Methoden der Mensch-Maschine-Interaktion

1. Termin: Einführung & Historie

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Modul „Mensch-Maschine Interaktion“

V+Ü “*Mensch-Maschine-Interaktion*” (2+2 SWS, SS)
- 180h = 6 LP
- Aktive Teilnahme an Vorlesung und Übungen, Bestehen der Klausur

S bzw. Pj/Pr "*Interaktive soziale Agenten*" (4 SWS, WS)
- 120h = 4 LP
- Aktive Teilnahme an Seminar bzw. Praktikum/Projekt, Vortrag +Essay (S) bzw. Ausarbeitung (Pj/Pr)

Für BA (NWI,KoI,BIG,MIG,NF) und MA (NWI,ISy,IMW)

Vorlesung „Mensch-Maschine-Interaktion“

Vorlesung
Überblick, zentrale Grundlagen und ausgewählte fortgeschrittene Methoden der MMI

Übungen
- *Julia Tolksdorf* (Org.), *Maha Salem*, *Oliver Damm*
- Drei praktische Aufgaben:
  - Entwurf, Realisierung und Evaluation einer Nutzerschnittstelle nach Usability-Gesichtspunkten
  - Schriftliche Ausarbeitung + Präsentation im Tutorium

http://www.techfak.uni-bielefeld.de/~skopp/MMI.html

Übersicht

- **Menschen & Kognitive Systeme**

  Aufgabe 1: Schnittstellenentwurf
  - Wahrnehmung, Aufmerksamkeit & Gedächtnis
  - Nachdenken & Handeln

- **Computer & Schittstellen**
  - Schnittstellenansätze und -technologien

  Aufgabe 2: Schnittstellenrealisierung
  - Design-Prozess
  - Testen & Evaluation

- **Interaktionsarten**
  - Natürliche Sprache
  - Multimodalität

  Aufgabe 3: Schnittstellenevaluation
  - Dialog
  - Face-to-Face Konversation
  - Kollaboration und Kooperation

Literatur

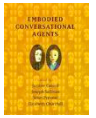
Dix et al.: *Human-Computer Interaction* (3. Aufl.). London: Prentice Hall, 2003.

Shneiderman: *Designing the User Interface - Strategies for Effective Human-Computer Interaction* (3. Aufl.). Addison Wesley, 1998.

M. Dahm: *Grundlagen der Mensch-Computer-Interaktion*, Pearson Studium, 2006.

Reed: Cognition (5. Aufl.), Wadsworth, 1999.

Jurafsky & Martin: *Speech and Language Processing*, Prentice Hall, 2000.



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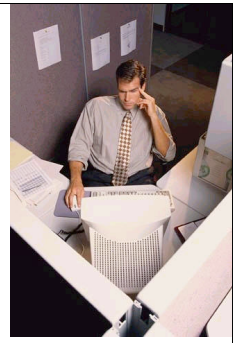
Breazeal, C.: *Designing Sociable Robots*, MIT Press

What is HCI and why should I learn about it?

Simply because computers are built for and used by humans



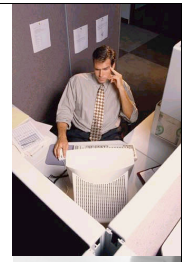
→ Humans interact with computers and everything has to work properly, the human, the computer, and the interaction

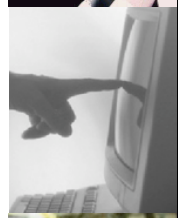
Three interacting parts of one system

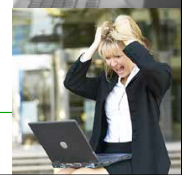
The Human
- end-user of a program
- wants to get a particular task/problem done

The Machine
- program built for accomplishing a certain task
- machine to run the program, devices for input/output

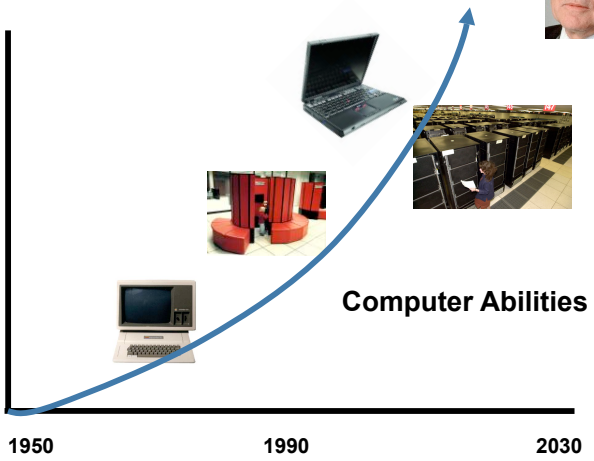
The Interaction
- user tells the computer what s/he want
- computer solves task and communicates results
- communication via common codes and channels



