

CS 4530: Fundamentals of Software Engineering

Lesson 6.1 UI Design / User-Centered Design

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Learning Objectives for this Lesson

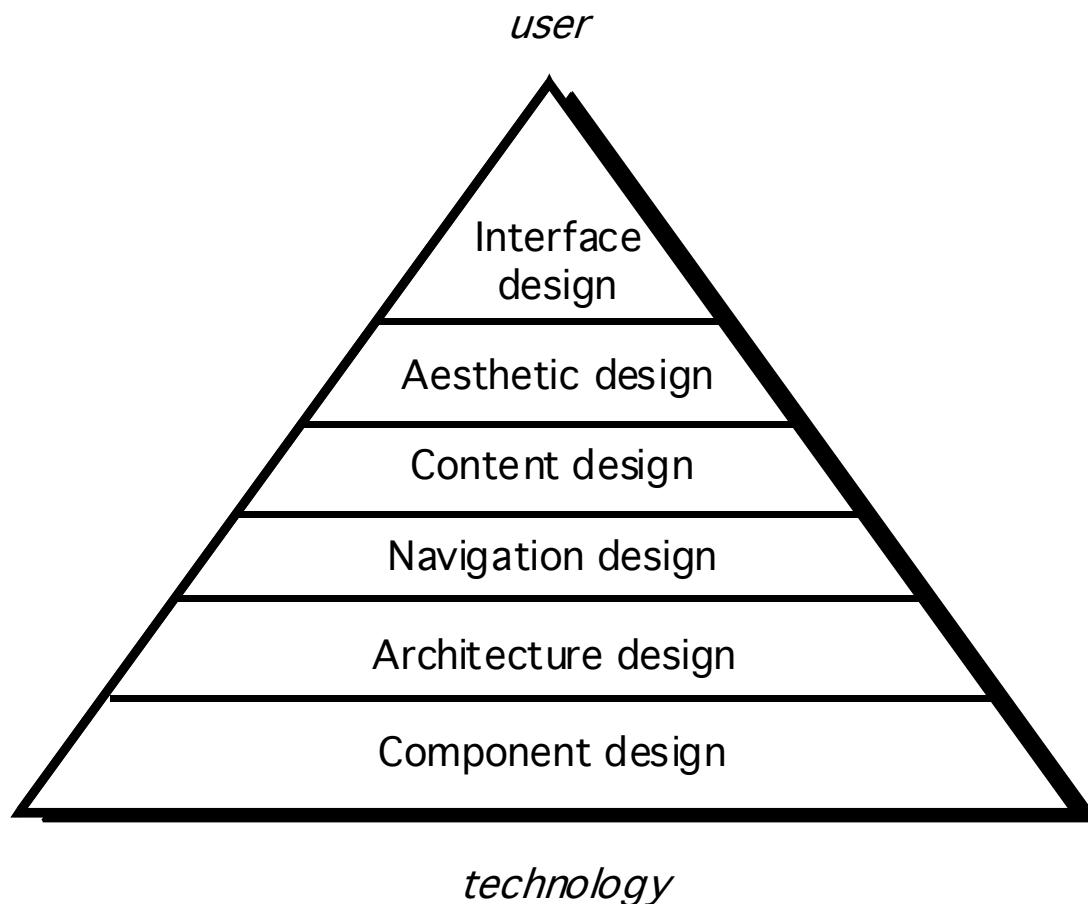
- By the end of this lesson, you should be able to:
 - Describe the major aspects of usability;
 - Articulate the process of user-centered design;
 - Explain several heuristics for good user interaction.

Goal: Build the Right Product

- If the product doesn't do what the users want...
 - ... we've wasted time and money.
- If the product is not usable by the users...
 - ... we will need to invest time/money to make it usable.
- Users are often not sure exactly what they want,
 - ... so we iterate the requirements process.
- We shift development “to the left” (closer to user)
 - We correct mistakes
 - Before design, or else
 - Before coding, or else
 - Before debugging, or else
 - Before deployment.

The earlier,
The better!

UI Design is important part of the link between user and technology



- Software Design includes a lot more than just designing components and architecture
- Important to design:
 - User Interfaces
 - Contents
 - Navigation
- We want “Usable” software

Usable or Unusable?



Usable or Unusable?



From Don Norman, Psychology of Everyday Things (c 1988)

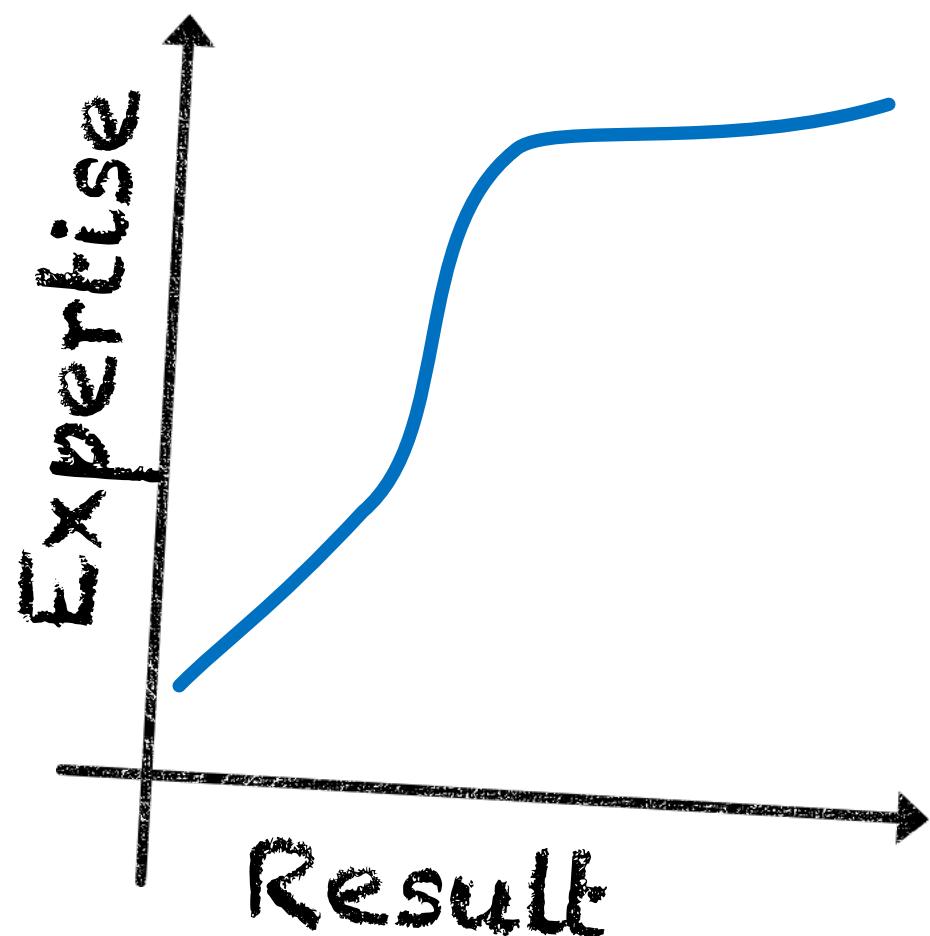
“Usability”: a Definition

- *Usability* is ...
- ... a measure of how ...
 - ... an artifact ... ←
 - ... impacts ...
 - ... a human ...
 - ... with particular goals.

