Users and Usability Principles

CS 4640 Programming Languages for Web Applications

[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 Elmqvist, "Designing the User Interface: Strategies for Effective Human-Computer Interaction"]

What is Usability?

Quality attribute

- 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 Usability is 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 website; they scan the site. When users encounter a difficulty, they leave.

What Does This Course Cover?

- How to break down the essential characteristics of usable software from an analytical viewpoint
- Engineering principles for designing and building software interface that are
  - Fast to learn
  - Speedy to use
  - Avoid user errors
  - Increase retention
  - Improve user's subject satisfaction
- How to recognize and articulate the difference between "this program sucks" and "I can improve this program by changing X, Y, and Z"
- Life-long habits for engineering usable products .. Usability is not just for software

Usability Principles of the Day

- 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 who the user is

- Work experience
- Computer experience
- Age
- Education
- Reading skills
- Language skills
- Work environment
- Task frequency
- … many more possibilities

Do users look at web apps the way they are?

Or do users look at web apps the way they think?

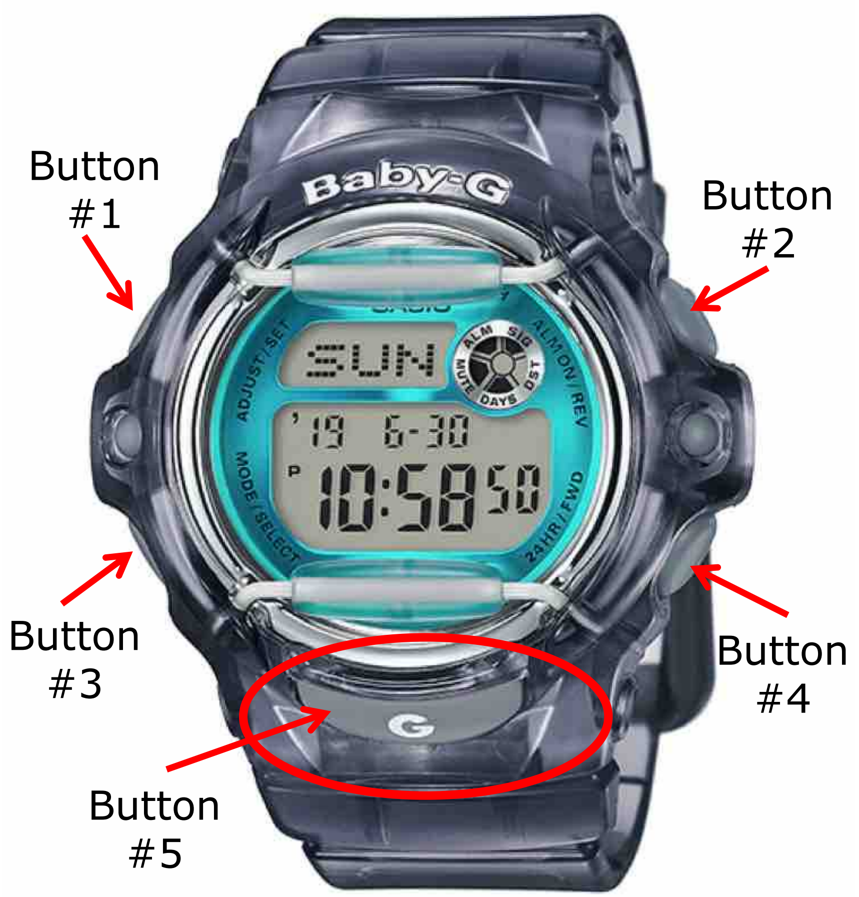
"User profile"

