Interaction Techniques

SWE 632
Fall 2023

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Administrivia

- Midterm Exam scores up on Blackboard / Gradescope
- HW4 due today
- HW5 due next week

Class Overview

1. *Overview of Interaction Design:* Thinking about User Actions

2. *Considering Physical Actions:* Designing to Ease Physical Constraints

3. *Mobile Design Considerations:* Designing for Mobile Interaction

4. *Universal Design:* Considering Accessibility

Interaction Design Overview

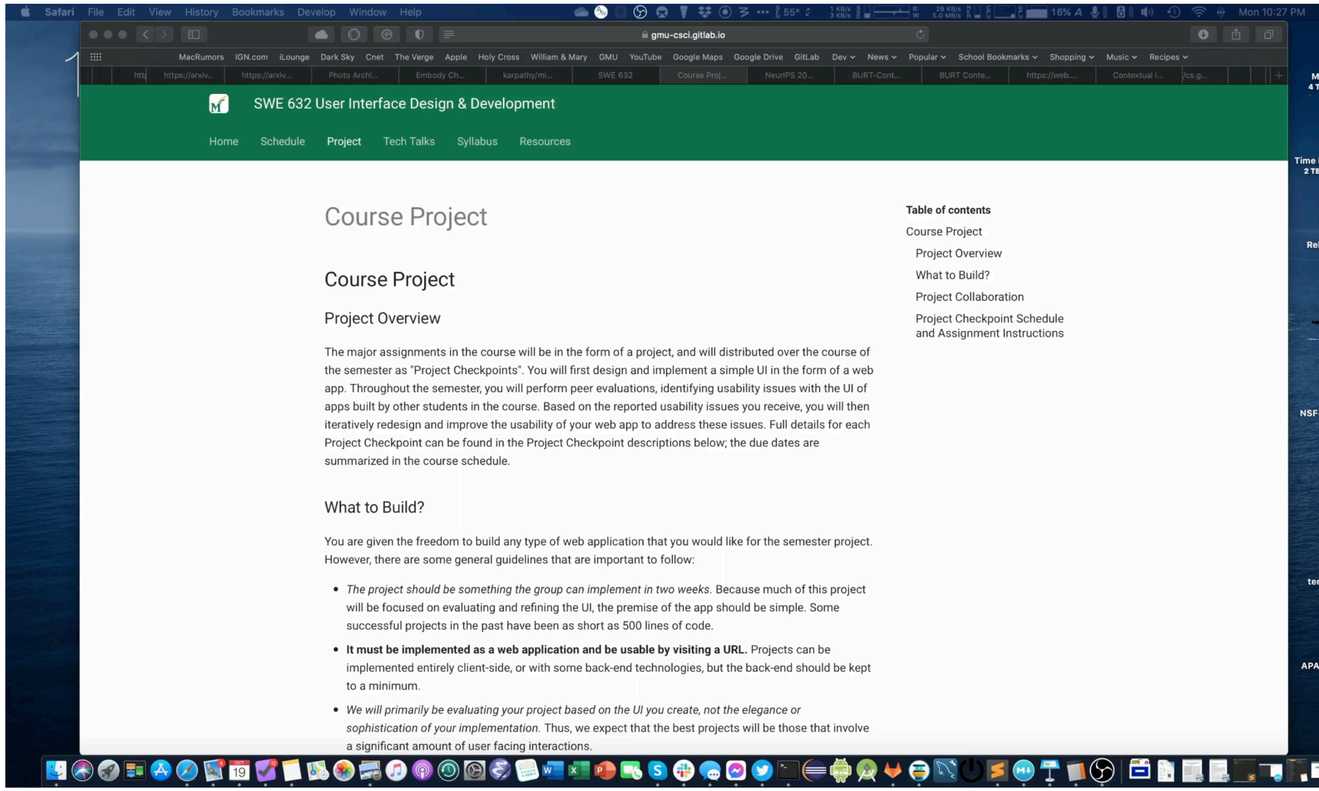
Identifying Actions

Signifiers

- Goals
  - Show which UI elements can be manipulated
  - Show how they can be manipulated
  - Help users get started
  - Guide data entry
  - Suggest default choices
  - Support error recovery

