

Lecture 17: Usability

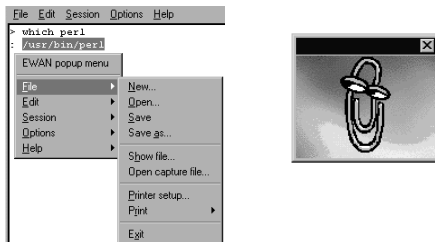
6.170 Lab in Software Engineering
October 21, 2002

A Few Examples



Source: Interface Hall of Shame

More Examples



Source: Interface Hall of Shame

User Interface Matters

- UI strongly affects perception of software
- Costs
 - UI accounts for 50% of design time, implementation, maintenance, and code size
 - Users' time isn't getting cheaper
 - Design it right now, or pay for it later
- Disasters
 - Therac-25
 - Aegis radar system in USS Vincennes

UIs are Hard to Design

- You are not the user
 - "Know thy user"
- The user is always right
 - Consistent errors are the system's fault
- ...but the user is not always right
 - Users aren't designers
- Online help doesn't
- User testing is costly

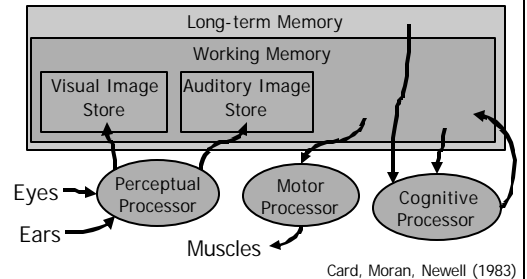
Usability is Multidimensional

- **Learnability:** easy to learn?
- **Efficiency:** fast to use?
- **Memorability:** easy to remember what you learned?
- **Errors:** few and recoverable?
- **Satisfaction:** enjoyable to use?

Outline

- The human machine (a brief look)
 - Perception, motor, memory, color
- Usability engineering techniques
 - Iterative design
 - Low-fidelity prototypes
 - Heuristics
 - User testing

Model Human Processor



Properties of Model Human Processor

- Processors have cycle time
 - Perceptual: $T_p \sim 100\text{ms}$
 - Motor: $T_m \sim 70\text{ms}$
 - Cognitive: $T_c \sim 70\text{ms}$
- Memories have size, decay time, encoding

Perception

- Perceptual fusion
 - Two stimuli within the same perceptual processor cycle ($T_p \sim 100\text{ms}$) seem fused
 - Movie frame rate
 - 10 frames per sec is enough for average user
 - Responses within T_p feel instantaneous
 - Causality strongly influenced by fusion

Motor Skills

- Moving your hand to a target involves a sequence of corrections
 - Cycle time = $T_p + T_c + T_m \sim 240\text{ms}$
 - One cycle covers distance D with error eD
- Fitts's Law
 - Time T to move your hand to a target of size S at distance D away is:
 - $T = a + b \log(D/S)$
 - Depends only on relative precision required

Memory

- Working memory
 - Small capacity: 7 ± 2 "chunks"
 - B, M, W, R, C, A, A, O, L, I, B, M
 - BMW RCA AOL IBM
 - Fast access ($\sim 70\text{ms}$) and fast decay (a few seconds, depends on # of chunks)
- Long-term memory
 - Huge capacity, slower access time ($\sim 100\text{ms}$), little decay

Color

- Color blindness
 - Red-green color blindness affects 8% of males, 0.4% of females
- Chromatic aberration
 - Lens can't focus blue and red simultaneously
 - So blue-on-red text looks fuzzy (and hurts!)
- Fovea has no blue cones
 - Can't resolve tiny blue features on dark backgrounds

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Iterative Design

- Usability engineering (like all software design) is an iterative process
 - Design, implement, evaluate, repeat
 - Do you want the design cycle to be internal, or visible to your customers?
- "Spiral model"
 - Use throw-away prototypes and cheap evaluation for first few iterations

Further Reading

- Good and bad user interfaces
 - Interface Hall of Shame, <http://www.iarchitect.com/>
 - Jeff Johnson, *GUI Bloopers*, Morgan Kaufmann 2000.
 - Don Norman, *The Design of Everyday Things*, Doubleday 1998.
- Disasters
 - Therac-25 <http://sunnyday.mit.edu/therac25.html>
 - USS Vincennes/Aegis accident <http://www.stanford.edu/~lswartz/acad/vincennes.pdf>
- Model Human Processor
 - Card, Moran, Newell, *Psychology of Human-Computer Interaction*, Erlbaum & Associates, 1983.
- Color
 - C. Lilley, F. Lin, W.T. Hewitt, T.L.J. Howard. "Colour in Computer Graphics." http://info.mcc.ac.uk/CGI/ITTI/Col/colour_announce.html