because computers are built for humans.

→ Humans interact with computer systems and everything has to work properly, the human, the system, and the interaction.

Human & computer are interacting parts of *one system*

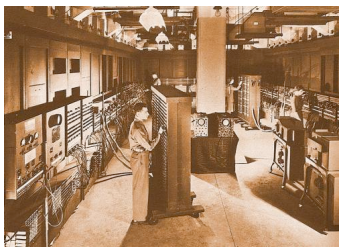




- Human
  - the end-user of a program
  - wants to solve a particular task/problem
- Computer
  - the program built for accomplishing a certain task
  - the machine the program runs on
- Interaction
  - the user tells the computer what s/he want
  - the computer communicates results
  - exchange of meaning via a shared sign system

Moore's Law (1964)

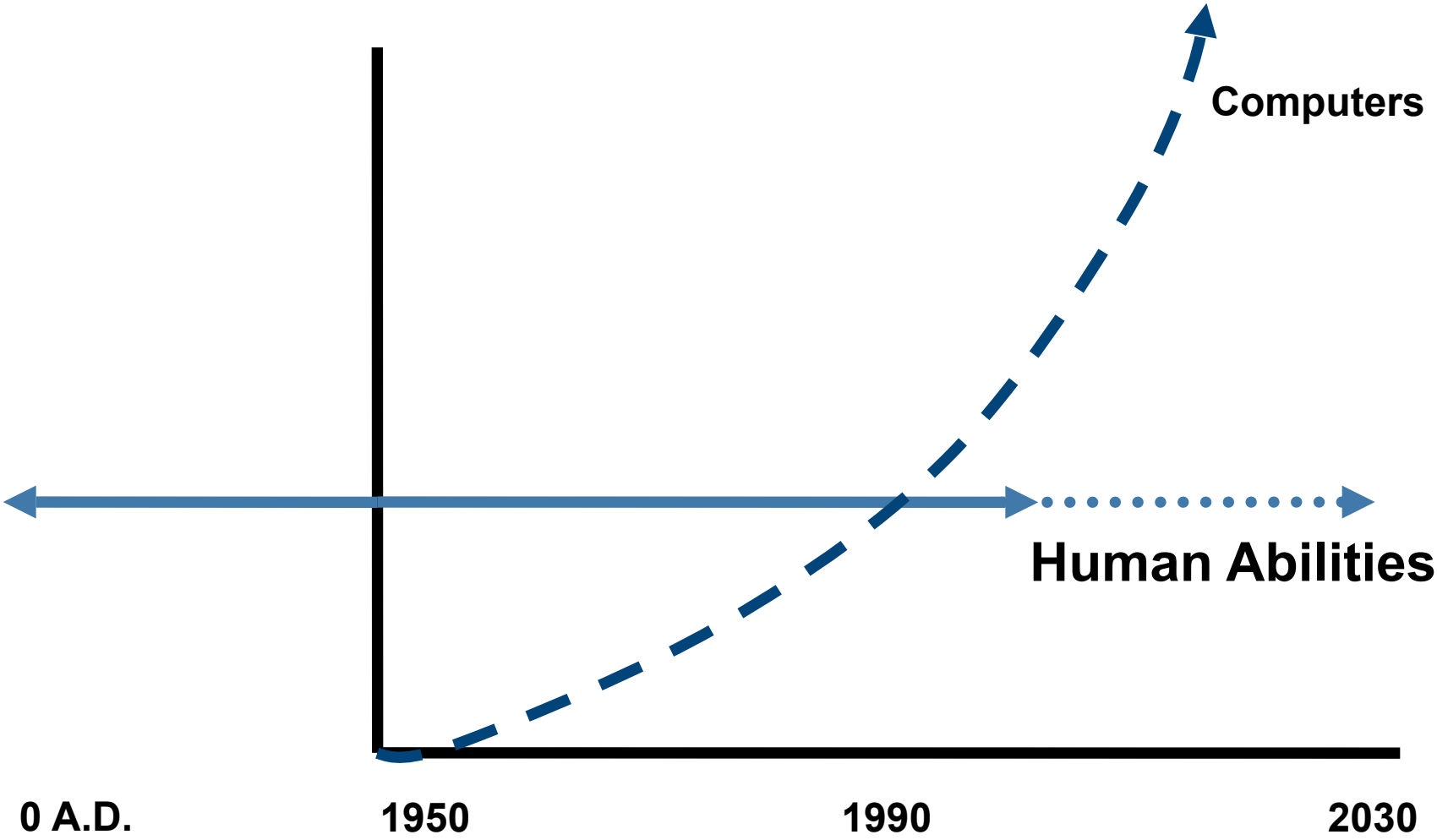
Memory
Speed
Portability
Affordability



Computer Abilities

1950 **1990** **2030**

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.

