Vorlesung
Mensch-Maschine-Interaktion

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Chapter 2
Basics of HCI and History

- 2.1 Motivation
- 2.2 Principles for UI-Design
  - Principle 1: Recognize User Diversity
  - Principle 2: Follow the Eight Golden Rules
  - Principle 3: Prevent Errors
- 2.3 Understanding Errors
- 2.4 Consistency
- 2.5 Basic Models
- 2.6 A Brief History of HCI

Ben Shneiderman in Munich
Saturday, Nov. 5th 16-20Uhr

- Nassi-Shneiderman diagram (1972)
- Split menu (1992/1994)


```
while (a>0 and b>0)
            a>b?
   ja              nein
   a:=a-b       b:=b-a
            b=0?
   ja              nein
  Ausgabe a     Ausgabe b
```

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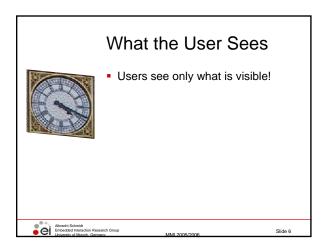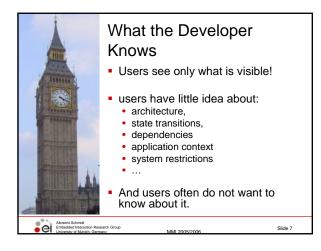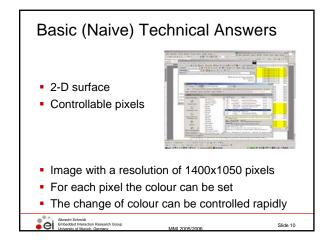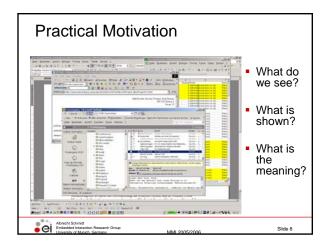## Outline of the course

- 1 Introduction
- **2 Basics of HCI and History**
- 3 Designing Systems for Humans
- 4 Analysis
- 5 Designing Interactive Systems
- 6 Implementing Interactive Systems
- 7 Evaluation

What the User Sees

- Users see only what is visible!

What the Developer Knows

- Users see only what is visible!

- users have little idea about:
  - architecture,
  - state transitions,
  - dependencies
  - application context
  - system restrictions
  - …

- And users often do not want to know about it.

Basic (Naive) Technical Answers

- 2-D surface
- Controllable pixels

- Image with a resolution of 1400x1050 pixels
- For each pixel the colour can be set
- The change of colour can be controlled rapidly

Practical Motivation

- What do we see?

- What is shown?

- What is the meaning?

Perfect User's Answers

- My work environment

- Meeting notes
- Budget for next year
- Request to write a technical article
- Background information on a psychological phenomenon

Skilled Computer Users Answers

- Win2000 desktop
- Text and figures
- Icons and toolbars
- Overlapping windows
- Scroll bars and menus
- Task bar and status information
- Handles and a pointer
- Representations of documents

Example I – Overlaying Windows

- What is the meaning that a window is behind another window?

- What is real? What is illusion?

- What does iconizing do?

- Models? Conceptual… Implementation… Represented…

Example II – Scrolling vs. Hand

- Moving up the scroll bar
  Moves down the document

- What happens in realit
  What do we imagine?
  What is the metaphor?

Principles for UI design

- Implementation and technology independent

- Shneiderman's principles:
  (see http://media.pearsoncmg.com/aw/aw_shneiderma_dtui_4/chapter2.pdf)
  - **Principle 1 : Recognize User Diversity**
  - **Principle 2 : Follow the Eight Golden Rules**
  - **Principle 3 : Prevent Errors**

- Restated in different variants – basically telling the same story

Example II – Scrolling vs. Hand

- Moving up the hand
  Moves up the document

- What happens in reality?
  What do we imagine?
  What is the metaphor?