Designing for the User

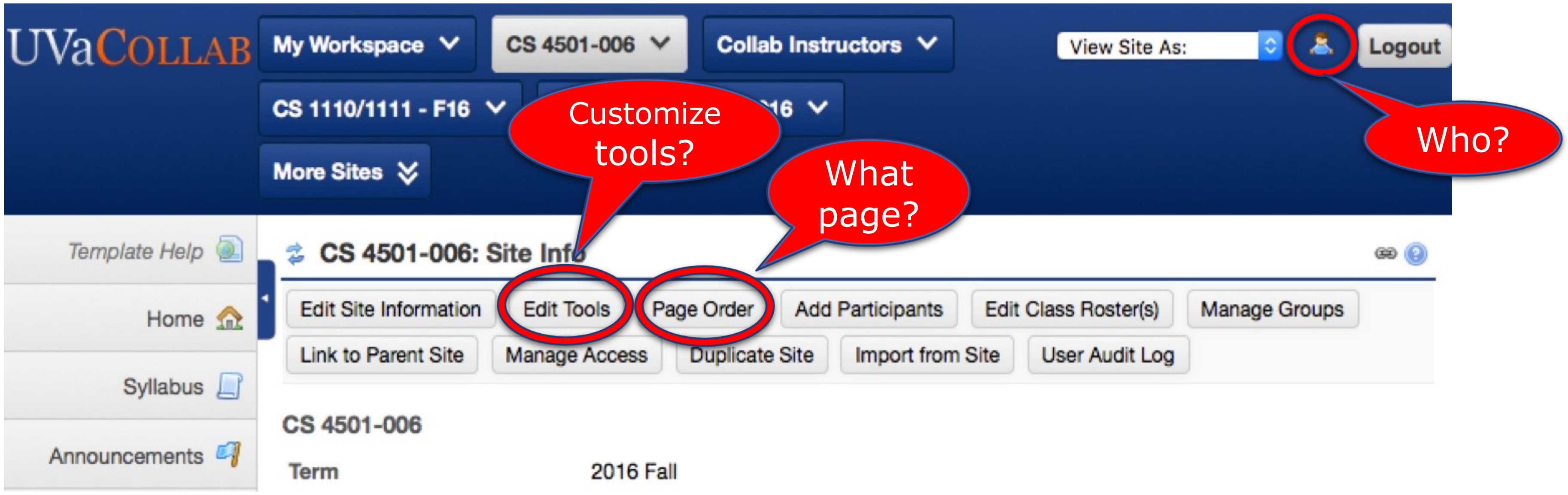
- Engineers tend to focus on functionality
- But if users cannot always understand how to use all the exciting features … **They won't**

- My watch has five buttons
- I normally use one (button #5)

- 36-fine-printed-pages manual !!
- Can I set time without looking at the manual?
- How about a stopwatch feature?



Designing for the User



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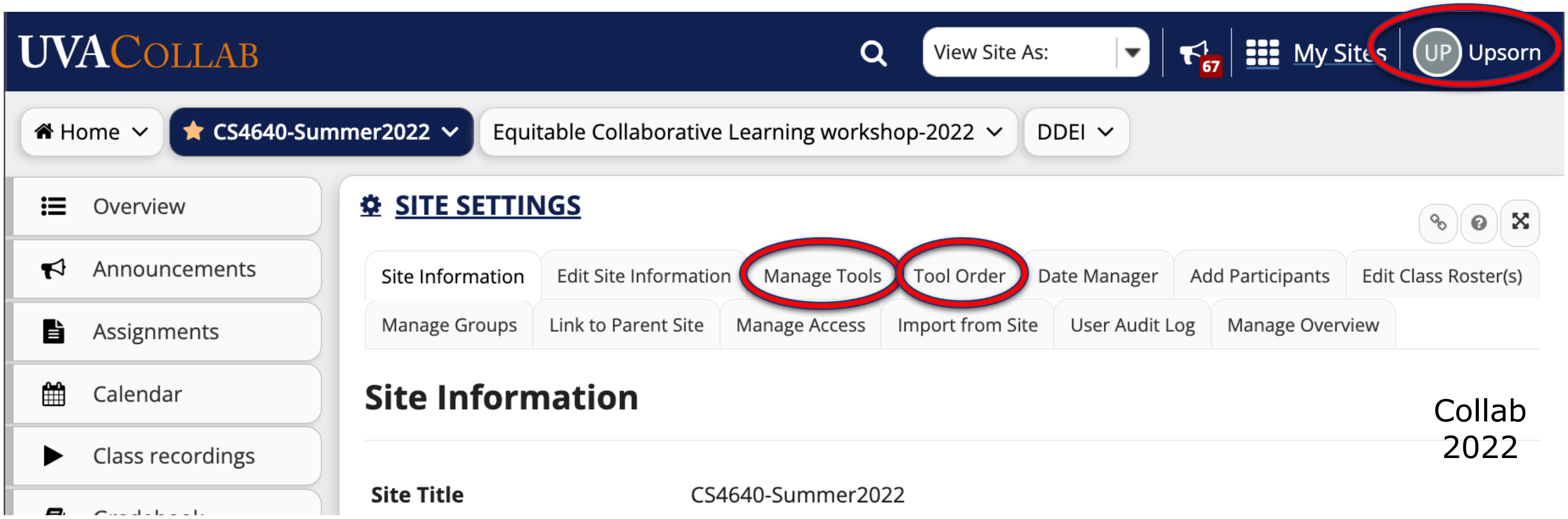