Hinting

- Indicate which UI elements can be interacted with
- Possible visual indicators
  - ***Static hinting*** - distinctive look & feel
  - ***Dynamic hinting*** - rollover highlights
  - ***Response hinting*** - change visual design with click
  - ***Cursor hinting*** - change cursor display

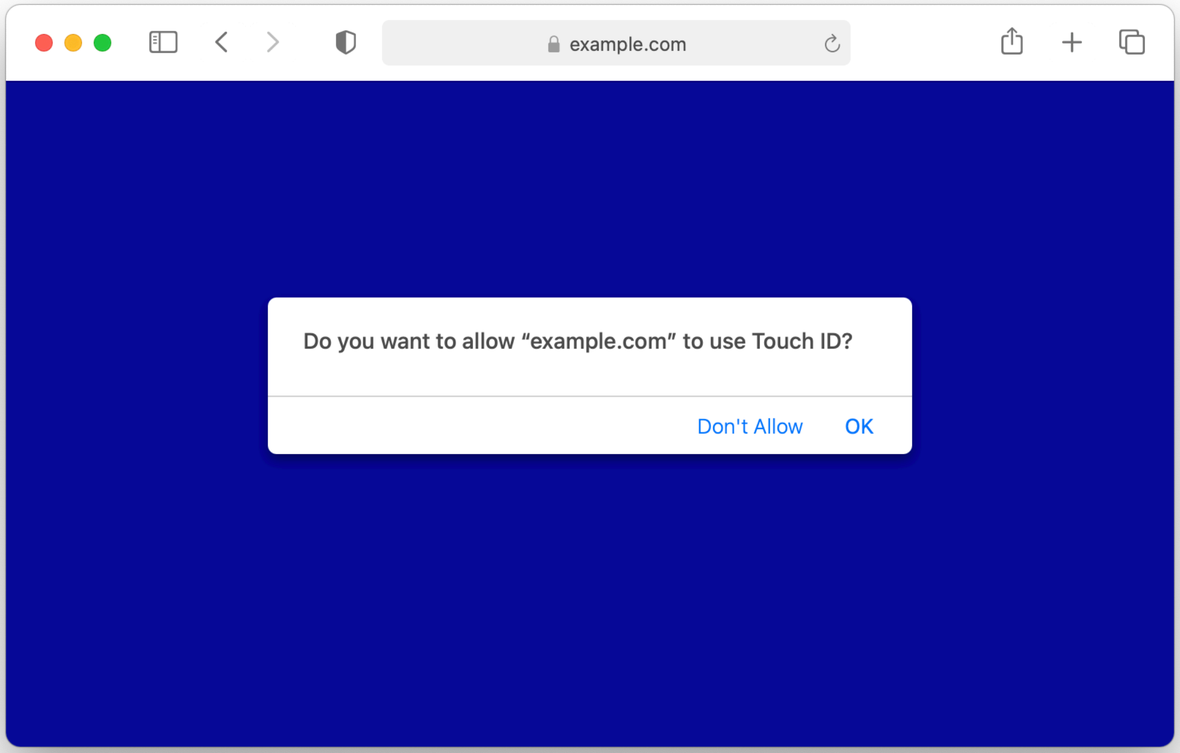


Help Users Predict Outcome of Actions

- What does this do?
- Should I click it?

Clarity of Wording (Bad Example)

- Design for clarity & precision



Clarity of Wording

- Choose words carefully
- Speak the user’s language
- Avoid vague, ambiguous terms
- Be as specific as possible
- Clearly represent domain concepts

Likely & Useful Defaults

- Default text, if relevant (e.g., date)
- Default cursor position
- Avoid requirements to retype & re-enter data

Modes

- Vary the effect of a command based on state of system
- Examples
  - caps lock
  - insert / overtype mode
  - vi / emacs command modes
  - keyboard entry used for controlling game and chatting

Challenges with Modes

- Modes create inconsistent mapping
  - E.g., control S sometimes saves, sometimes sends email
  - Especially dangerous for frequent interactions that become highly automatic System 1 actions

- Avoid when possible
- Clearly distinguish if necessary
  - Make clear to user which mode they are in and how to change

Command Interactions

- How can a user invoke a command?
- Common examples
  - Menus
  - Buttons
  - Toolbar
  - Dialog box
  - Keyboard shortcut
  - Gesture
  - Voice commands

- What are some advantages and disadvantages of each approach?