For us:
a software artifact

The goals are key!

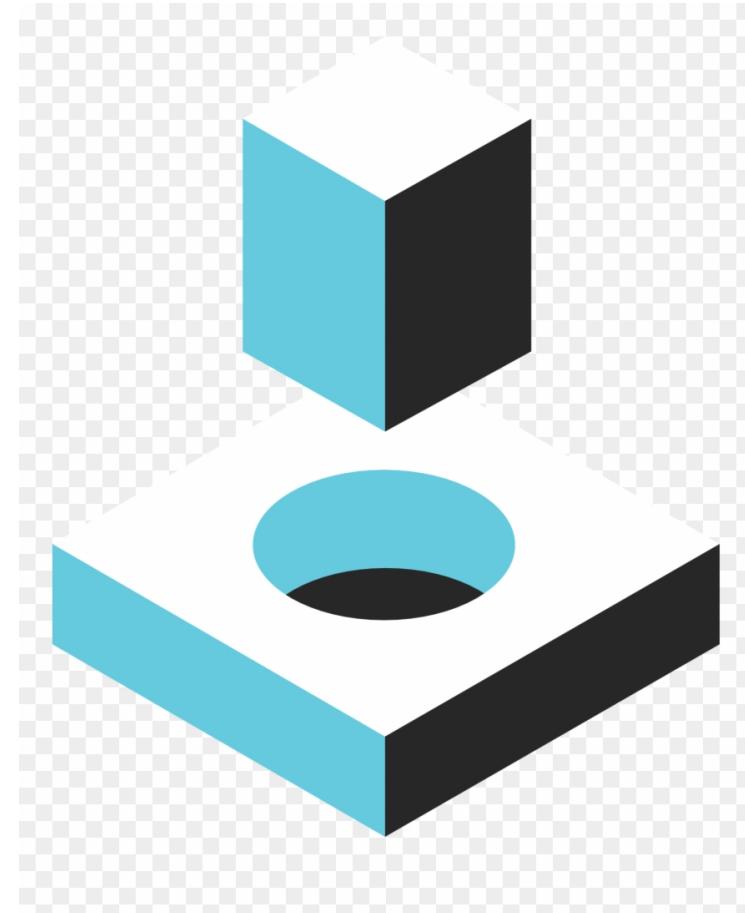
Usability Characteristics (1 of 5): Learnability



- How easy is it to learn to use the artifact to accomplish a goal?
- A “steep” learning curve requires a lot of expertise before one can achieve results.

Usability Characteristics (2 of 5): Effectiveness

- How often does the use lead to completion of a goal?
- Is the artifact “fit for purpose”?



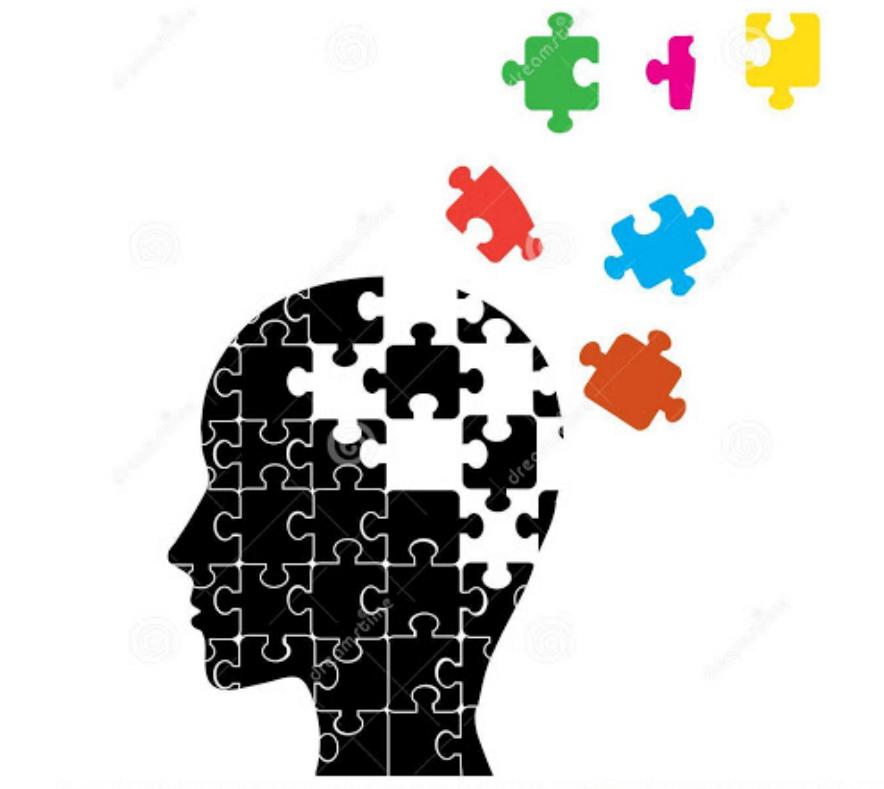
Usability Characteristics (3 of 5): Productivity

- How large a multiplier of human effort does this artifact give?
- Does it make hard things easy?
(or the reverse!)



Usability Characteristics (4 of 5): Retainability

- How long is the ability to use the artifact retained between uses?
- Inner consistency can help mitigate a steep learning curve.



Usability Characteristics (5 of 5): Satisfiability

- How pleasant is the artifact to use?
- Is it elegant and simple?



Why study Usability?

