

Jakob Nielsen and Hoa Loranger, "Prioritizing Web Usability"
Nielsen Norman Group,
<https://www.nngroup.com/articles/usability-101-introduction-to-usability/>
Ben Shneiderman, Nicholas Diakopoulos, Steven Jacobs, Catherine Plaisant, Maxine Cohen, Niklas Elmquist, "Designing the User Interface: Strategies for Effective Human-Computer Interaction"

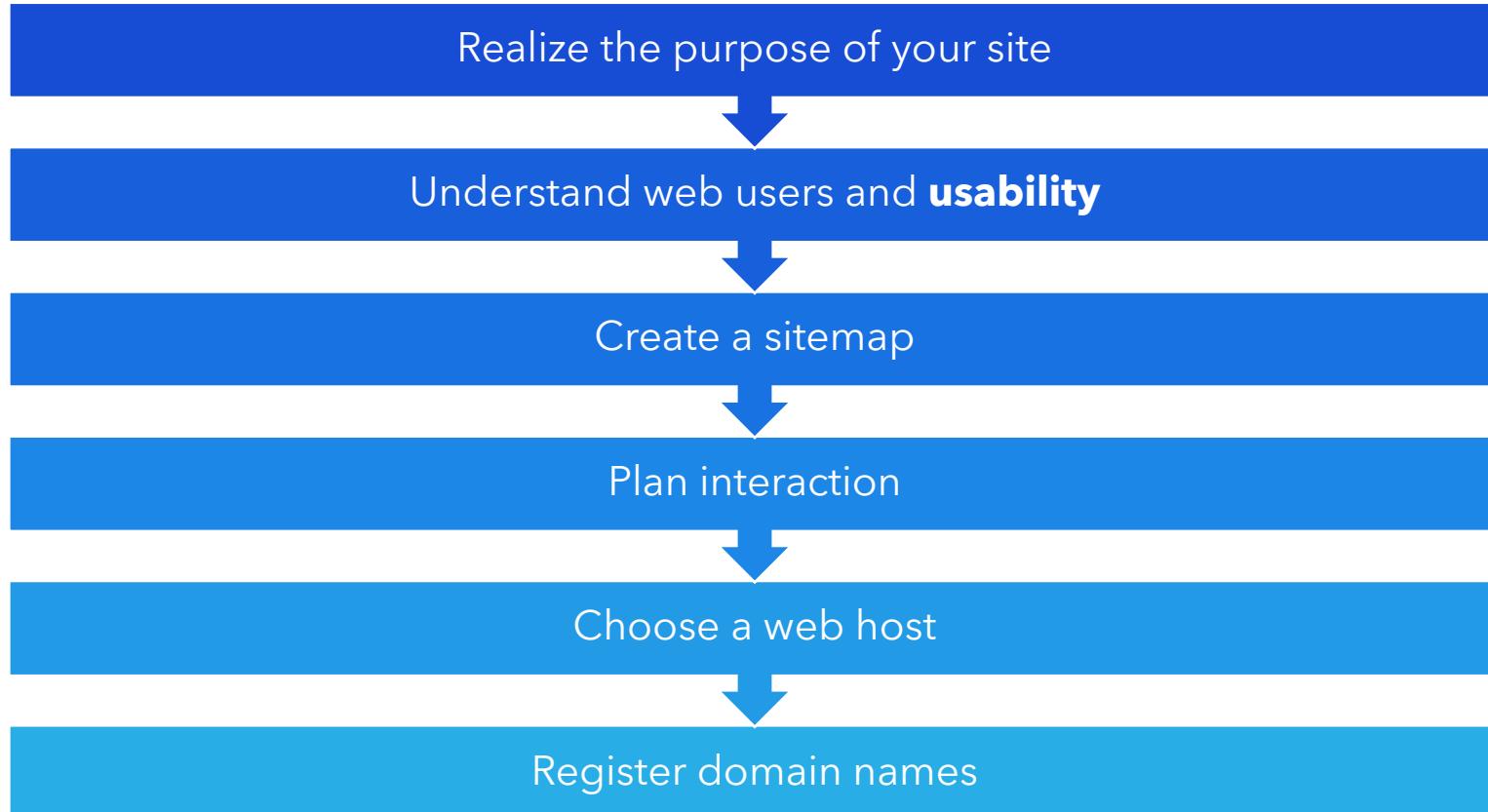
Programming Languages for Web Applications