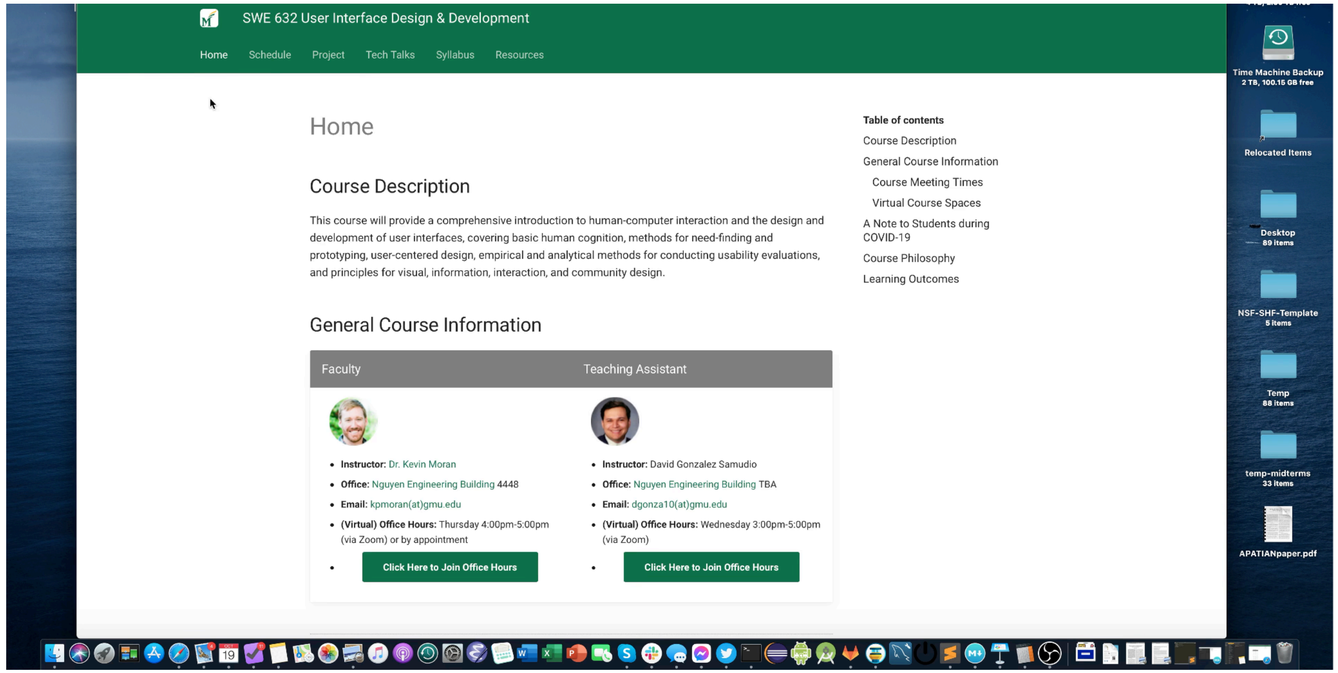
Physical Actions

Avoid Physical Awkwardness

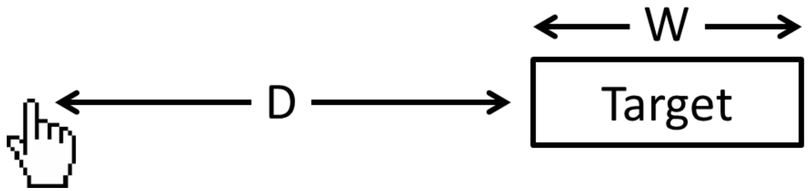
- Switching between input devices takes time
- Avoid forcing user to constantly switch between input devices (e.g., keyboard & mouse)
  - e.g., Effective tab order between fields
- Avoid awkward keyboard combinations

