Accessible Design and Universal Design

EECS 493: User Interface Development

Winter 2025

Today's Learning Objectives

- After this class, you should be able to:

  Compare and contrast principles of Accessible Design *with those of* Universal Design

  – Considerations for designing for accessibility

  – Learn what is web accessibility and how to implement some of those standards

  – Compare how accessible design can be a jumping-off point for universal design

  – Evaluate use cases based on the seven principles of Universal Design
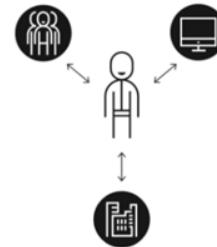
Disability 1980 Today

a context dependent **mismatched interaction**

Disability as a personal attribute "restriction or lack of ability ... within the range considered normal for a human being" (medical model)

Disability as context-dependent "the interaction between features of a person's body and features of the society in which they live" (social model)

Worldwide Stats

1 Billion (~15%) of population [WHO'11];
19% of USA [Census'12]

Visual	Hearing	Cognitive	Speech	Mobility	Neural
Ray Charles	Marleen Matlin	Temple Grandin	President Biden	Ali Stroker	Catherine Zeta-Jones
Colorblind Low Vision Blind	*Hearing loss Deaf*	*Dyslexia Seizure Learning Disabilities Autism*	*Stutter*	*Quadriplegia*	*Bipolar Anxiety PTSD Depression*

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Rates of disability are increasing

- Aging population
- Situational Impairment
- Increasing numbers of people with chronic illness (can span disability segments)

Parkinson's Disease	ALS

Michael J. Fox

Prof. Stephen Hawking

Parkinson's affects cognition, speech and mobility

ALS affects mobility and speech

A note on language

Many ways to think about disability, ability.

- Medical Model (how do we *fix* people)
- Social Model (disability as social construct)
- Combined: Disability resides both in the person ☐and in society

Ability first vs person first

A note on language

DISABILITY

Many ways to think about disability, ability.

- Medical Model (how do we *fix* people)
- Social Model (disability as social construct)
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Ability first vs person first

Accessibility

Disability is a mismatched interaction between someone and their context

Accessibility is a broad term for tools that help people navigate mismatched interactions and provides options for people of all ability

Inclusive design is a framework that helps us design more accessible products
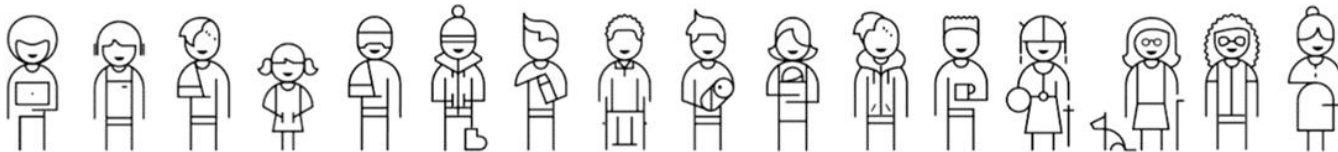
Assistive technology

"[anything] … used to increase, maintain, or improve functional capabilities of individuals with disabilities" (Wikipedia)

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Not a *medical* device

Screen Readers
Narrator, VoiceOver, JAWS, Window Eyes, NVDA, TalkBack

Screen adjustment
ZoomText, Magnifier, Zoom, High Contrast

Speech input
Dragon Naturally Speaking, Dictation, Speech Recognition

Keyboarding
Sticky Keys, Mouse Keys, Filter Keys, Keyboard Shortcuts

Many more

Some terms used in HCI

Universal Design

- One design works for everybody
- Typical example: curb cuts

Accessibility software

- Accessibility of a computer system to all people, regardless of disability

Access Technology - Richard Ladner

- Technology that makes accessible what otherwise isn't (including things out in the world and computers)

Ability-Based Design - Jacob Wobbrock

- Technology that adapts to the abilities of the user in their current context

Accessibility Software

Most Operating Systems have a whole collection of adaptations

- Accessories/Ease of Access
- Magnifier – make whole screen or a portion bigger
  - Can also just use larger fonts, lower resolution
  - Change colors and contrast
- Free Screen Reader – read the words on the screen
- On-Screen keyboard
  - Can be scanned
- Built-in speech recognition
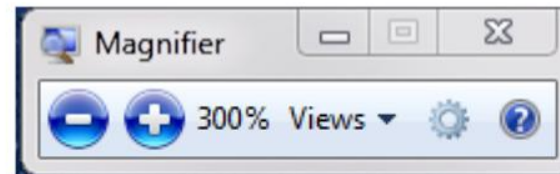
Quick notes about terminology

- Key point: we are talking about **PEOPLE**

- **Emphasize abilities, not limitations.**

- **Remember that disability is not an illness and people with disabilities are not patients.**

- https://adata.org/factsheet/ADANN-writing

Are you "helping"?

Accessible Design

What is accessible design?

- Design process in which the needs of people with disabilities are specifically considered.

- *Accessibility* sometimes refers to the characteristic that products, services, and facilities can be independently used by people with a variety of disabilities.