Site Information

Site Title CS4640-Summer2022

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Design of UIs

- Inside-out design
  - Develop a system
  - Then add the interface
- Outside-in design
  - Design the interface
  - Then build the system to support it

Traditional computer science courses are almost entirely inside-out!

When design decisions are made,
either the developer must conform to the users,
or the user must conform to the developer.

Web sites sink or swim based on the usability

Mental Models

Information in the head
- What we memorize
- Knowledge for using a UI

Information in the world
- What we see

Declarative knowledge ("of")
- Facts and rules
- Easy to write down and teach
- Usually requires memorization

Procedural knowledge ("how")
- To accomplish a task
- Hard to teach and learn
- Taught by demonstration and learned through practice
- Requires deeper understanding

Mental models
(users' perception of reality)

Example: Driving a Car

- 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

Another example:
https://www.youtube.com/watch?v=pAOyWFOFhsg

UIs and Mental Models

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

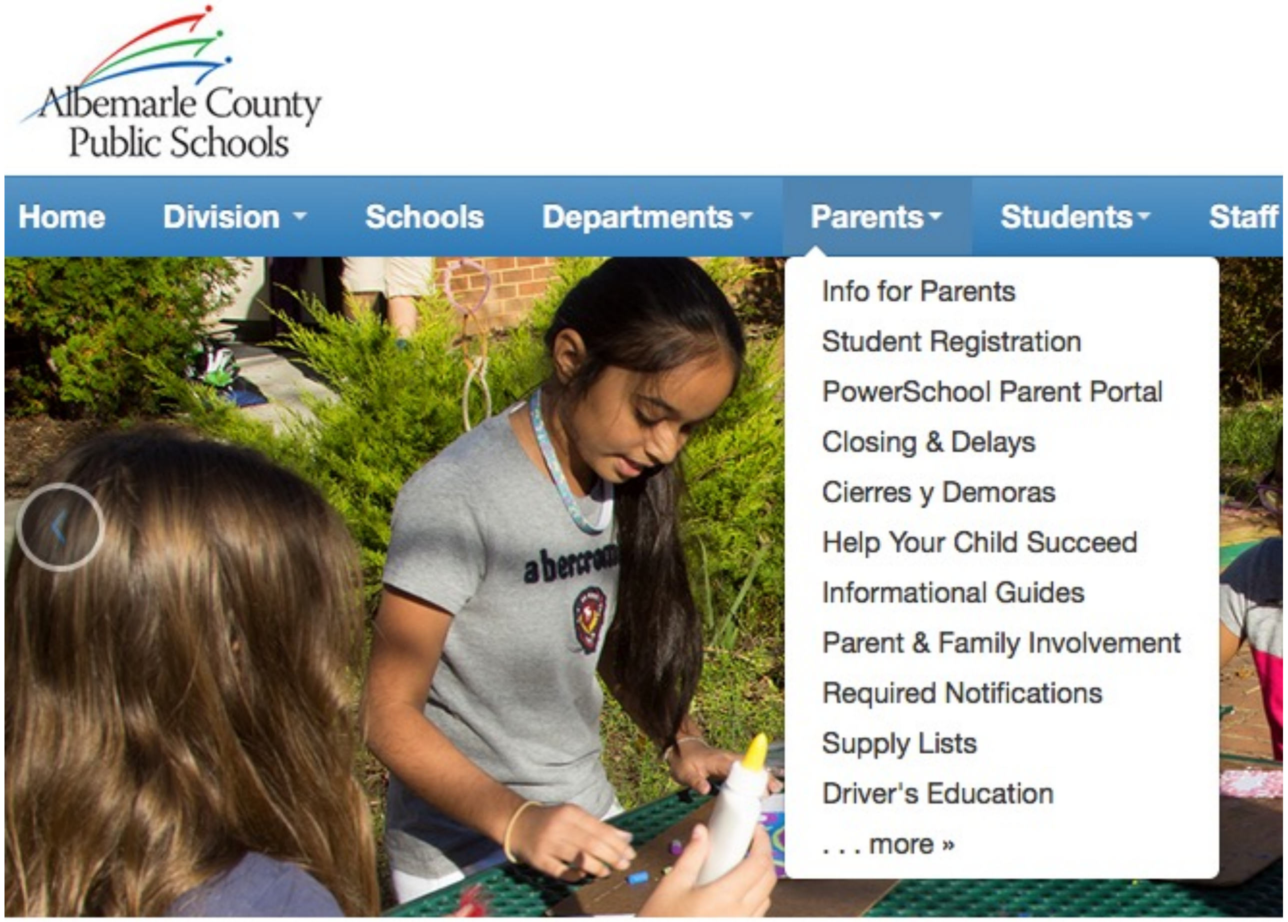
- Move on the same disk
- Copy from USB thumb drive to disk

