

# Interaction Techniques

**SWE 632**

**Spring 2022**



# Administrivia

- Midterm Exams returned today
- 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

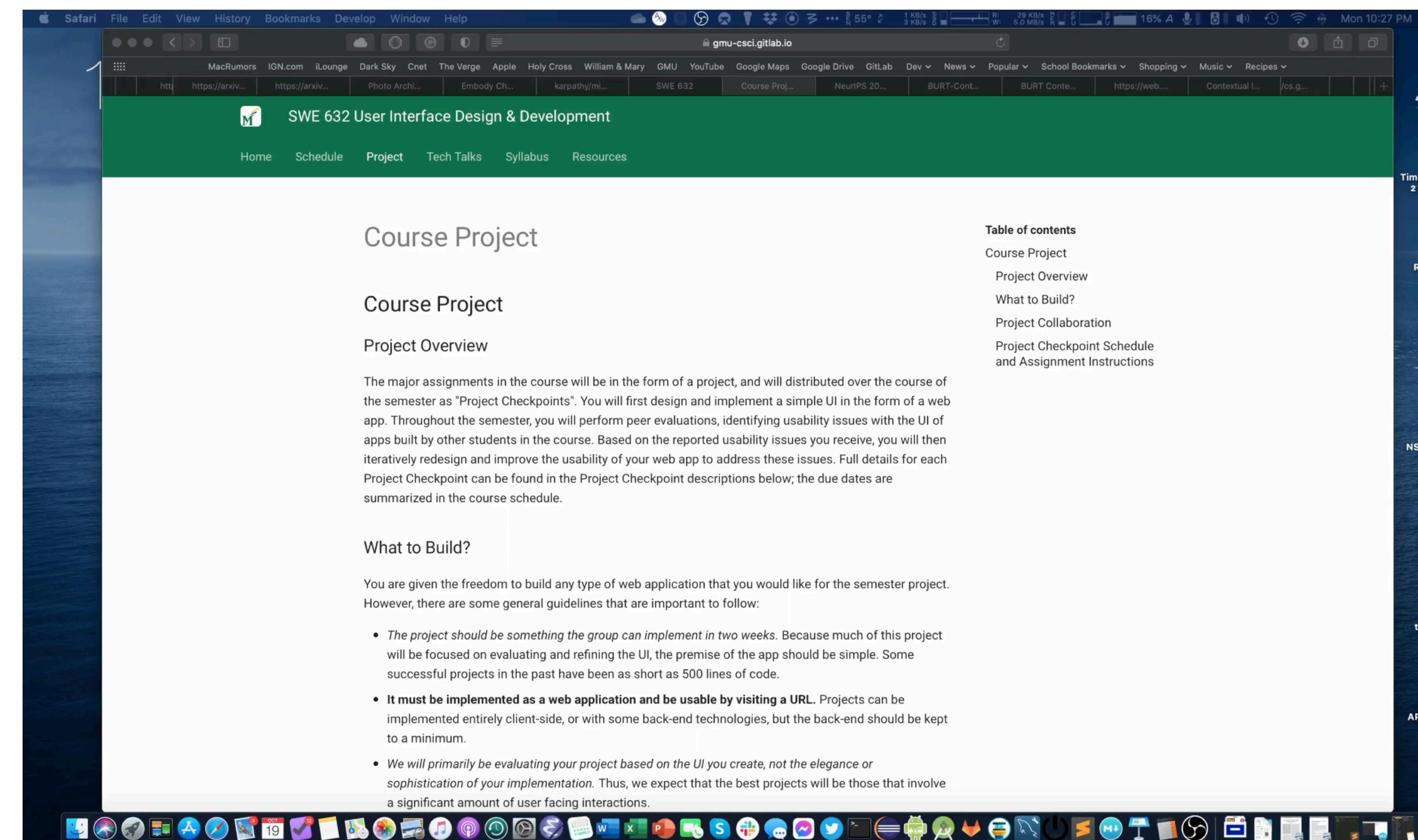
Is this a button?

