

CS 4530: Fundamentals of Software Engineering

Lesson 6.1 UI Design / User-Centered Design

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Learning Objectives for this Lesson

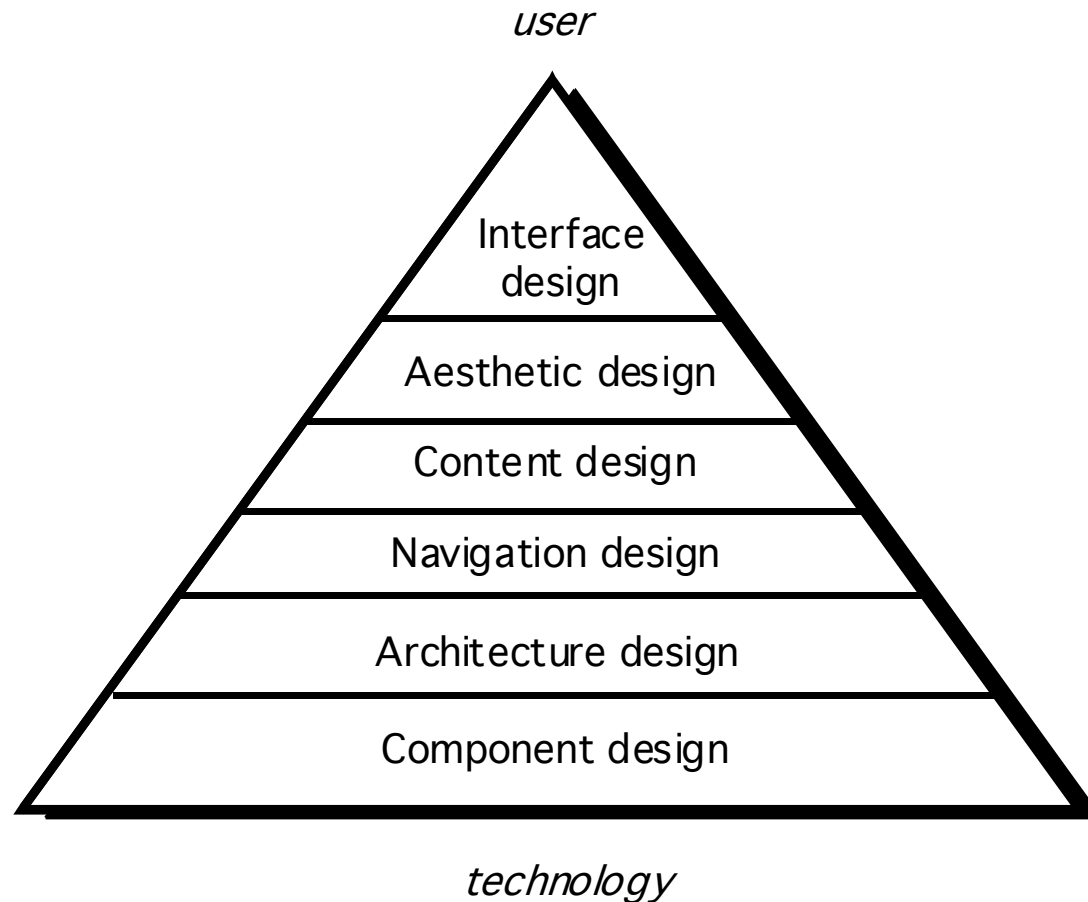
- By the end of this lesson, you should be able to:
 - Describe the major aspects of usability;
 - Articulate the process of user-centered design;
 - Explain several heuristics for good user interaction.

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.

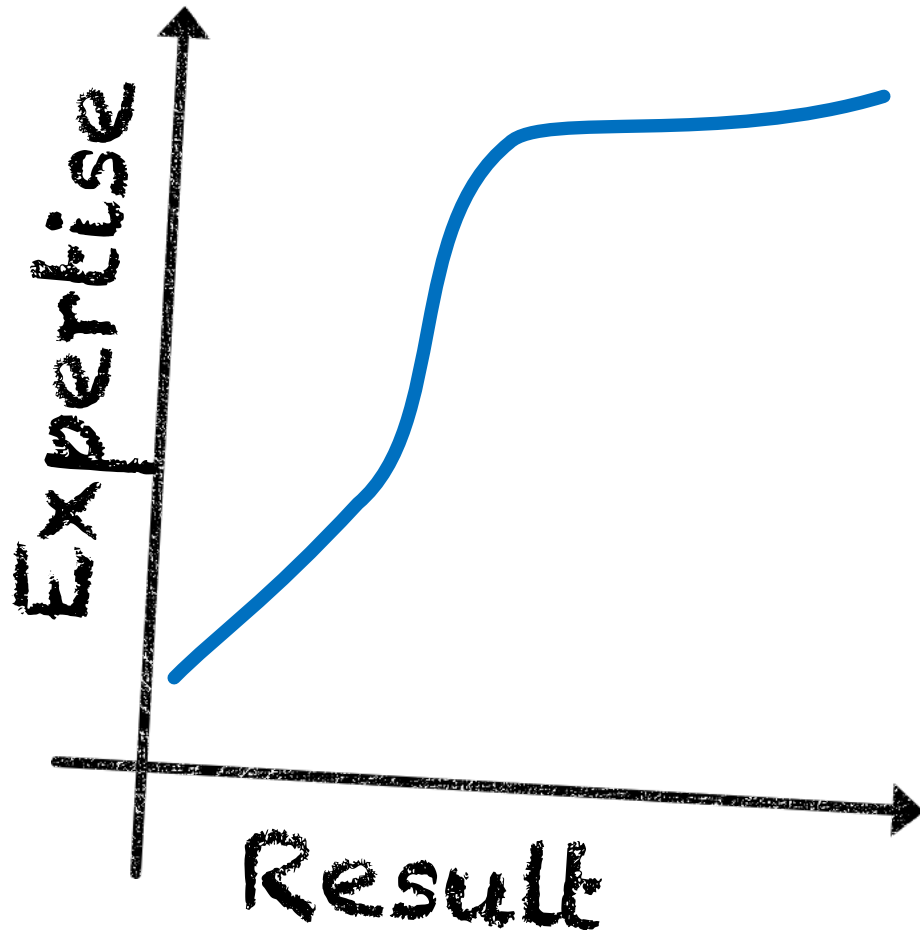
For us:
a software artifact

A light orange rectangular box with a blue border containing the text 'For us: a software artifact'. A black arrow originates from the left side of the box and points to the text '... an artifact ...' in the list above.