Example User Considerations

- Blind / low vision

- Deaf / hard-of-hearing

- Motor impairments

- Cognitive impairments

- Other accessibility needs

Example Designs for Access

- Screen readers

- Closed Captions / Transcription

- Tactile / haptic feedback

- Resistant to touchscreen errors

ADA - reasonable accommodation

World Wide Web Consortium (W3C) Guidelines

- https://www.youtube.com/watch?v=20SHvU2PKsM

Components of Web Dev and Interaction

- Content
  - Info in a web page or web app (multimedia, code, etc.)
- User agents
  - Web browsers
  - Media players
- Assistive technology
  - Screen readers
  - Alternative keyboards
  - Switches
  - Scanning software
- Users' knowledge / experiences in using web
- Developers
- Authoring tools
  - Software that creates websites
- Evaluation tools
  - Web accessibility evaluation tools
  - HTML / CSS validators

https://www.w3.org/WAI/fundamentals/components/
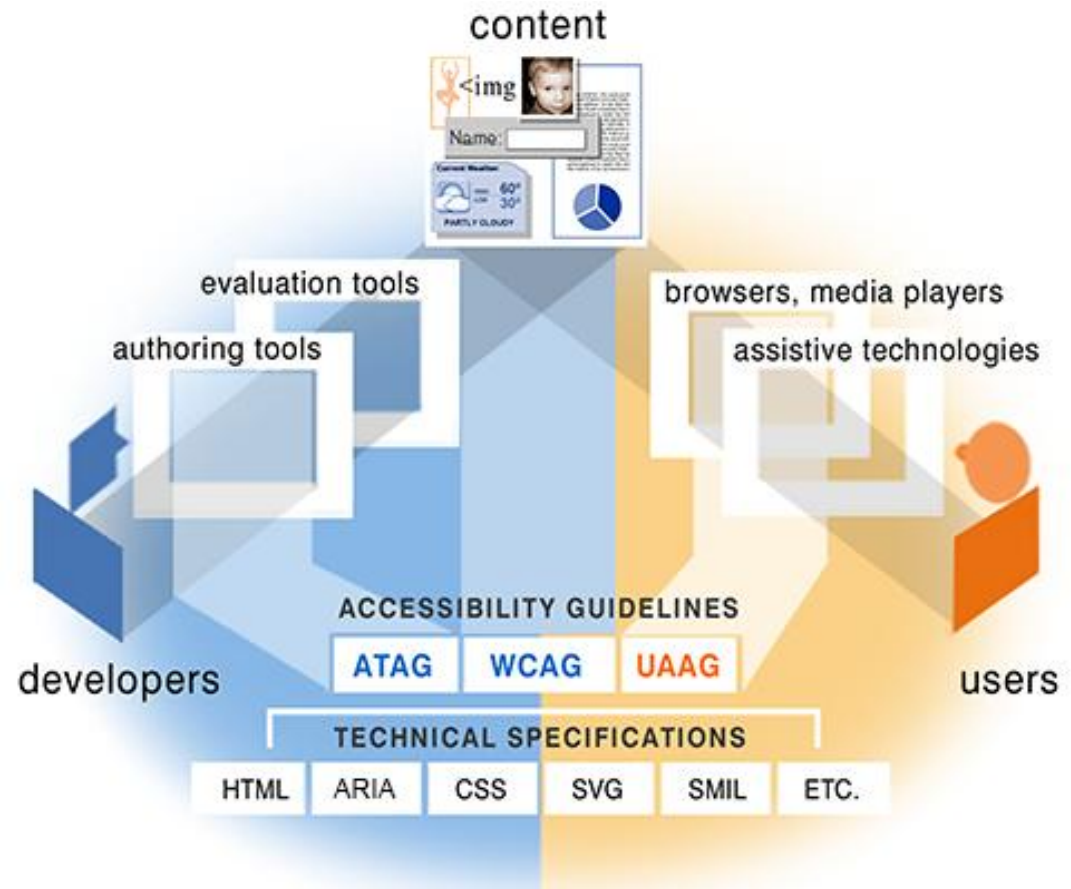
Web Accessibility Development

- Alt Text:
  - alt = "description of your image or video here"
  - People forget this most of the time... Please don't be like that!

- Page structure: labeling input
  - Lists + selectors ought to be paired correctly
  - Use the <label> tag to associate labels with inputs

- Page structure: headings and focus
  - Use <h1>, <h2>, etc., to structure headings, not as a style
    - Use CSS to fit styling needs
  - <strong> tags help emphasize text, even to a screen reader!