Important Design Considerations

Administrativa

- Homework 0 due Thursday
- Sprint 1 due next week
- Discord server invite is out, please join
- We will meet in Rice 130 next Tuesday
 - Remember:
 - Please stay home if you feel unwell
 - Masks are required
 - The lecture will be live streamed and recorded

Planning Your Website



Realize the Purpose of Your Website

- Why are you building a website?
- What do you want it to achieve?
- What will you and your visitors benefit from the website?
- Examples:
 - Build new relationships
 - Enhance your reputation and profile
 - Sell something or make money (ads?) - See Google AdSense
 - Improve customer service
 - Education

Understand Web Users

- The competition is only **one click away**
 - How does your website benefit its visitors?
 - What do you do better than other similar sites?
- Who are your potential visitors or target users?
 - What stage of life are they at?
 - How much disposable income could they spend with you?
 - How sensitive are they to pricing?
 - What are they interested in outside of your website?
 - How experienced are they at using the Internet?
 - Where do they use the Internet?
 - How do they use the Internet?
 - What kind of device will they use to view your site?

Understand Web Users

The image displays three separate browser windows side-by-side, each showing a different type of web interaction:

- Left Window:** A "Contact Us - Social Networks and Archival Context" page from the SNAC website. It features a large "Contact SNA" button and a detailed "SNAC" sidebar with sections like "Discover SNA", "Archival Resources", and "Feedback". Below the sidebar is a "New Ticket Alert" message for a "Due Book" ticket, which includes fields for "To:", "Subject: Due Book", and "Message: My grandson found one of your member due books. It's still quite readable, none of the gold is gone. He wants to return it to you and is really motivated to return it". At the bottom, there's a URL and a "Referer" link.
- Middle Window:** A "New Ticket Alert: Due Book" message from the SNAC system. It shows a "SR" profile icon, the subject "New Ticket Alert: Due Book", and the recipient "To: [REDACTED]". The message body contains the same information as the previous window, along with a "From:" field and a "Topic: Other".
- Right Window:** An archival record for the "International Brotherhood of Teamsters, Chauffeurs, Warehousemen, and Helpers of America" from the SNAC cooperative. The title is "Variant names". Below the title are tabs for "Detailed View", "Revision History", "Sources", and "Export". The main content area has tabs for "History", "Resources", "Relationships", "Places", "Subjects", "Occupations", and "Activities". The "Resources" tab is active, displaying a detailed description of the union's history and formation. To the right, there's a sidebar for "Corporate Body" with "Exist Dates" (Active 1904, Active 1952), and sections for "Related Descriptions" (Virtual International Authority File, WorldCat Identities, LC/NACO). A small question mark icon is in the bottom right corner of the sidebar.

Understand Web Users: Satisfaction

- Users spend **less than two minutes** on a site before abandoning it
 - Most sites are rarely revisited
- Most users visit deep links through search engines
- Three guidelines for supporting deep link users
 - Internal pages **must** tell users where they are and where they can go
 - **Name and logo** on every page
 - Direct, one-click link to home page
 - Search facility in a common place (upper right corner)
 - Encourage users to **look elsewhere** on the site
 - Breadcrumb trail
 - **Do not assume** users took the standard route to a page

“A website is like a house with a thousand doors, and visitors can enter anywhere”

Understand Web Users: Home Page

- So much to say, so little time
- Clarity is crucial
- Users only read **20 to 30 words**
- Only 23% of users scrolled down the home page

Users are not reading - they are deciding where to go next

Understand Web Users: Home Page

- Four goals for a home page
 - Define the site (use your tagline)
 - Articulate what benefits are offered
 - Describe the company and its products
 - Provide navigation to the rest of the site

Users are goal directed -- help them reach those goals

Understand Web Users: Interior Pages

- Users do read more content on interior pages
- Put important links in content area
- Users spend **27 seconds** looking at a page
 - Do not make them think about the navigation!