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



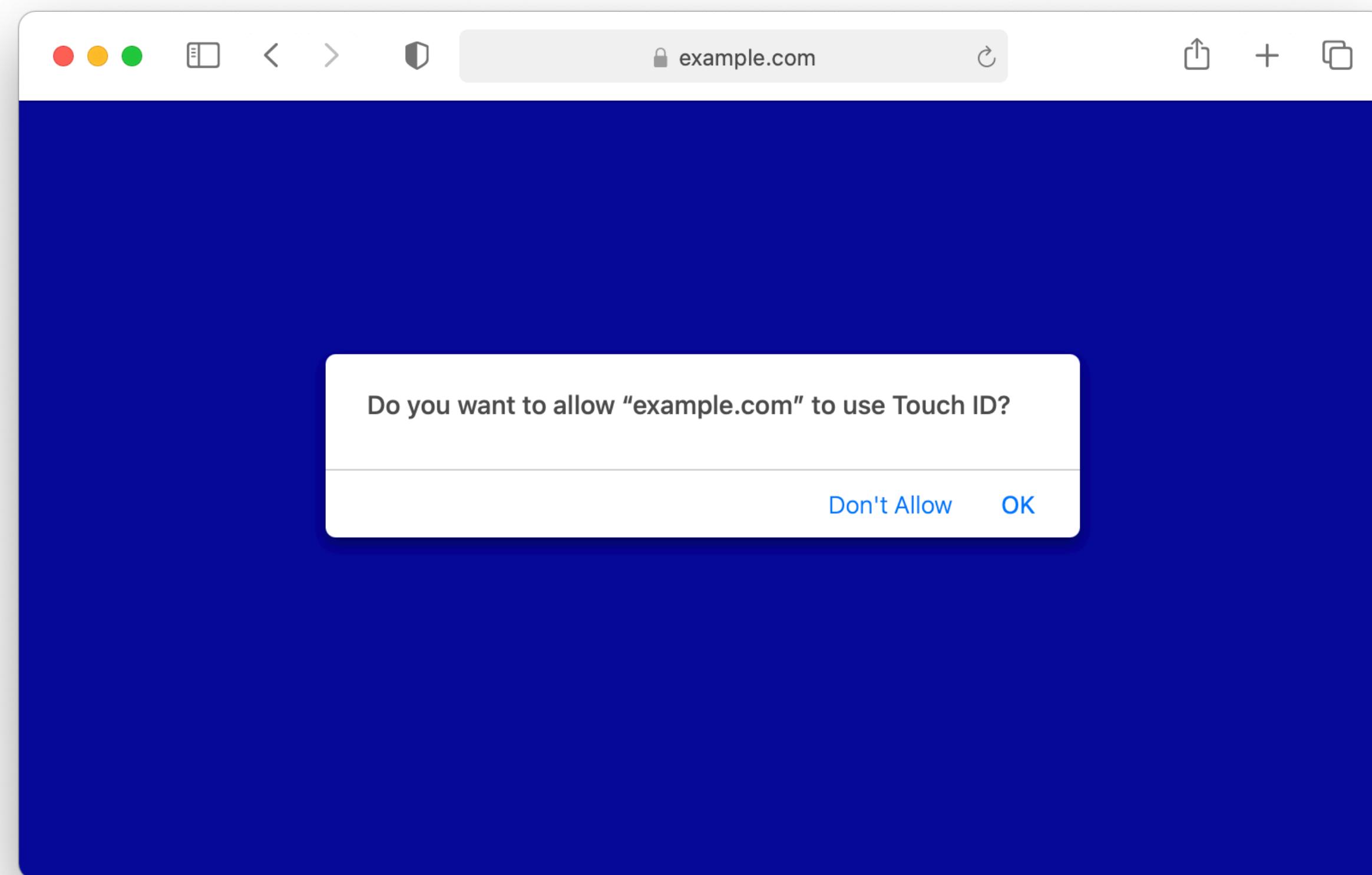
# Help Users Predict Outcome of Actions

- 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 / 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?