- Text in images
  - Try not to do this
  - Text has layout, structure, style BUT images don't, as far as browser is concerned
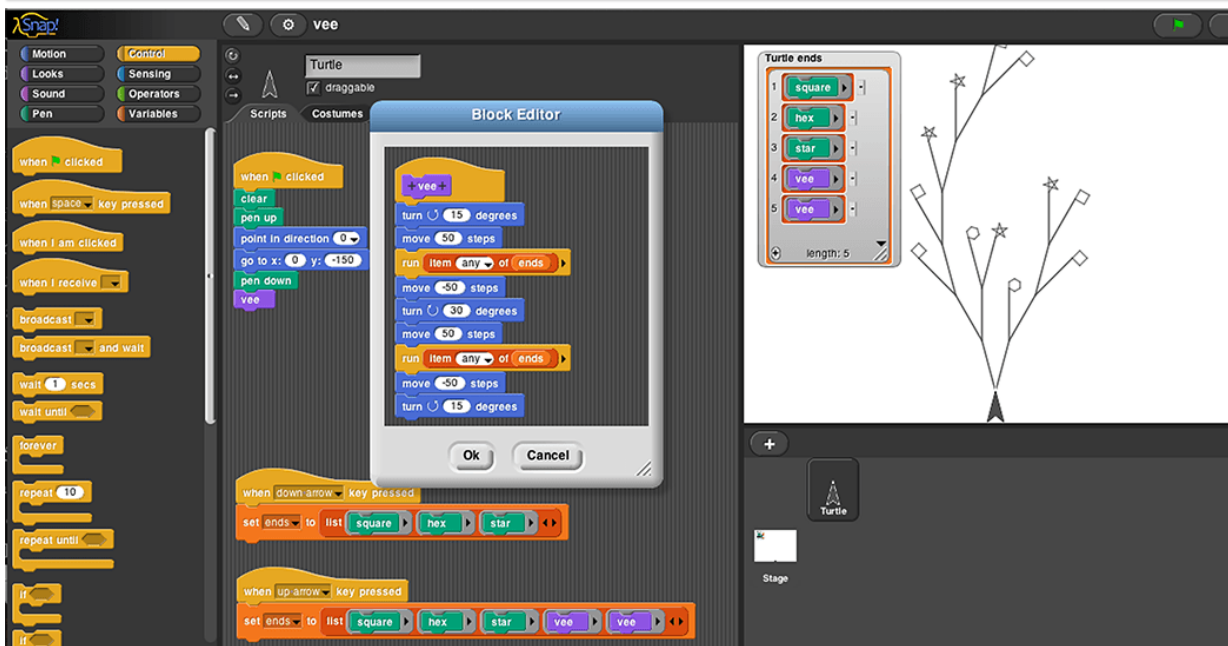
Survey - Block-based Programming

https://forms.gle/GGmjjhpJ9WHW4LcaA   www.yellkey.com/pick
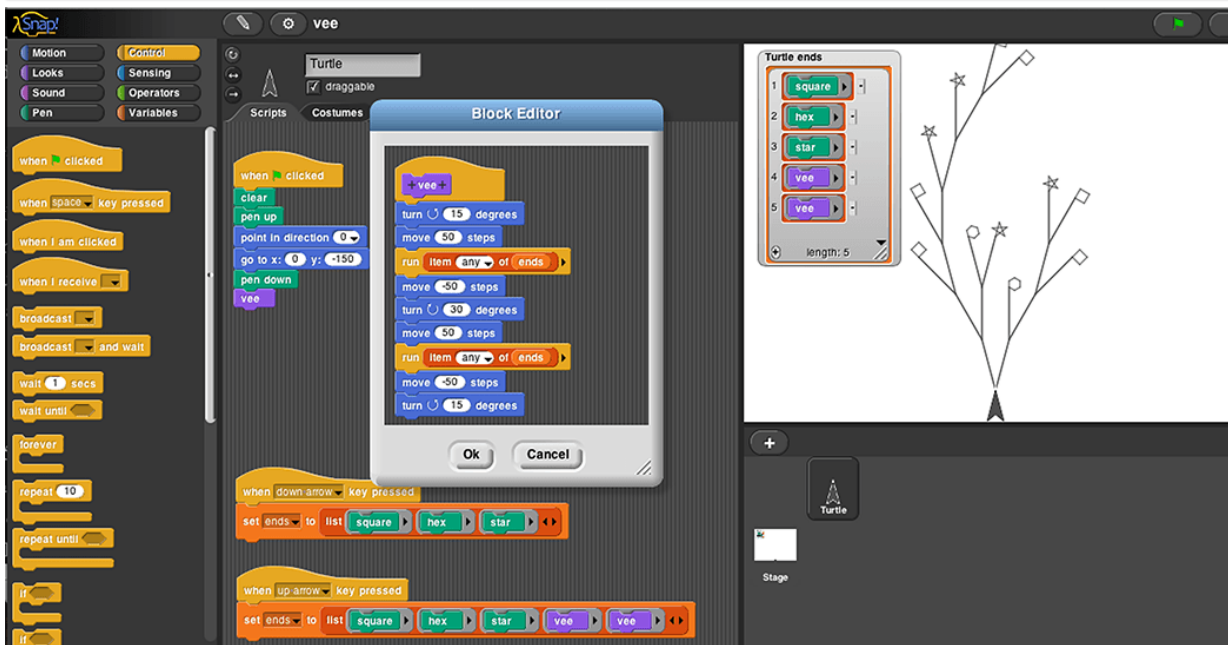
Think about this for a minute or two

Please compare the accessibility of block-based programming versus textual programming for blind people and people with low-vision.

Which of the following are correct about the accessibility of block-based programming versus textual programming for visually impaired users? Select all that apply

☐ Textual programming is more accessible than block-based programming for blind people since blind people can read textual code with screen readers.

☐ Textual programming is more accessible for all users that are visually impaired since it is easier for screen readers to interpret text.