Moving the Mouse

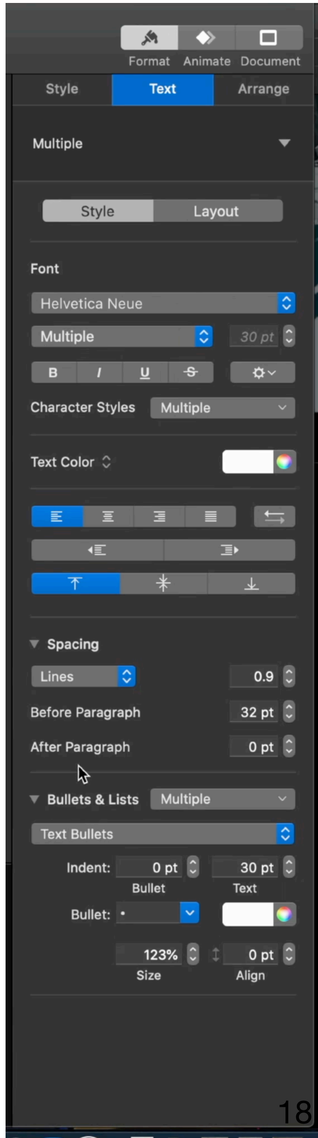
- After a user has (1) realized that a region is interactable, (2) decided that it will cause the desired action to be invoked
- How long does it take for a user to move the cursor to click on it?
- What factors might influence this time?