The goals are key!

A light orange rectangular box with a blue border containing the text 'The goals are key!'. A black arrow originates from the left side of the box and points to the text '... with particular goals.' in the list above.

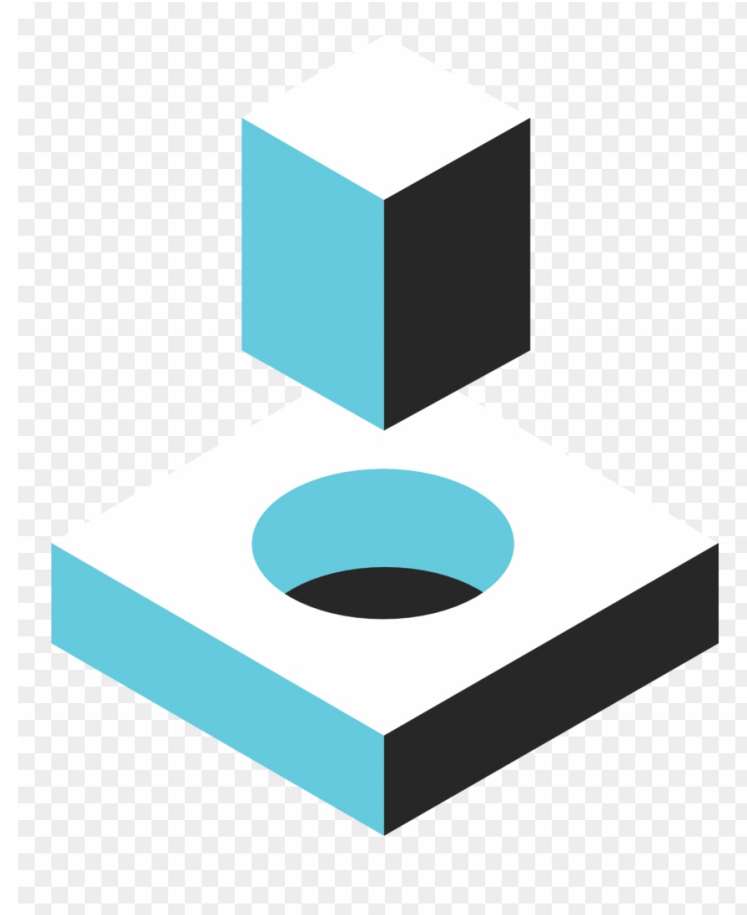
Usability Characteristics (1 of 5): Learnability



- 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!)



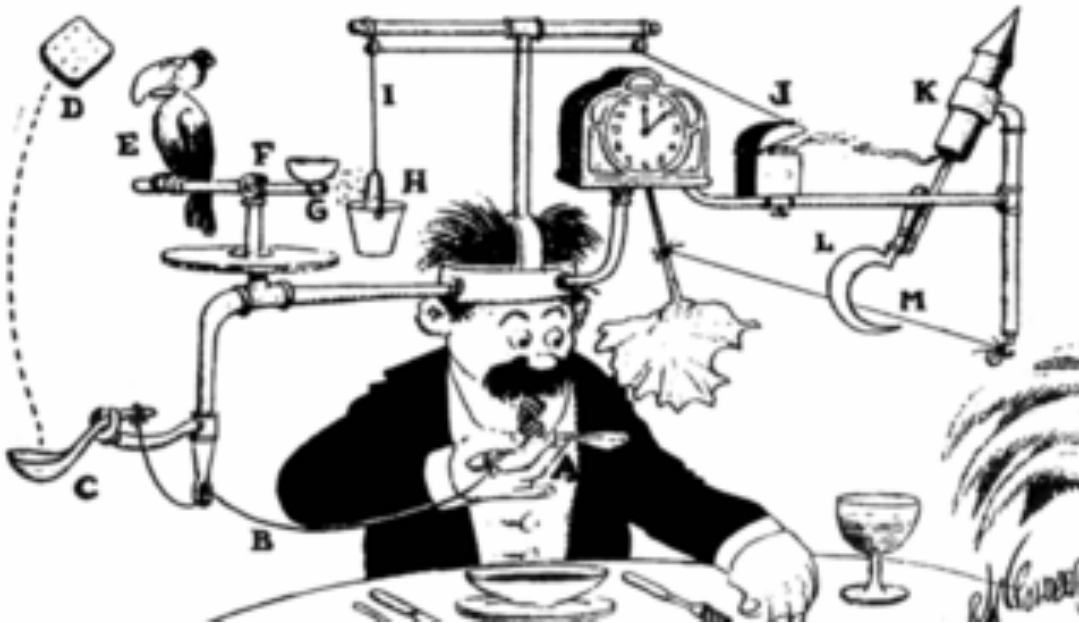
Usability Characteristics (4 of 5): Retainability

- 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](http://en.wikipedia.org/wiki/American_Airlines_Flight_965)



