

Interaction Techniques

SWE 632

Fall 2024

Administrivia

- Midterm Exam scores up on Canvas / 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

Goals → Action Sequence

Signifiers

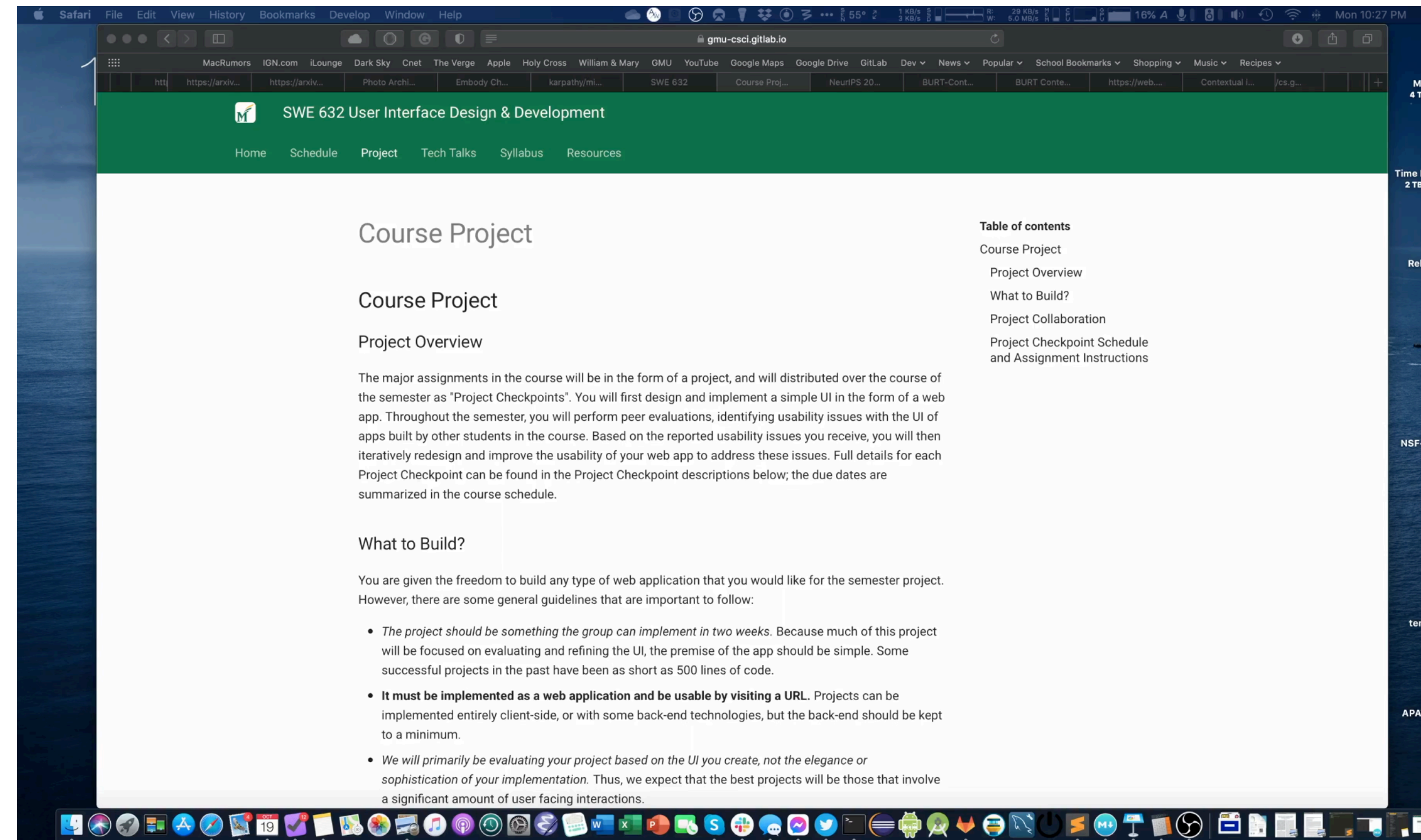
Is this a button?

Or a link?