☐ Block-based programming is more accessible for all users that are visually impaired since it reduces the cognitive load required in programming.

☐ Block-based programming is more accessible than textual programming for people with low-vision since blocks are more colorful than texts that low-vision users could perceive.

Think about this for a minute or two

Please compare the accessibility of block-based programming versus textual programming for people with motor disabilities (low manual dexterity). (Which is more accessible and why?)

Which of the following are correct about the accessibility of block-based programming versus textual programming for people with motor disabilities (low manual dexterity)? Select all that apply

☐ Block-based programming is more accessible since it reduces the cognitive load required for users.

☐ Block-based programming is more accessible since it requires fewer motor movements.

☐ Textual programming is more accessible since it requires less precise movement from users' hands.

☐ Block-based programming is less accessible since it is hard for people with motor disabilities to perform mid-air gestures (such as drag and drop).

Accessibility for Situational Impairments

- "Situational impairment"
  - Settings where users may lack an ability that they have in other contexts
  - Examples?

- There is a great design opportunity here:
  - By supporting better access for people with disabilities, we can also better support a broader set of users

Universal Design

What is universal design?

Universal Design is the design of all products and environments to be usable by people of all ages and abilities, to the greatest extent possible.

- Ronald L. Mace, 1991

- Universal Design benefits people with disabilities, parents with baby strollers, delivery workers, and others.
- Human characteristics considered in universal designs may include age, gender, stature, race/ethnicity, culture, native language and learning preference.

What Universal Design Means

- In the world of architecture and building, adaptability is subtle, integrated into the design, and benefits everyone.

- A shift from thinking why we should make changes to accommodate a few people in wheelchairs to an appreciation of how much better things can be for all of us

Accessible vs. Universal

- Accessible Design: for people with disabilities

- Universal Design: for everyone, *including* people with disabilities
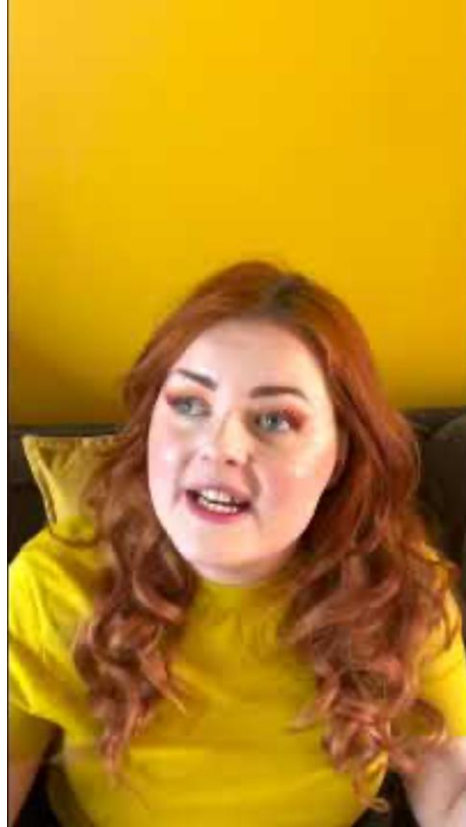
Accessible vs Universal Design