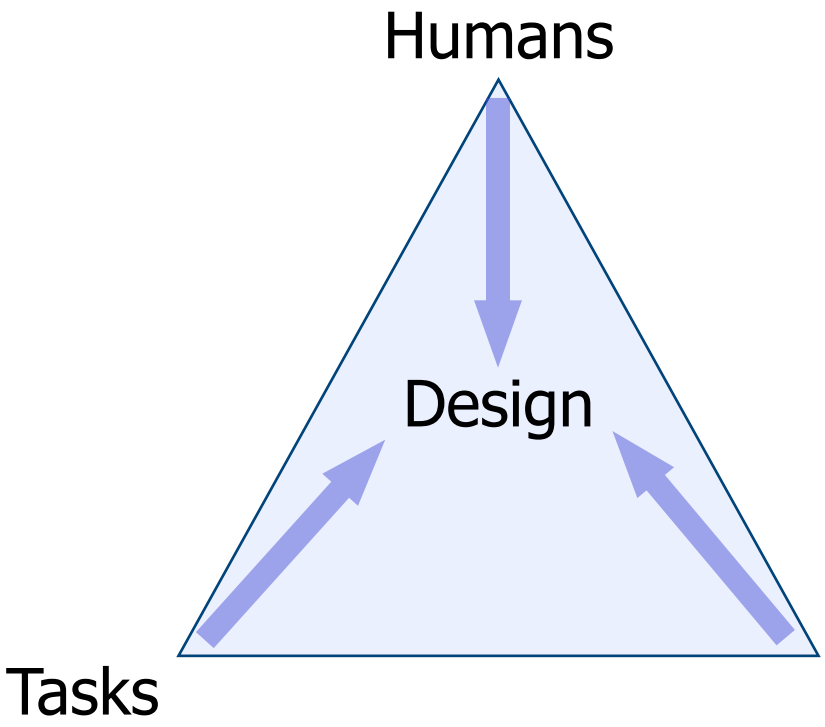
Shootdown of an Iranian airliner (July 1988)

"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.