- It is crucial for user satisfaction



Crash of AA Flight 965

http://en.wikipedia.org/wiki/American_Airlines_Flight_965



Adapted from Maneesh Agrawala & Bjoern Hartmann



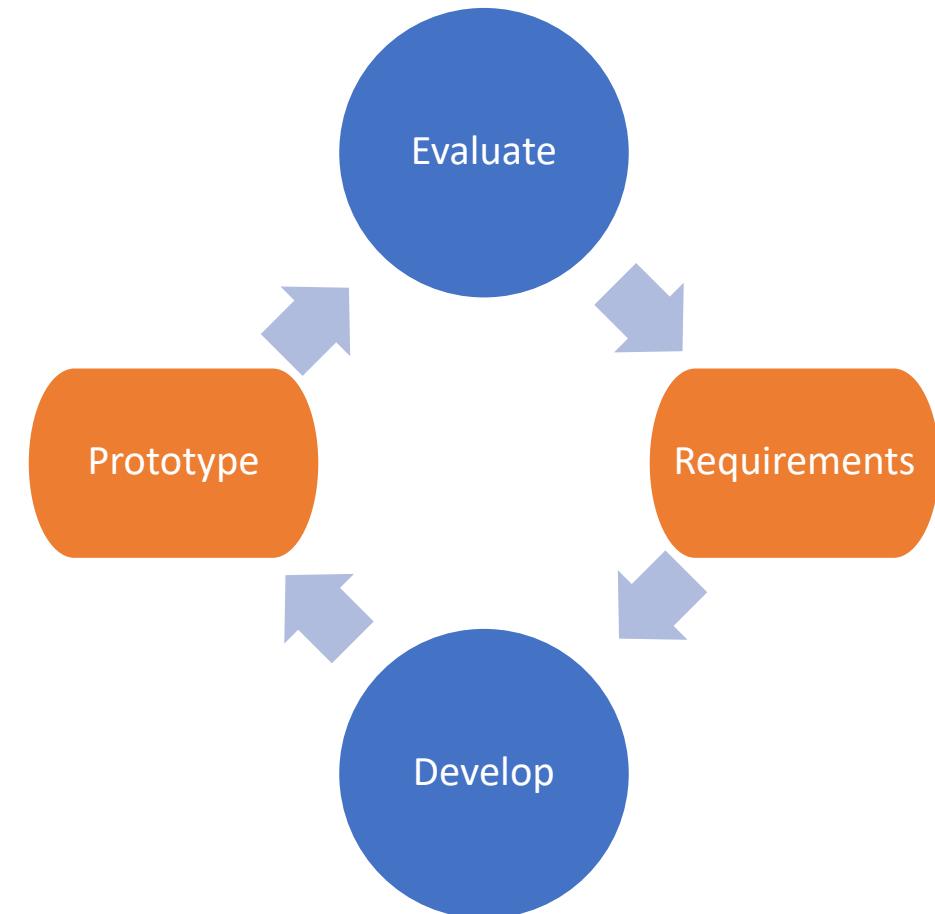
Airbus A350 Cupholders

“Usability

- **Not...**
 - “dummy proofing”
 - being “user-friendly”
 - making software pretty
- **Usability IS:**
 - Recognize: “The user may not be like me”
 - Understanding user needs, tasks, goals
- **User’s mental model *matches with* designer’s mental model**

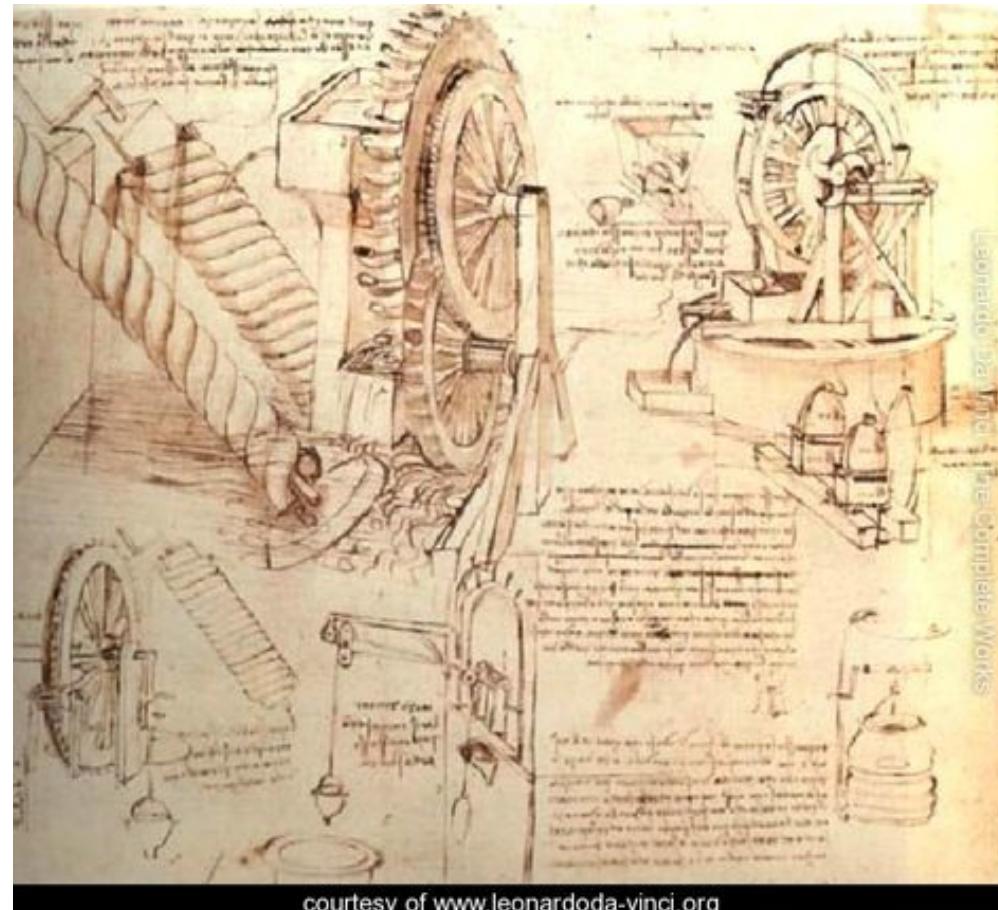
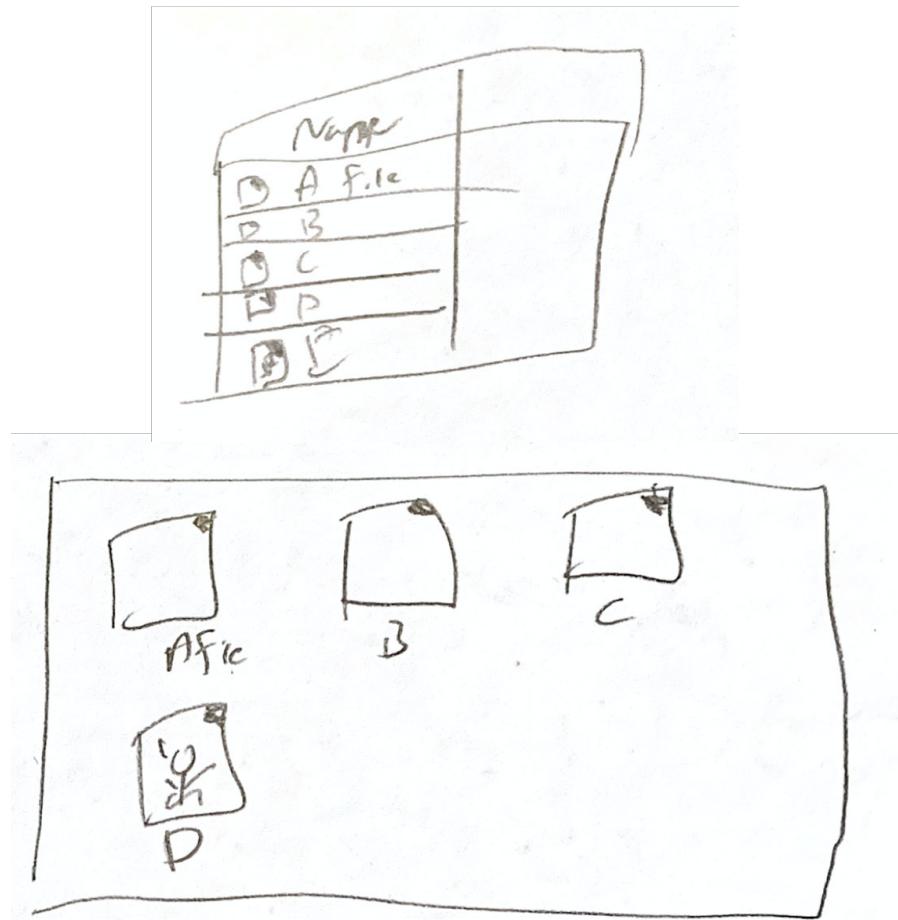
User-Centered Design