Calendars: paper calendars require paging,
online calendars can scroll

Fundamental Software Design Principle
The 7 ± 2 Rule

- Human's short term memory can only hold about seven things at a time (plus or minus 2)

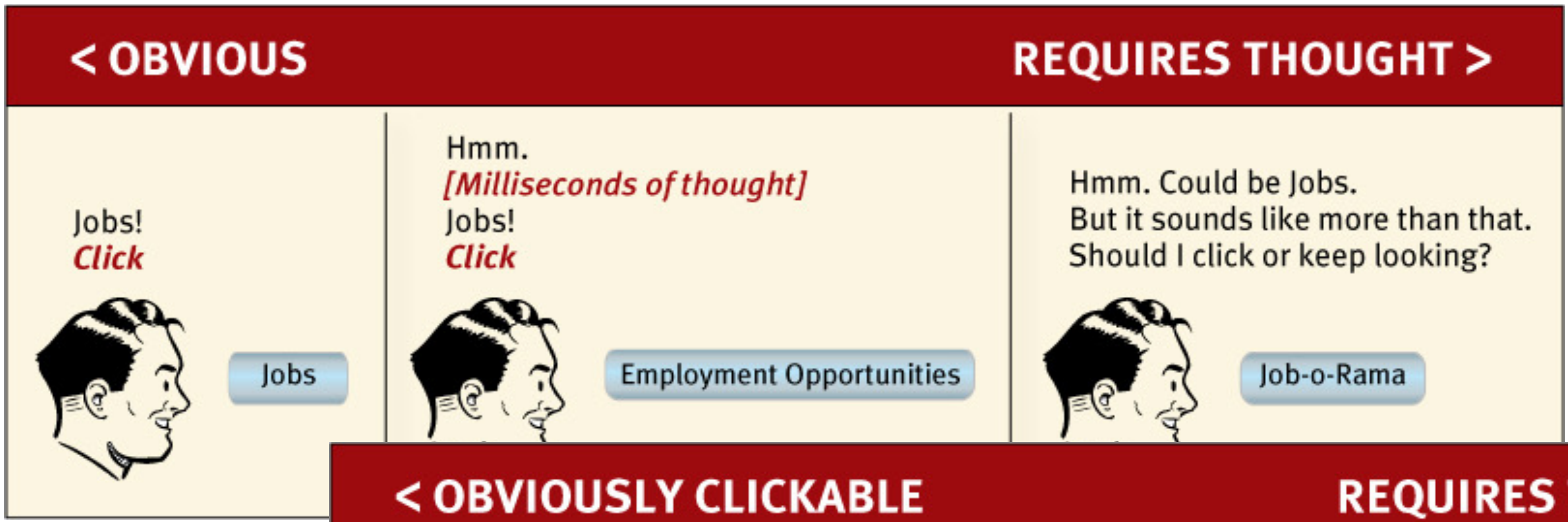
When we get more than about 7 items, we get confused

