

2 Basic HCI Principles

2.1 Motivation: Users and Developers

2.2 Principle 1: Recognize User Diversity

2.3 Principle 2: Follow the 8 Golden Rules

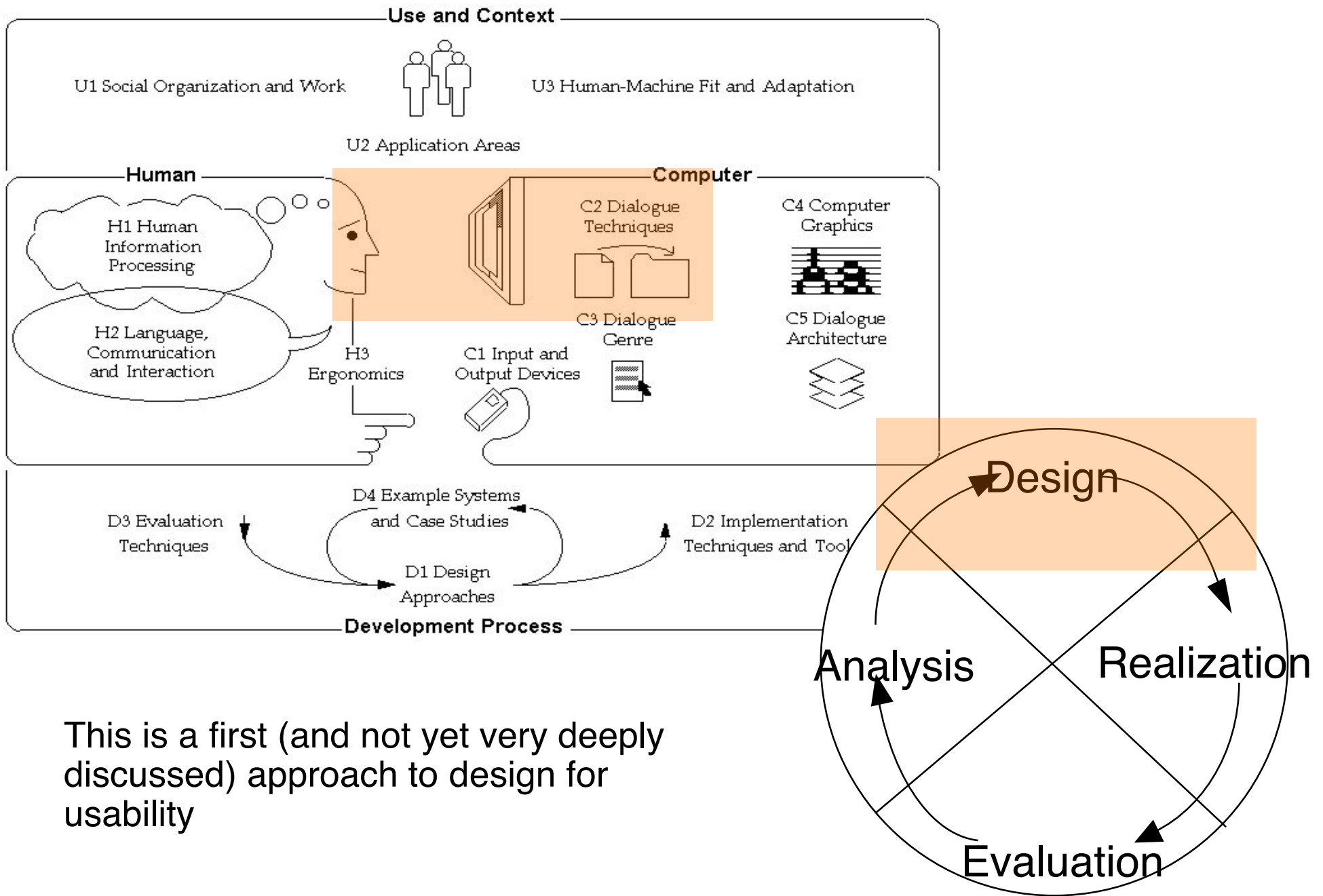
2.4 Principle 3: Prevent Errors

2.5 Background: The Psychology of Everyday Action

2.6 GOMS: Goals, Operators, Methods, Selection Rules

Corresponding extension topic:

E1 Fitt's Law



This is a first (and not yet very deeply discussed) approach to design for usability

What the User Sees

- Users see only what is openly visible!