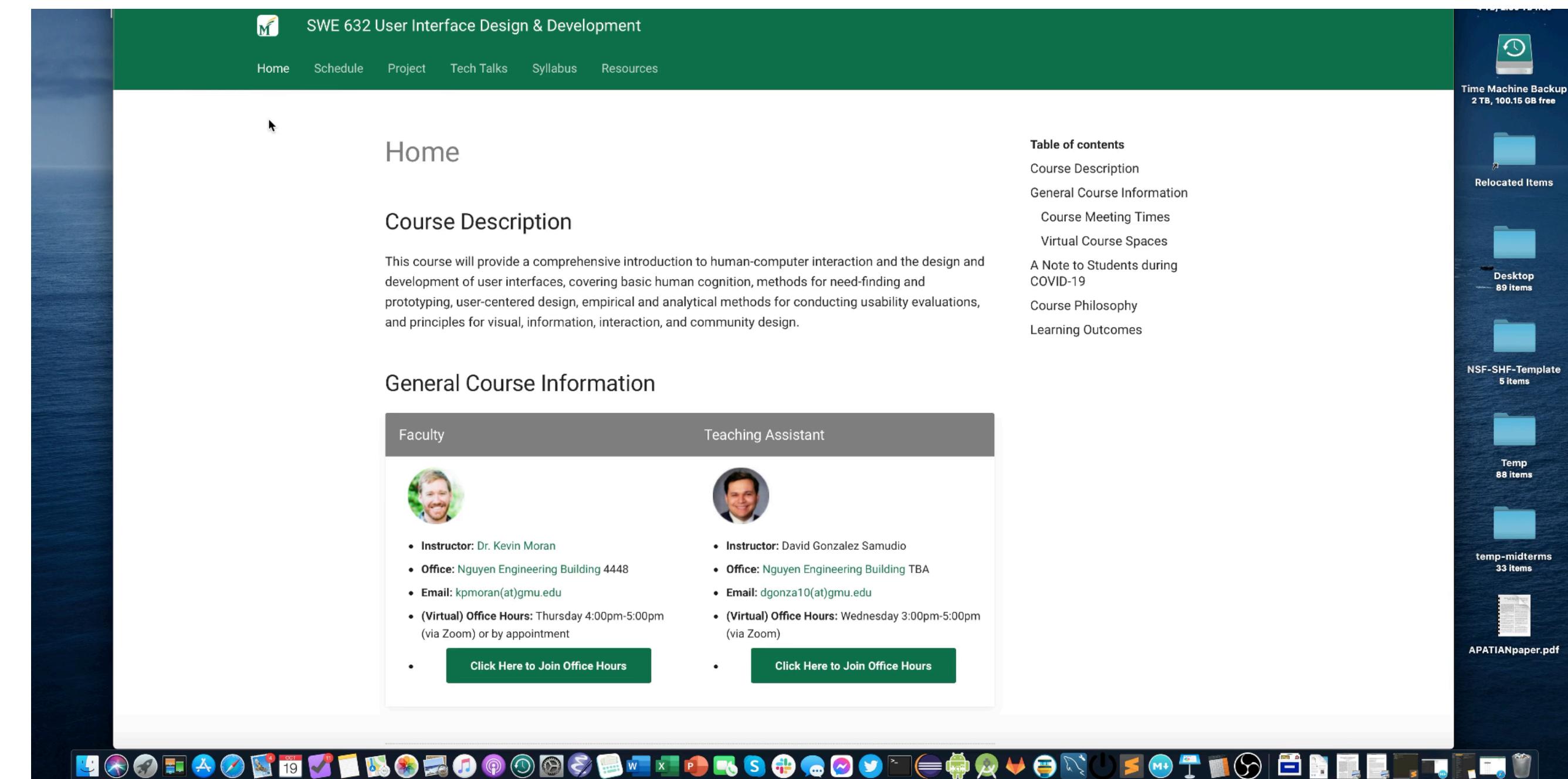
# Physical Actions

# Avoid Physical Awkwardness

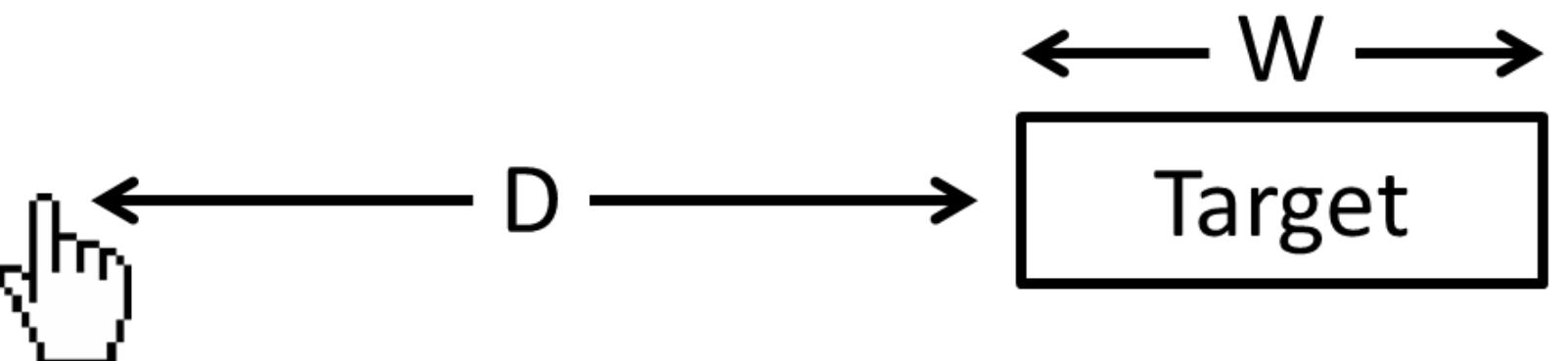
- Switching between input devices takes time
- Avoid forcing user to constantly switch between input devices (e.g., keyboard & mouse)
  - e.g., Effective tab order between fields