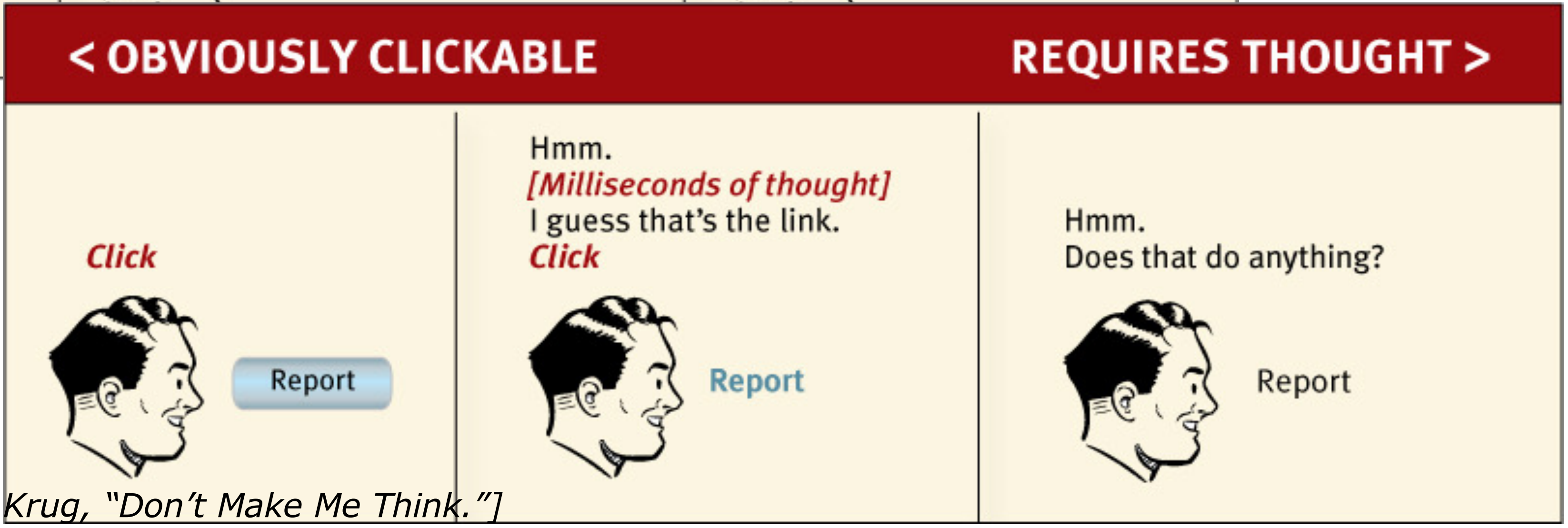


Have a Point, Make Your Point!

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





[Figures from Steve Krug, "Don't Make Me Think."]

Preventing 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 can prevent the user from making dangerous choices
- Software seatbelts: If the dangerous choice must be available, allow it with a hesitation (“are you sure?”)

"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

Helping Users Choose Action

- Visibility
  - The user can see the state of the system and how to use it
- Good conceptual model
  - The system works the way the users expect
- Good mappings
  - Users can see relationships between actions and results, controls and effects, and state and appearance
- Feedback
  - The system tells the user what happened at every step

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

Excise Tasks

- Overhead relates to solving problems:
  1. Revenue Tasks: Sub-tasks that work to solve the problem directly
     - Studying
     - Doing homework
     - Listening to lectures
  2. 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
- Excise tasks satisfy the needs of the tools or process, not the users

Example: GUI Excise

- Competent command lines users see a lot of excise in GUI – primarily the navigation
  - Using the mouse
  - Having to go through multiple screens
  - Generally – GUIs 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
  - VIM: Less than five minutes; one process, repeat searching and commands (assuming text files)