- A system is evaluated from the user viewpoint.
 - Ideally by the users!
- Tension: when do we evaluate?
 - An incomplete product may not be usable;
 - If a product is complete, using evaluation has cost.
- Resolution: evaluate *prototype*!



Key Idea: Design Alternatives

- Use sketches



courtesy of www.leonardoda-vinci.org

Key Idea: Design Alternatives

- Think broadly with wide range of possible designs then choose “one”

The image shows a file system interface with two main windows side-by-side, illustrating different design approaches for course materials.

Left Window (Design Alternative 1):

- Root folder contains: academic-integrity.html, css, description.html, handouts, Homeworks, img, index.html, js, link to origin.html.url, MaterialsByWeek, other-policies.html, pdf, pol.html, README.md, sched.html.

Right Window (Design Alternative 2):

- Root folder contains: CS4530-CS...0-Fall2020, CS4530-CS...020-Private, Videos.
- CS4530-CS...0-Fall2020 folder contains: academic-integrity.html, css, description.html, handouts, Homeworks, img, index.html, js, link to origin.html.url, MaterialsByWeek, other-policies.html, pdf, pol.html, README.md, sched.html.
- CS4530-CS...020-Private folder contains: hw0-git.html, hw0-zip-contents, hw0.html, hw0.zip, hw1.html, hw2.html, logs, project-overview.html.

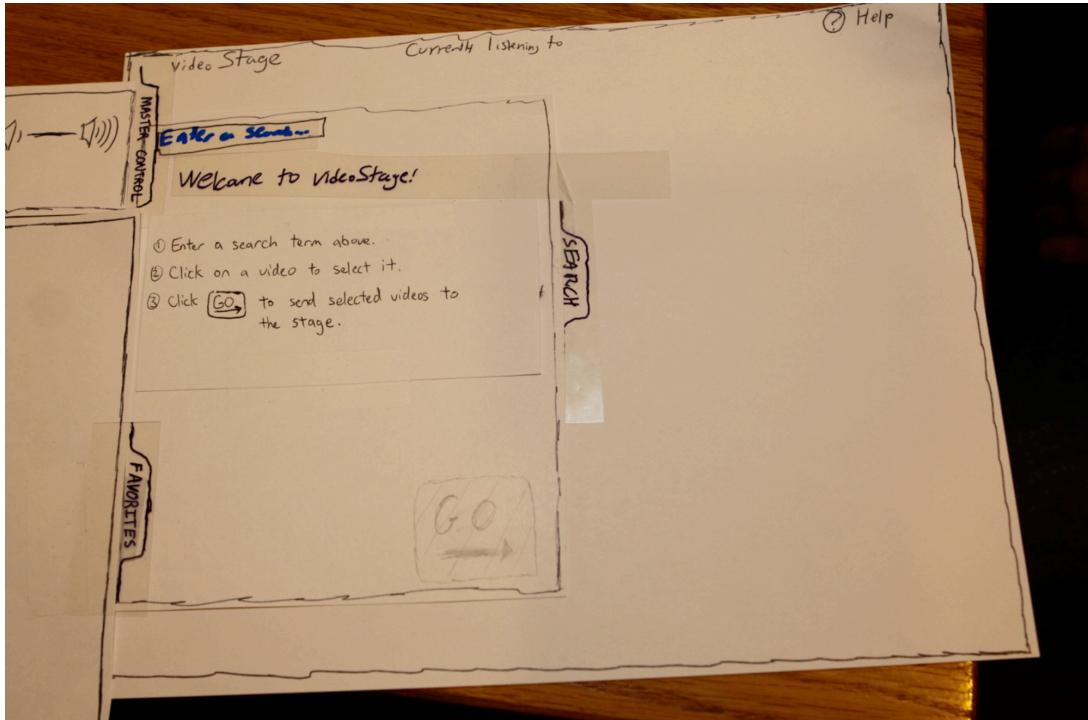
Bottom Left: A screenshot of a course schedule application showing weeks 1 and 2 with various notes and topics.

Bottom Center: A screenshot of a file card for "sched.html".