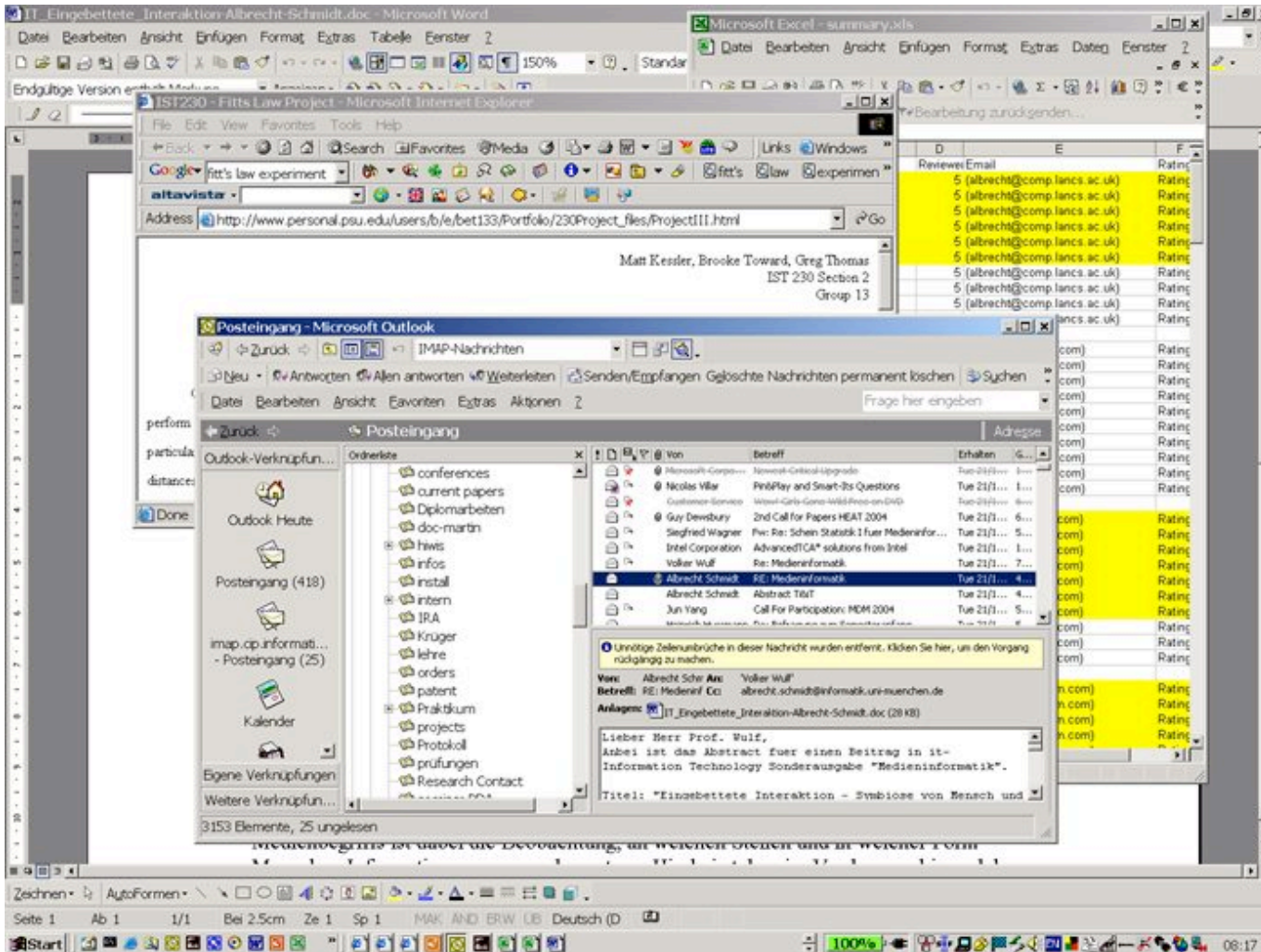
What the Developer Knows



- Users have little idea about:
 - architecture,
 - state transitions,
 - dependencies
 - application context
 - system restrictions
 - ...
- And users often do not want to know about it.



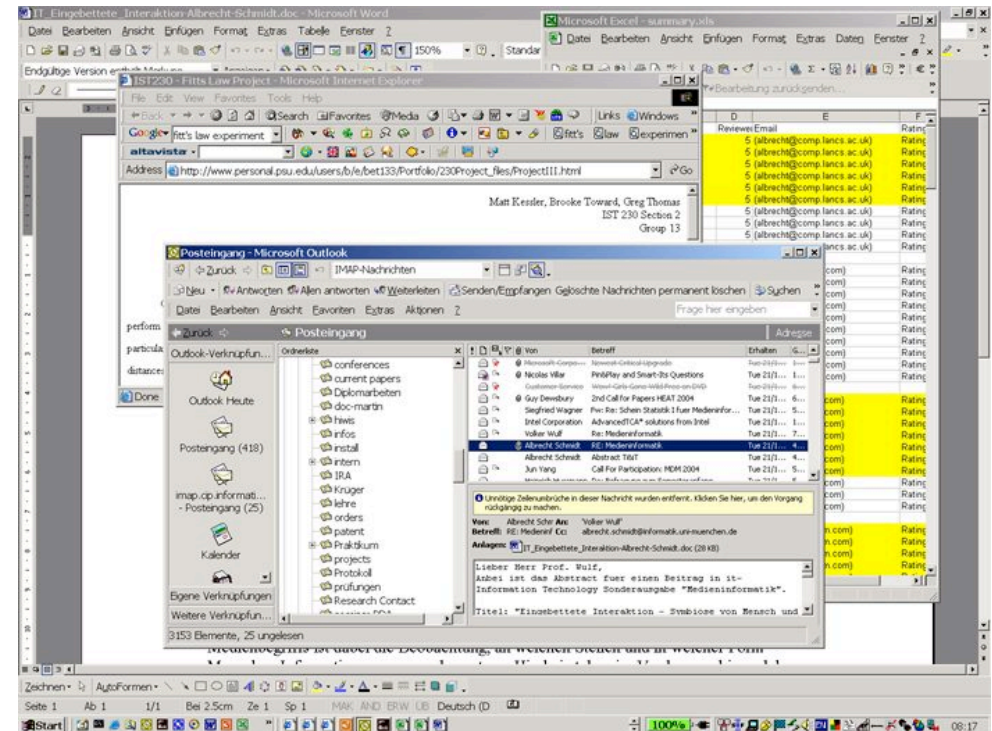
A Computer Screen and its Interpretation



- What do we see?
- What is shown?
- What is the meaning?

