Methoden der Mensch-Maschine-Interaktion

1. Termin: Einführung & Historie

Administrivia

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

- Semesterapparat:
  - Uni Bibliothek, FB 10, "Wachsmuth, Kopp, Becker"
- Webseite:
  - *www.techfak.uni-bielefeld.de/~skopp/Lehre/MMI_S08/MMI_web.html*

Leistungspunkte/Einzelleistung

Regelmäßige Teilnahme an der VL und den Übungen

Erfolgreiches Bearbeiten **zweier** Kurzprojekte im Laufe des Semesters
- in Kleingruppen von 3 Personen
- mit kurzer schriftlicher Ausarbeitung und Vorstellung in der Übungsgruppe

Teilnahme an der Klausur

→ 5 Leistungspunkte und eine benotete Einzelleistung

Übungen

- Tutoren: *Julia Tolksdorf, Felix Rabe*
- Zwei Kurzprojekte:
  1. Entwurf und Programmierung einer Nutzerschnittstelle nach „Usability"-Gesichtspunkten
  2. Gegenseitige Evaluation zur Überprüfung und Verbesserung der erstellten Schnittstellen
- Übungsgruppentermin (*nicht wöchentlich*)
  - Di 18-20h, H9
  - ??

Übersicht

- **Humans & Cognitive Systems**
  - Perception & Attention
  - Cognition & Acting & Reacting
- **Computers & Interfaces**
  - Interface Styles & Technologies

1st student project: interface development

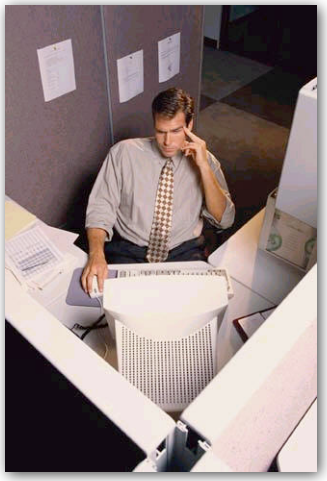
  - User-centered design
  - Testing & Evaluation
- **Interaction Styles**
  - Spoken Language
  - Dialogue

2nd student project: usability evaluation

  - Multimodality
  - Face-to-Face Conversation
  - Collaboration & Social Systems

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.
- Cassell et al.: Embodied Conversational Agents, MIT Press, 2000.
- Breazeal, C.: Designing Sociable Robots, MIT Press



What is HCI and why should I learn about it?

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.

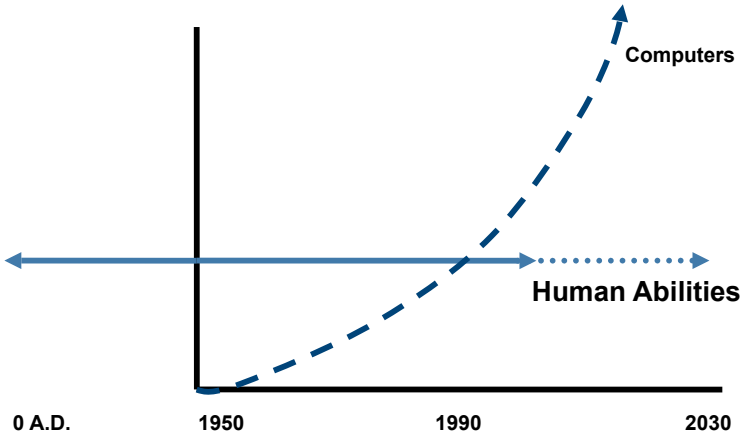
Human & computer are interacting parts of *one system*

- **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
  - various channels for input/output

Moore's Law (1964)

Memory
Speed
Portability
Affordability

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.

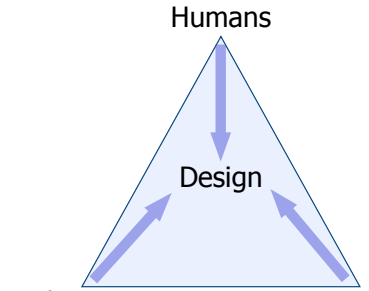
Shootdown of an Iranian airliner (July 1988)

"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

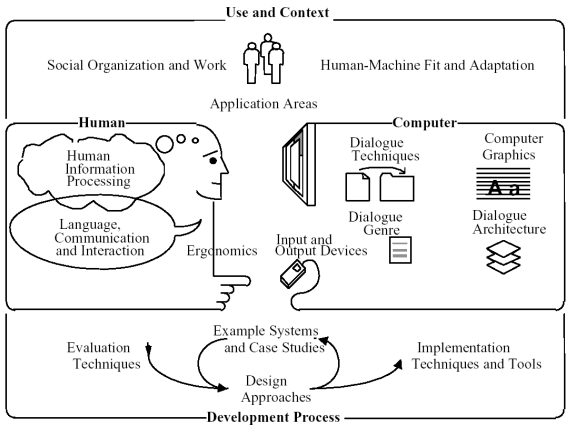
...is concerned with the *design*, *evaluation* and *implementation* of interactive systems for human use.