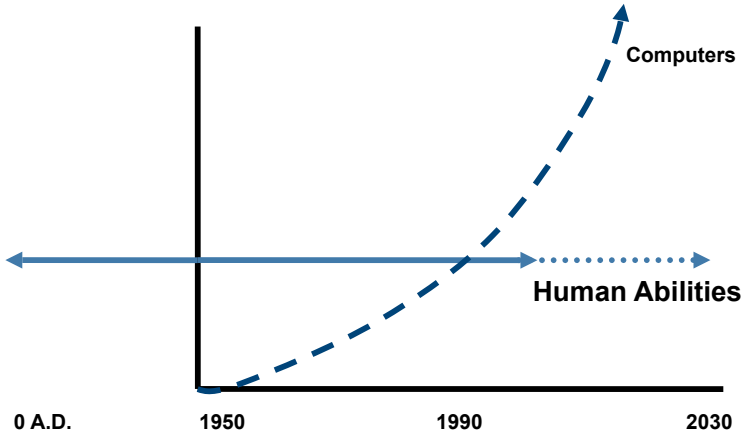




Moore's Law (1964)



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)

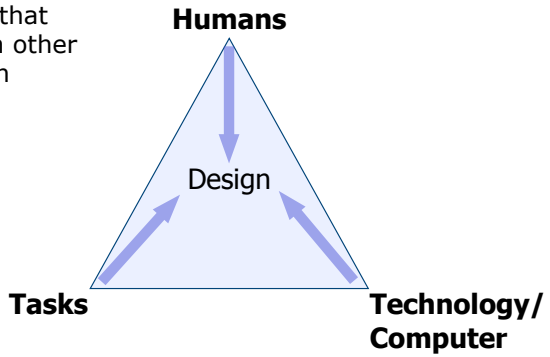
"We have determined that the Aegis radars and computers functioned correctly and that the misidentification of an Airbus airliner as an F-14 was due to human error induced by combat stress. ... The operator interpreted a display indicating the Airbus was at 12,000 feet and flying level as indicating 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

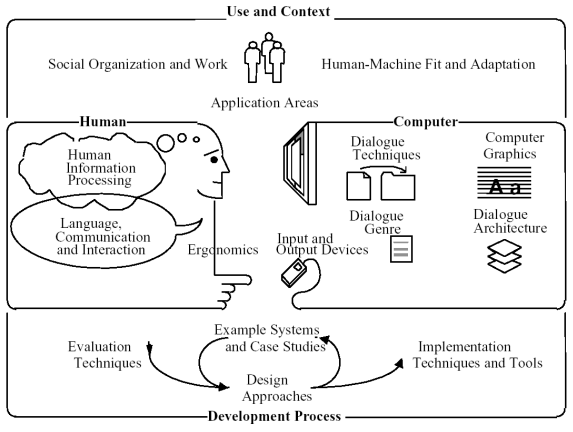
...is concerned with the design, evaluation and implementation of interactive systems for human use.

Three factors that influence each other and the design



Issues

ACM SIGCHI - „contents of CHI“



Related terms you will find

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

Why learn about HCI?

Interface is of major importance in “real” systems

- is all the ordinary user has (sees, operates, feels)
- major part in terms of development costs & amount of code
- of utmost importance in systems with high costs of failure and high demands on operators

Bad interfaces cause users to...

- need more time for learning & performing their tasks
- make more errors
- feel dissatisfied
- miss the full functionality of the software
- refrain from buying and using the software

Why improve HCI?

Business view:

- to exploit humans more productively/effectively
- human costs far outweigh hardware and software costs

Personal view:

- people want computers to perform like applicances
  - expect "easy-to-use systems"
  - are lazy, want computers to save own work
  - not tolerant of poorly designed systems
  - little vendor control of training users with their systems
  - system will face heterogeneous group of users
- people seek systems most easy to use
  - e.g., Mac vs. PC+Windows

Why improve HCI?

Societal view: machines get used for all kinds of tasks

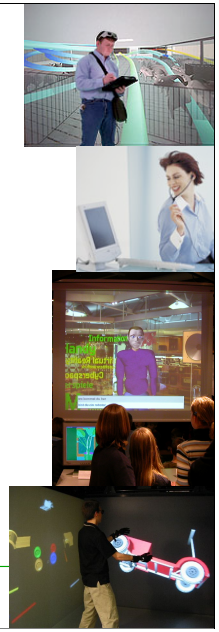
- educate our children
- take medical histories and provide expert advice
- keep track of our credit worthiness
- play war games (and help form policies)
- control air and ground traffic flow
- book travels
- control chemical/oil/nuclear plants
- control space missions
- assist humans with their everyday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

Why research HCI?