Bottom Right: A grid of icons representing files and folders from the file system, including:

- HTML files: academic-integrity.html, other-policies.html
- Folders: css, description.html, handouts, Homeworks, img, pdf, pol.html, README.md, sched.html
- Other files: hw0-git.html, hw0-zip-contents, hw0.html, hw0.zip, hw1.html, hw2.html, logs, project-overview.html
- Special icons: URL, More...

Prototype (1 of 3): Paper Simulation



- Hand-drawn user interfaces:
 - on paper or card;
 - made on the spot.
- Developers animate:
 - Present to test user;
- Users act:
 - Indicate what they would do.
- Advantage: *fast turnaround, cost less, allow more iterations*

Prototype (2 of 3): Wizard-of-Oz

- Software has right “look”
 - But barely functional.
- Scripted interaction only
 - All responses are “canned.”
- Illusion is effective.

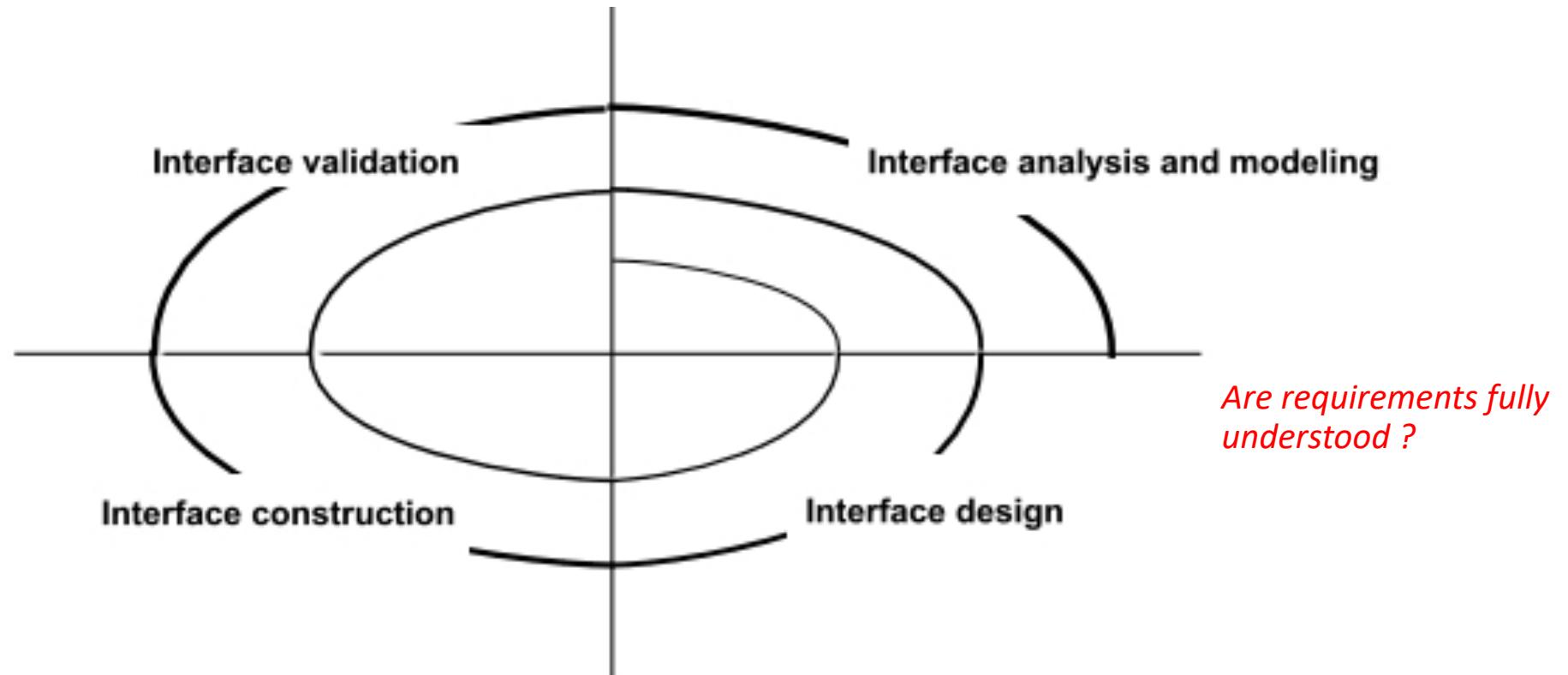


Prototype (3 of 3): Working Prototype

- The software system partly implemented:
 - User interface fully realized;
 - Functionality limited.
- Particularly for feature requests:
 - New feature can get quick-and-dirty implementation
 - Quickly get feedback if the right feature is implemented.
- Comparison of UCD with TDD:
 - In TDD: feature request is realized in a test;
 - In UCD: feature request is realized in a user-interface.

In both cases, we delay implementation until more understanding gained:
Move decisions closer to customers.

User-Centered Design is *refined*



Tips for Aesthetic Design (UI Design)

- Don't be afraid of **white space**.
- Emphasize content that meets user needs.
- Organize **layout** elements from top-left to bottom right.
- Group navigation, content, and function geographically within the page/screen.
- **Don't extend** your real estate with the scrolling bar.
- Consider resolution and browser window size when designing layout.

<https://blog.prototypr.io/ux-design-101-prototyping-rapidly-sketching-wireframes-65b7dfbabf52>

Forms of User Evaluation

- Empirical evaluation study
 - “How many tasks accomplished in N minutes?”
- Qualitative evaluation
 - Observers find patterns in interaction;
 - Users give feedback after use.
- “Dogfooding” (internal evaluation)
 - Developers use product as soon as feasible.
- Heuristic evaluation
 - Evaluate against best practices.

Best Practice Heuristics (Nielsen)

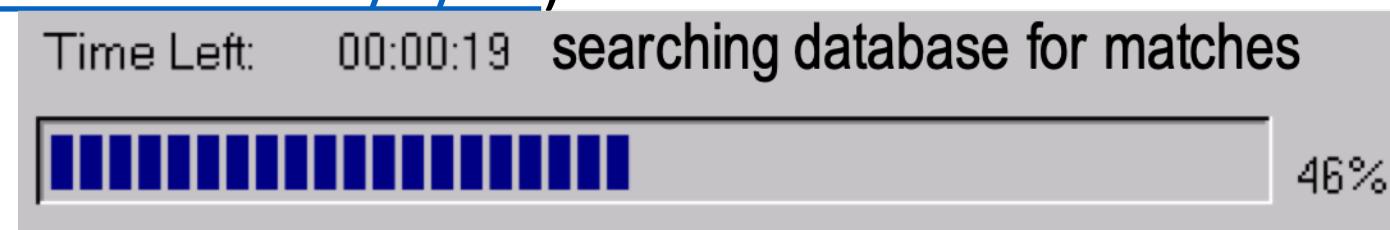
- “*Discount (\$)* usability engineering methods”
 - Pioneered by Jakob Nielsen in the 1990s
- Involves a small team of evaluators to evaluate an interface based on recognized usability principles
- Heuristics—“rules of thumb”

Much cheaper than an evaluation with “real” users!