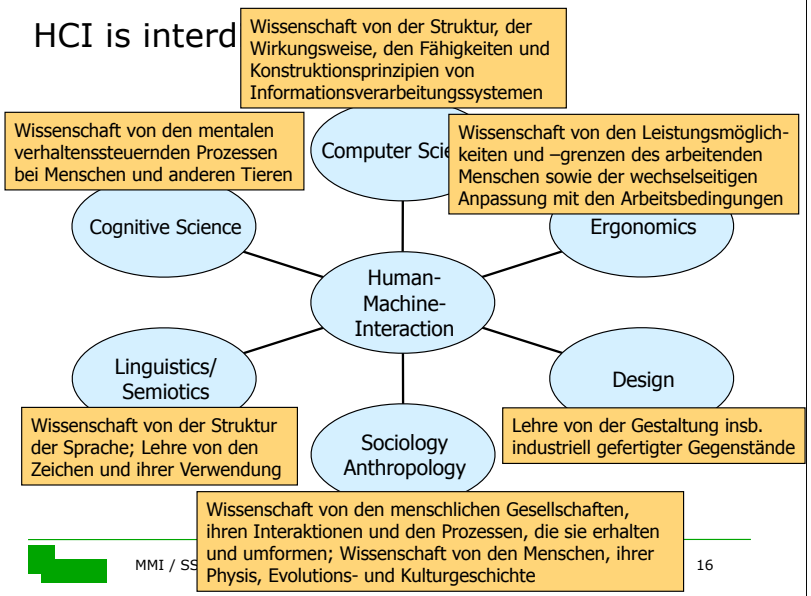
These factors influence each other and the design

Issues

ACM SIGCHI - „contents of CHI“



HCI is interd



Related terms

- 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 is a major part of most systems, in terms of importance for system's success, development costs, amount of code
- Bad interfaces cause users to
  - need more time for learning & 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 and high demands on operators

Why improve HCI?

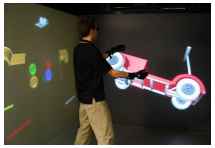
- Business view:
  - to use humans more productively/effectively
  - human costs now far outweigh hardware and software costs
- Personal view:
  - people view computers as appliances, and want it to perform as one
    - expect "easy-to-use systems"
    - not tolerant of poorly designed systems
    - 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

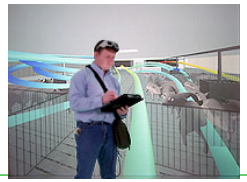
Why improve HCI?

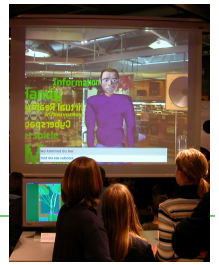
- Society view: machines get used for all kinds of tasks
  - educate our children
  - take medical histories and provide expert advice
  - keep track of our credit worthiness
  - play war games (and help form policies)
  - control air and ground traffic flow
  - book travels
  - control chemical/oil/nuclear 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, and thus to help people using computers, in a systematic way (not *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

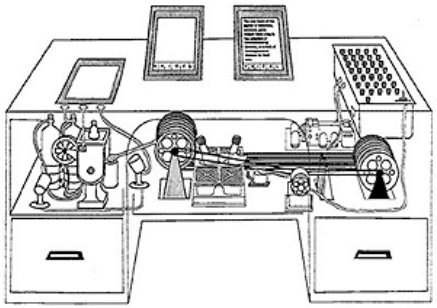
- Coordinator of U.S. scientific activities; offered new role for military scientists after WW II
- **„As we may think" (1945):**
  „The summation of human experience is being expaned at a prodigious rate, and the means we use for threading through the consequent maze to the momentarily important item 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 1960*

- Short-term goals:
  - Time-sharing among multiple users
  - 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 !!