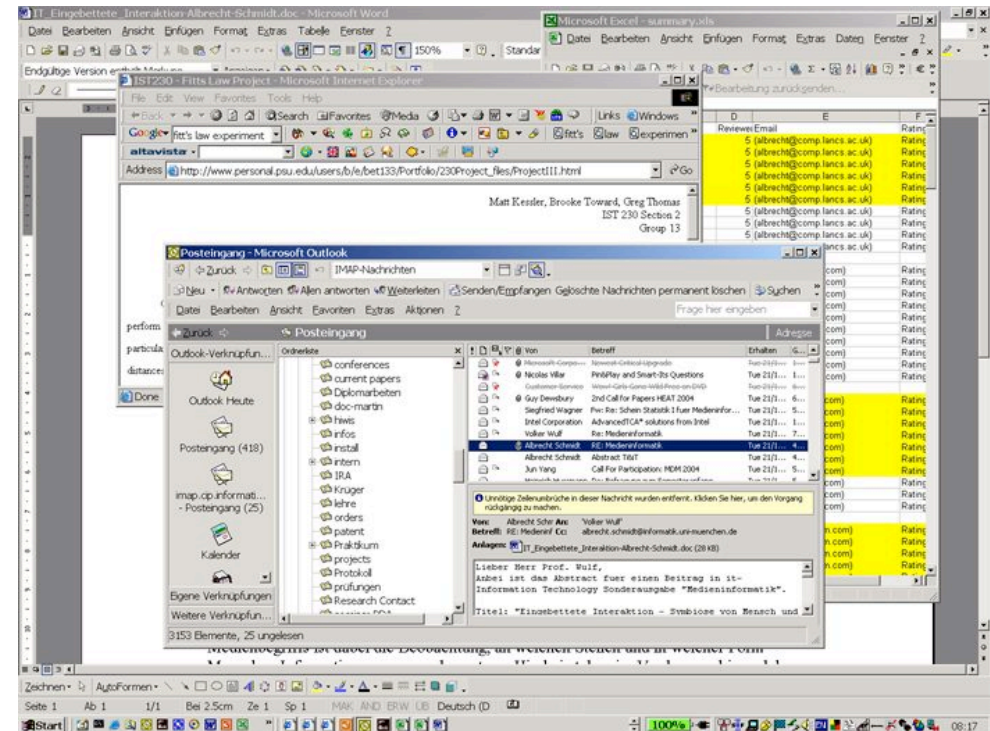
Answers from Skilled Computer Users

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



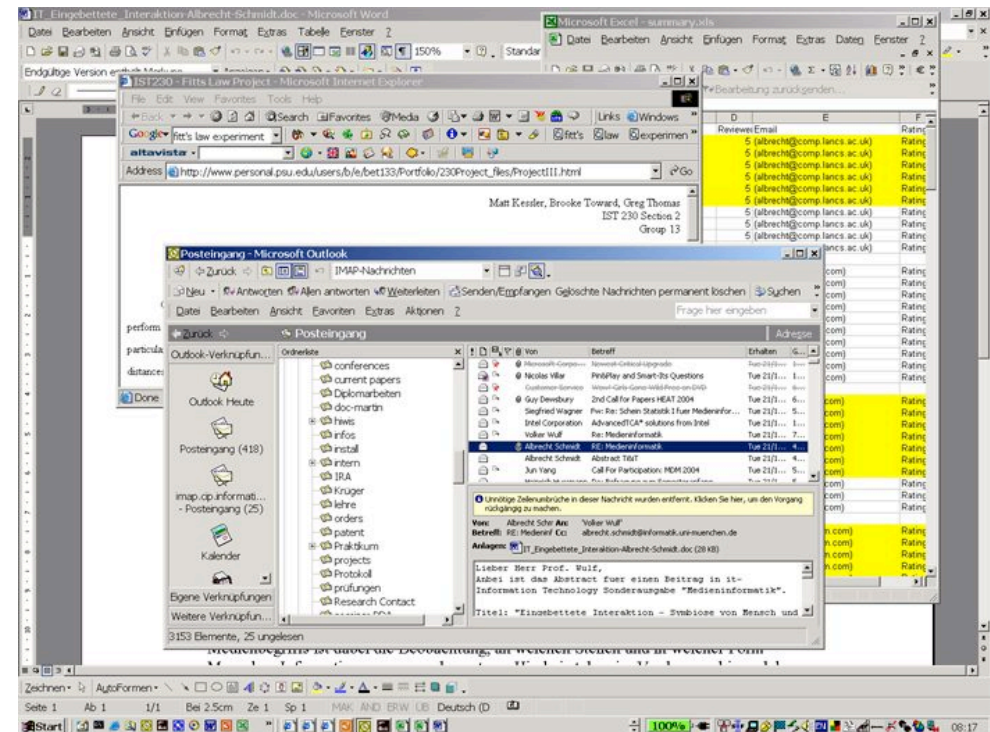
Basic (Naive) Technical Answers

- 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



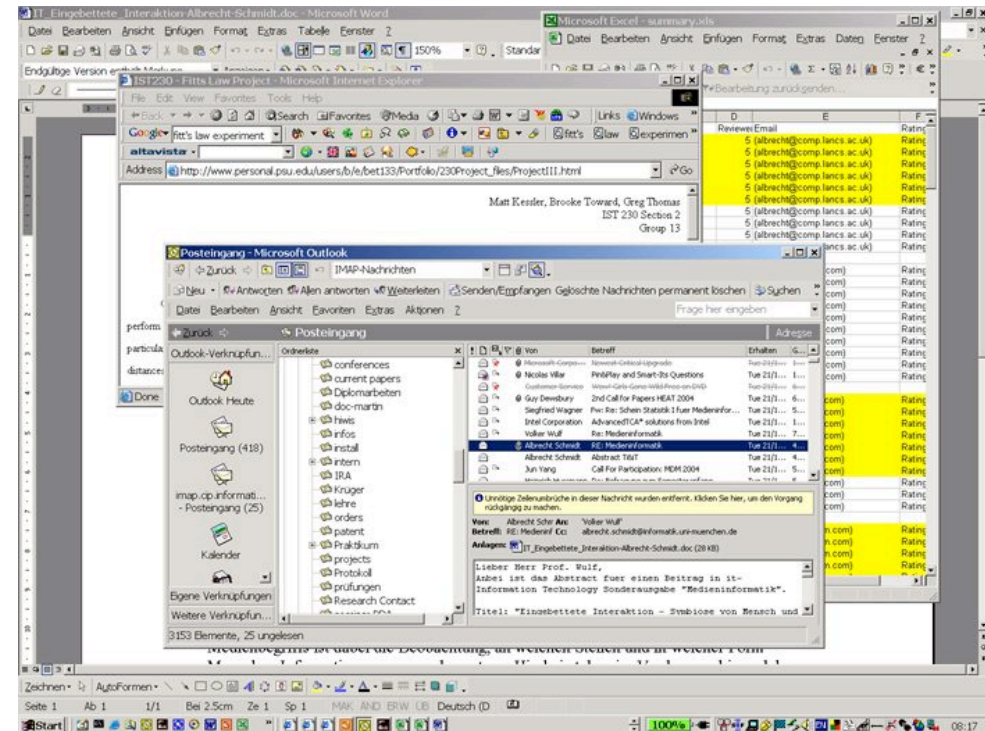
Perfect User's Answers