- https://www.youtube.com/watch?v=bVdPNWMGyZY

Accessible vs Universal Design

- https://www.youtube.com/shorts/siRGTjo0hhI?feature=share

Principles of Universal Design

Seven Principles of Universal Design

1. Equitable Use

2. Flexibility in Use

3. Simple and Intuitive Use

4. Perceptible Information

5. Tolerance for Error

6. Low Physical Effort

7. Size and Space for Approach and Use

https://universaldesign.ie/what-is-universal-design/the-7-principles/

Principle 1: Equitable Use

Principle 1: Equitable Use

- The design is useful and marketable to people with diverse abilities

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M ENGINEERING

Principle 2: Flexibility in Use

Principle 2: Flexibility in Use

- The design accommodates a wide range of individual preferences and abilities

Flexible in Use…

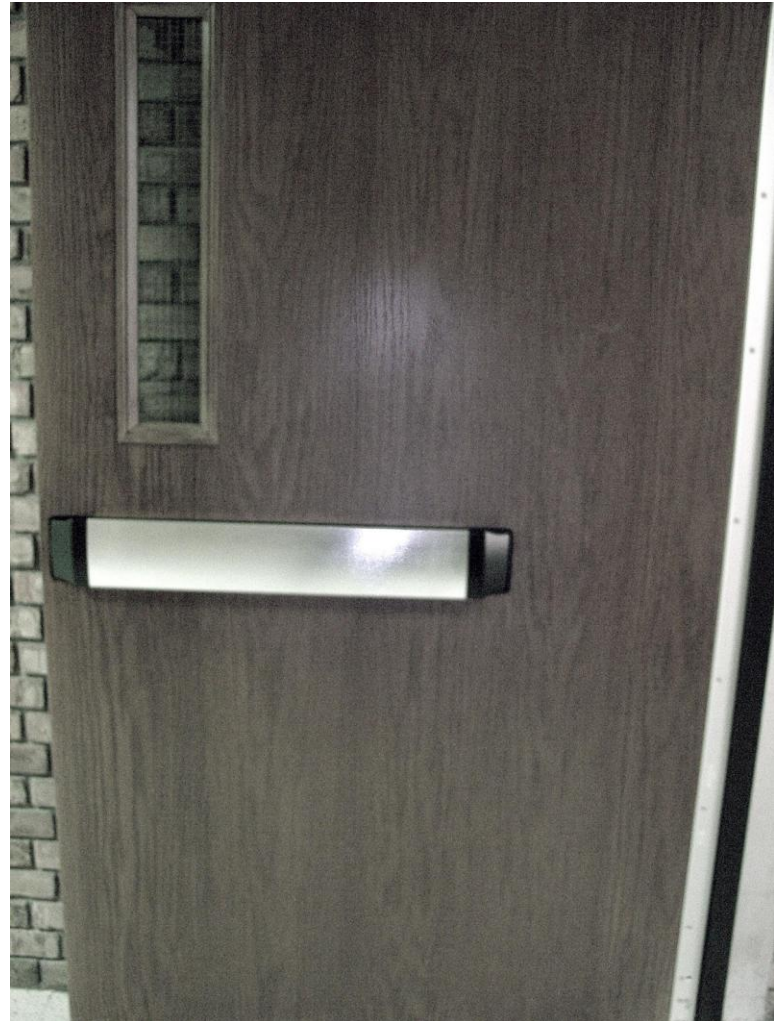- Latch door knob

Flexible in Use

- Push opener

Inflexible in Use…

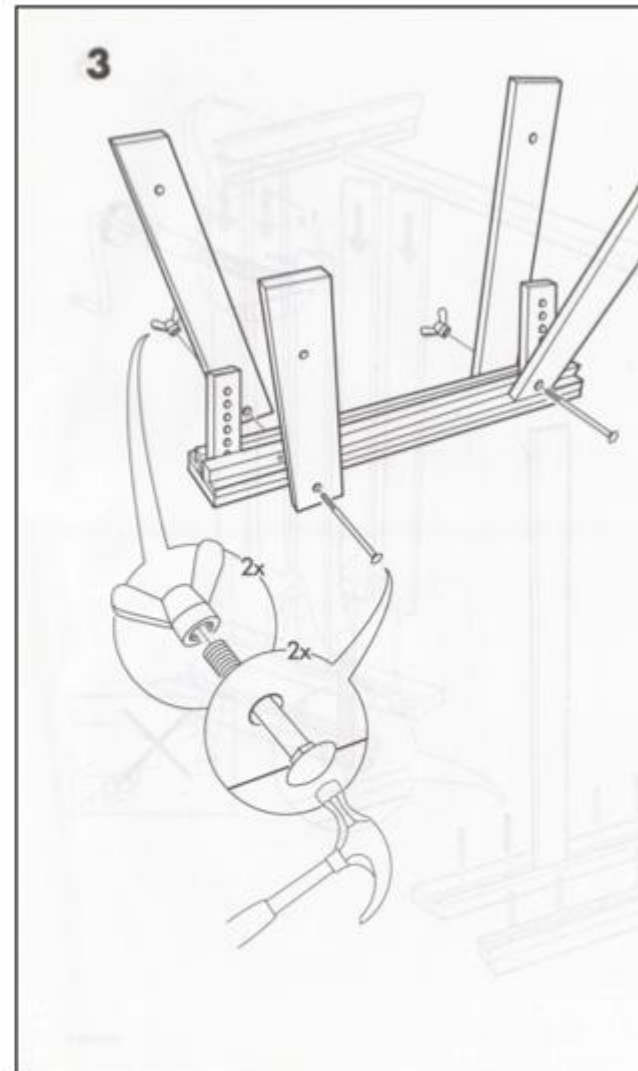- Round door knob

Flexibility in Use

- Push door opener

Principle 3: Simple and Intuitive Use

Principle 3: Simple and Intuitive Use

- Use of the design is easy to understand regardless of the user's experience, knowledge, language skills, or current concentration level

Principle 3: Simple and Intuitive Use

Simple and Intuitive Use

- Make it error-free as much as possible

- https://www.interaction-design.org/literature/topics/universal-design

Principle 4: Perceptible Information

Principle 4: Perceptible Information

- The design communicates information effectively to the user, regardless of the environment or the user's abilities