Understand Web Users: Searching

- 88% of tasks started in a search engine
 - Search engines are replacing bookmarks
- 1994: Searches were used to *find resources*
- 2017: Searches are used to *answer questions*
- Four ways to grab value from search engine visitors
 - Offer *flytrap* content: clear answers to common problems
 - Embellish with useful “see also” links
 - Provide deep analysis and insights
 - Publish newsletters with additional tips and information
- Users ignore your navigation, but may click your links

Understand Web Users: Searching

- Encourage, do not discourage, deep linking
 - Navigation is always a barrier, no matter how well designed
- Organic vs. sponsored links
 - Organic links are best matches for users' query
 - Sponsored links are ads
- Search Engine Results Page (SERP)
 - 93% of users visit first SERP only
 - Only 47% scroll the first SERP (6-10 results from Google)
 - 51% click on first site; only 16% click on second site
- Goal: Try to be the top search engine result!
 - After 5, you are invisible

Understand Web Users: Scrolling

- Users do not scroll
 - They are lazy?
 - Or ... maybe they are busy?
- 23% of users scroll the home page on the first visit
- 52% scroll interior pages on website
- 47% scroll Search Engine Results Pages
- *Users with more web experience scroll more*

Usability

What is usability?

- **Learnability:** How easy is it for users to start using the system?
- **Efficiency:** How quickly can they perform tasks?
- **Memorability:** How easily can returning users reestablish proficiency?
- **Errors:** How many errors do users make, how severe are these errors, and how easily can they recover from the errors? How much does the system help prevent errors?
- **Satisfaction:** How pleasant is it to use the system?

Why is usability important?

- If a website is difficult to use, people **leave**.
- If the users can't tell what the site offers, they **leave**.
- If users get lost on a website, they **leave**.
- If a website's information is hard to read or doesn't answer users' questions, they **leave**.
- Users won't read a site; they scan the site. When users encounter a difficulty, they **leave**.

Usability Principles

- Understand the users
- Design for the user
- Match the users' mental model
- Follow the 7 ± 2 rule
- Have a point, make your point
- Prevent errors
- Reduce excise tasks
- Nine golden rules of UI design
- Shneiderman's five criteria: Learn, Speed, Errors, Skills, SS

Understand the Users

- It is important to know your users
 - Work experience
 - Computer experience
 - Age
 - Education
 - Reading skills
 - Language skills
 - Work environment
 - Task frequency
 - ... *many more*