Adapted from Maneesh Agrawala & Bjoern Hartmann



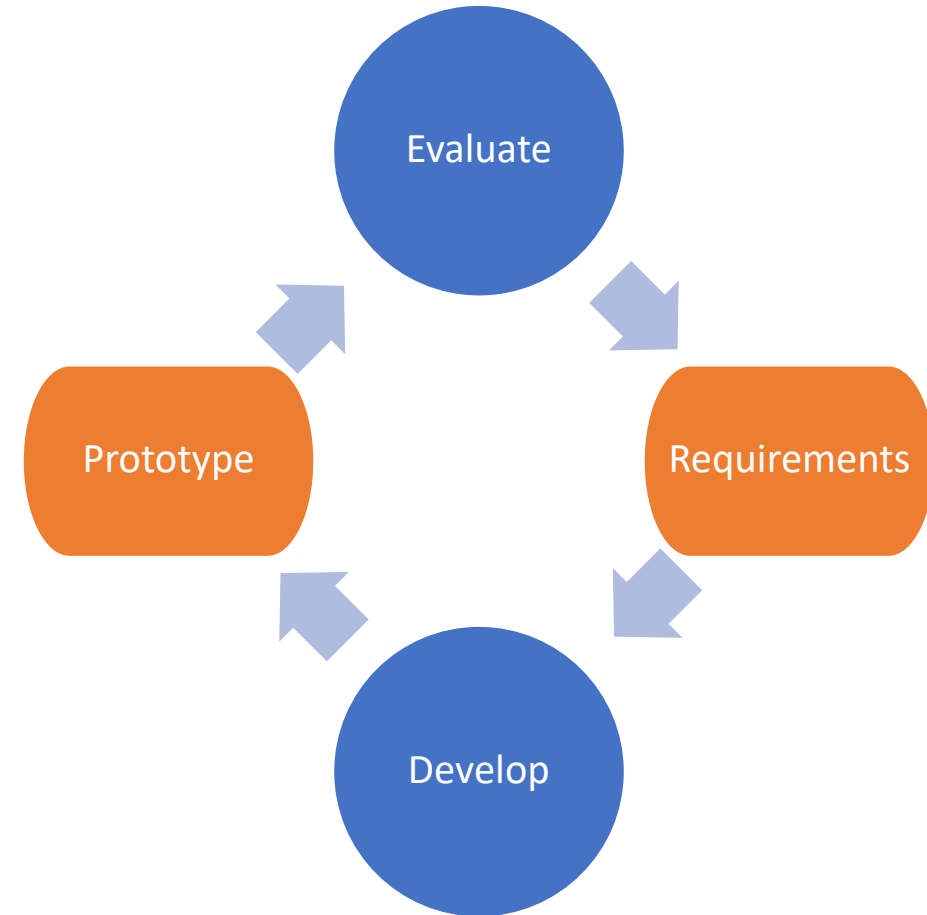
Airbus A350 Cupholders

“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**

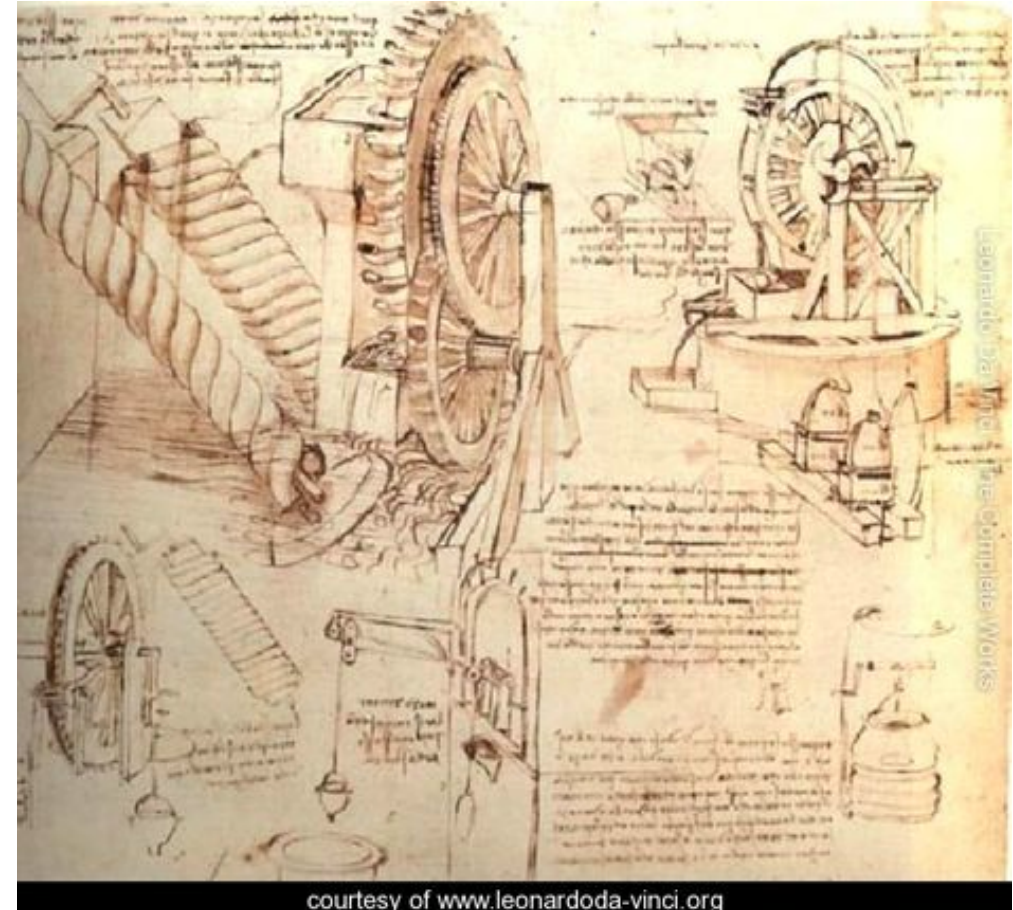
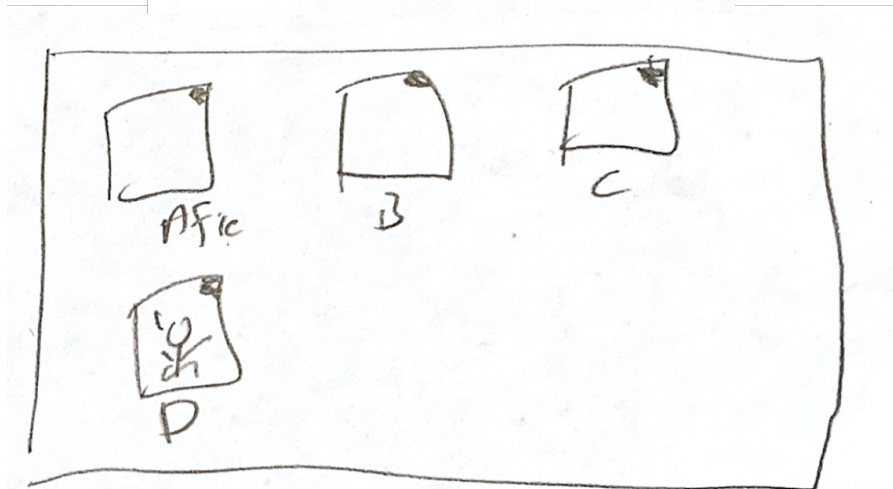
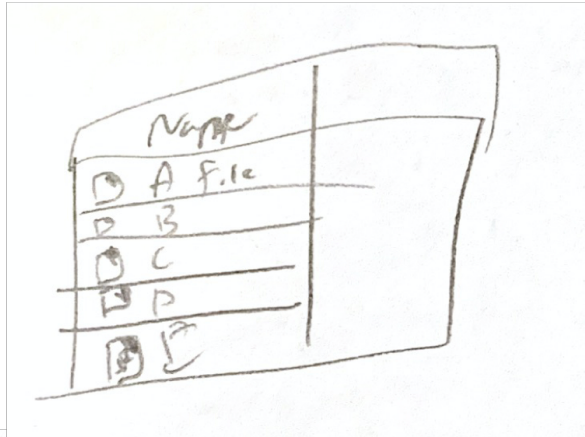
User-Centered Design

- 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*!