Principle 4: Perceptible Information

- ATM buttons

Principle 4: Perceptible Information
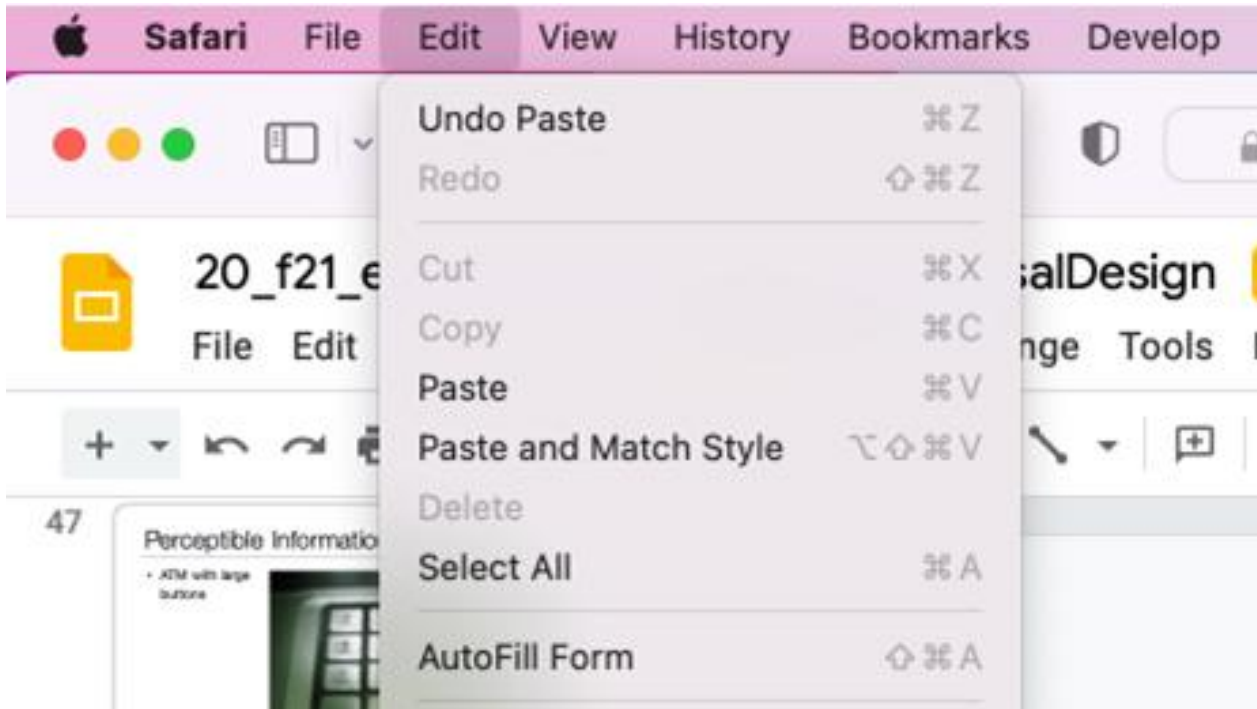
- Elevators buttons

Principle 5: Tolerance for Error

Principle 5: Tolerance for Error

- The design minimizes hazards and negative consequences of accidental actions.

Tolerance for Error…high?

- Outside power door button for entry system

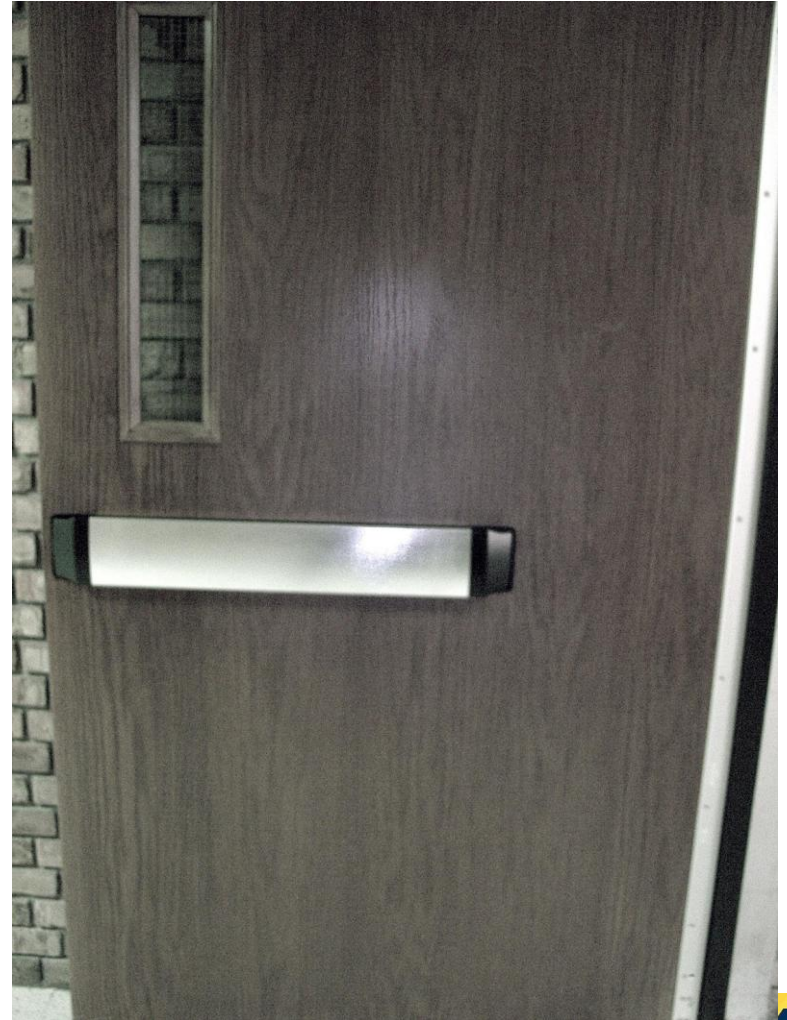# Principle 6: Low Physical Effort

Principle 6: Low Physical Effort

- The design can be used efficiently and comfortably and with a minimum of fatigue.