- Avoid awkward keyboard combinations

# Moving the Mouse

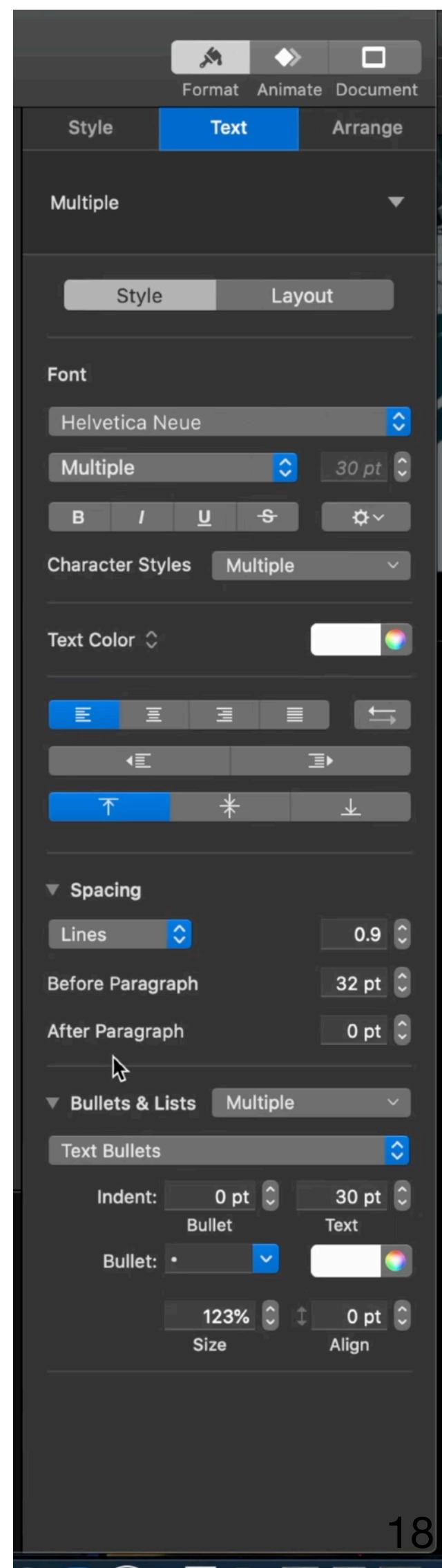
- After a user has (1) realized that a region is interactable, (2) decided that it will cause the desired action to be invoked
- How long does it take for a user to move the cursor to click on it?
- What factors might influence this time?