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



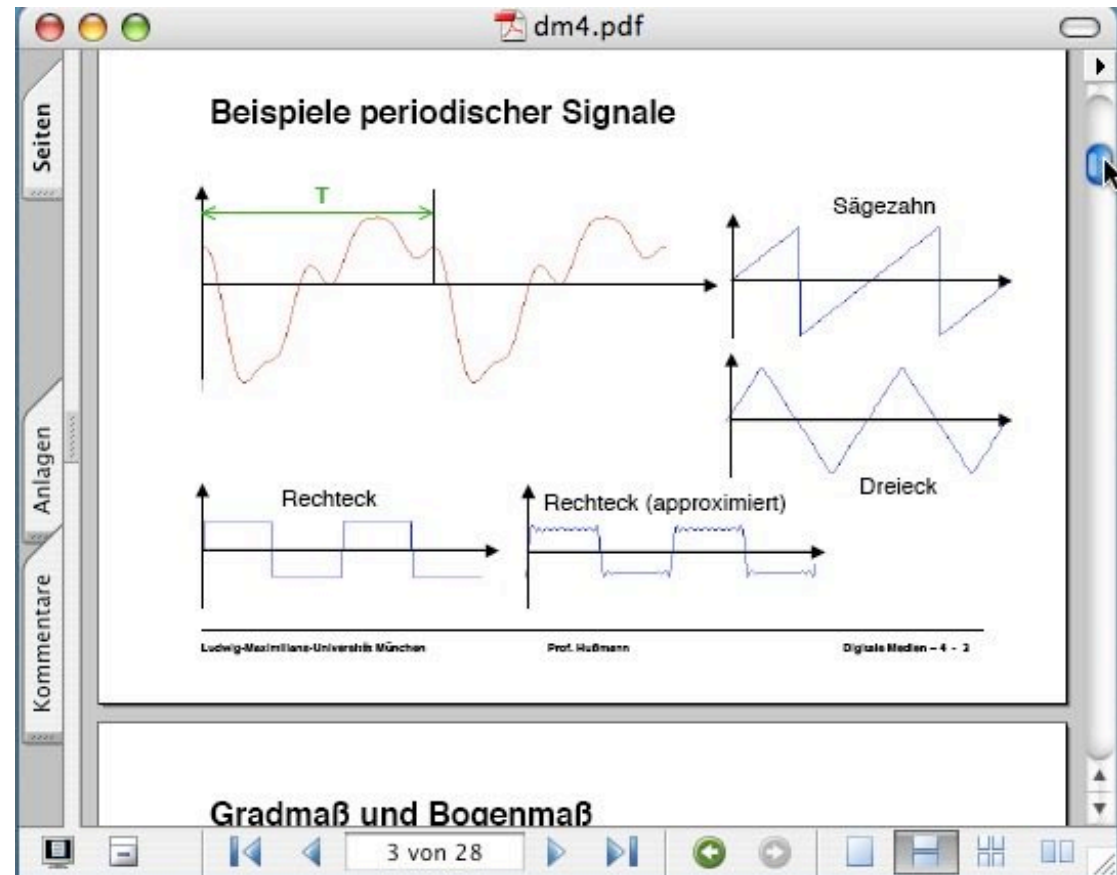
Metaphor Example 1 – Overlaying Windows

- What is the meaning of the fact that a window is behind another window?
- What is real?
What is illusion?
- What does iconizing do?
- Models?
Conceptual...
Implementation...
Represented...