- 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



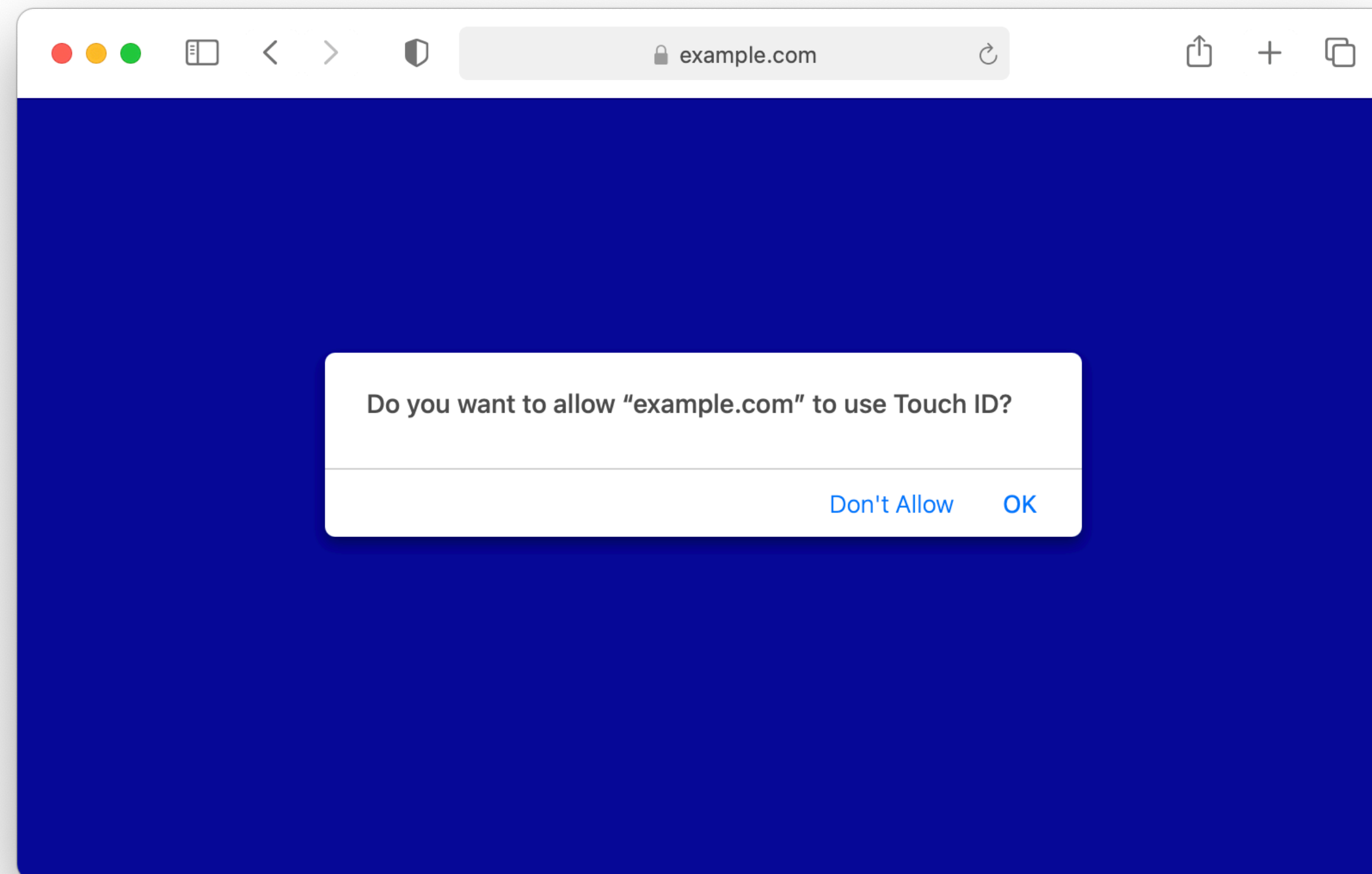
Help Users Predict Outcome of Actions

- 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 / overwrite 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?