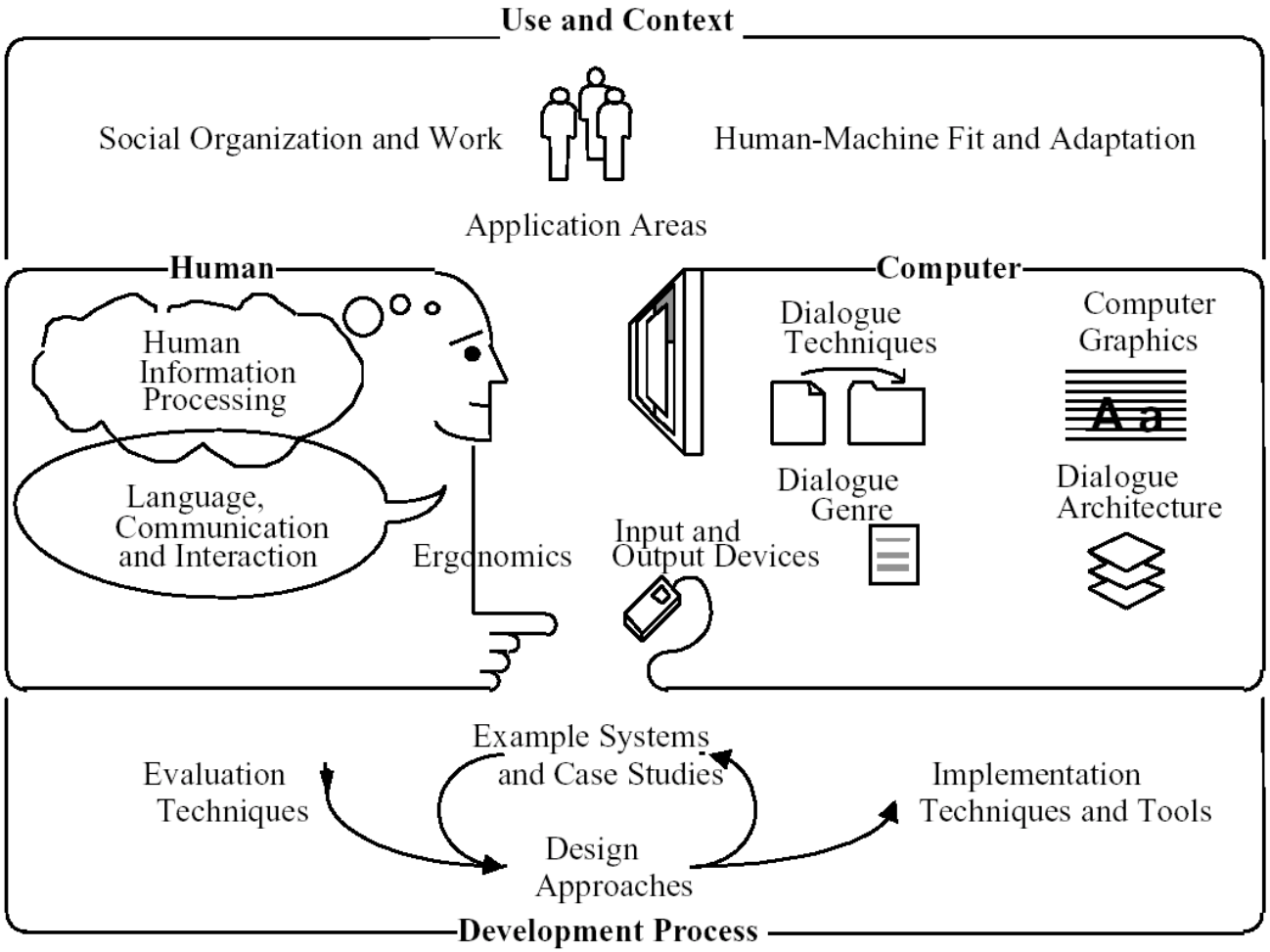
Human-Computer Interaction

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



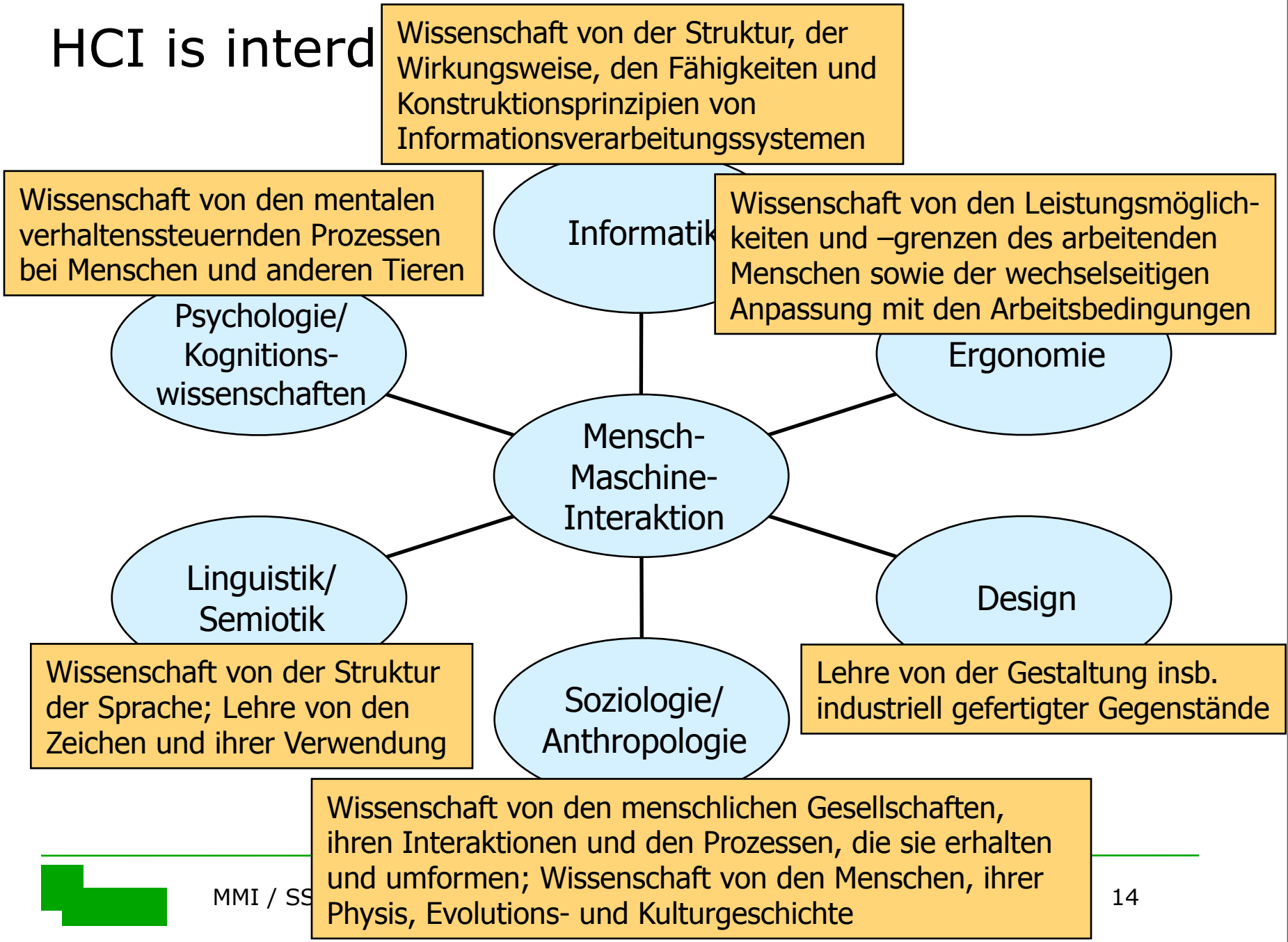
These factors influence each other and design