(Adapted from slides by Bonnie John and Jennifer Mankoff)

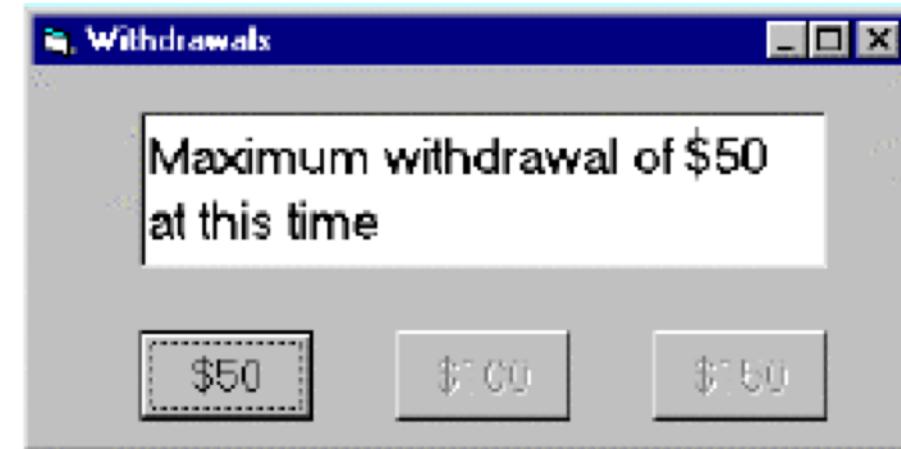
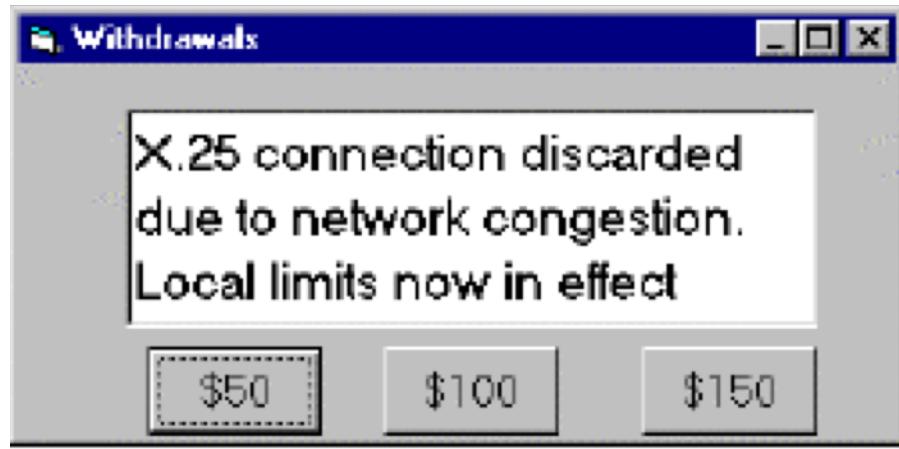
H1: Visibility of System Status

- Interface should show:
 - What input has been received;
 - What processing is currently happening;
 - What results have already been completed.
- This feedback allows
 - user to monitor progress towards solution of their task;
 - allows the closure of tasks; and
 - reduces user anxiety (Lavery et al).
- Great podcast with interview with Brad Myers,
creator/popularizer of progress bar in his 1985 PhD
thesis ([99 Percent Invisible 9/3/19](#))