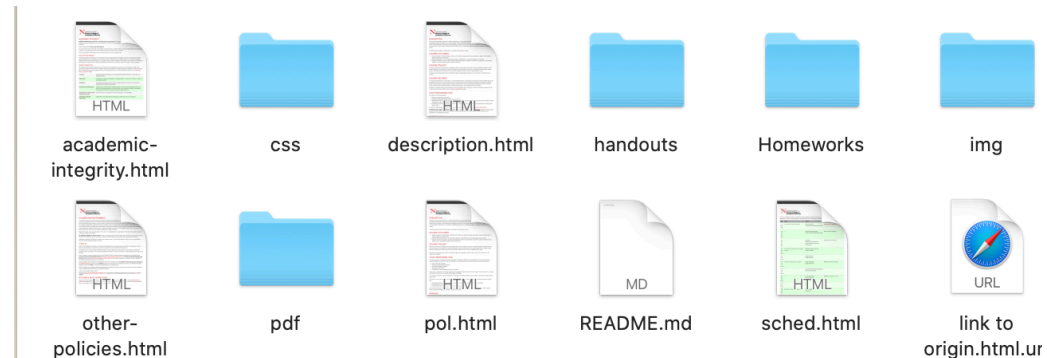
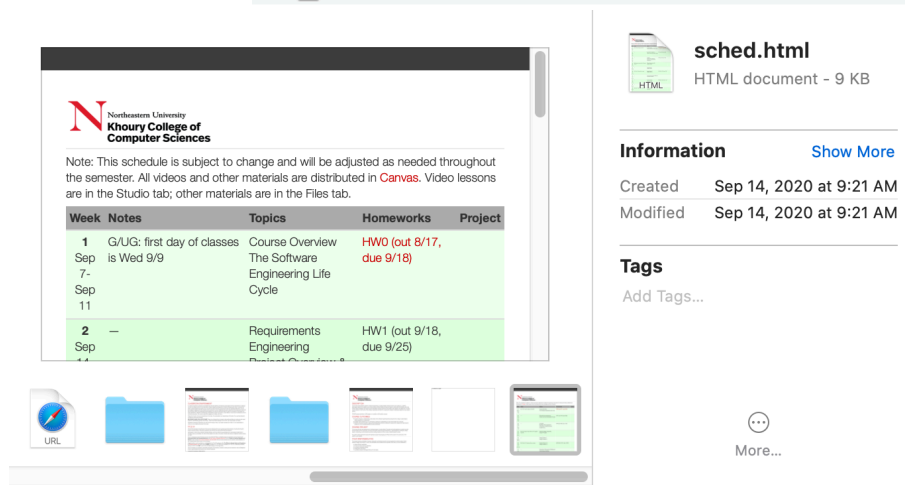
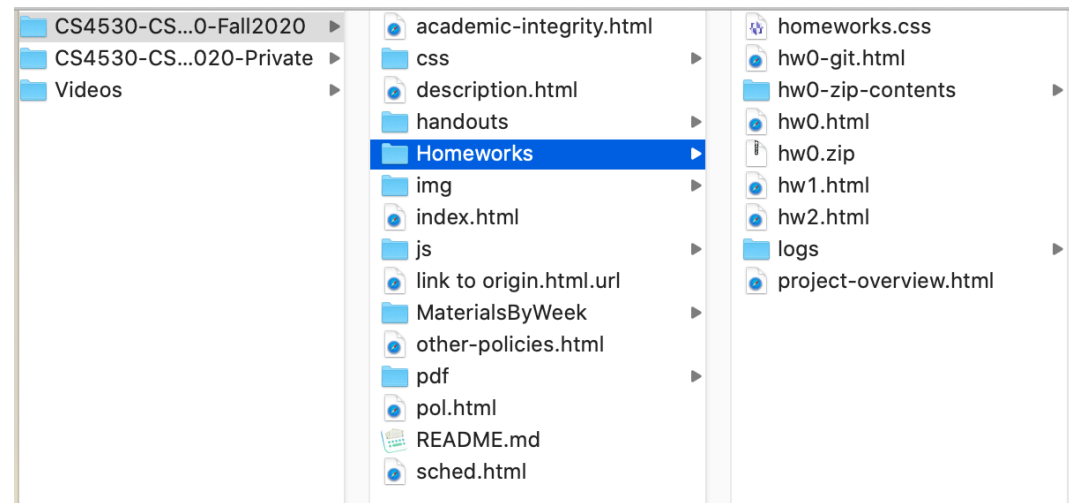
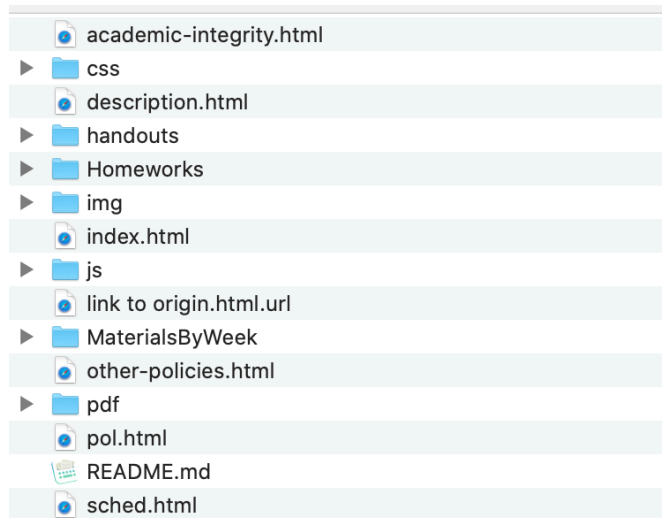
Key Idea: Design Alternatives