Human-Computer Interaction - Overview



Graphik: Saul Greenberg

HCI is interd



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 study HCI ??

- Sooner or later, you will be building "real" systems
- Interface(s) major part of most systems, often over 50%
  - Development costs
  - Number of lines of code
- Bad UI's cause users to
  - need more time for learning the software & performing their tasks
  - make more errors
  - feel dissatisfied
  - not learn/use the full functionality of the software
  - refrain from buying and using the software
- Good interfaces are important for any kind of interactive software, and of *utmost* importance in
  - systems with high costs of failure
  - systems with high demands on operators

Why improve HCI ??

- Business view:
  - to use humans more productively/effectively
  - human costs now far outweigh hardware and software costs
- Personal view:
  - people view computers as appliances, and want it to perform as one
    - now expect "easy to use system"
    - not tolerant of poorly designed systems
    - little vendor control of training users with their systems
    - system will face heterogeneous group of users
  - if product is hard to use, people will seek other products
    - e.g. Mac vs. PC+Windows

Why improve HCI ??

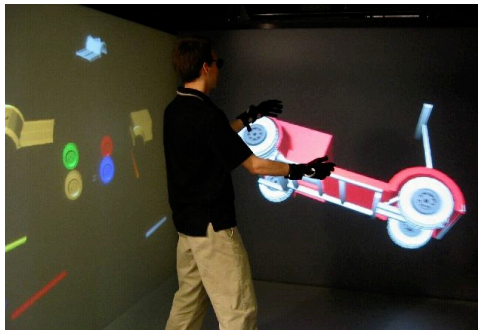
- Social view:

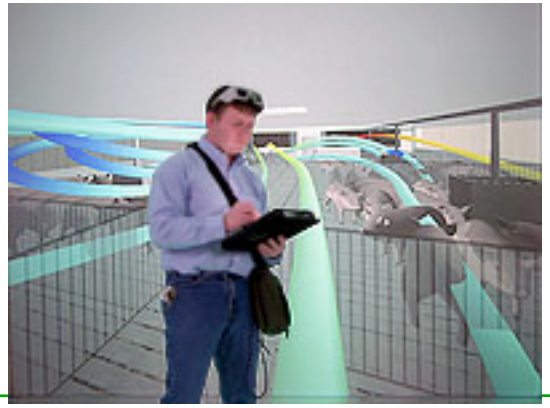
  Computers are getting increasingly used for all kinds of tasks people have to solve

  - educate our children
  - take medical histories and provide expert advice
  - keep track of our credit worthiness
  - play war games (and help form policies)
  - control air and ground traffic flow
  - book travels
  - control chemical/oil/nuclear plants
  - control space missions
  - assist humans with their everyday tasks (office automation)
  - control complex machines (aircraft, space shuttles, super tankers)
  - ....