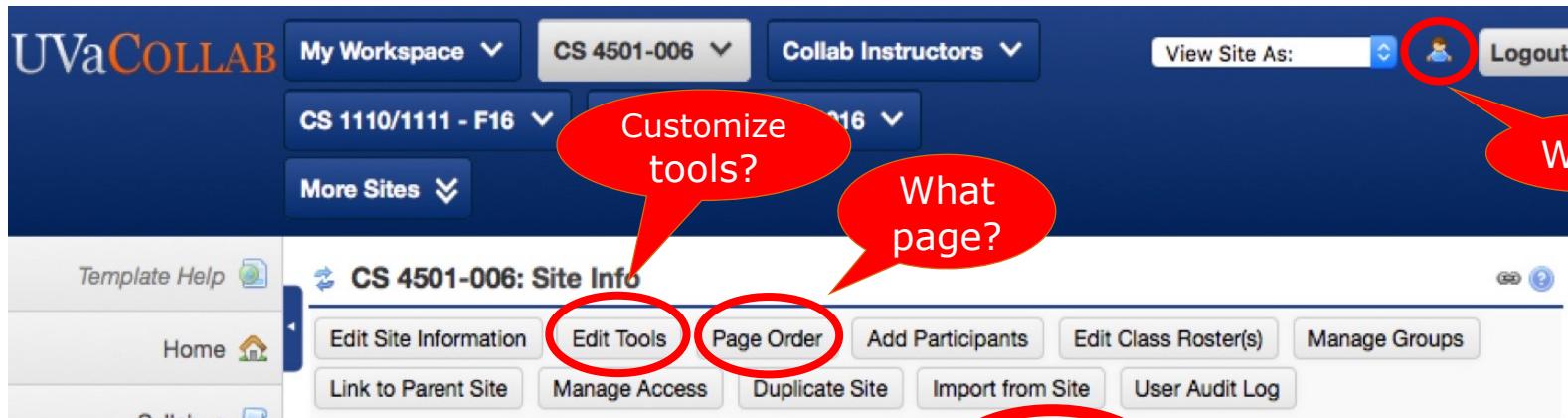
Design for the User

- Engineers tend to focus on *functionality*
- If users cannot understand how to use all the exciting features ...
they won't



comes with 36-page manual

Design for the User



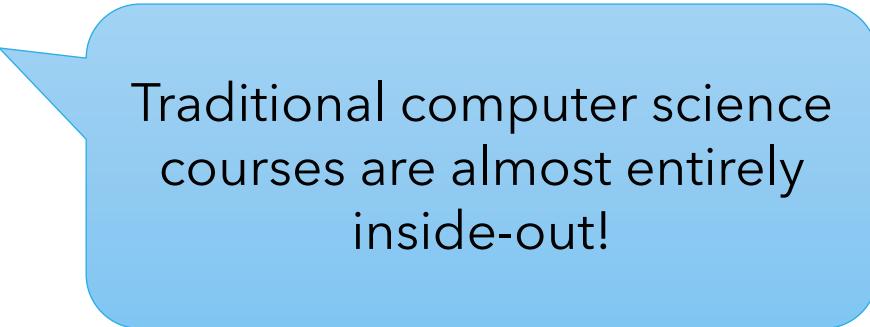
Collab
2016

A screenshot of the UVaCollab interface from 2021. The top navigation bar includes 'Home' dropdown, 'CS 2110 - Fall 2021' dropdown, 'CS 4640 - Fall 2021' (highlighted in yellow), 'CS 2110 - Spring 2021' dropdown, 'CS4640-Summer2021' dropdown, and 'CogSci Major' dropdown. The main content area features a sidebar with 'Overview', 'Homepage', 'Announcements', 'Assignments', 'Gradescope', and 'Gradebook'. The 'SITE SETTINGS' section is open, showing buttons for 'Site Information', 'Edit Site Information', 'Manage Tools' (circled in red), 'Tool Order' (circled in red), 'Date Manager', 'Add Participants', 'Edit Class Roster(s)', 'Manage Groups', 'Link to Parent Site', 'Manage Access', 'Import from Site', 'User Audit Log', and 'Manage Overview'. Below this is the 'Site Information' section with fields for 'Site Title' (CS 4640 - Fall 2021) and 'Term' (2021 Fall). A red speech bubble points to the 'Manage Tools' and 'Tool Order' buttons with the text 'Customize tools?'. Another red speech bubble points to the user icon with the text 'Who?'.