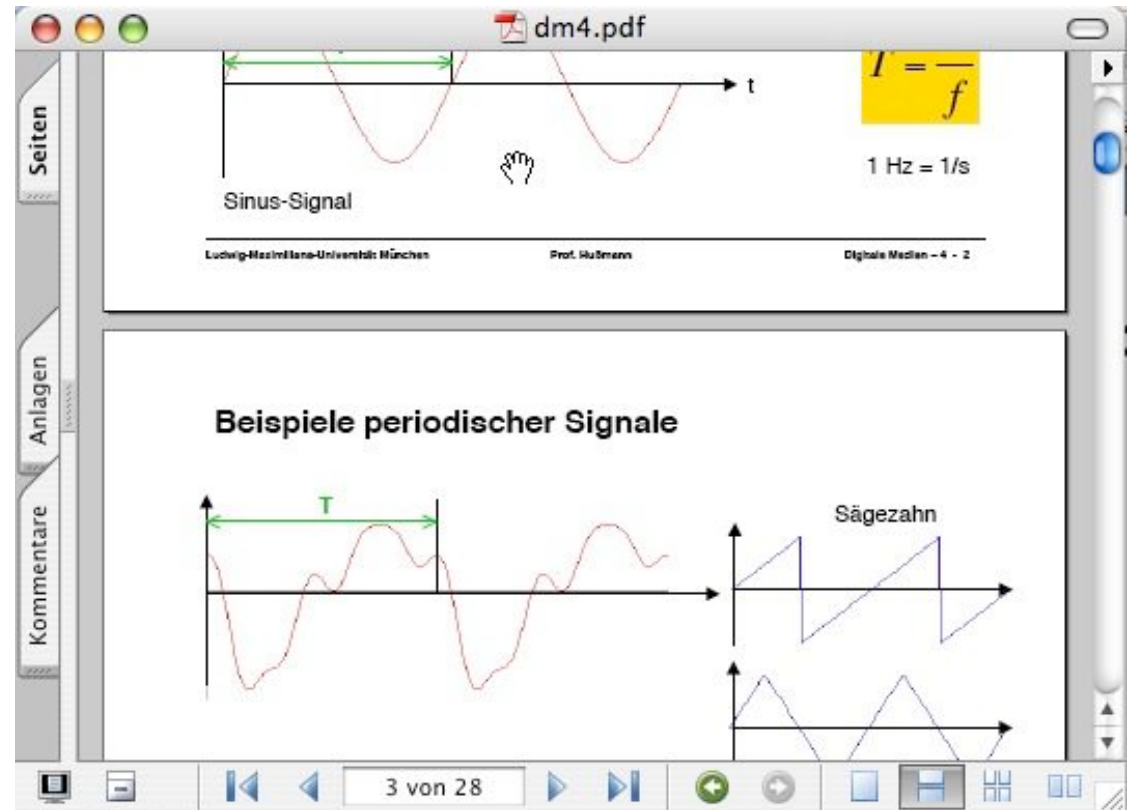
Metaphor Example 2 – Scrollbar vs. Hand

- Moving *up* the scroll bar moves *down* the document
- What happens in reality?
What do we imagine?
What is the metaphor?

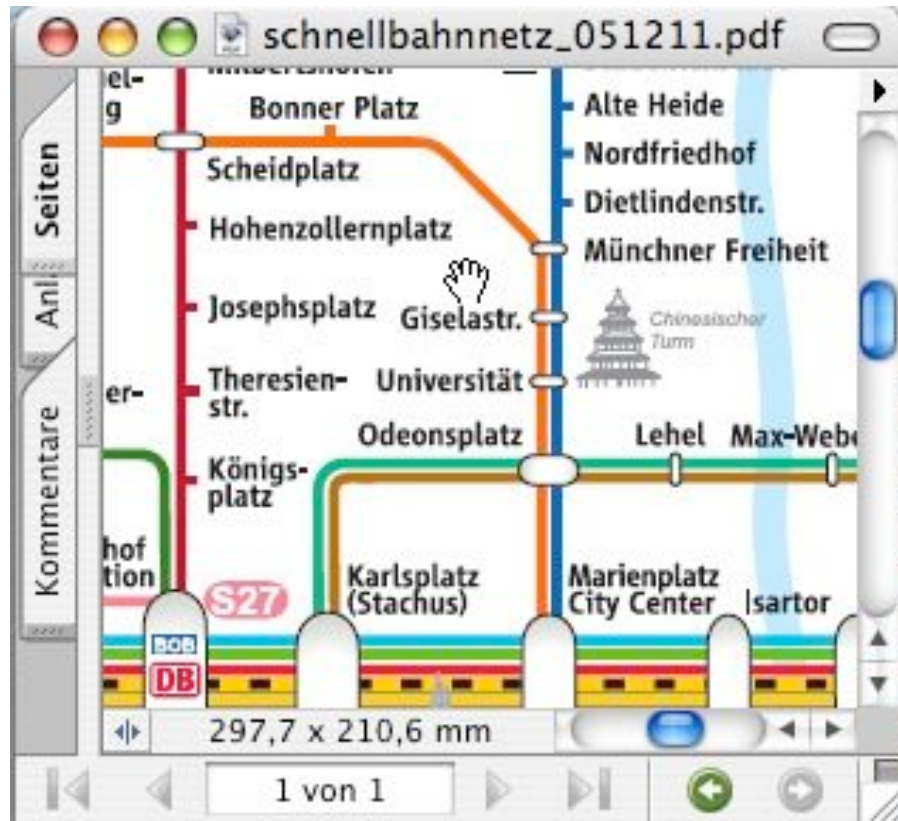


Metaphor Example 2 – Scrollbar vs. Hand (contd.)

- Moving *up* the hand
Moves *up* the document
- What happens in reality?
What do we imagine?
What is the metaphor?



Metaphor Example 2 - Scrollbar vs. Hand (contd.)



