# **3 Basic HCI Principles and Models**

- 3.1 Predictive Models for Interaction: Fitts' / Steering Law
- 3.2 Descriptive Models for Interaction: GOMS / KLM
- 3.3 Users and Developers
- 3.4 3 Usability Principles by Dix et al.
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- 3.6 Background: The Psychology of Everyday Action



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### 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**

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- 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 hand Moves *up* the document

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



### 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

 Adequacy of interaction mechanism depends on content displayed



## **Types of Design Rules**

- Principles
  - abstract design rules
- Golden rules and heuristics
  - more concrete than principles
- Standards
  - (very) detailed design rules
- Design pattern
  - generic solution for a specific problem
- Style guides
  - provided for devices, operating systems, widget libraries



increasing authority

- Authority: whether or not a rule must be followed or whether it is just suggested
- **Generality**: applied to many design situations or focused on specific application situation.

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## Usability 101 (by Jakob Nielson)

- "Usability is a quality attribute that assesses how easy user interfaces are to use. The word 'usability' also refers to methods for improving ease-of-use during the design process."
- Usability has *five quality components*:
  - Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?
  - Efficiency: Once users have learned the design, how quickly can they perform tasks?
  - Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency?
  - Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?
  - **Satisfaction**: How pleasant is it to use the design?

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## **Principles to Support Usability**

- Learnability
  - the ease with which new users can begin effective interaction and achieve maximal performance
- Flexibility

- the multiplicity of ways the user and system exchange information

- Robustness
  - the level of support provided to the user in determining successful achievement and assessment of goal-directed behavior

Dix, A. J., Finlay, J., Abowd, G., Beale, R. Principles to support usability, Human-Computer Interaction, 260-273, Third Edition

# Principles of Learnability (1 / 2)

- Predictability
  - determining effect of future actions based on past interaction history
  - operation visibility
- Synthesizability
  - ability of the user to assess the effect of past operations on the current state
  - the user should see the changes of an operation
  - immediate vs. eventual feedback









C:\WINDOWS\system32\cmd.exe
C:∖>move test.txt test
C:\>dir *.txt Volume in drive C has no label. Volume Serial Number is FCB2-566A
Directory of C:\
25.05.2007 12:36 0 installDebug.txt 1 File(s) 0 bytes 0 Dir(s) 14,052,261,888 bytes free
C:\>cd test
C:\test}dir *.txt Volume in drive C has no label. Volume Serial Number is FCB2-566A
Directory of C:\test
19.11.2007 16:56 0 test.txt 1 File(s) 0 bytes 0 Dir(s) 14,052,261,888 bytes free

::\test>

## Principles of Learnability (2 / 2)

- Familiarity
  - how prior knowledge applies to new system
  - affordance (guessability)
- Generalizability
  - extending specific interaction knowledge to new situations
- Consistency
  - likeness in input/output behavior arising from similar situations or task objectives







# **Principles of Flexibility (1 / 6)**

- Ways in which the user and the system exchange information
- Dialogue initiative
  - freedom from system imposed constraints on input dialogue
  - user preemptiveness: user initiates dialog
  - system preemptiveness: system initiates dialog

Open Explore		Confirm File Replace
Search Sharing and Security	y	This folder already contains a file named 'x'.
Contractions and the second se	•	Would you like to replace the existing file
Scan for Viruses Send To	•	0 bytes modified: 22 November 2007, 11:26:07
Cut Copy		í with this one?
Create Shortcut Delete		0 bytes modified: 22 November 2007, 11:26:14
Properties		Yes No

# Principles of Flexibility (2 / 6)

- Multithreading
  - ability of system to support user interaction for several tasks at a time
  - concurrent multimodality: simultaneous communication of information pertaining to separate tasks
    - » multi-model dialog
    - » editing text and beep (incoming mail) at the same time
  - interleaving multimodality: permits temporal overlap between separate tasks, dialog is restricted to a single task
    - » window system, window = task
    - » modal dialogs
    - » interaction with just one window at a given time



## Principles of Flexibility (3 / 6)

- Task migratability
  - passing responsibility for task execution between user and system

Task migratability

- example: spell checking

TUSK	<u>iiiig</u> i aca s		
Spelling			×
Not in Dictionary <u>:</u>	migratability		
Change <u>t</u> o:	irritability	Ignore	Ignore All
Suggestions:	irritability	⊆hange	Change All
		Add	<u>S</u> uggest
Add <u>w</u> ords to:	CUSTOM.DIC	AutoCorrect	Close

# Principles of Flexibility (4 / 6)

- Substitutivity
  - allowing equivalent values of input and output to be substituted for each other
  - representation multiplicity



- equal opportunity: blurs the distinction between input and output



	A	В	С	D	
1					
2	Summand 1	1	2	1	
3	Summand 2	2	2	2	
4	Summand 3	3	3	3	
5	Total sum	6	7	6	
C.					

# Principles of Flexibility (5 / 6)

- Customizability
  - modifiability of the user interface by the user (adaptability) or system (adaptivity)
  - adaptability: users ability to adjust the form of input and output



# **Principles of Flexibility (6 / 6)**

- Customizability
  - modifiability of the user interface by the user (adaptability) or system (adaptivity)
  - adaptability: users ability to adjust the form of input and output
  - adaptivity: automatic customization of the user interface by the system

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# Principles of Robustness (1 / 2)

- → Level of support provided to the user in determining successful achievement and assessment of goal-directed behavior
- Observability



- ability of the user to evaluate the internal state of the system from its perceivable representation
- Recoverability
  - ability of the user to correct a recognized error
  - reachability (states): forward (redo) / backward (undo) recovery
  - commensurate effort (more effort / steps for deleting a file than for moving it)

Total Co	ommander 🔀
?	Do you really want to delete the selected file AUTOEXEC.BAT?
	Yes <u>N</u> o Cancel

## Principles of Robustness (2 / 2)

- Task conformance
  - degree to which system services support all of the user's tasks
  - task completeness; task adequacy
- Responsiveness
  - how the user perceives the rate of communication with the system
  - preferred: short durations and instantaneous responses (< 100ms)
  - stability and indication of response time



# **3 Usability Principles by Dix**

- Learnability
  - Predictability
  - Synthesizability
  - Familiarity
  - Generalizability
  - Consistency
- Flexibility
  - Dialogue initiative
  - Multithreading
  - Task migratability
  - Substitutivity
  - Customizability

- Robustness
  - Observability
  - Recoverability
  - Responsiveness
  - Task conformance

[Section 7.2 in Dix. "Human Computer Interaction"]

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