Collab
2021

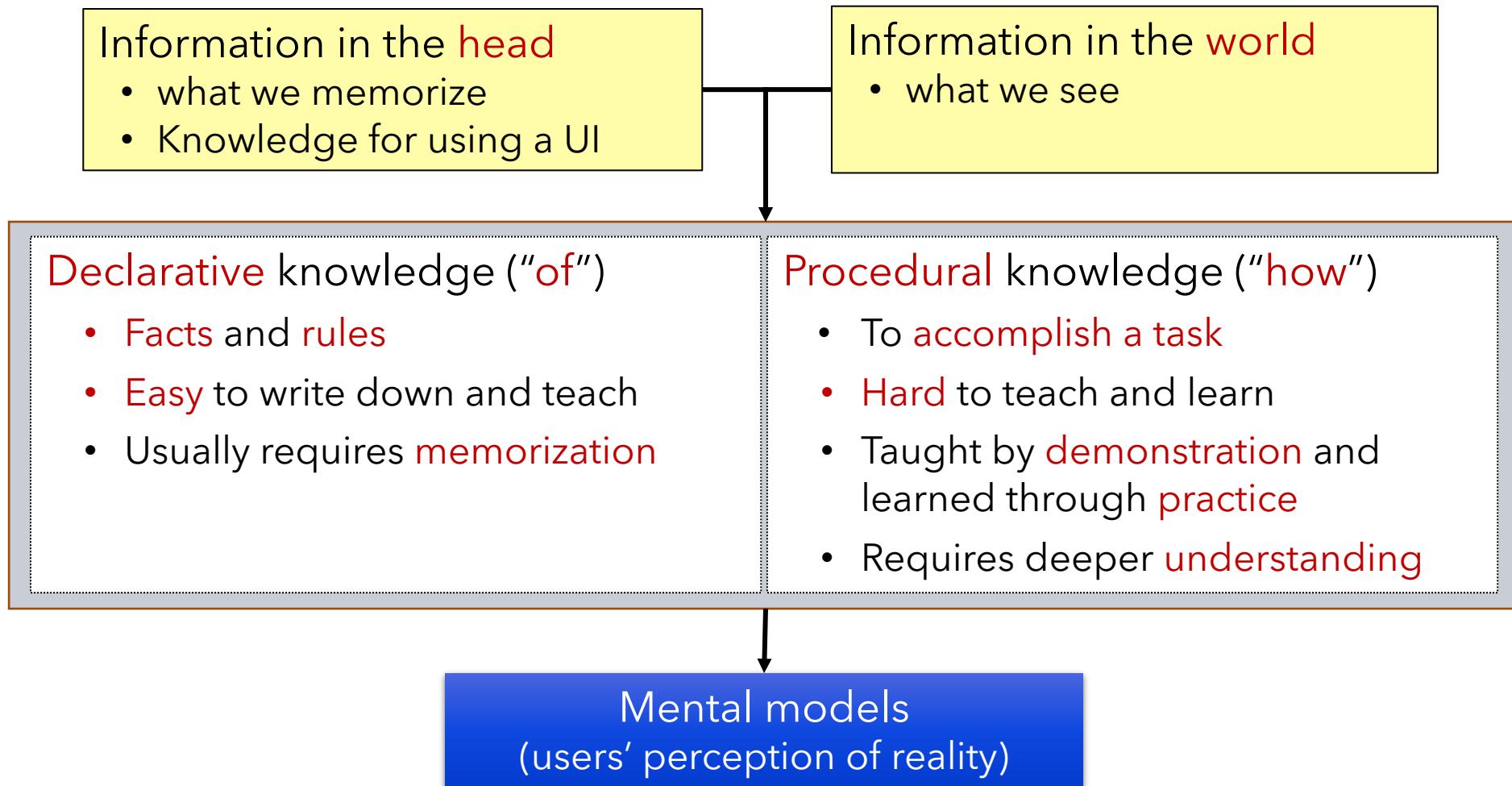
Design for the User: Designing UIs

- Inside-out design
 - Develop a system
 - Then add the interface
- Outside-in design
 - Design the interface
 - Then build the system to support it
- When design decisions are made, either the developer must conform to the users, or the user must conform to the developer.



Traditional computer science courses are almost entirely inside-out!