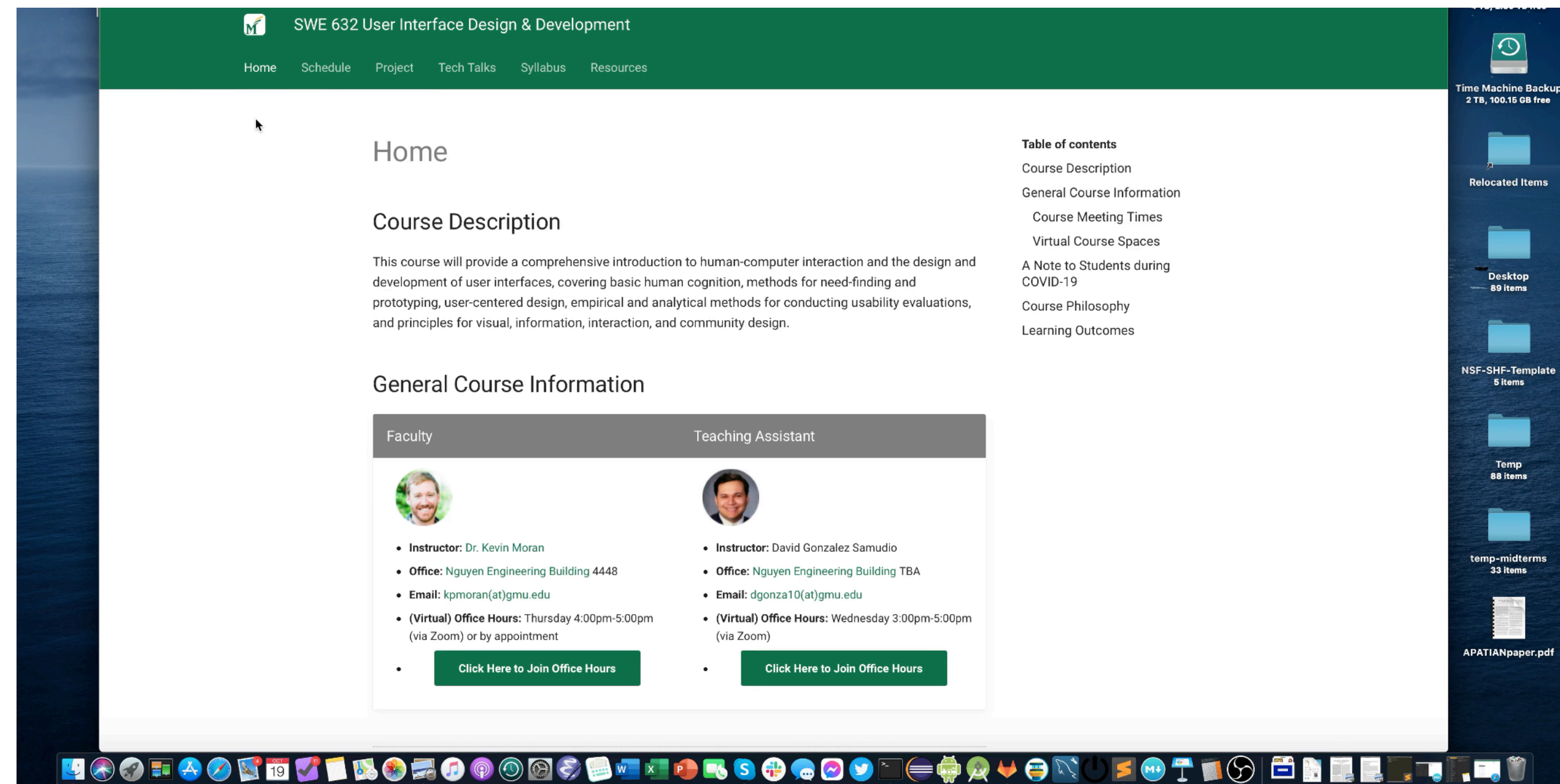
Physical Actions

Avoid Physical Awkwardness

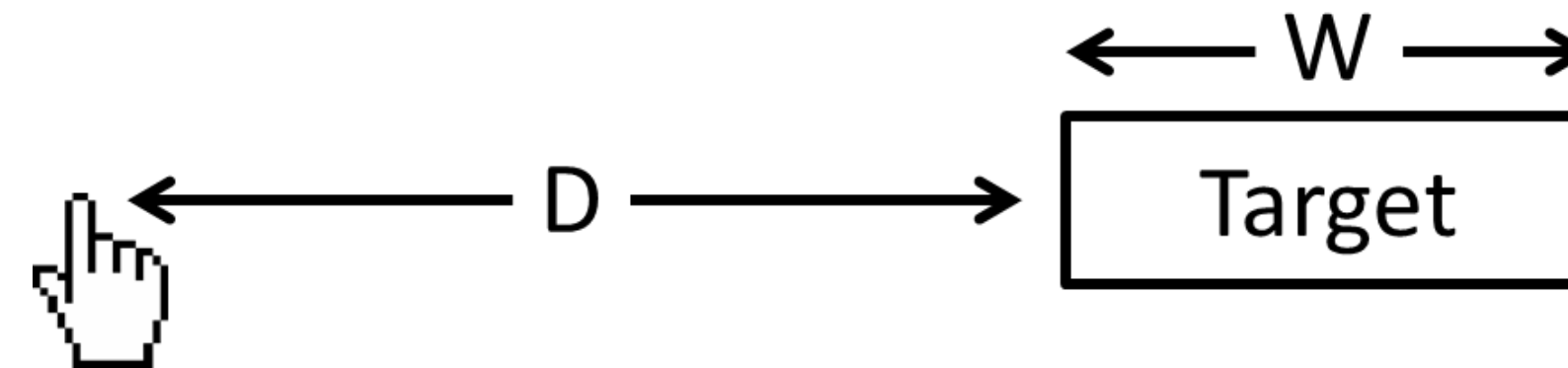
- Switching between input devices takes time
- Avoid forcing user to constantly switch between input devices (e.g., keyboard & mouse)
 - e.g., Effective tab order between fields