- Use sketches

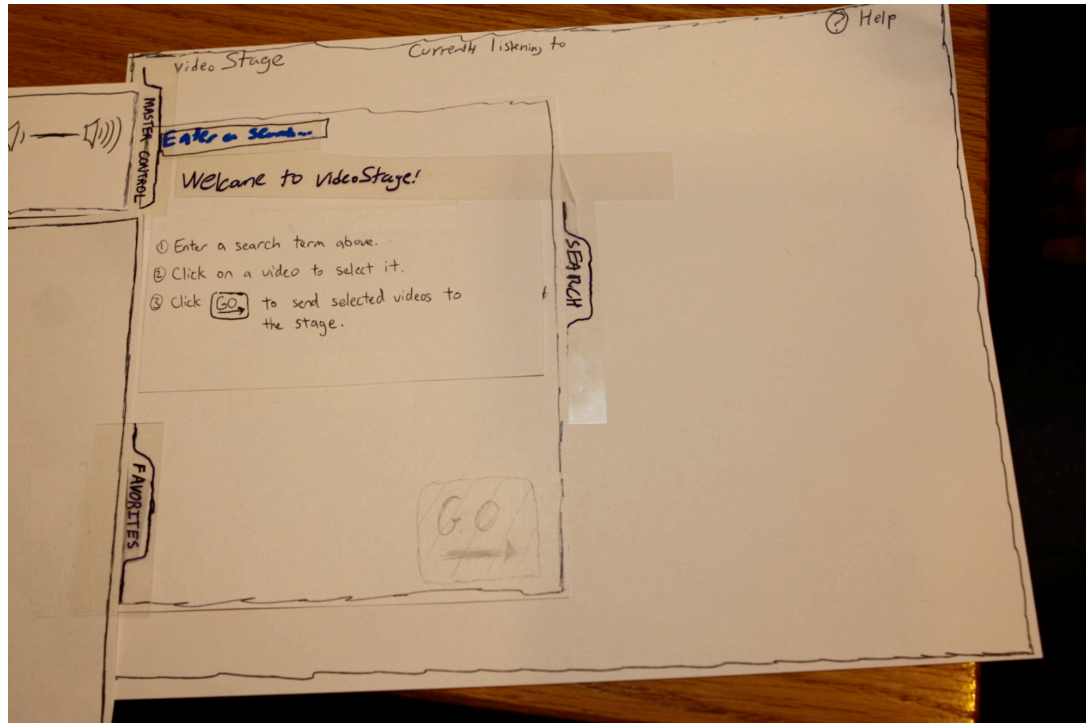


Key Idea: Design Alternatives

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



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.

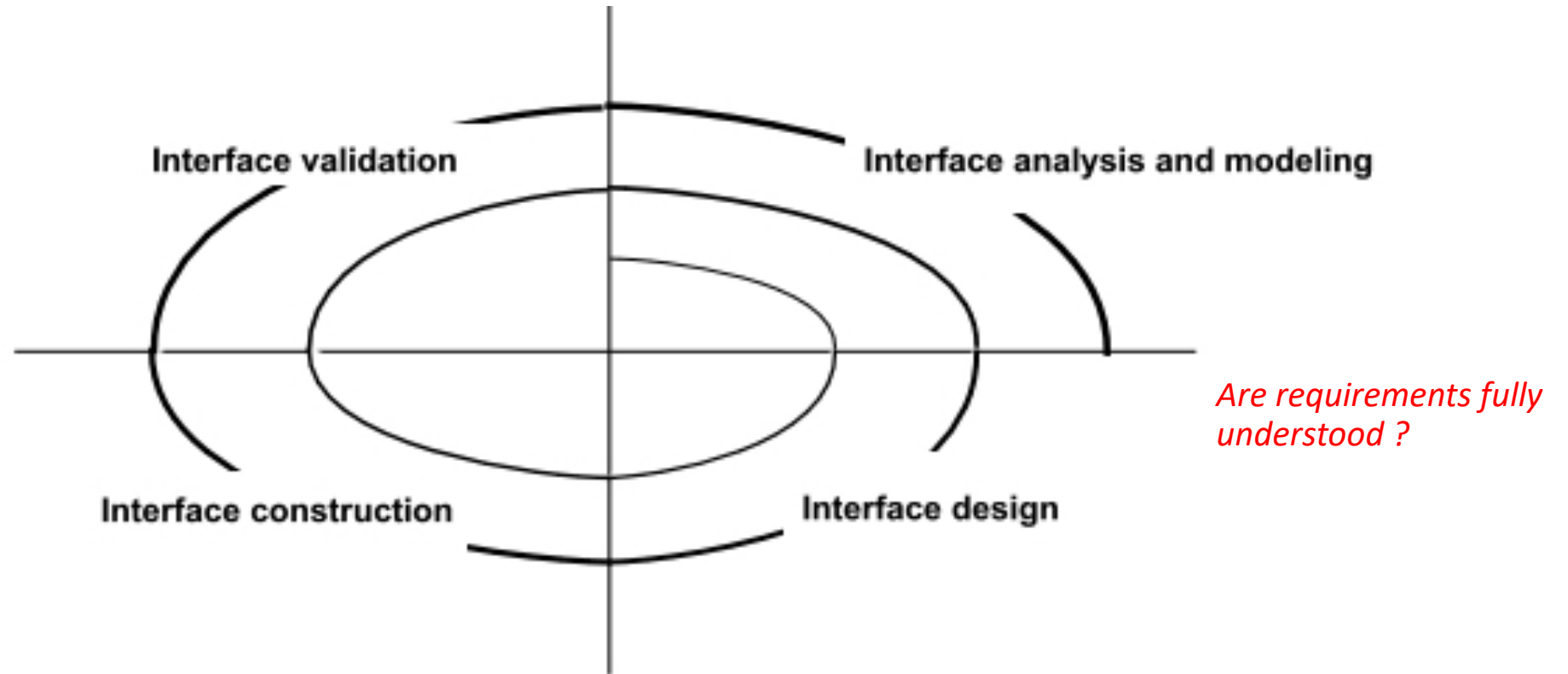


Prototype (3 of 3): Working Prototype

- 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)