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

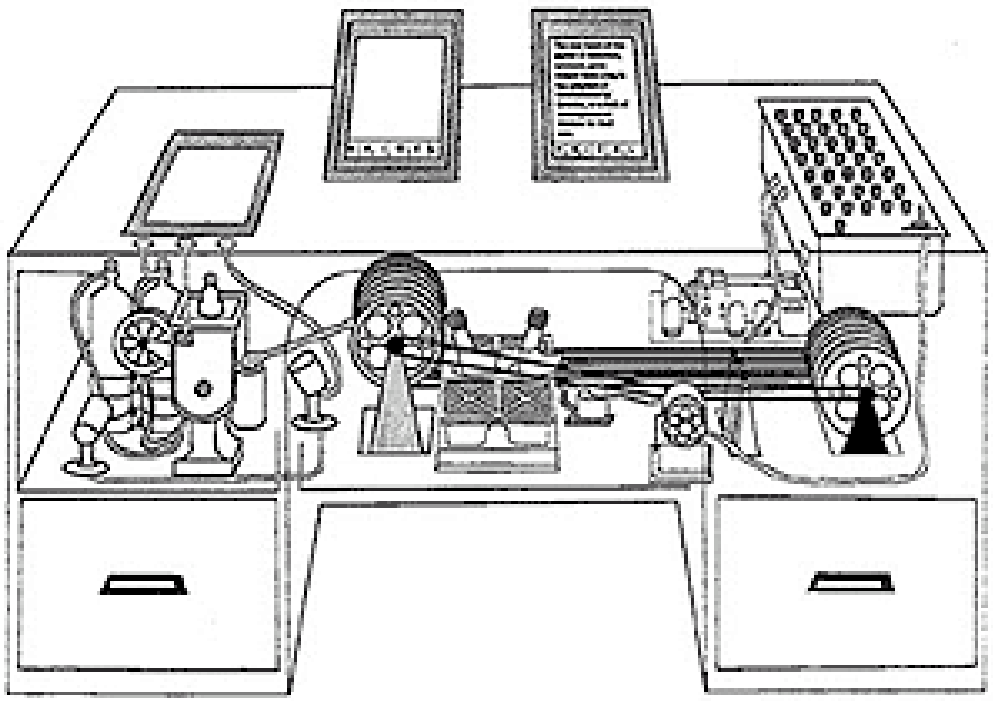
- Coordinator of U.S. scientific activities; offered new role for military scientists after WW II
- **„As we may think" (1945):**
  „The summation of human experience is being expaned at a prodigious rate, and the means we use for threading through the consequent maze to the momentarily important item 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

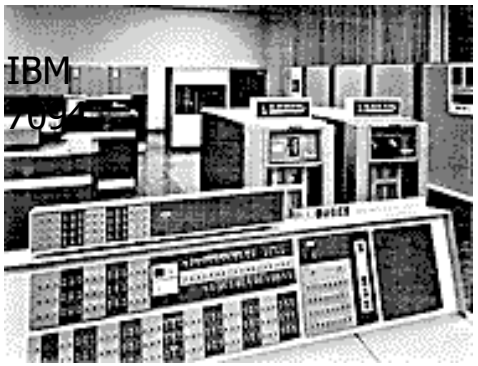
- Great impact on development of graphical user interfaces and world-wide networks; conception of what became the internet later on in 1962, coined term "Netizen" (1968)
- 1962-1964 Director of ARPA Information Processing Technology Office

- **„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*

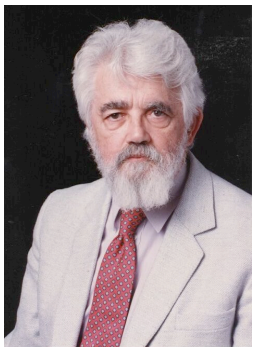
- Short-term goals:
  - Time-sharing among multiple user
  - Input/Ouput of symbolic and pictorial information
  - Interactive real-time systems
  - Storage & retrieval of large data sets
- Mid-term goals:
  - Facilitation of human cooperation in design and programming of large software systems
  - combined 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

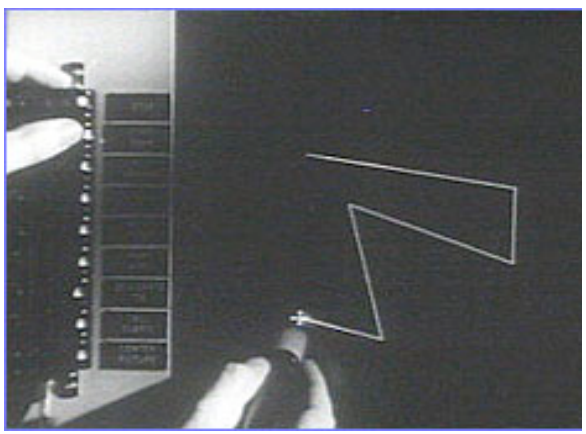
Whirlwind (MIT, 1951): „real time"-rendering of text and graphics on CRT terminal