Match the User's Mental Model



Match the User's Mental Model

- When we push the gas pedal, the car goes faster
 - **Mental:** pushing makes it go faster
 - **Implementation:** more gas to the engine, more pressure, pistons go faster, tires go faster
- When we turn the wheel, the car turns
 - **Mental:** turning the wheel turns the tires
 - **Implementation:** turning the wheel turns something else (with help of a motor for power steering), which causes something else to turn, which puts the tires into a different angle

Match the User's Mental Model

Other Examples

- Telephones: I want to call mom, not 1-434-xxx-xxxx
- Compile: I want to run my program, not compile, run
- File manager: dragging a file from window to window
 - Move on the same disk
 - Copy from USB flash drive to disk

The 7 ± 2 Rule

- Fundamental Software Design Principle
- Human's **short-term memory** can only hold about seven things at a time (plus or minus 2)
- Try to limit to about 7 items at a time



Have a Point, Make Your Point

- You have **less than two minutes** to convince first time visitors to stay on your web site
- Every page must justify **WHY** the user should stay



Prevent Errors

- People often make mistakes
- Faster computers can increase errors
- Prevention strategies:
 - Flow: Users make fewer mistakes when the flow through the UI make sense
 - Education: Better error messages can reduce errors
- The software should prevent the user from making dangerous choices
- **Software seatbelts:** If the dangerous choice must be available, allow it with a hesitation ("are you sure?")

Prevent Errors: Stuff Happens

- If an error is possible, **someone will make it**
- Good UI designers **must** assume all possible mistakes will happen
 - Design to minimize the chances of mistakes
 - Design to minimize the consequences of mistakes
 - Design to maximize recovery from mistakes
- **Do not assume users are perfect**

Prevent Errors: Help Users

- Increase visibility
 - The user can see the state of the system and how to use it
- Have a good conceptual model
 - The system works the way the users expect
- Ensure good mappings
 - Users can see relationships between actions and results, controls and effects, and state and appearance
- Provide feedback
 - The system tells the user what happened at every step

When something seems easy to use, it was probably hard to design

Reduce Excise Tasks

- There is overhead relating to solving problems:
 - **Revenue Tasks:** Sub-tasks that work to solve the problem directly
 - Studying
 - Doing homework
 - Listening to lectures
 - **Excise Tasks:** Sub-tasks that must be done but that are not really part of the problem
 - Driving to school
 - Parking
 - Doing homework that does not reinforce concepts
 - *The needs of the tools or process, not the users*

Reduce Excise Tasks: Examples

- Command line users see a lot of excise tasks in GUI – primarily the navigation
 - Using the mouse
 - Having to go through multiple screens
 - GUIs generally require more navigation
- Example: Changing background in all class slides
 - PPT: More than 30 minutes; load each file separately, 1 or 2 minutes to change each file (lots of clicking)
 - VIM + Latex/Beamer: Less than five minutes; one process, repeat searching and commands

Don't make me do work that's not related to my goal

Reduce Excise Tasks

<https://www.youtube.com/watch?v=3Sk7cOqB9Dk>

Reduce Excise Tasks: Techniques

- Put the mouse focus in the first input box
- Don't interrupt flow unless necessary
- Try not to show error messages
- Don't ask users to "correct" what they don't understand
- Don't separate input from output
- Don't make users remember where files are
 - MUST let users define file organization
 - MS Word not does, eclipse does not

Reduce Excise Tasks: Techniques

- Don't require passwords for everything
 - Authentication is almost always excise!
- Don't make users move or resize windows
- Don't make users remember or reenter personal settings
- Don't make users enter unnecessary data
 - Telephone number as a DB key - use the name or invent a number!
- Don't make users confirm actions – unless undo is impossible
- Avoid or correct errors

Reduce Excise Tasks: Techniques

- Remember what the user did the last time
- Avoid unnecessary questions
- Imagine a boyfriend (or girlfriend) that asked you every time whether you wanted cream with your coffee!
- Dialog boxes ask questions, buttons offer choices