- Avoid awkward keyboard combinations

Moving the Mouse

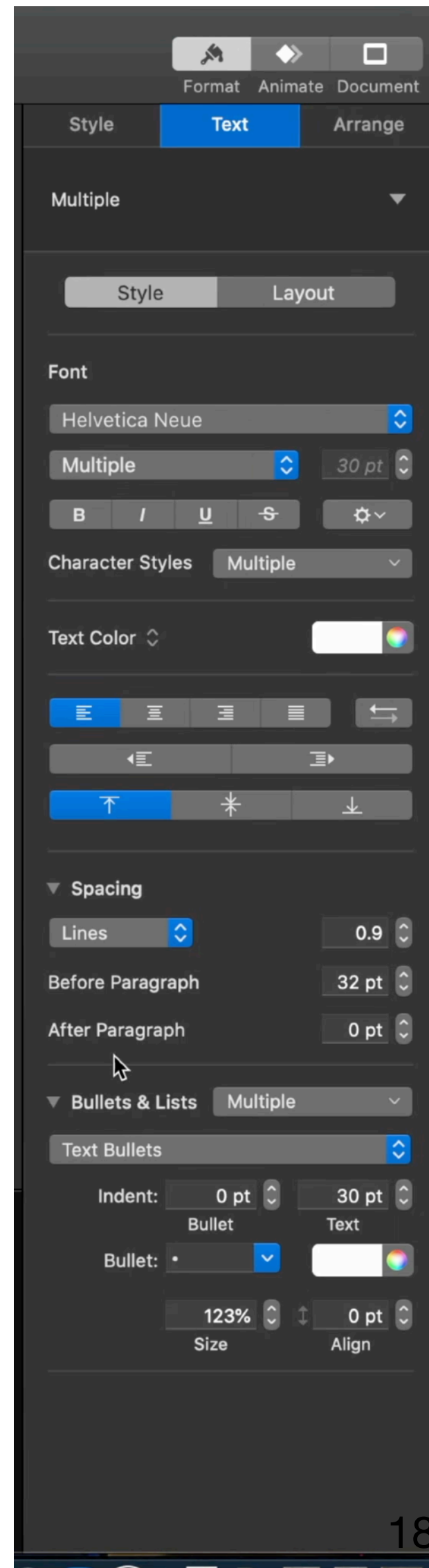
- After a user has (1) realized that a region is interactable, (2) decided that it will cause the desired action to be invoked
- How long does it take for a user to move the cursor to click on it?
- What factors might influence this time?