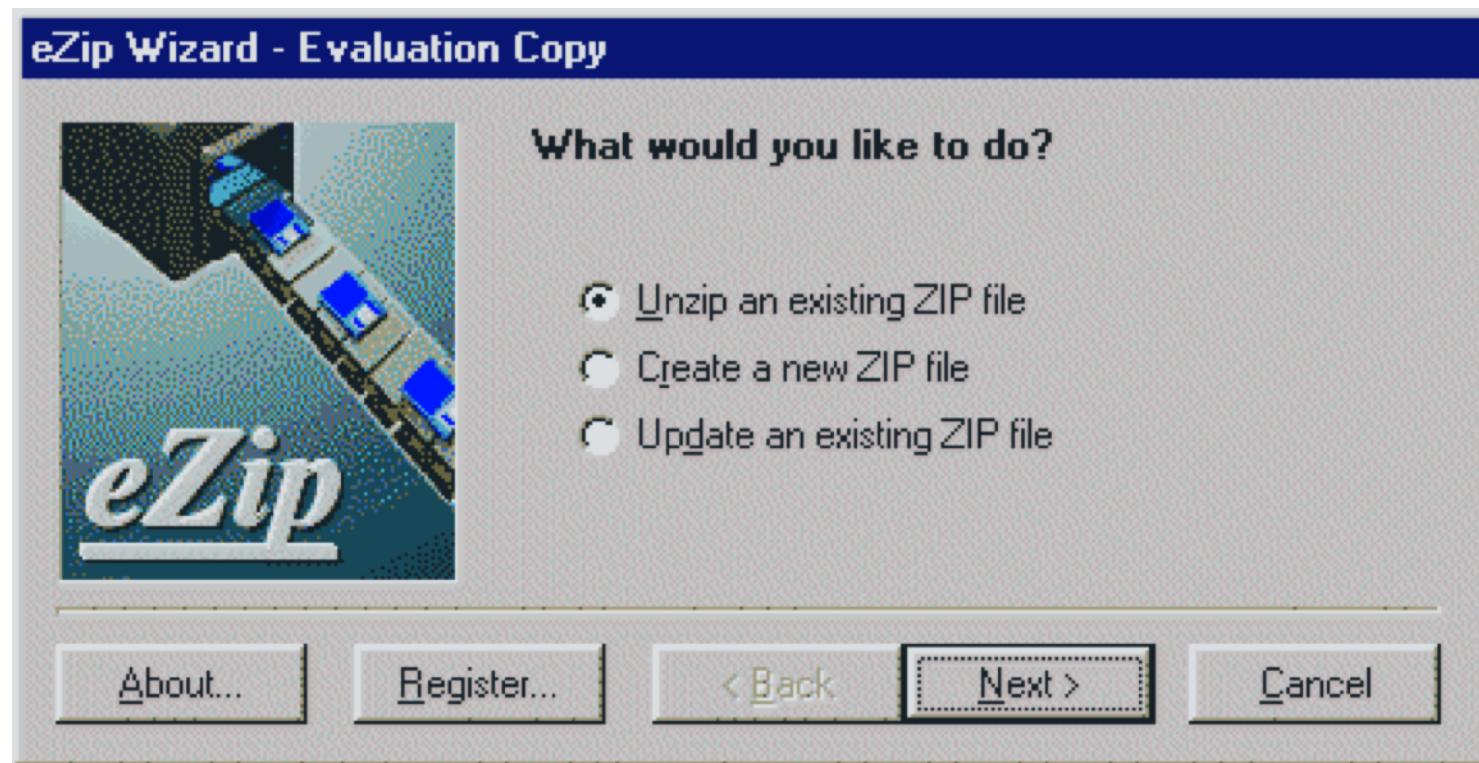
H2: Match Between System and Real World

- Speak the users' language.
- Follow real world conventions.
- Don't use internal jargon ("X.25 connection discarded")
- "Gray out" illegal options.



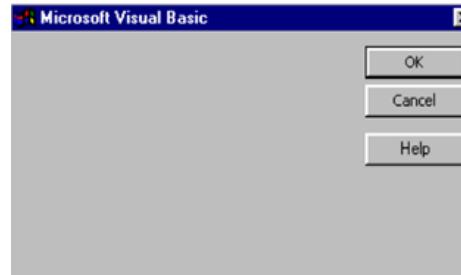
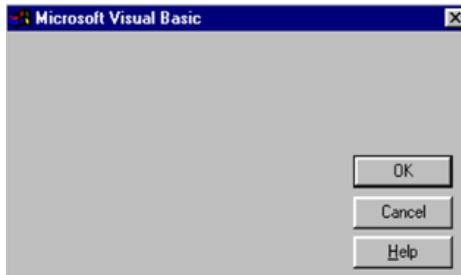
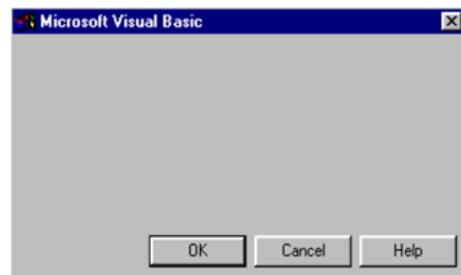
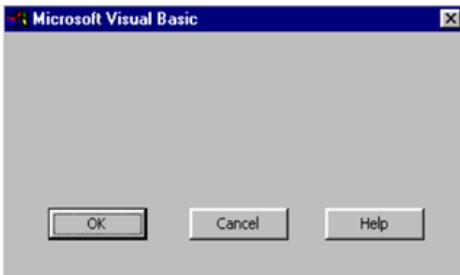
H3: User Control and Freedom

- “Exits” for mistaken choices: undo, redo, cancel
- Don’t force down fixed paths.



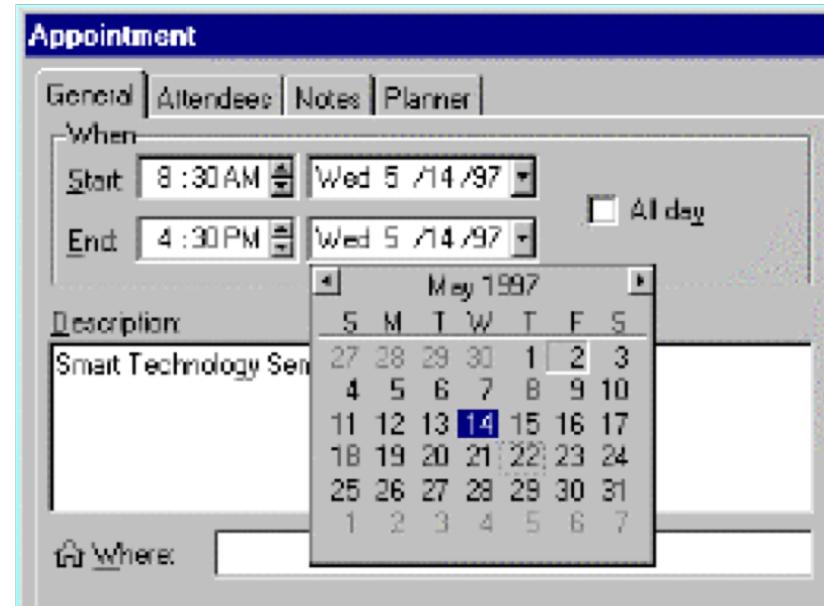
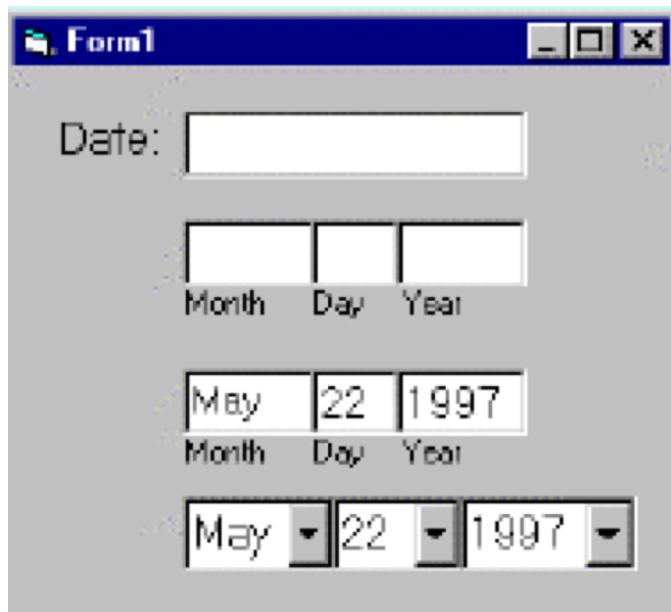
H4: Consistency and Standards

- Same words, situations, actions, should mean the same thing in similar situations;
- Same things look the same and be located in the same place.
- Text consistent with figures. →
- Different things should be different.