9 Golden Rules of UI Design

1. Build a UI that is consistent
2. Design usable and discoverable shortcuts
3. Provide appropriate feedback
4. Yield closure
5. Provide appropriate error handling
6. Allow users to undo all actions
 - Use hesitation for the operation that cannot be “undone”
7. Put the user in charge
8. Reduce the load
9. Design for the user

Shneiderman's Five Criteria

1. **Time to learn:** The time it takes to learn some basic level of skills
2. **Speed of UI performance:** Number of UI “interactions” it takes to accomplish tasks
3. **Avoiding user errors:** How often users make mistakes
4. **Retention of skills:** How well users remember how to use the UI after not using for a time
5. **Subjective satisfaction:** The lack of annoying features

Shneiderman's Five Criteria

Time to learn

- How long it takes to learn to use an interface
- With complicated UIs, learning happens in “plateaus”
- Well designed interfaces make
 - The first plateau easy to get to
 - Subsequent plateaus clearly available

Shneiderman's Five Criteria

Speed of UI performance

- How fast users can navigate the interface (not about interface performance)
- Interaction points: where the users interact with the software
 - (e.g., buttons, text boxes, or commands)
- Speed of UI performance is roughly the number of interactions needed to accomplish a task
- Good UI designers should reduce the number of keyboard-to-mouse switches

Shneiderman's Five Criteria

Avoiding user errors

- Users will always make mistakes
- UIs can encourage or discourage mistakes
 - Consistency, instructions, navigation, ...
- Consider:
 - Entering letter grades in a dropdown instead of radio buttons

Course Name	Credit Hours	Grade
	3	<input type="radio"/> A+ <input checked="" type="radio"/> A <input type="radio"/> A- <input type="radio"/> B+ <input type="radio"/> B <input type="radio"/> B- <input type="radio"/> C <input type="radio"/> F

[Add another course](#)

Student Grade		EE	ID	Name	Roster Grade	Official Grade	Grading Basis	Program and Plan	Level	Change Grade
<input type="checkbox"/>	1			Graduate Student	B		GRD	Arts & Sciences Graduate - Mathematics (PhD)	Level Four	change grade

Shneiderman's Five Criteria

Retention of skills

- Some interfaces are easy to remember, some are hard
- If they flow logically, they are very easy to remember
 - I.e., They match the user's mental model or expectations
- If an interface is very easy to learn, then the retention is not important
 - Users can just learn again
- Retention is typically more important with UIs that are hard to learn

Shneiderman's Five Criteria

Subjective satisfaction

- How much the users “like” the UI
 - How comfortable the users are with the software
 - **This depends on the user** (thus the word “subjective”)
- Think of it in reverse: users are unhappy when there is something annoying in the interface
 - **Blinking**
 - **Ugly colors**
 - Spelling errors in **masssages**
- Most important in competitive software systems
 - Like ... everything on the Web!

Shneiderman's Five Criteria

- We always have tradeoffs among the criteria
- Most people today equate “user friendly” with “time to learn” - this is a narrow view
- Making a UI easier to learn often slows it down!
 - Ex: Many GUIs are easy to learn, but slow to navigate
 - Ex: Many command line shells / languages are fast, but hard to learn
- To be an effective UI designer:
 - Consider each criterion carefully and prioritize before designing
 - Decide what is acceptable for each of the five criteria

Improving Usability: Usability Testing

- Get representative users
- Ask the users to perform representative tasks
- Observe how the users use or interact with the UI
 - What the users do
 - Where they succeed
 - Where they have difficulties with the UI
- They will likely not perform the tasks in the way you expect

Usability Tips

- Test the old design before starting a new design
- Test your competitors' designs
- Study how users use the system
- Make paper prototypes and test them
 - Transform paper prototypes to executable prototypes, iteratively refine the design idea
- Inspect the design relative to established usability guidelines
 - Don't wait until you have a fully implemented design. It will be impossible to fix the critical usability problems, especially problems related to architectures.
- Start user testing early in the design process and keep testing every step
- Implement the final design, test it again.