Fitt's Law

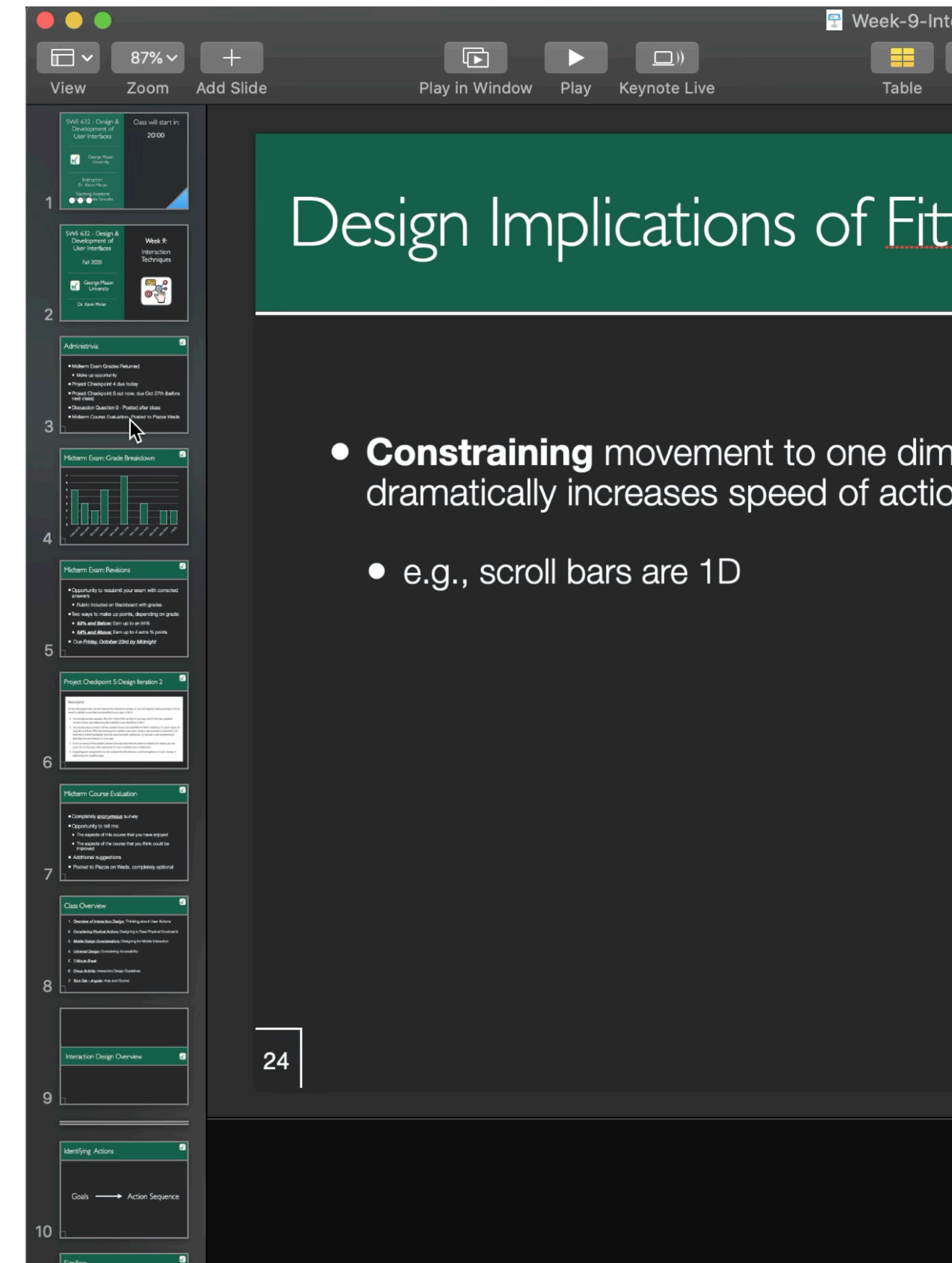


- Time required to move to a target decreases with target size & increases with distance to the target
- Movements typical consist of
 - one large quick movement to target (ballistic movement)
 - fine-adjustment movement (homing movements)
- Homing movements generally responsible for most of movement 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