Fitt's Law

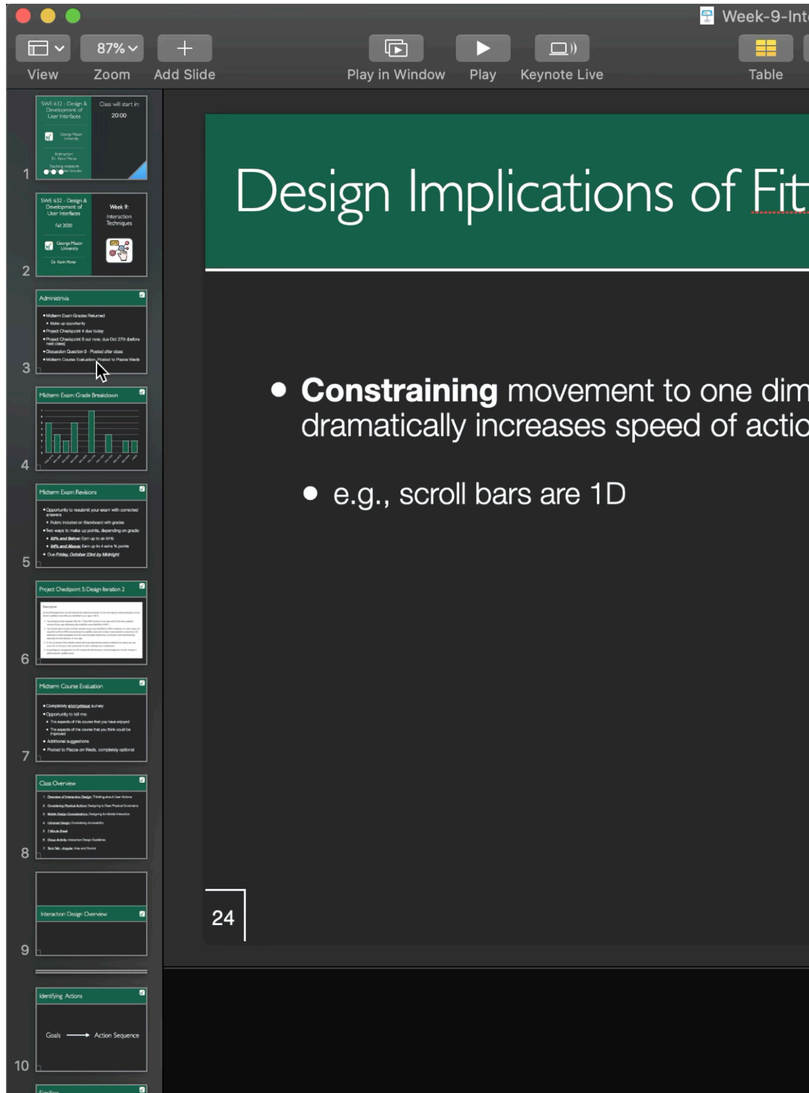


- Time required to move to a target ***decreases*** with target ***size*** & ***increases*** with ***distance*** to the target
- Movements typical consist of
  - one large quick movement to target (***ballistic*** movement)
  - fine-adjustment movement (***homing*** movements)
- Homing movements generally responsible for most of movement time & errors
- Applies to rapid pointing movements, not slow continuous movements



Design Implications of Fitt's Law

- ***Constraining*** movement to one dimension dramatically increases speed of actions
  - e.g., scroll bars are 1D