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)

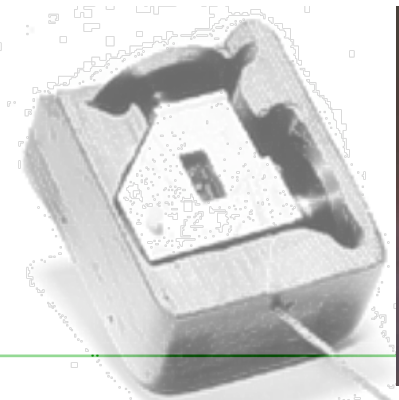
oNLine System (NLS, `60s)

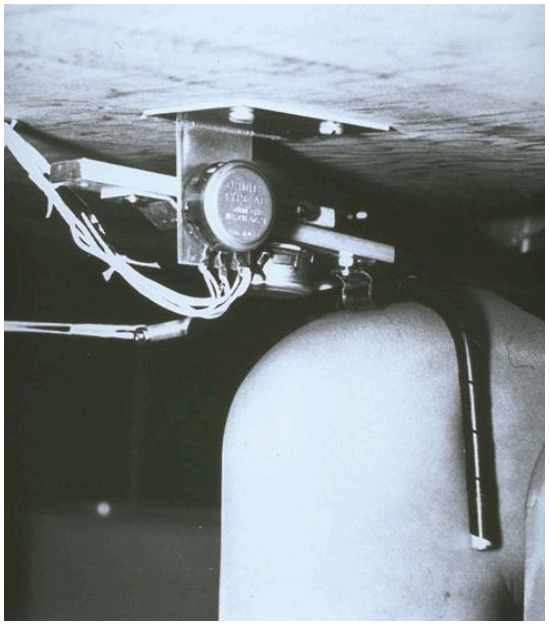
- Two persons edit the same text from different consoles, 2D display editing
- Multiple windows, on-screen teleconferencing
- *„Mother of all demos"* (1968)
- Raised need for new input devices

Douglas C. Engelbart

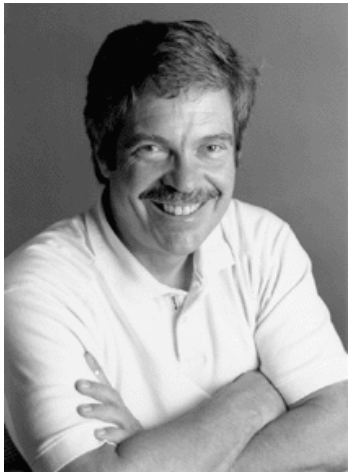
Which device most suitable for CRT display-selection in text-manipulation systems?

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





Alan Kay



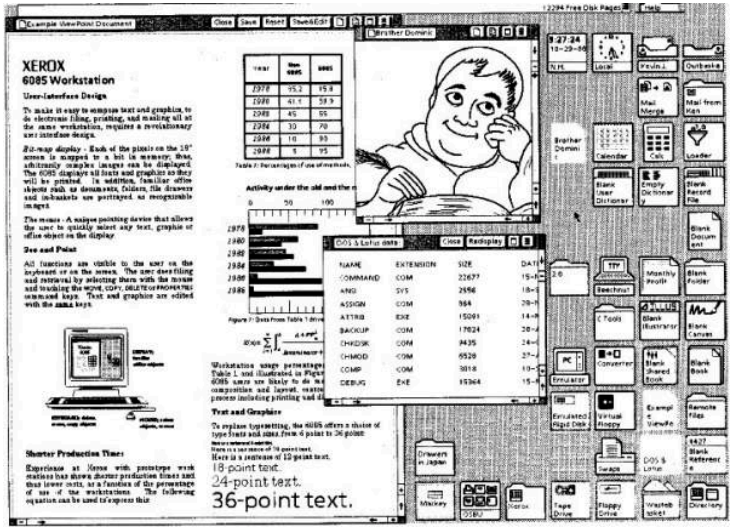
- Invented Smalltalk, contributed to Ethernet, laser printer, client-server network model
- Designed **Dynabook (1977),** a laptop with graphical user interface
  - Predecessor of notebooks/PDAs
  - *"We envision a device as small and portable as possible which could both take in and give out information in quantities approaching that of human sensory systems"*
  - Realized later on by Apple as „Newton"