To explore how it can be improved in a more systematic way (not *trial-and-error)*

To understand how people approach 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

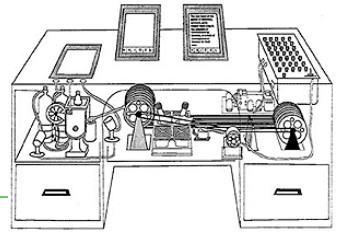
Pioneers & innovations

Vannevar Bush

Coordinator of US scientific activities during and 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"

Memex (memory expander):
Hypothetical device for storage and retrieval of knowledge
➜ multimedia, hyperlinks



Joseph C.R. Licklider

Director ARPA Information Processing Technology Office (1962-64)

„Man-Computer Symbiosis" (1960):
"The hope is that [...] 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 [...] today."

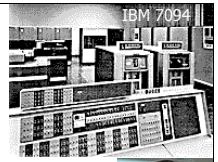
Enable humans „to cooperate [with computers] in making decisions and controlling complex situations" and „to think in interaction with a computer in the same way that you think with a colleague whose competence supplements your own".

Joseph C.R. Licklider

Visions as from 1960:

- Short-term
  Time-sharing, input/ouput of symbolic and graphical information, real-time systems
- Mid-term
  Facilitate human cooperation, speech recognition, character recognition, light-pen editing
- Long-term
  Natural language understanding, heuristic programming (=A.I.), learning systems

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 impression that they are on their own personal machine
- Afforded interactive systems and interpreted programming languages
- Foundations of, e.g., current word processors

➜ need for support in human-computer interaction

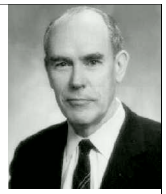
First graphical user interfaces

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 (selection)

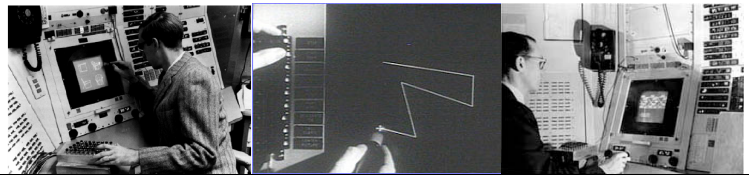
Ivan Sutherland



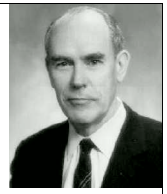
Ph.D. (MIT, 1963): *"A man-machine graphical communication system"*

Sketchpad (1963)

- First interactive graphics application & sophisticated drawing package
- Direct manipulation interface
- Major impact on HCI and user interfaces



Ivan Sutherland



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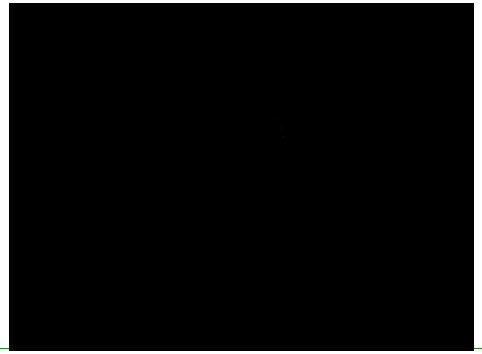


Douglas C. Engelbart

„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"

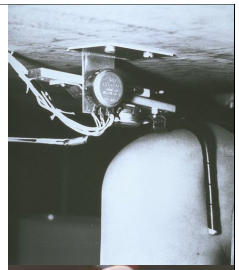
ONLine System (1968)

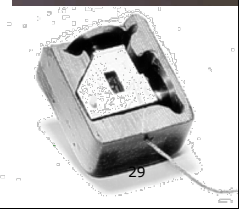
- Two persons collaboratively edit a text from two separate consoles
- Multiple windows, on-screen teleconferencing
- need for new input devices for text selection and manipulation

Douglas C. Engelbart

First „usability evaluation“: Which device most suitable for CRT display-selection in text-manipulation systems?

Light pen?
Joystick?
Knee input device?
„Mouse“?