Principle 6: Low Physical Effort

Principle 7: Size and Space for Approach and Use

Principle 7: Size and Space for Approach and Use

- Appropriate size and space is provided for use, regardless of user's body size or posture.

Principle 7: Size and Space for Approach and Use

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Survey - Universal Design

https://forms.gle/kVhRUYXibU1gMBQr5

yellkey.com/approach

Think about this for a minute or two

Consider which universal design principles the "Curb Cub" demonstrate. Which of the following are correct (Select all that apply)?

☐ It demonstrates equitable use because people with different abilities can use the curb well.

☐ It demonstrates low physical effort because it reduces the effort required for people using wheelchairs or with bicycles to go off the curb.

☐ It demonstrates flexibility in use because it gives users multiple options in going off the curb.

☐ It demonstrates tolerance for error because people are less likely to make mistakes (e.g., fall) in this context.

Think about this for a minute or two

Consider which universal design principles the "Push door opener" demonstrate. Which of the following are correct? (Select all that apply)

☐ It demonstrates flexibility in use since a user can use different parts of their body to push it, not limited to using hands.

☐ It demonstrates the perceptible information principle since it has text, images and embossed shapes.

☐ It demonstrates the "size and space for approach and use" principle since it allows people with different heights (including using wheelchairs) to push.

☐ It demonstrates the tolerance for error principle since it's unlikely that a user hits it and it's not triggered.

Some Nice Examples of Universal Design

Duracell hearing aid batteries

Packaging that reduces effort is as important to usability as the product itself.

Photo courtesy of Duracell

Florian Ratchet-Cut Shears

Addressing the needs of customers with disabilities results in products everyone wants.

Photo courtesy of American Standard
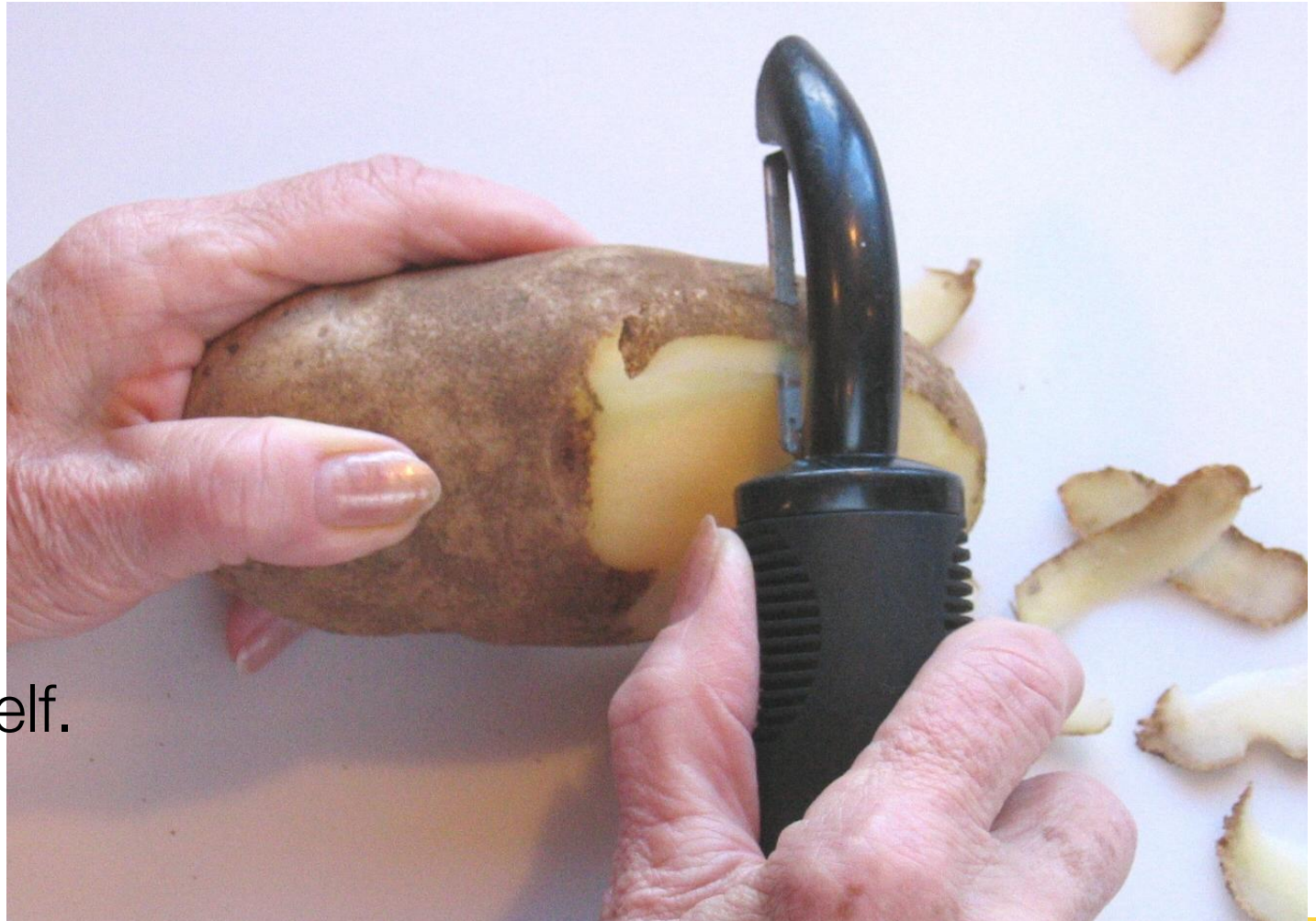
Leviton Manufacturing Company

Oxo Good Grips

Sometimes universal design markets itself.