Personal Computer & WIMP

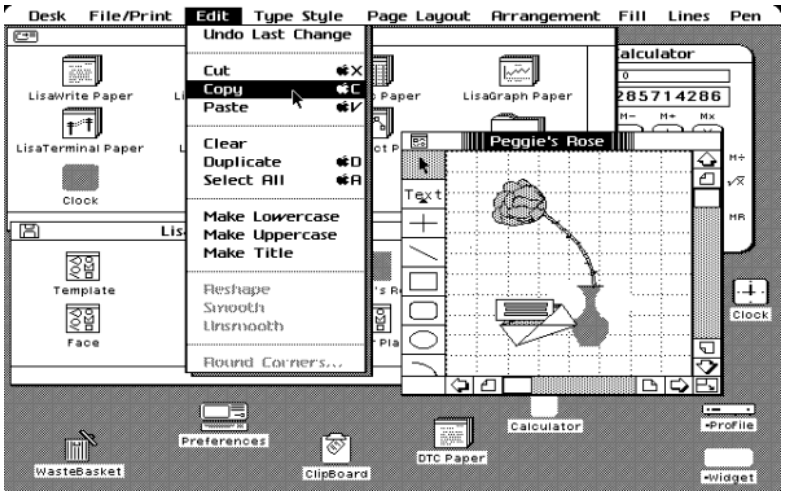
- **Xerox Alto** (1973): 1st *personal computer*
  - First WIMP Interface: *Windows, Icons, Menus, Pointing*
  - First computer with regular mouse (Engelbart's) and ethernet
  - First WYSIWYG-Editor *Bravo/BravoX (what you see is what you get),* direct predecessor of MS Word
  - $40.000 - commercial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



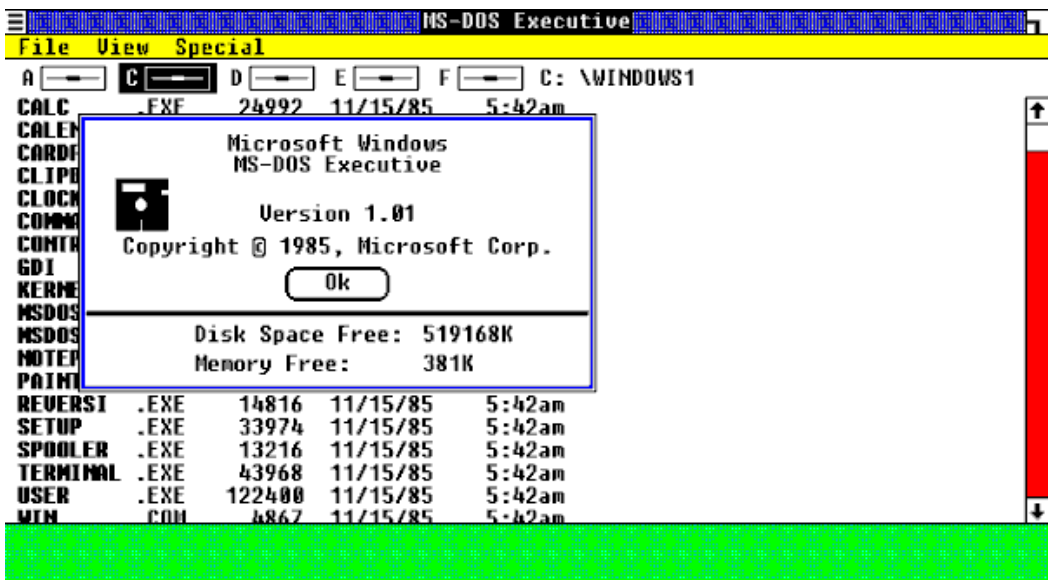
- **Apple Lisa (1979)**
  - **L**ogical **I**ntegrated **S**oftw. **A**rch.
  - Document-centered view