Principle 1:
Recognize User Diversity

- Simple and obvious - nevertheless in reality extremely difficult

- Example: consider a online travel agent
  - Travel agent booking many flights a day – everyday
  - A teacher organizing a field trip (once a year) and making bookings for a large group
  - A business person changing bookings while travelling
  - A family looking for a package holiday

- Basic concepts to structure the problem
  - Usage profiles
  - Task profiles

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Usage Profiles "Know Thy User"

- What is the background of the user?
- Different people have different requirements for their interaction with computers.

- Issues to take into account:
  - goals, motivation, personality
  - education, cultural background, training
  - age, gender, physical abilities, …

- Experience:
  - Novice users
  - Knowledgeable intermittent users
  - Expert frequent users

User-Needs and Task Profiles

- Find out what the user is trying to do! The Goal!

- Needs of users, goals and resulting tasks

- Supported tasks should be determined before the design starts
- Functionality should only be added if identified to help solving tasks
  - Temptation: If additional functionality is cheap to include it is often done – this can seriously compromise the user interface concept!

- Frequency of tasks related to user profiles

Task Frequency - Examples

- Bold is available in the toolbar
- Subscript requires menu and dialog
- Assumption for the standard UI is that user needs more often bold than subscript
- For users with different needs the customization is available

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Hypothetical Frequency of Tasks
(Example of a booking system for travel)

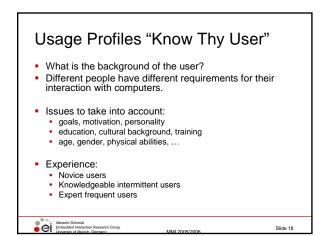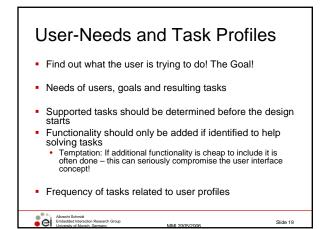| Task Position	Group reservation	Change of itinerary	Booking child care	Comparing sales agent performance
Sales agent	0.2	0.1	0.1	0
Manager	0	0	0	0.3
Family	0.05	0.05	0.3	0
Business traveler	0.01	0.2	0.01	0

Task Frequency: Trade-off between quick access and over-crowed interface

- Example toolbar
  - More tasks directly available in the toolbar make it quicker to do these tasks
  - Increasing the number of options in the toolbar increase the time needed to locate them
  - Screen area that is used

Task Frequency

- Helps to shape a menu structure
  - Frequent action should be simple and quick to carry out
  - Infrequent action may take longer

- Example
  - Frequent actions: Toolbar or special key
  - Intermediate frequent actions: Pull-down menu, key combination (Ctrl+S)
  - Infrequent actions: Sequence of menus or dialogs

- Problem – if many (all) actions occur with very similar relative frequency…

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Principle 2:
Follow the 8 Golden Rules

- Strive for consistency
- Enable frequent users to use shortcuts
- Offer informative feedback
- Design dialogues to yield closure
- Error prevention/handling
- Permit easy reversal of actions
- Support internal locus of control
- Reduce short-term memory load

Shneiderman, chapter 2

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8 Golden Rules - Feedback

- For **any** action performed the user should have appropriate and informative feedback

- For frequent actions it should be modest, peripheral

- For infrequent action is should be more substantial

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8 Golden Rules - Consistency

- Within an application it is the developer's job
  (see earlier slides…but that is the easy part)

- In a specific environment it is defined by guidelines (e.g. for GNOME, for KDE, for Mac OSX, for Win XP, for JAVA Swing)

- In the WWW it gets pretty hard!
  - No real guidelines and no authority
  - How are links represented?
  - Where is the navigation?
  - Styles and "fashion" change quickly…

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8 Golden Rules - Closure

- Sequences of actions should have a beginning, middle, and end.
- For non-instantaneous actions
- On different levels –
  - E.g. in the large: Web shop - it should be clear when I am in the shop, and when I have successfully check-out
  - E.g. in the small: a progress bar