# Fitt's Law



- Time required to move to a target decreases with target size & increases with distance to the target
- Movements typically 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

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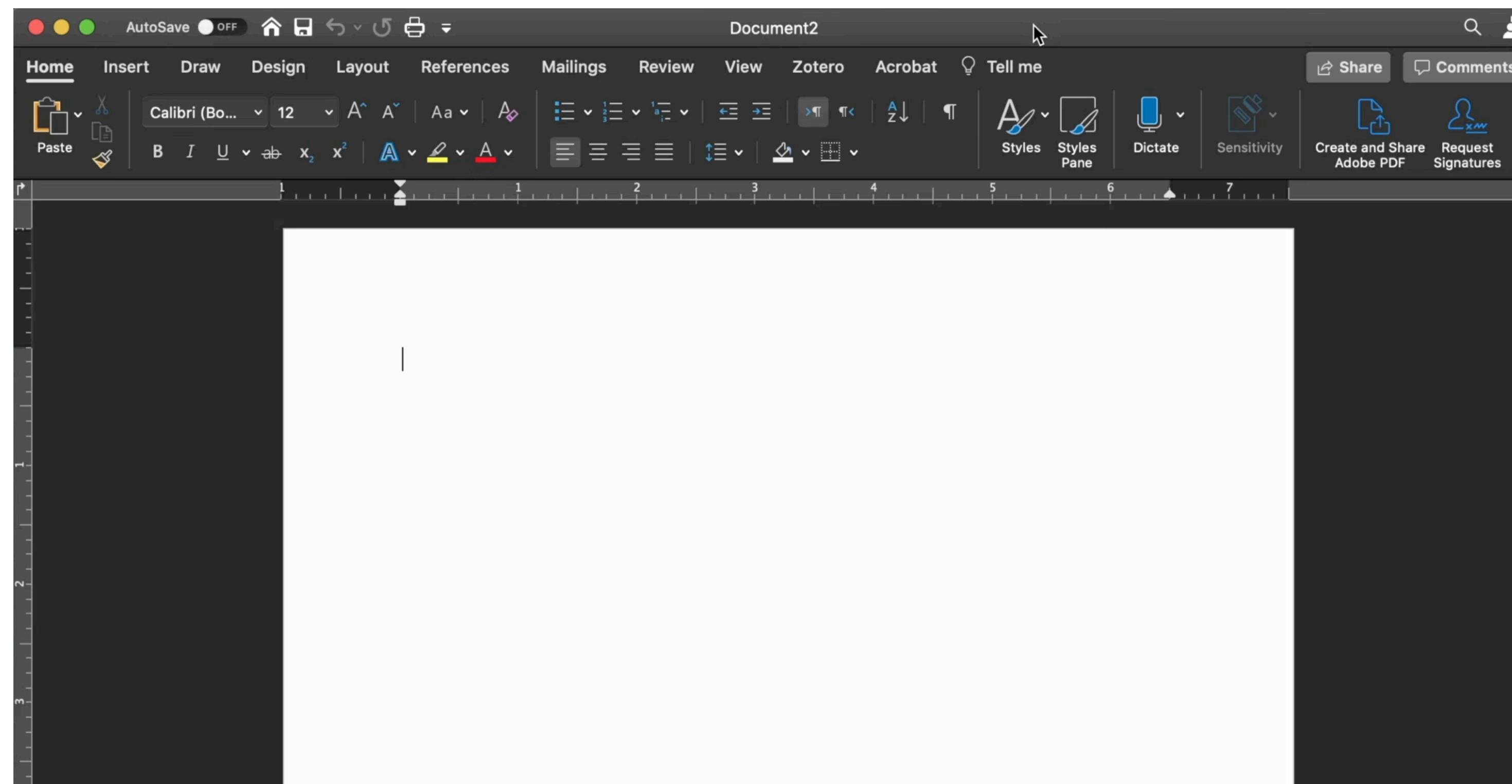
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# Design implications of Fitt's law

- 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

- 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., chatbot, AR)
- Describe pros and cons of each alternative
- Describe how each alternative might be adapted to support mobile and universal design