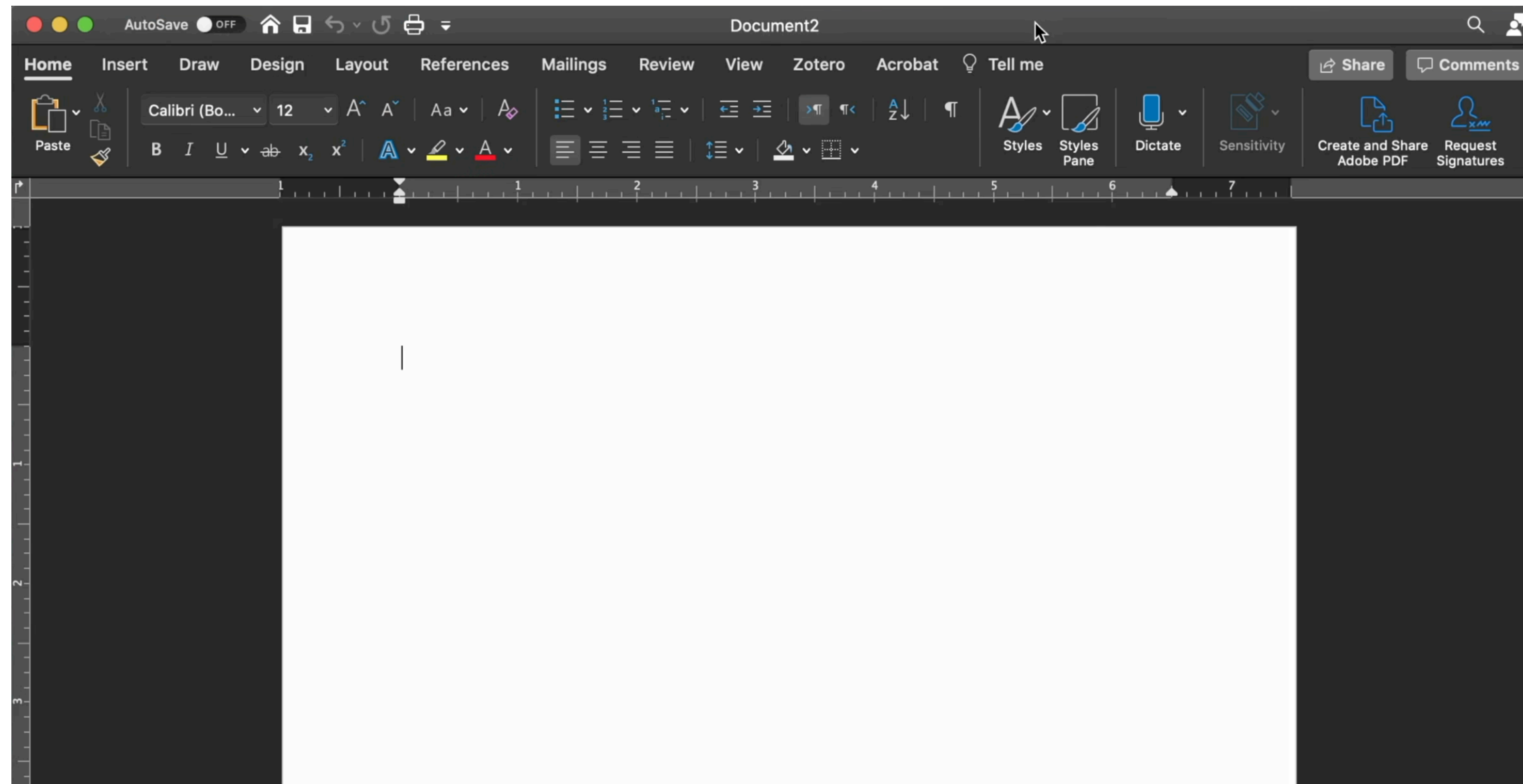


Design implications of Fitt's law

- 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>

10 Minute Break

Tech Talks

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 formatted text)
- Build a list of alternatives to the standard interaction techniques for this task (e.g., LLM based chat, AR)
- Describe pros and cons of each alternative
- Describe how each alternative might be adapted to support mobile and universal design