- Convert 20 files to PDF
  - Word: about an hour, print dialog for each file
  - Latex: 3 minutes with a simple shell script, 10 by hand

Example: Command Line Excise

- Users must learn all the syntax – a significant tax!
  - Equivalent to learning programming languages
  - CLs are primarily preferred by programmers

- Command line users will often make extensive use of shortcuts and customization in GUIs

Reduce Excise Tasks

Don’t make me think

also means

Don’t make me do work that’s <u>not</u> related to my goal

Techniques to Avoid Excise

- 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 require passwords for everything
    - Authentication is almost always excise!
- Don’t make users remember where files are
    - MUST let users define file organization
    - MS Word not does, eclipse does not

Techniques to Avoid Excise (cont.)

- 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
  - https://www.youtube.com/watch?v=3Sk7cOqB9Dk
- Avoid or correct errors

Memory – Auto-Customization

- 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

Nine Golden Rules of UI design

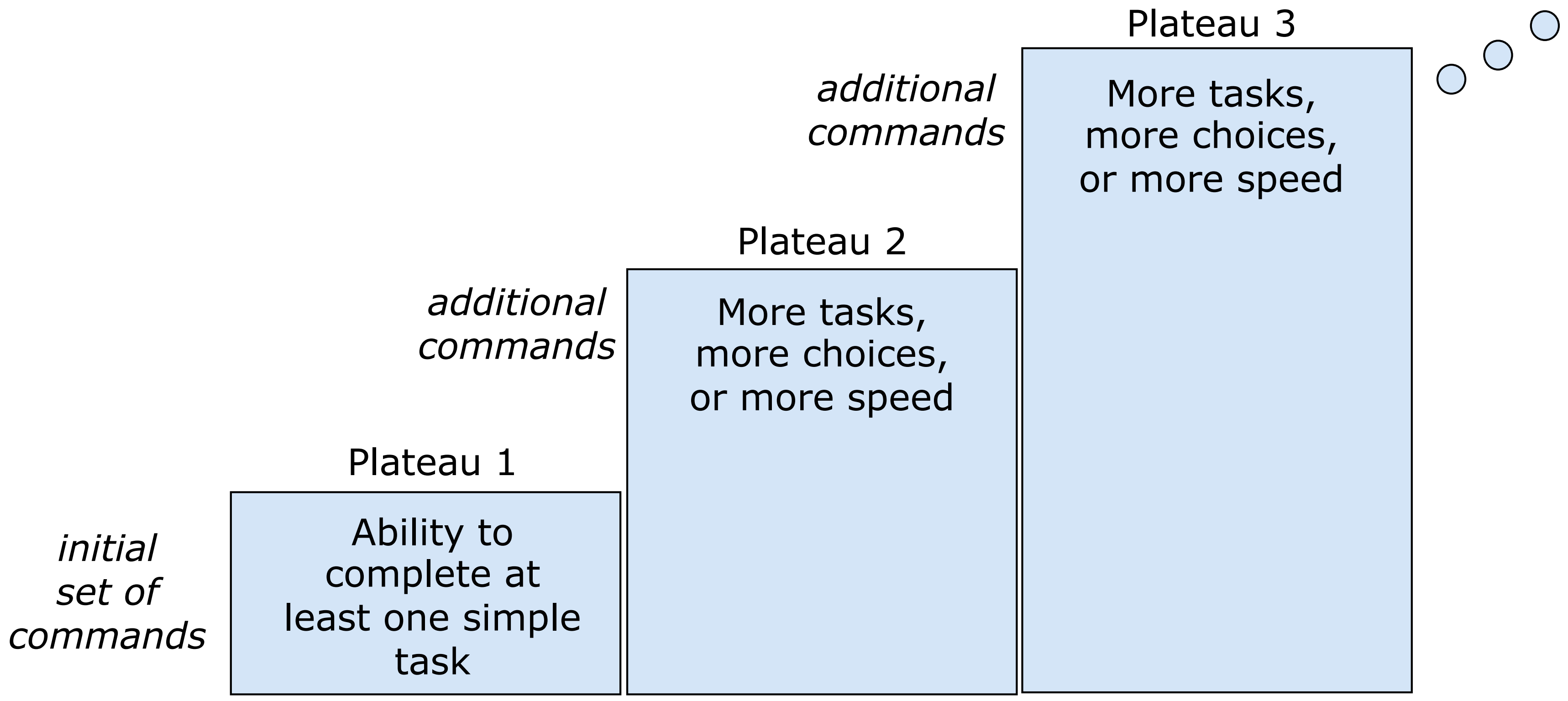
1. Build a UI that is consistent
2. Design usable and discoverable shortcuts
3. Provide appropriate feedback
4. Yield closure
5. Provide appropriate error handling
6. Allow users to undo all actions
    - Use hesitation for the operation that cannot be "undone"
7. Put the user in charge
8. Reduce the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