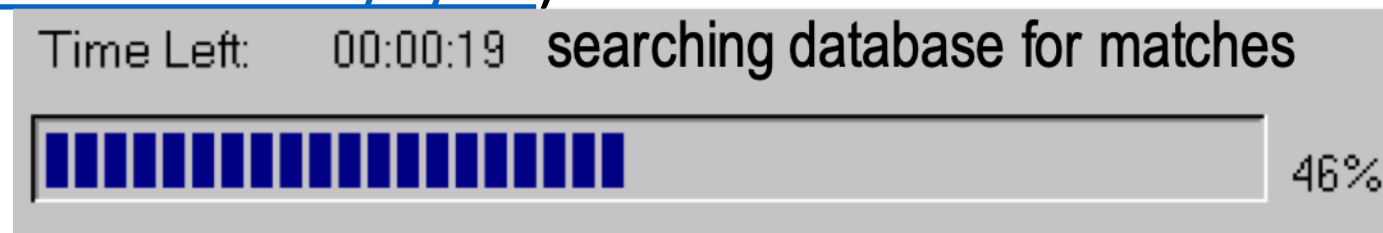
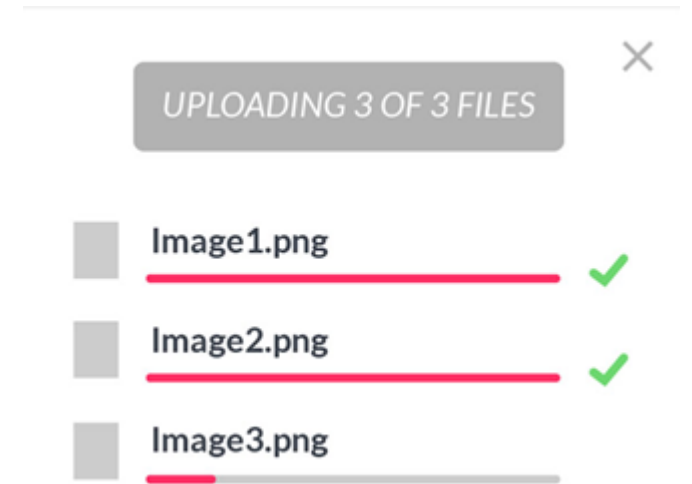
- “*Discount* (\$) usability engineering methods”
 - Pioneered by Jakob Nielsen in the 1990s
- Involves a small team of evaluators to evaluate an interface based on recognized usability principles
- Heuristics—“rules of thumb”

Much cheaper than an
evaluation with “real” users!

(Adapted from slides by Bonnie John and Jennifer Mankoff)

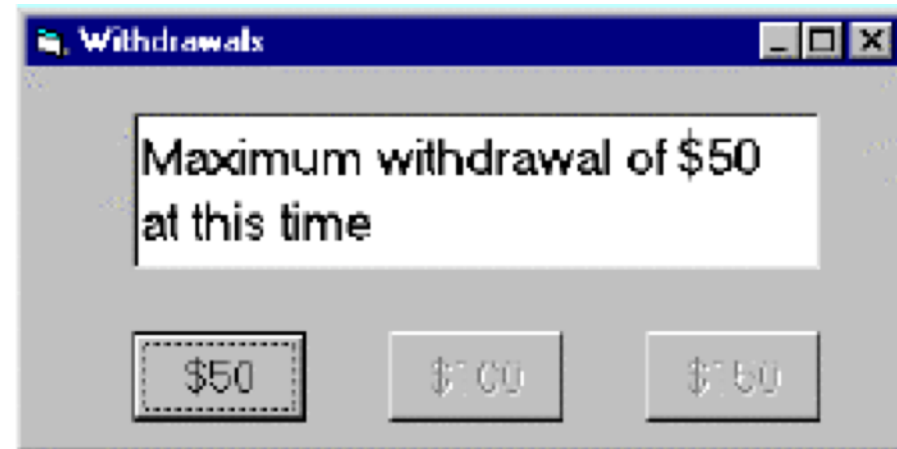
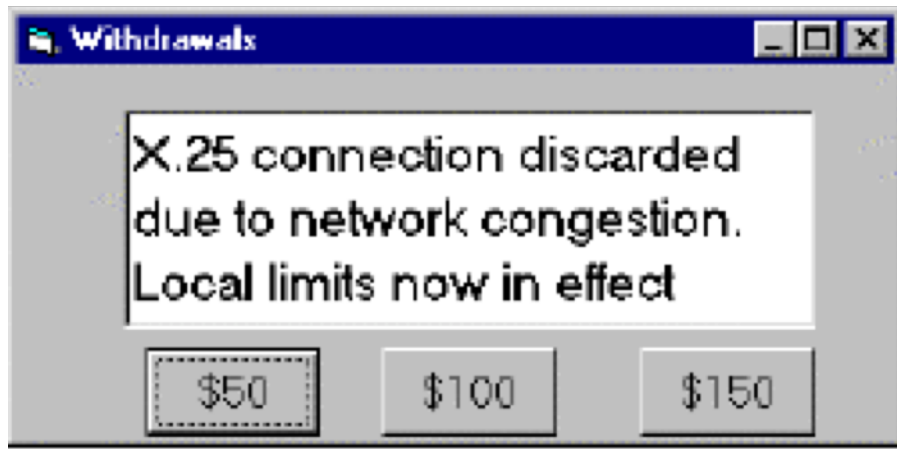
H1: Visibility of System Status

- 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](#))