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8 Golden Rules - Shortcuts

- Improves speed for experienced users
- Shortcuts on different levels
  - Access to single commands, e.g. keyboard shortcuts (CTRL+S) or toolbar
  - Customizing of commands and environments, e.g. printer preset (duplex, A4, …)
  - Reusing actions performed, e.g. history in command lines, macro functionality

- Shortcuts to single commands are related to consistency
  - CTRL+X, CTRL+C, CTRL+V in Microsoft applications for cut, copy and paste
  - However CTRL+S (saving a document) is only implemented in some applications…

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8 Golden Rules – Prevent Errors

- Create UI that make it hard to make errors (e.g. menus instead of commands)
- Detect errors or possible errors
- Is related to "easy reversal of actions"

- Examples
  - Leaving a editor without saving
  - Writing to a file that already exists

- Different options how to handle it:
  - Involve the user (current practice)
  - Prevent the error or its consequences on system level (e.g. create backups/versions when a file is overwritten, keep all files that have been created by the user)

8 Golden Rules –
Permit Easy Reversal of Actions

- As a basic rule – all actions should be reversible
- Providing UNDO functions (possibly with infinite depth)
- Allow undo of groups of actions

- Undo is not trivial if user is not going sequential
  - E.g. write a text, copy it into the clipboard, undo the writing
    → the text is still in the clipboard!

- Reversal of action becomes a usage concept
  - Browser back-button is used for navigation (for the user a conceptual reversal of action)
  - Formatting of documents – e.g. "lets see how this look, … don't like it, … go back to the old state"

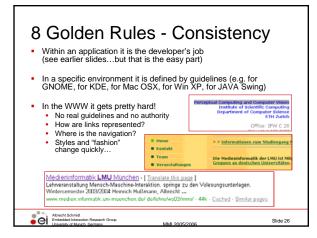## Chapter 2
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8 Golden Rules - Feeling in Control

- Users should feel to be in control of the system
- User should initiate actions (initiator instead of responder)
- Avoid non-causality
- The system should be predictable

- Some current developments are in contrast:
  - Proactive computing
  - Intelligent agents
- Have to be aware when designing these!

Principle 3:
Prevent Errors - Examples

- Correct matching pairs
  - Examples:
    - Making some text <B>**bold**</B> will make too much bold if the </B> is omitted or mistyped
    - IDE often provide {} match checking
- Complete sequences
  - Assistance for the user to complete a sequence of actions to perform a task
  - Example: Wizards
- Command correction
  - Aim: Trying to prevent users entering incorrect commands
  - Examples:
    - File completion on Unix
    - Helpful error messages

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8 Golden Rules –
Reduce Short-term Memory Load

- 7 +/- 2 chunks of information
- The system should remember, not the user

- Examples that create problems
  - Multi-page forms where the user has to know at form N what she filled in in form N-1
  - Abbreviations introduced in one step and used in the following (e.g. user selects a destination – as the name of a city – and the

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Human Error

Top News

Bombardier 'Stands Down' Against Human Error
Wed, 26 Oct '05

Event Aims To Reduce Pilot Mistakes
More than 420 pilots, crewmembers, safety specialists, industry officials and media representatives have gathered at Bombardier's 9th Annual Safety Standdown in Wichita, KS. The event, billed as the industry's foremost safety event, is being held Oct. 25-27.

The only safety seminar of its kind to be offered by a civil aircraft manufacturer, Bombardier's Safety Standdown is taking dead aim at the cause of 78 percent of all accidents in aviation -- human error.

"The intent of Safety Standdown is to reduce accidents caused by human failure across the aviation industry as a whole, whether they occur during corporate, commercial or military missions," stated Bob Agostino, director, flight operations, Bombardier Business Aircraft. "While we believe current training programs using simulators and other training devices are excellent, we also recognize that accident prevention requires more than simply perfecting technical skills."