First graphical user interfaces

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

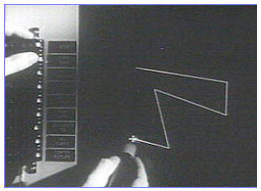
SAGE (Semi-Automatic Ground Environment) project (1963): advancement of *Whirlwind* for military purposes (radar intelligence)

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

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)

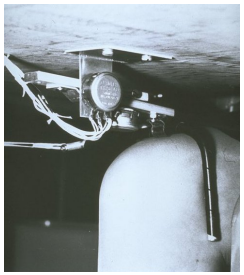
oNLine System (NLS, `60s)

- Two persons edit the same text from different consoles, 2D display editing
- Multiple windows, on-screen teleconferencing
- 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),** the first 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"*
  - Developed further and realized later on by Apple as „Newton"

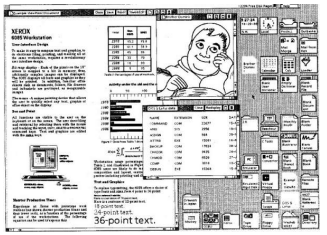


First Personal Computer

- **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

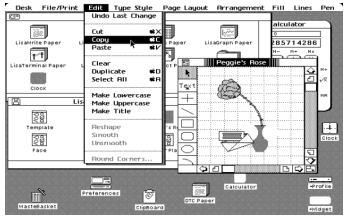
- **Xerox Star** (1981): Idea of the invisible computer, Desktop-Metaphor:
  - Windows and menus
  - direct data manipulation & graphical control (icons)
  - progressive disclosure: present common choices to user, while hiding more complex ones (e.g. expanding dialogue box)



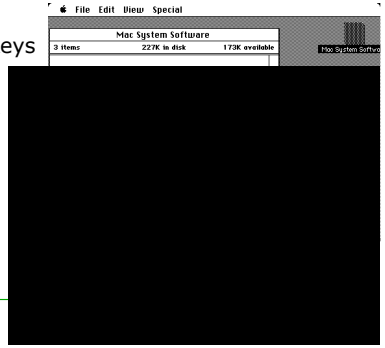
WIMP & Desktop

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

  → Lisa 2 → Macintosh XL

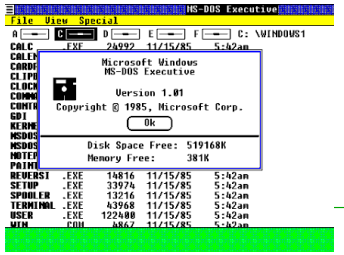


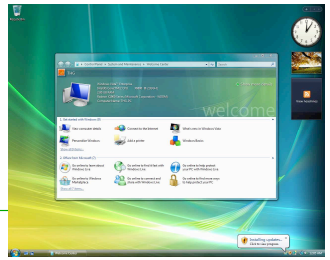
- **Apple Macintosh (1984)**
  - Consequent GUI, no cursor keys
  - $2495 – commercial success
  - Killer apps: Finder, MacDraw, MacWrite, DTP, MS Word

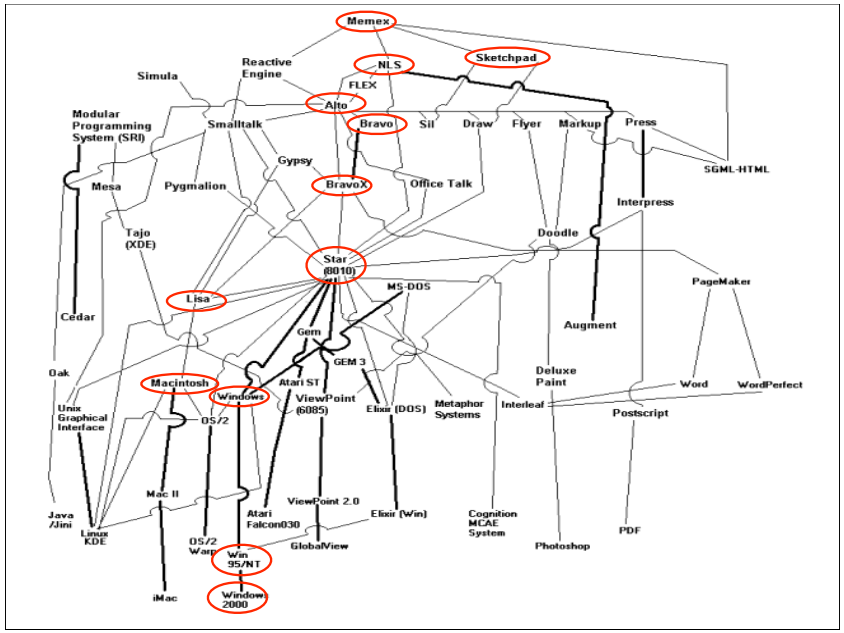


WIMP & Desktop

- 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, Vista







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*

Visions...

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

Visions...

Easy Living (Microsoft research, 1999):
Smart environments