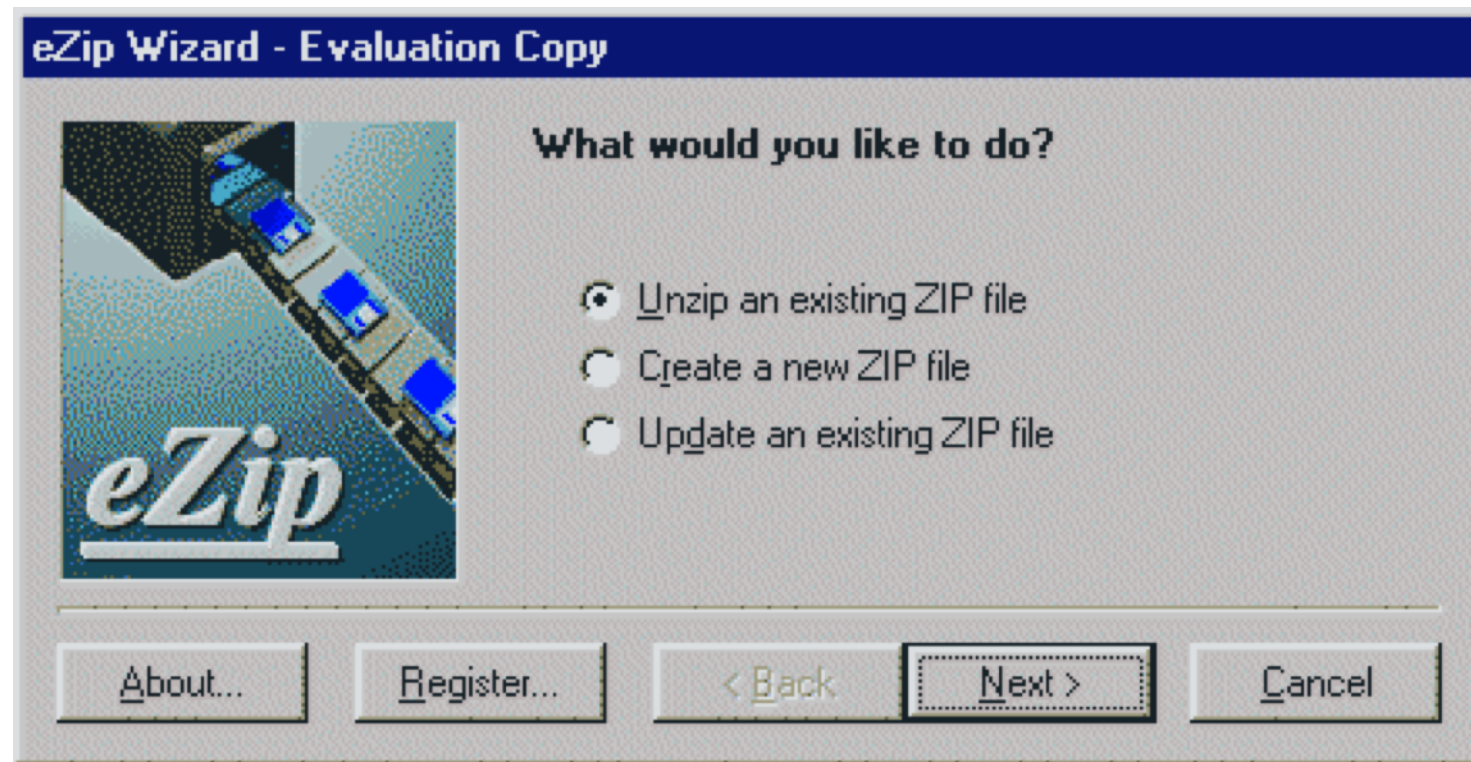
H2: Match Between System and Real World

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



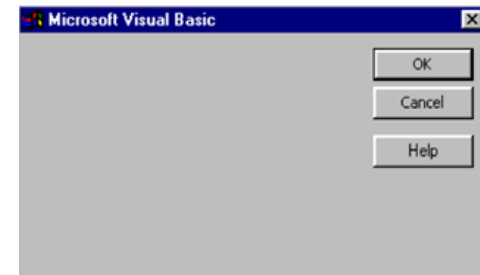
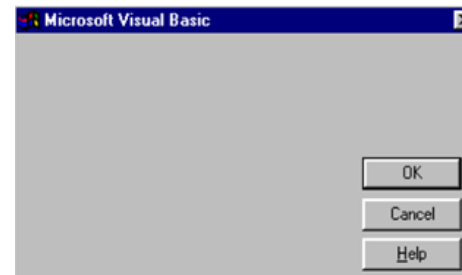
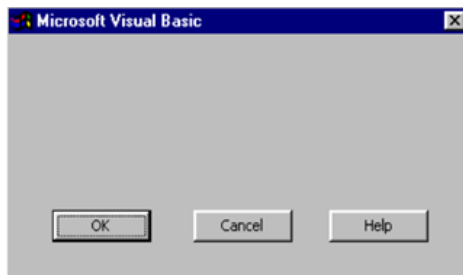
H3: User Control and Freedom

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



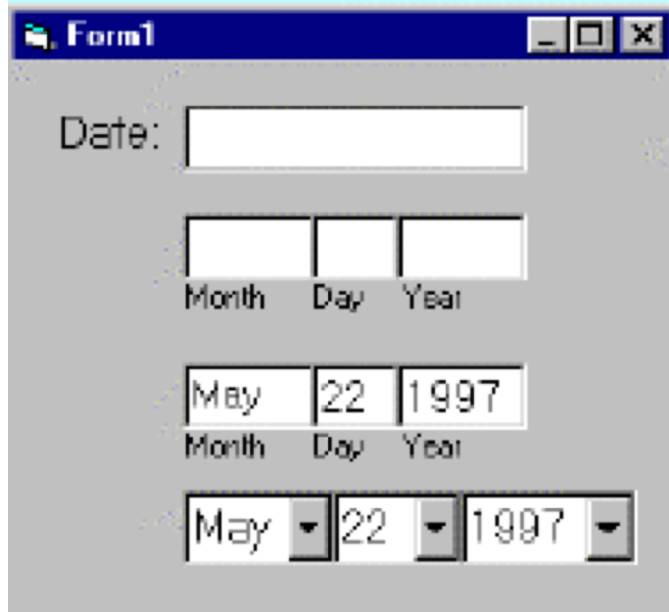
H4: Consistency and Standards

- 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.



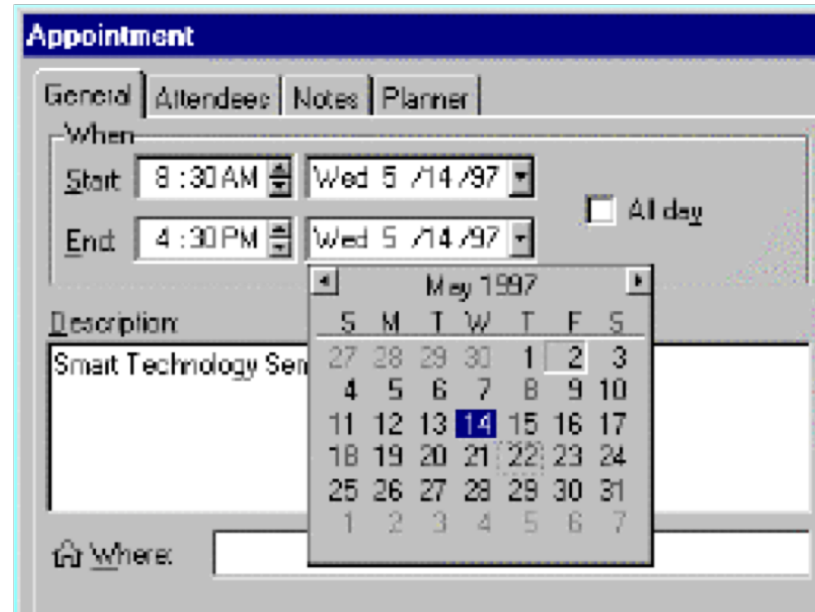
Form1

Date:

Month Day Year

May 22 1997
Month Day Year

May 22 1997



Appointment

General Attendees Notes Planner

When

Start 8:30 AM Wed 5 /14 /97

End 4:30 PM Wed 5 /14 /97

☐ All day

Description

Smart Technology Sen

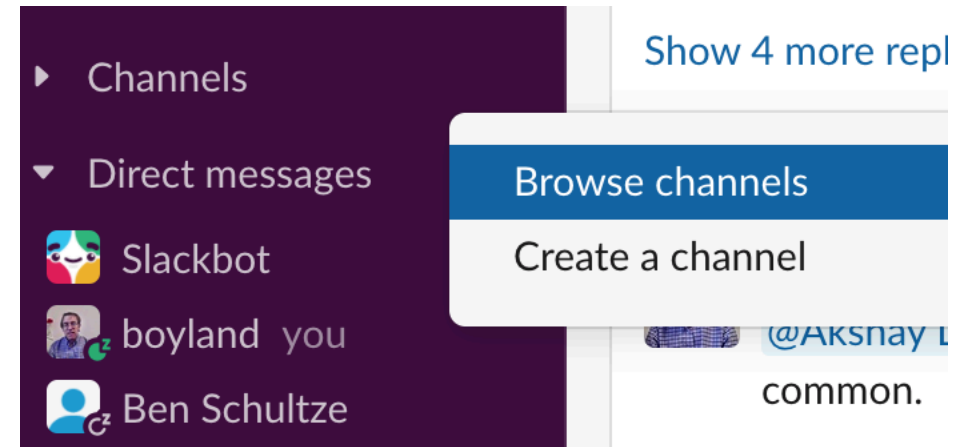
Where:

May 1997

S	M	T	W	T	F	S
27	28	29	30	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
1	2	3	4	5	6	7

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

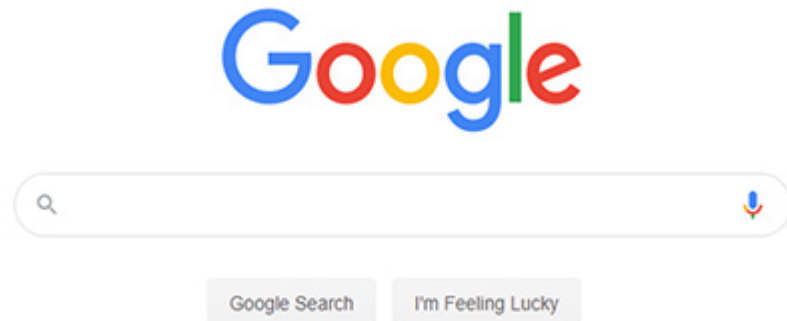
- Accelerators for experts (e.g., gestures, kb shortcuts)
- Allow users to tailor frequent actions (e.g., macros)

H8: Aesthetic and Minimalist Design

- Interfaces should not contain irrelevant or rarely needed information.

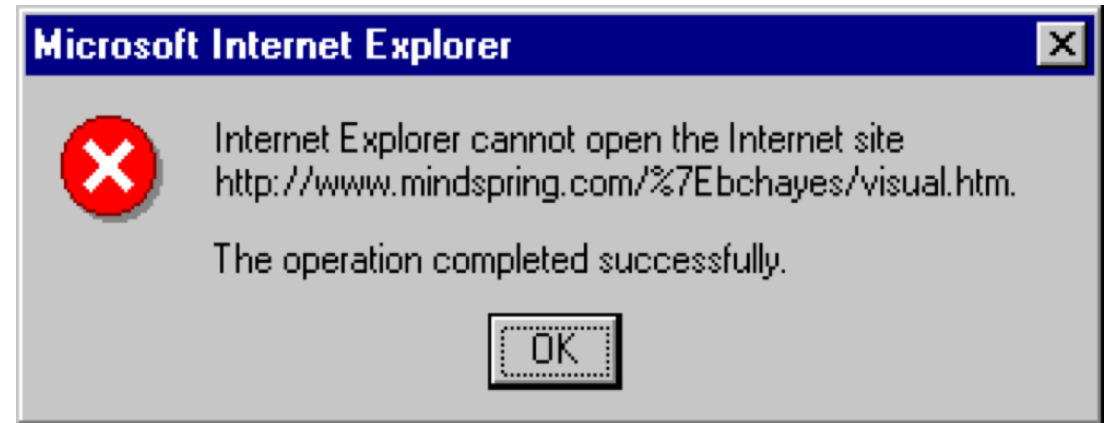
Form Title -- (appears above URL in most browsers and is used by WWW search)		Background Color:
Q&D Software Development Order Desk		FFFBF0
Form Heading -- (appears at top of Web page in bold type)		Text Color:
Q&D Software Development Order Desk <input checked="" type="checkbox"/> Center		000080
E-Mail responses to (will not appear on)	Alternate (for mailto forms only)	Background Graphic
dversch@q-d.com		
Text to appear in Submit button	Text to appear in Reset button	<input type="radio"/> Mailto
Send Order	Clear Form	<input checked="" type="radio"/> CGI
Scrolling Status Bar Message (max length = 200 characters)		
WebMania 1.5b with Image Map Wizard is here!		
<input type="button" value=" << Prev Tab"/>		<input type="button" value=" Next Tab >>"/>

- Here is an example of minimalist design:

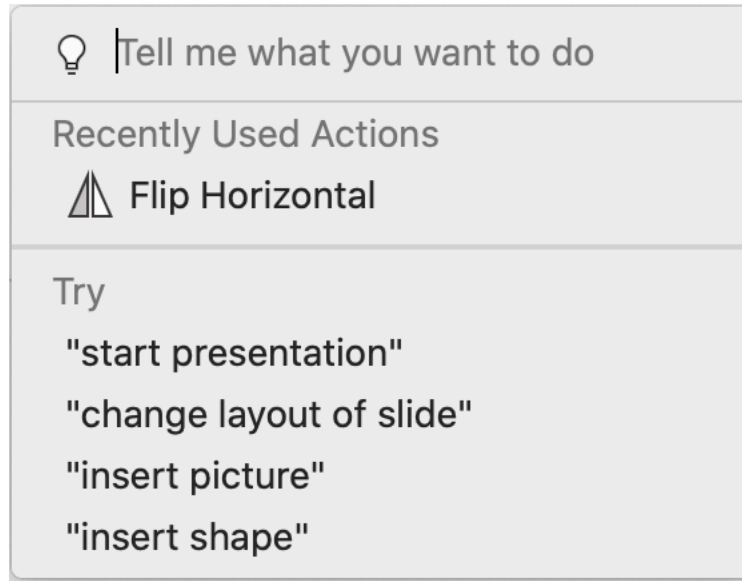


H9: Help users recognize, diagnose, and recover from errors

- 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.