- Adequacy of interaction mechanism depends on content displayed

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Principles for User Interface (UI) design

- Implementation and technology independent principles
 - Provide a rough guideline for design
 - To be supplemented by more detailed analyses (see later)
- Ben Shneiderman's list of 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**
- Similar lists exist in several variants

Principle 1: Recognize User Diversity

- Simple and obvious - nevertheless in reality extremely difficult
- *Example:* consider an 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

Usage Profiles

- “Know thy user”
(Wilfred J. Hansen, User Engineering Principles for Interactive Systems, 1971)
- Starting point for design: What is the background of the user?
 - Different people have different requirements for their interaction with computers.
- Complex multi-dimensional classification problem!
- Issues to be taken into account:
 - Goals, motivation, personality
 - Education, cultural background, training
 - Age, gender, physical abilities, ...
 - Multiple user communities, various combinations of background
- Well-known and frequently used classification:
 - Novice users
 - Knowledgeable intermittent users
 - Expert frequent users

Task Profiles

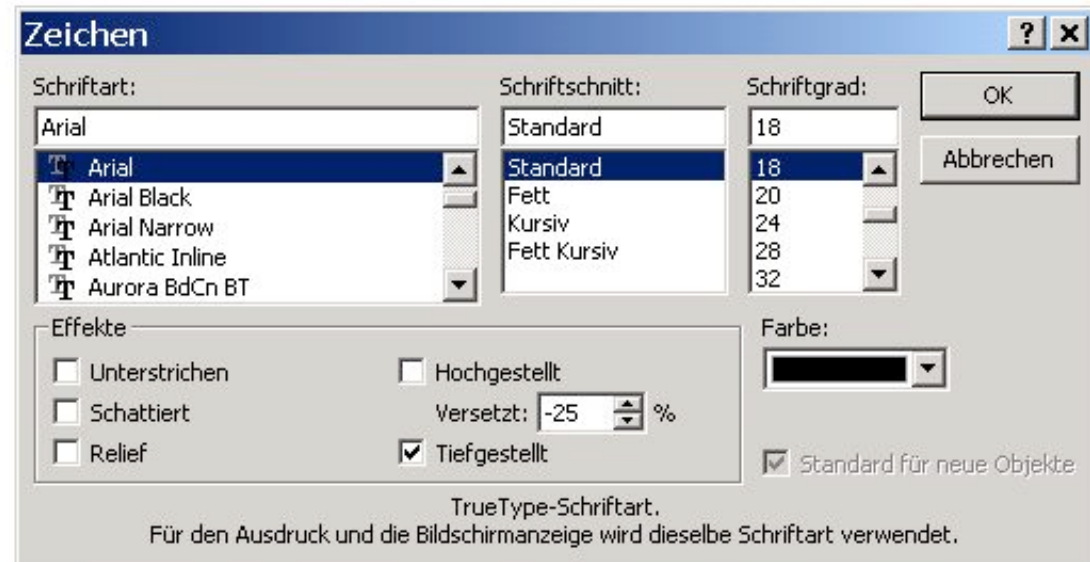
- The goal: Find out what the user is trying to do!
 - Needs of users, goals and resulting tasks
- Supported tasks should be determined before the design starts
 - Determine granularity of atomic tasks: Flexibility vs. ease of use
- Functionality should *only* be added if identified to help solving tasks
 - Temptation: Unneeded functionality should never be added just because it is “cheap” to achieve!
- Frequency of actions (relative to user profiles) leads to design choices
 - The more frequent an action, the easier its invocation
 - Example:
 - » Very frequent actions invoked by special keys (e.g. DEL)
 - » Intermediately frequent actions invoked by keyboard shortcut, special button, ...
 - » Infrequent actions invoked through menu selections, form fillins, ...

Hypothetical Frequency of Tasks

(Example of a booking system for travel)

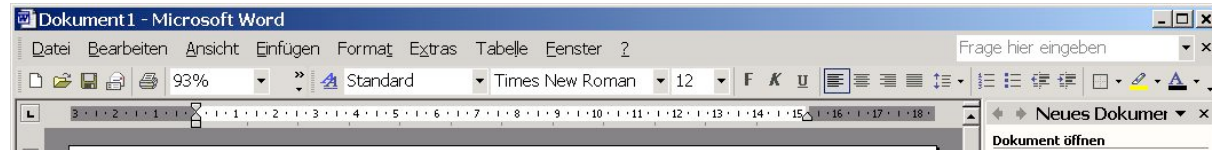
<i>Task</i>	Group reservation	Change of itinerary	Booking child care	Comparing sales agent performance
<i>Position</i>				
Sales agent	0.2	0.1	0.1	0
Manager	0	0	0	0.3
Family	0.05	0.05	0.3	0
Business traveler	0.01	0.2	0.01	0

Task Frequency - Examples

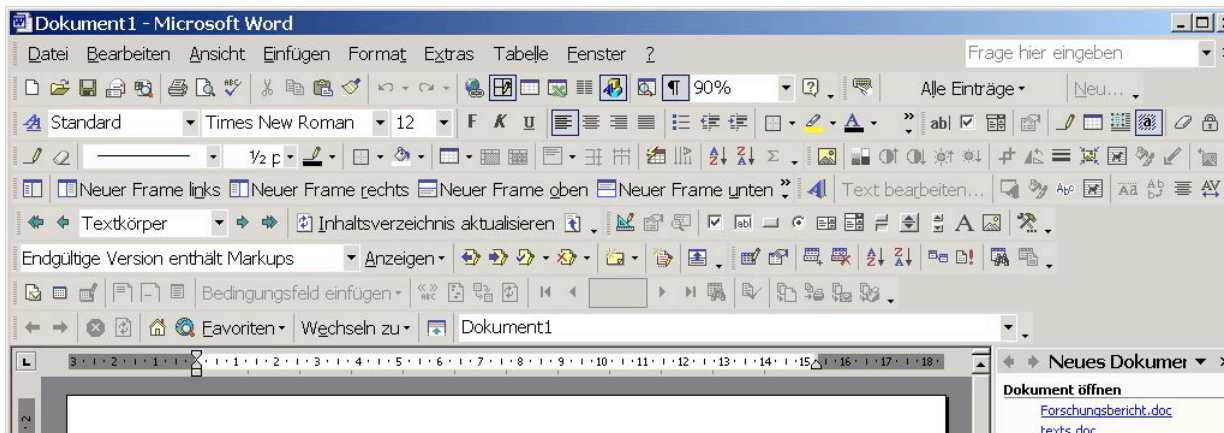


- Bold format is available in the toolbar
- Subscript requires menu and dialog
- Assumption for the standard UI is that user needs more often bold than subscript
- For users with different needs the customization is available