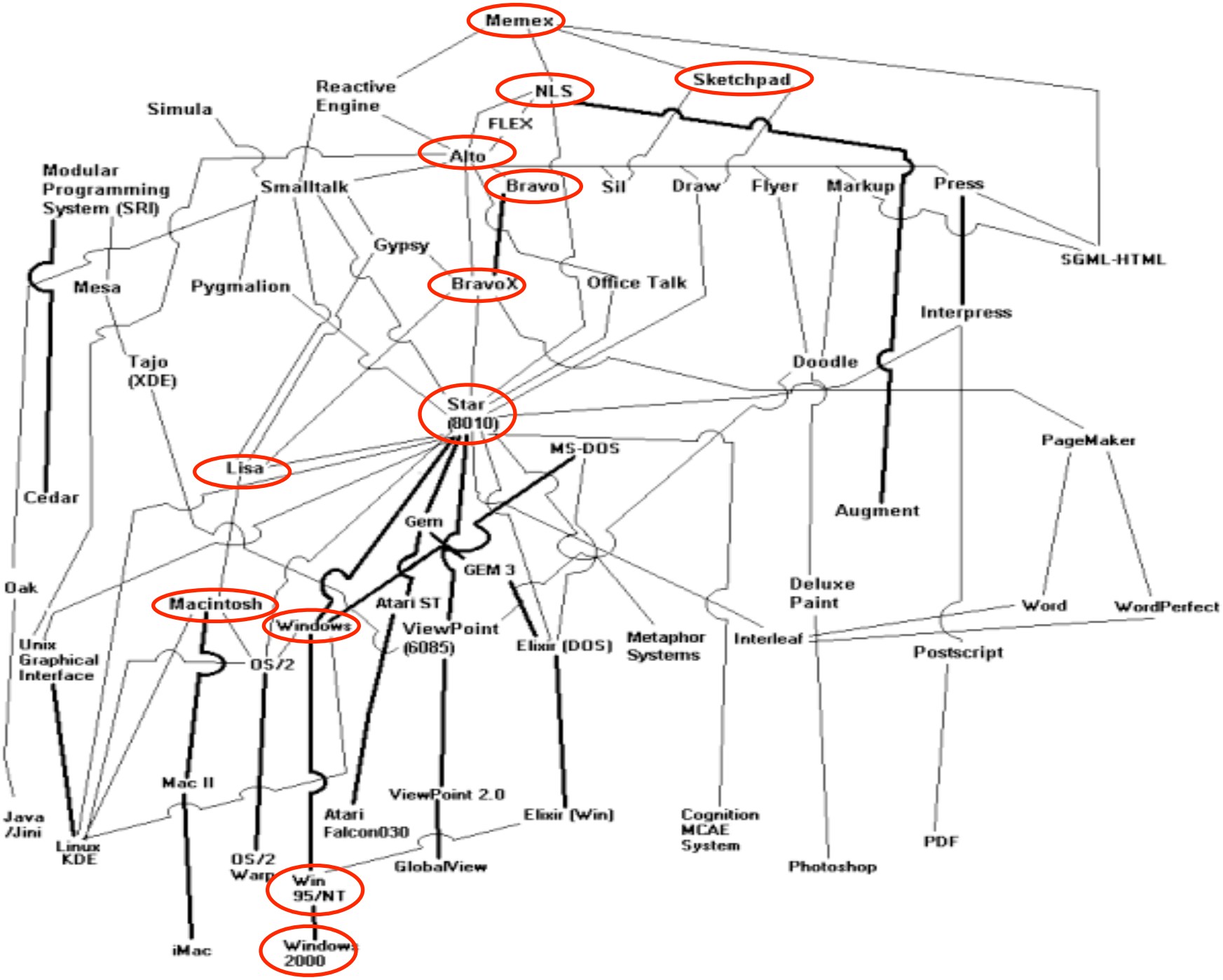
  → Lisa 2 → Macintosh XL

- **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, …




Memex
Reactive Engine
NLS
Sketchpad
Simula
FLEX
Alto
Modular Programming System (SRI)
Smalltalk
Bravo
Sil
Draw
Flyer
Markup
Press
Gypsy
SGML-HTML
Mesa
Pygmalion
BravoX
Office Talk
Interpress
Tajo (XDE)
Doodle
Star (8010)
PageMaker
MS-DOS
Lisa
Cedar
Augment
Gem
GEM 3
Oak
Deluxe Paint
Macintosh
Atari ST
Word
WordPerfect
Windows
ViewPoint (6085)
Unix Graphical Interface
OS/2
Elixir (DOS)
Metaphor Systems
Interleaf
Postscript
Mac II
ViewPoint 2.0
Java /Jini
Atari Falcon030
Elixir (Win)
Cognition MCAE System
Linux KDE
OS/2 Warp
GlobalView
PDF
Win 95/NT
Photoshop
iMac
Windows 2000

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 & ubiqitious intelligence

Outlook from 1988…

The Knowledge Navigator
(concept video for Apple)

Outlook from 1999

Easy Living (Microsoft): Smart environments