Shneiderman’s 5 Criteria for Measuring Usability

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

1. 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


Plateau 3
additional commands
More tasks, more choices, or more speed
Plateau 2
additional commands
More tasks, more choices, or more speed
Plateau 1
initial set of commands
Ability to complete at least one simple task

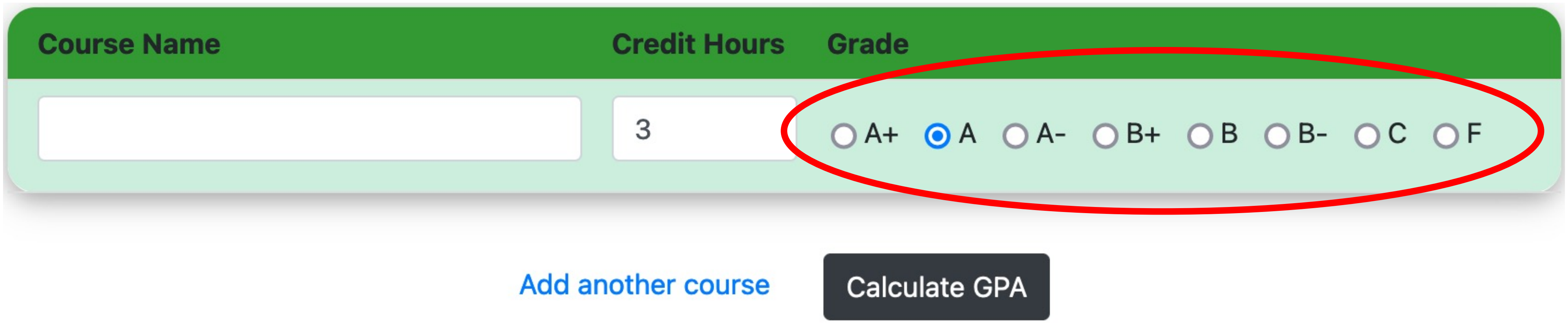
2. Speed of UI Performance

- This is about navigating through the interface, **not** how fast the software or network runs
- *Interaction points* are places 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 need to reduce the number of keyboard-to-mouse switches

Speed of user interface – NOT software, hardware, or network

3. Rate of 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



[https://cs3250.uk.r.appspot.com/calculategpa-bypass.jsp]

4. Retention of Skills

- "Once you learn to ride a bicycle, you never forget"
- Some interfaces are easy to remember, some are hard
- If they flow logically (that is, match the user's mental model or expectations), they are very easy to remember
- 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

5. Subjective Satisfaction

- Subjective satisfaction is defined to be 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!

I'm moving

Tradeoffs Among 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!
    - Example: Many GUIs are easy to learn, but slow
    - Many command languages are fast, but hard to learn
- To be an effective UI designer, we must consider each criterion carefully and prioritize before designing
- Decide what is acceptable for each of the five criteria

How to Improve 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

Tips When Working on Usability

- Test the old design before staring 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
- Implement the final design, test it again.
- 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

Summary

- Good UIs take time to design
- Designing a good UI requires thinking like the user instead of an engineer
  - Engineers often think they are users
- Different users want different things

Engineers love features
They want to do everything the technology allows!

All an interface designer has to do is

- **Be polite**
- **Be considerate**
- **Be clear**