Task Frequency: Trade-off between quick access and over-crowded 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



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8 Golden Rules - Rule 1: Consistency

- Many forms of consistency:
 - Consistent sequences of actions in similar situations
 - Identical terminology used in prompts, menus, help screens
 - Consistent color, capitalization, layout, fonts etc.
- Bad example: WWW!
 - No real guidelines and no authority
 - » How are links represented?
 - » Where is the navigation?
 - Styles and “fashion” change quickly...



Multimodal Interacti
Department of Comp
Darmstadt University o

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Lehrveranstaltung Mensch-Maschine-Interaktion. springe zu den Volesungsunterlagen.
Wintersemester 2003/2004 Heinrich Hußmann, Albrecht ...
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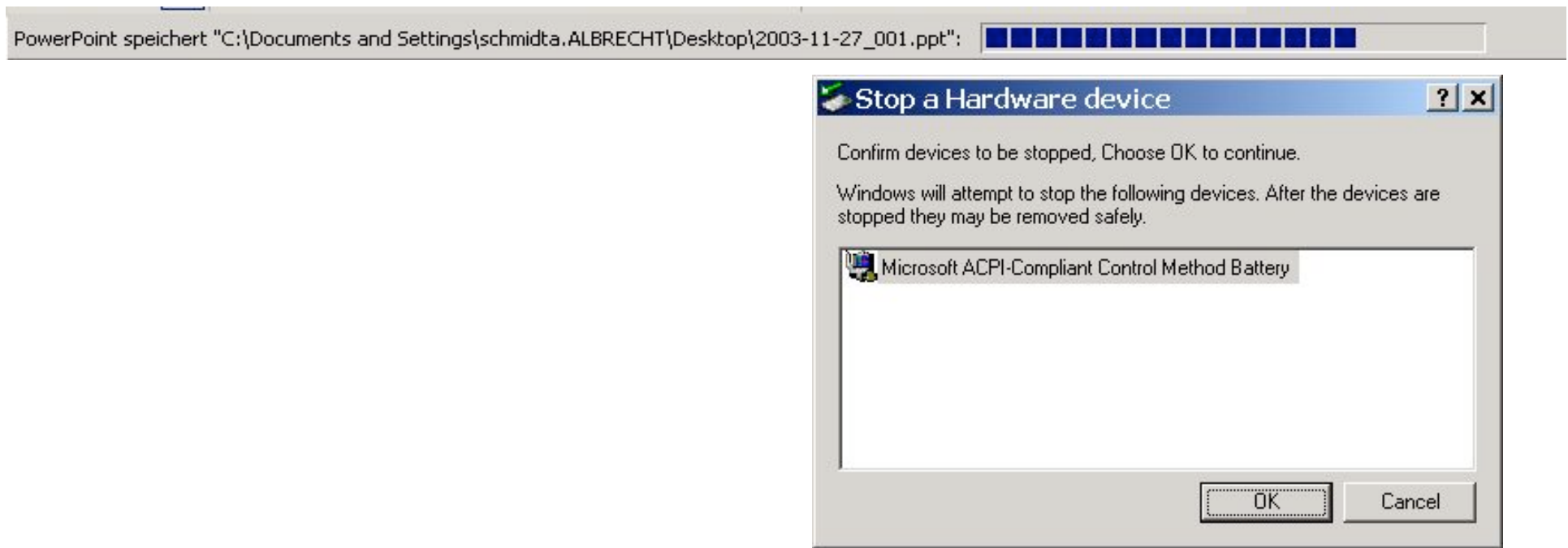
Deutsch · English

8 Golden Rules - Rule 2: Shortcuts

- Enable 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 & Apple applications for cut, copy and paste
 - However CTRL+S (saving a document) is only implemented in some applications...
 - Apple applications are more consistent in shortcuts (e.g. CTRL-S) due to early guidelines/toolkits for developers