This year's event will focus on "Winning The War On Error," enabling aviation professionals to better understand why and how crucial mistakes occur by providing in-depth, knowledge-based training in areas such as fatigue, nutrition and psychological factors.

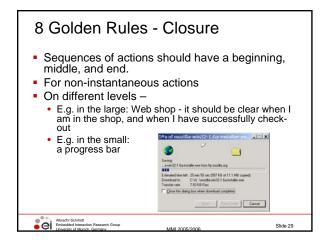- http://www.aero-news.net/index.cfm?ContentBlockID=cda9332e-b872-4d41-960a-2352e5f47744

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more (Human) Errors…

TAIPEI TIMES

Published on TaipeiTimes
http://www.taipeitimes.com/News/taiwan/archives/2003/10/18/2003072381

Fighter pilots find panic button at last

MISTAKE MANAGEMENT: Two crashes blamed on human error have prompted the developers of the IDF to remind the air force about a built-in emergency function
By Brian Hsu
STAFF REPORTER
Saturday, Oct 18, 2003, Page 4

Although Taiwan's Indigenous Defense Fighter (IDF) has an emergency function that minimizes the chance of a plane crash due to human error, pilots have only now found out about it.

The previous two accidents involving IDFs this year were caused by human error, defense sources said yesterday.

"The crash was also caused by the negative G-force which the flight instructor created"

…In an attempt to prevent similar accidents in future, the air force has asked the AIDC to help teach pilots how to use the fighter's emergency function.

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Human Error
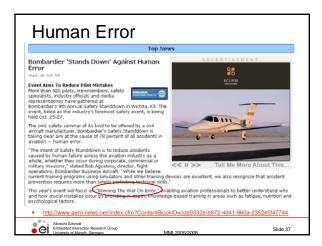

Blame Subway Accidents On Human Error

Oct 5, 2005 11:36 am US/Eastern
(1010 WINS) (NEW YORK) Human error has caused all of the subway derailments and crashes over the past 20 months, according to The Daily News. No one was seriously hurt in the eight accidents which occurred from January 2004 to last month. But Transit Authority reports say the accidents cost more than 600-thousand dollars worth of damage and included emergency passenger evacuations.

In one incident, a motorman fell asleep at the throttle as the Times Square shuttle was coming into Grand Central and slammed the train into a bumper. The worker was demoted.

Most of the mishaps involved workers and supervisors not following the rules.

- http://1010wins.com/topstories/local_story_278071424.html

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About (Human) Errors…

- "If an error is possible, someone will make it" (Norman)

- Human Error may also be a starting point to look for design problems.

- Design implications
  - Assume all possible errors will be made
  - Minimize the chance to make errors (constraints)
  - Minimize the effect that errors have (is difficult!)
  - Include mechanism to detect errors
  - Attempt to make actions reversible

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Human Error

PITTSBURGH TRIBUNE-REVIEW
Back to headlines

Barring human error made area firm a health leader

By Rick Stouffer
TRIBUNE-REVIEW
Wednesday, October 19, 2005

More than 30 years ago, bar codes began showing up on the bottoms, backs or sides of everything from blocks of cheese to 2-by-4s.

Medicine, however, was a late arrival to tracking equipment and medications using bar code technology. In the early 1990s, it was a Pittsburgh-based start-up, Automated Healthcare, that jump-started the use of the vertical black and white lines for tracking medicine in hospitals.

"It really was quite amazing that we were bar coding ketchup, but not bar coding things that could kill you if an error was made," said Sean McDonald, who founded Automated Healthcare in 1990, sold it to drug distribution giant McKesson in 1996 for $65 million, then stayed for five years to continue running the company. Today, the company is known as McKesson Automation.