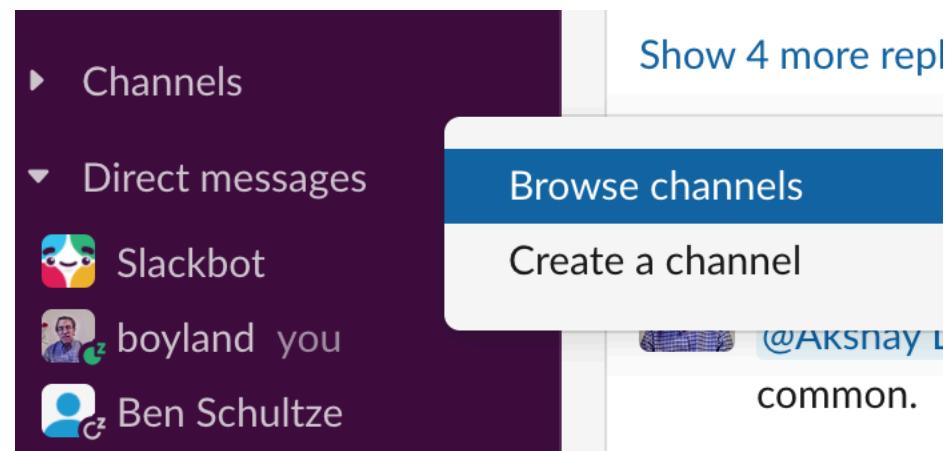
H5: Error Prevention

- Careful design can prevent a problem from occurring in the first place.
- It's easier to point to a date on the calendar than to type it in the correct format.



H6: Recognition rather than Recall

- Make objects, actions and options visible or easily retrievable.
- It's easier to pick out the channel we want to add than to enter the correct name.



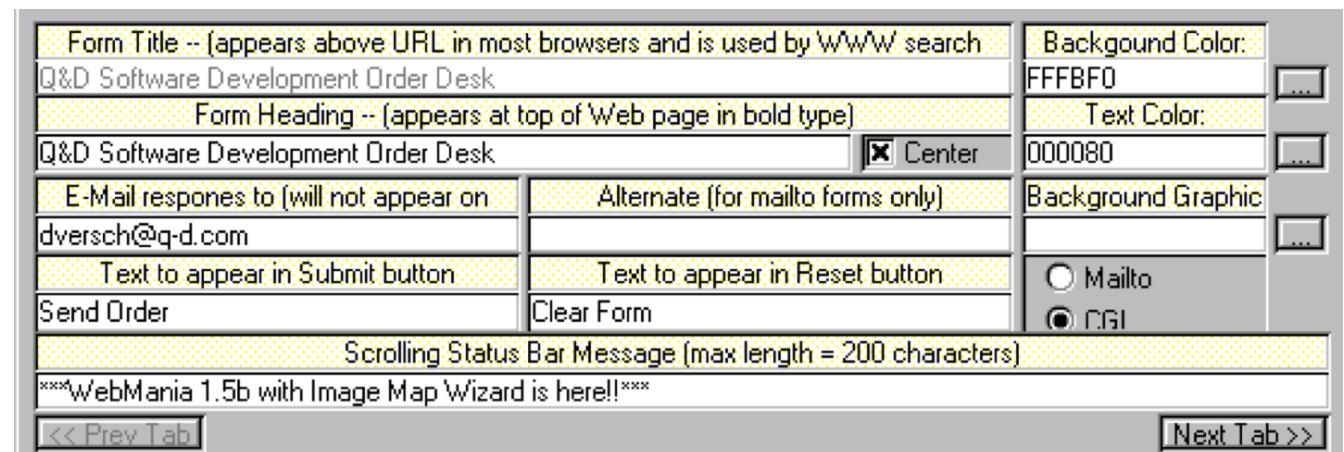
H7: Flexibility and Efficiency of Use

| Edit | Selection | View | Go | Run |
|----------------------------|-----------|------|----|---------|
| Undo | | | | ⌘Z |
| Redo | | | | ⇧⌘Z |
| Cut | | | | ⌘X |
| Copy | | | | ⌘C |
| Paste | | | | ⌘V |
| Find | | | | ⌘F |
| Replace | | | | ⌥⌘F |
| Find in Files | | | | ⇧⌘F |
| Replace in Files | | | | ⇧⌘H |
| Toggle Line Comment [⌘/] | | | | |
| Toggle Block Comment | | | | ⌥⇧A |
| Emmet: Expand Abbreviation | | | | → |
| Start Dictation... | | | | |
| Emoji & Symbols | | | | ⌘⌘Space |

- Accelerators for experts (e.g., gestures, kb shortcuts)
- Allow users to tailor frequent actions (e.g., macros)

H8: Aesthetic and Minimalist Design

- Interfaces should not contain irrelevant or rarely needed information.



- Here is an example of minimalist design:

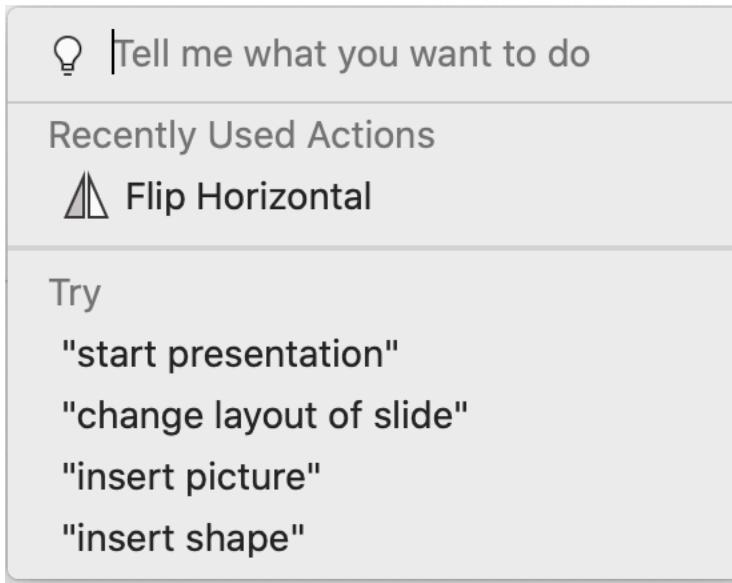


H9: Help users recognize, diagnose, and recover from errors

- Use standards to convey errors;
- Error messages should be in language user will understand;
- Precisely indicate the problem;
- Constructively suggest a solution.



H10: Help and Documentation



- Should be
 - Easy to search;
 - Focused on the user's task;
 - List concrete steps to carry out;
 - Always available.

Review: Learning Objectives for this Lesson

- you should now be able to:
 - Describe the major aspects of usability;
 - Articulate the process of user-centered design;
 - Explain several heuristics for good user interaction.