Douglas C. Engelbart

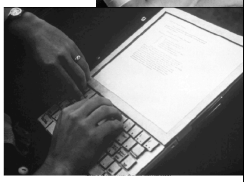
ONLine system demo with the first mouse (1968)

Alan Kay

Smalltalk, Ethernet, laser printer, client-server network model

Dynabook (1977)

- Predecessor of notebooks/PDAs, first laptop with graphical user interface
- *"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"*
- Further developed and realized later on by Apple as „Newton“


First Personal Computer

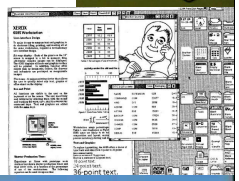
Xerox Alto (1973):

- First GUI: Windows, Icons, Menus, Pointing
- First computer with 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


First GUIs

Xerox Star (1981): invisible computer, desktop metaphor:

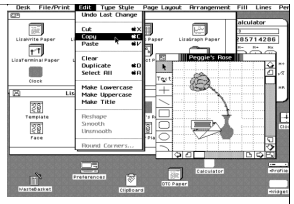
- Windows and menus
- direct data manipulation & graphical control (icons)
- „progressive disclosure“ present common choices to user, hide more complex ones (e.g. expanding dialogue box)

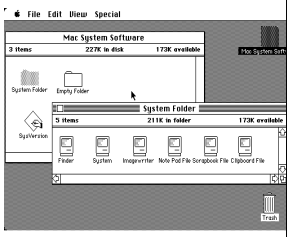


First GUIs

Apple Lisa (1979)

- **L**ogical **I**ntegrated **S**oftw. **A**rch.
- Document-centered view
- $10.000
  → Lisa 2 → Macintosh XL

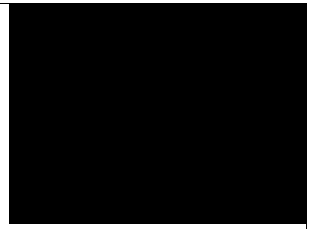




Apple Macintosh (1984)

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

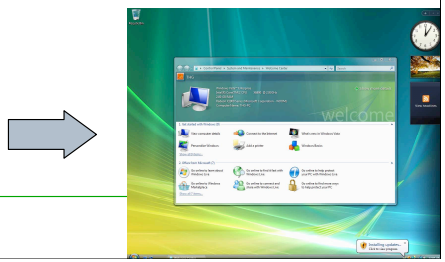
Apple Macintosh (1984)

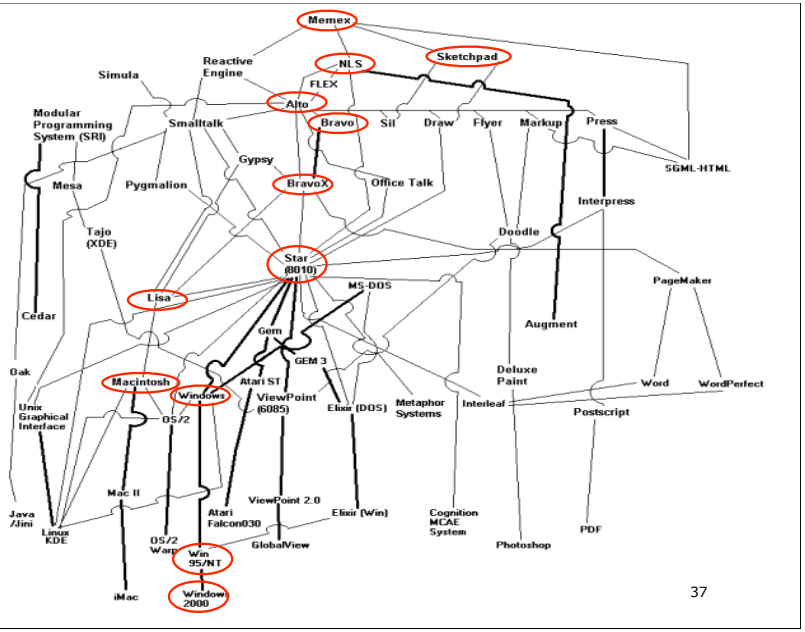


First GUIs

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 - barely usable
- 1988: Windows 2.03
- ... Windows 3.1, 95, 98, NT, 2000, XP, Vista





Visions from the past

The Knowledge Navigator
(concept video created for Apple in 1989)

Evolution

~ Outline of this lecture

Year	Paradigm	Implementation
1950s		*Switches, punched cards*
1970s	*Typewriter*	*Command-line interface*
1980s	*Desktop*	*Graphical user interface, direct manipulation*
1980s+	*Spoken Language*	*Speech recognition/synthesis, natural language processing, dialogue systems*
1990s+	*Natural interaction*	*Perceptual, multimodal, interactive, conversational, tangible, adaptive*
2000+	*Social interaction*	*Agent-based, anthropomorphic, social, emotional, affective, collaborative*