- http://pittsburghlive.com/x/tribune-review/business/s_385507.html

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Understanding Errors

- Errors are routinely made
  - Communication and language is used between people to clarify – more often than one imagines
  - Common understanding of goals and intentions between people helps to overcome errors

- Two fundamental categories
  - Mistakes
    - overgeneralization
    - wrong conclusions
    - wrong goal
  - Slips
    - Result of "automatic" behaviour
    - Appropriate goal but performance/action is wrong

Norman, Chapter 5

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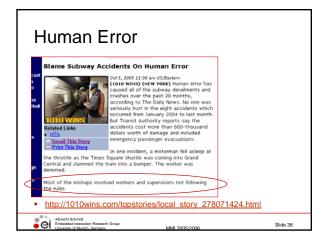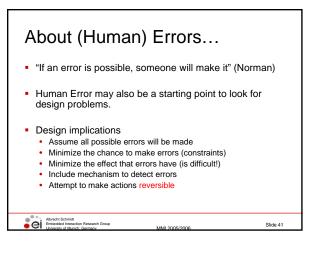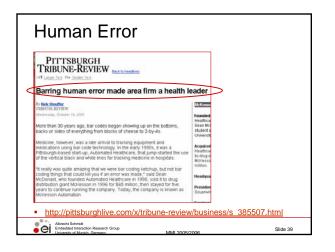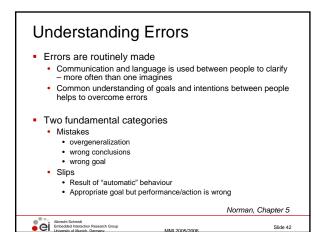Slide 42

Understanding the types of Slips Users Make

- Capture errors
  - Two actions with common start point, the more familiar one captures the unusual (driving to work on Saturday instead of the supermarket)
- Description errors
  - Performing an action that is close to the action that one wanted to perform (putting the cutlery in the bin instead of the sink)
- Data driven errors
  - Using data that is visible in a particular moment instead of the data that is well-known (calling the room number you see instead of the phone number you know by heart)
- Associate action errors
  - You think of something and that influences your action. (e.g. saying come in after picking up the phone)
- Loss-of-Activation error ~ forgetting
  - In a given environment you decided to do something but when leaving then you forgot what you wanted to do. Going back to the start place you remember.
- Mode error
  - You forget that you are in a mode that does not allow a certain action or where a action has a different effect

Norman, Chapter 5

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Preventing Mode Errors

- Why use modes in the first place?
  - User interface trade-off (e.g. number of buttons needed can be reduced, actions within a mode can be speeded up)
- Design recommendations
  - Minimize number of modes
  - Make modes always visible
- Example alarm clock
  - Mode vs. mode free
  - Visualization of mode
- What is your solution?
  - Draw the control elements
  - Provide labels

Setting time and alarm with mode?

Setting time and alarm without mode?

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Confirmation is unlikely to prevent Errors

- Example
  - User: "remove the file '`most-important-work.txt`'"
  - computer: "are you sure that you want to remove the file '`most-important-work.txt`'?"
  - User: "yes"
  - Computer: "are you certain?"
  - User: "yes of course"
  - Computer: "the file '`most-important-work.txt`' has been removed"
  - User: Oops, damm
- The user is not reconsidering the overall action – it only prompts to think about the immediate action (clicking)
- A solution is to make the action reversible

Norman, Chapter 5

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Making things reversible

- Is a great solution –
  but where is the problem with it?

- What is the cost?

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Preventing Description Errors

- Related to Gestalt theory

- Example Car
  - Different openings for fluids, e.g. oil, water, break, …
  - Openings differ in
    - Size
    - Position
    - Mechanism to open
    - Color

- Design recommendations
  - Make controls for different actions look different

| print | save | send | off |

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Meet the Authors

5. November 2005
16.00 Uhr
AudiMax der LMU

Medieninformatiktreffen
and der LMU

Es sprechen
Ben Shneiderman
und **Andreas Holzinger**

- Ben Shneiderman. (1998) Designing the User Interface, 3rd Ed., Addison Wesley; ISBN: 0201694972
- Andreas Holzinger. (2001) Basiswissen Multimedia. Band 3: Design; ISBN: 3802318587

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