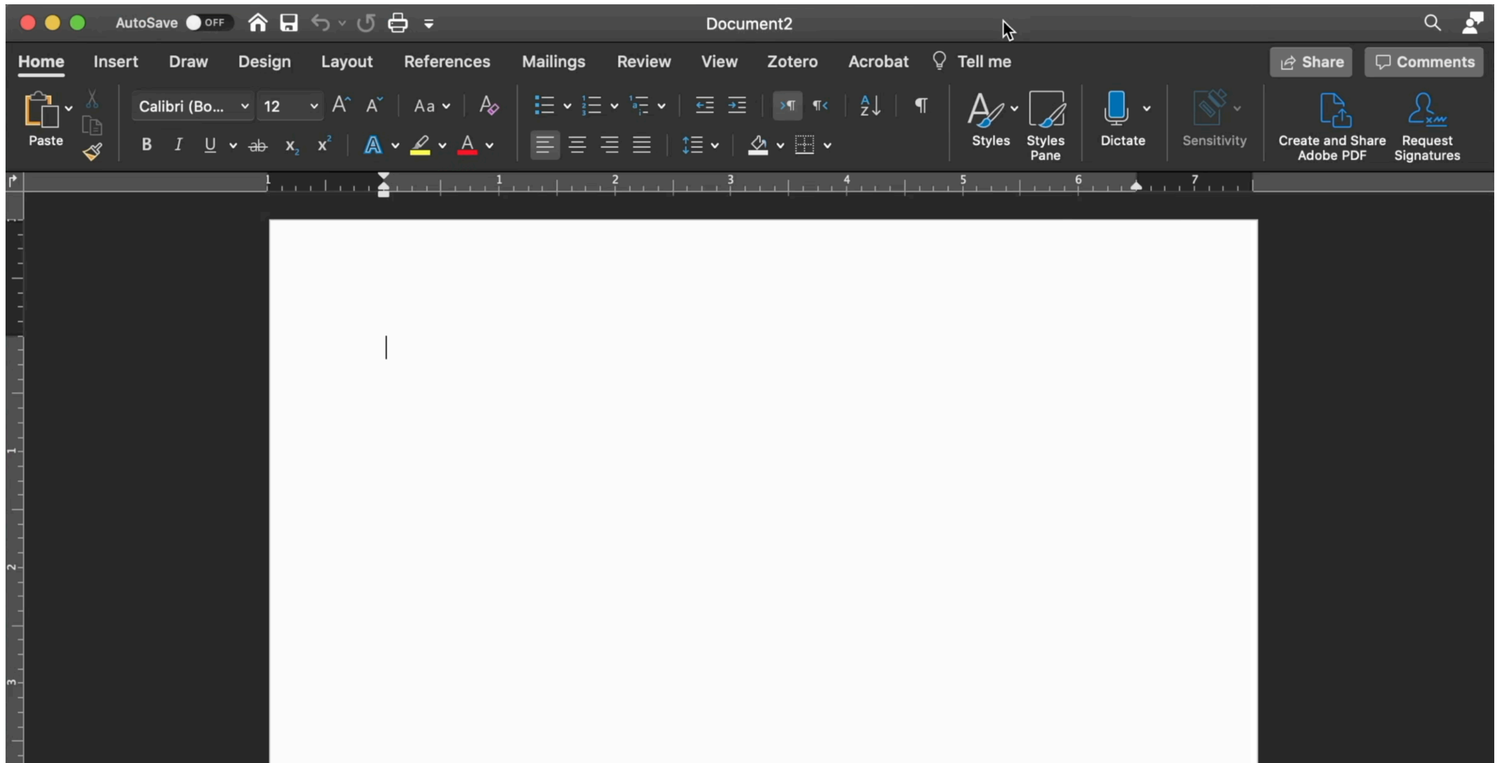


Design implications of Fitt's law

- Making controls ***larger*** reduces time to invoke actions
- Locating controls closer to user ***cursor*** reduces time
  - e.g., context menus

Design Implications of Fitt's Law

- Positioning button or control along ***edge*** of screen acts as barrier to movement, substantially reducing homing time & errors



Mobile Design

Responsive Design

- Mobile devices often have smaller form factor than desktop / laptop OS
- Can design a separate UI
- Or may build a ***fluid*** UI that rescales for different display sizes

Where's the Cursor?

- No cursor on many mobile devices
- Cannot use dynamic hinting to determine which elements can be interacted with
  - May require more use of static hinting
- Fitt's law still applies
  - Fingers are less sensitive, hard to select small buttons, occlude elements

Alternative Inputs

- Modern mobile devices often have a wide range of sensors which can be used for input
  - Camera
  - Microphone
  - Accelerometer
  - Three-axis gyro
  - GPS
  - Barometer
  - Proximity sensor
  - Ambient light sensor

- Enables new interaction techniques

Augmented Reality

- Overlaying generated content on top of view of the real world

Alternative Inputs + Augmented Reality

Universal Design

Supporting Users with Disabilities

- **Perception** - visual & auditory impairments
  - Blindness or visual impairments
  - Color blindness
  - Deafness & hearing limitations
- **Motion** - muscle control impairments
  - Difficulties with fine muscle control
  - Weakness & fatigue
- **Cognition** - difficulties with mental processes
  - Difficulties remembering
  - Difficulties with conceptualizing, planning, sequencing actions

Blindness and Visual Impairments

- Users use screenreader to listen to screen elements
- Reads all of the text on the page
  - Through practice, learn to listen to text at 400+ words per minute

- Important to have ***alt-text***
  - Images should have labels that explain them
- Important to have ***hierarchy***
  - Rather than visually skimming page, skims page by listening to section heads to determine which level to navigate to next

Motion Impairments

Universal Design

- How can users with physical disabilities be supported in user interactions?
- Good: ***assistive design*** - offering equivalent actions for disabled users that cannot take normal actions
- Better: ***universal design*** - designing interactions so broadest set of users across age, ability, status in life can use normal actions

Example - Curb cut

- Initially designed for ***accessibility*** - support for disabled & wheel chairs
- But potentially benefits ***all users*** of public spaces - people w/ suitcases, hand carts, roller blades, bikes, …

7 Principles of Universal Design

- ***Equitable use:*** The design is useful and marketable to people with diverse abilities
- ***Flexibility in use:*** The design accommodates a wide range of individual preferences and abilities
- ***Simple and intuitive:*** Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level
- ***Perceptible information:*** The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities
- ***Tolerance for error:*** The design minimizes hazards and the adverse consequences of accidental or unintended actions
- ***Low physical effort:*** The design can be used efficiently and comfortably and with a minimum of fatigue
- ***Size and space for approach and use:*** Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility

Big Topic - Further Reading

Jeff Bigham's Course at CMU: http://www.accessibilitycourse.com

Amy Ko's Book Chapter on Accessibility:
https://faculty.washington.edu/ajko/books/user-interface-software-and-technology/#/accessibility#ref-islam10

10 Minute Break

In-Class Activity

In-Class Activity: Interaction Design Guidelines

- In groups of 2 or 3

- Select a common application task (e.g., navigating list of items, invoking commands on content, entering formed text)
- Build a list of alternatives to the standard interaction techniques for this task (e.g., chat, AR)
- Describe pros and cons of each alternative
- Describe how each alternative might be adapted to support mobile and universal design

- Due by 6:25pm today