Philips Healthcare Services

Simple, intuitive use is
critical to success
of home healthcare
technologies.

Photo courtesy of Philips Interactive Healthcare

Tupperware

Products that last through several generations should be usable by people of all ages and abilities.

Photo courtesy of Tupperware Worldwide

"Curb Cut Effect"

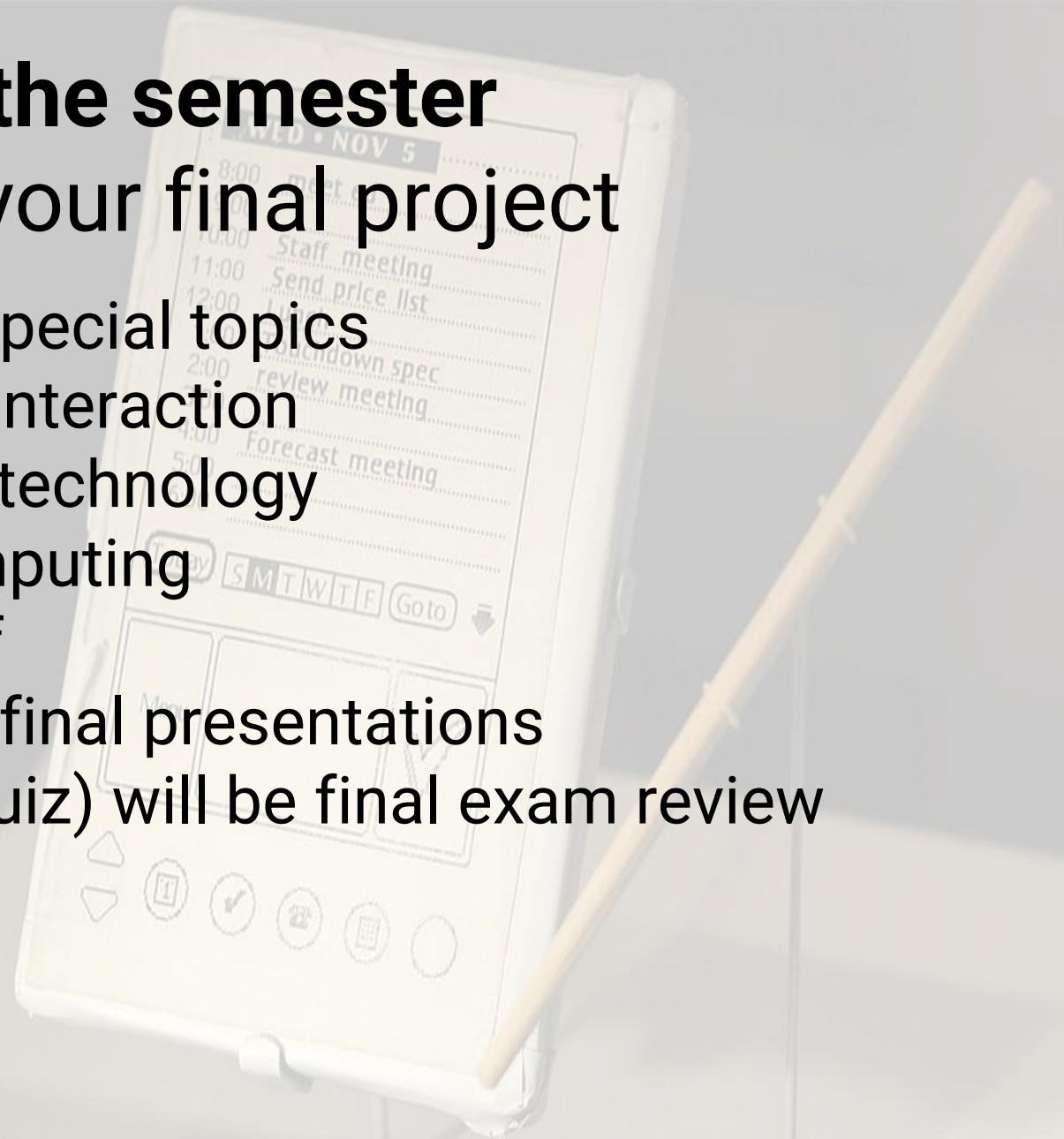- Curb Cuts help Everyone

Today's Learning Objectives

- After this class, you should be able to:

Compare and contrast principles of Accessible Design
with those of Universal Design

- – Considerations for designing for accessibility
- – Learn what is web accessibility and how to implement some of those standards
- – Compare how accessible design can be a jumping point for universal design
- – Evaluate use cases based on the seven principles of Universal Design

The rest of the semester
– focus on your final project

1. Lectures on special topics
   a. human-AI interaction
   b. education technology
   c. social computing
2. Final bake-off
3. 2 lectures on final presentations
4. Quiz 6 (last quiz) will be final exam review