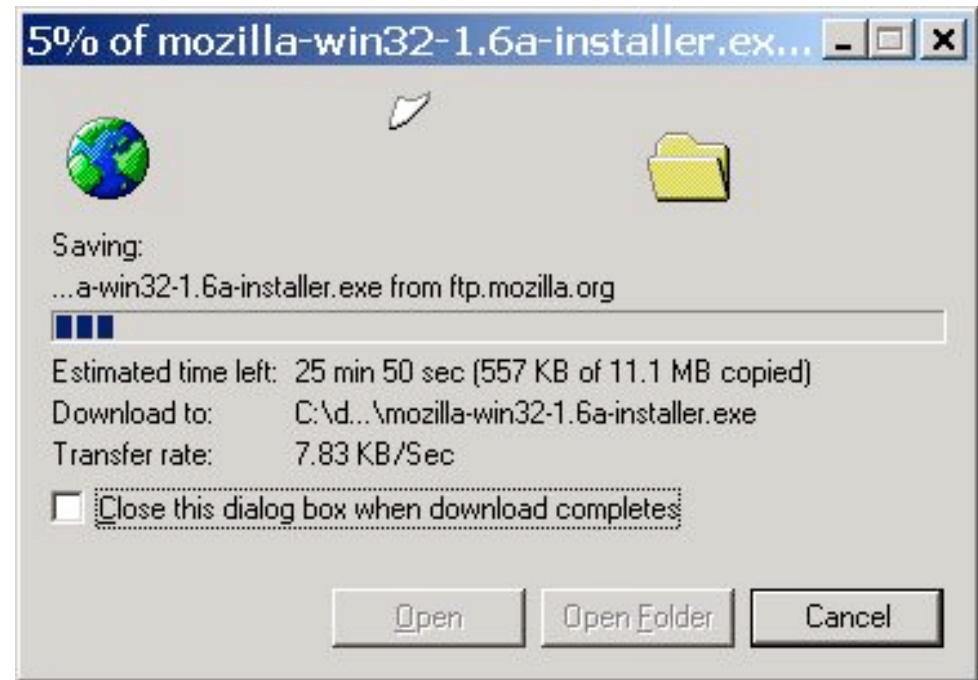
8 Golden Rules - Rule 3: Feedback

- For **any** action performed the user should have appropriate and informative feedback
- For frequent actions it should be modest, peripheral
- For infrequent actions it should be more substantial



8 Golden Rules - Rule 4: Closure

- Sequences of actions should have a beginning, middle, and end.
 - Satisfaction of accomplishment = relief
- 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



8 Golden Rules – Rule 5: Prevent Errors

- Create UIs that make it hard to make errors
 - Examples:
 - » Menus instead of commands
 - » Options instead of alphanumeric field (only certain values allowed)
- Detect errors or possible errors

– Examples

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



- Provides safety for the user
- Different options for handling:
 - 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 –

Rule 6: Permit Easy Reversal of Actions

- As a basic rule – all actions should be reversible
 - Relieves anxiety of users, encourages exploration of unfamiliar options
- Providing UNDO functions (possibly with infinite depth)
- Allow undo of groups of actions
- Undo is not trivial if user is not working sequentially
 - 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 looks, ... don't like it, ... go back to the old state”

8 Golden Rules - Rule 7: Feeling in Control

- Users (in particular experienced) like to feel to be in control of the system
- Gaines, 1981:
 - User should initiate actions (initiator instead of responder)
 - Avoid non-causality
- The system should be predictable
 - No surprising system actions, no tedious but unavoidable sequences of data entries, no unexpected silence or waiting state
 - Otherwise anxiety and dissatisfaction rise
- Note: Some current developments are in contrast, e.g.:
 - Proactive computing
 - Intelligent agents
- General tradeoff between transparency and intelligence of system

8 Golden Rules –

Rule 8: Reduce Short-term Memory Load

- The system should remember, not the user
 - George A. Miller, 1956: The magical number Seven, Plus or Minus Two
 - Humans can recall 7 +/- 2 chunks of information for a short time
- Interface designs have to be simple to comply with human memory
- 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 system does the following steps by showing the airport code)
- Helpful:
 - Keep dialogues compact (avoid splitting of pages)
 - Use memory aids (visual or audio) for mnemonics
- Apply rule with care
 - Sometimes complex menu structures are unavoidable
 - With sufficient training and support, also cryptic mnemonics are acceptable for frequent users

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More about rule 1: Consistency...

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Consistency (1)

- Consistency levels
 - lexical
 - syntactic
 - semantic
- Consistent
 - Delete/insert character
 - Delete/insert word
 - Delete/insert line
 - Delete/insert paragraph
- Inconsistent – variant 1
 - Delete/insert character
 - Delete/insert word
 - Remove/insert line
 - Delete/insert paragraph
- Inconsistent - variant 2
 - Take-away/insert character
 - Delete/add word
 - remove/put-in line
 - eliminate/create paragraph
- Inconsistent - variant 3
 - Character deletion/insertion
 - Delete/insert word
 - Line deletion/insertion
 - Delete/insert paragraph

Consistency (2)

- Lexical Consistency
 - Coding consistent with common usage, e.g.
 - » red = bad, green = good
 - » left = less, right = more
 - Consistent abbreviation rules
 - Equal length or first set of unambiguous chars.
 - Devices used same way in all phrases
 - Character delete key is always the same
- Syntactic Consistency
 - Error messages placed at same (logical) place
 - Always give command first - or last
 - Apply selection consistently, e.g. select text then apply tool or select tool and then apply to a text
 - Menu items always at same place in menu (muscle memory)

Consistency (3)

- Semantic Consistency
- Global commands always available
 - Help
 - Abort (command underway)
 - Undo (completed command)
- Operations valid on all reasonable objects
 - if object of class “X” can be deleted, so can object of class “Y”
- Applicability
 - to command line user interfaces
 - to keyboard short cuts
 - to speech interfaces
 - to tool bars
 - to menus
 - to selection operation
 - to gestures

Consistency Capture through Grammars

- Task-Action-Grammar (TAG), Reisner 1981
 - Task[direction,unit]→symbol[direction]+letter[unit]
 - Symbol[direction=forward]→"CTRL"
 - Symbol[direction=backward]→"ALT"
 - Letter[unit=word]→"W"
 - Letter[unit=paragraph]→"P"
- Example - Commands
 - Move cursor on word forward: CTRL-W
 - Move cursor on word backward: ALT-W
 - Move cursor on paragraph forward: CTRL-P
 - Move cursor on paragraph backward: ALT-P

Inconsistencies

- Dragging file operations?
 - folder on same disk vs. folder on different disk
 - file to trash can vs. disk to trash can
- Sometimes inconsistency is wanted
 - E.g. Getting attention for a dangerous operation
 - Consistency on semantic level may cause inconsistency on syntactic level
 - Example:
 - » Confirmation of operation is default option
 - » Confirmation of reformat command?

