Today’s Lecture

☐ Lecture Feedback

☐ C# Tips / Tricks
   ■ Drag / drop

☐ Continue
   ■ Human Information Processing

Reminders
- Blog Post (Week)
- Homework 5
- Project 3
Lectures

- Visualization
  - Feedback

- Prof. Villano
  - Feedback
Q: How can I drag / drop?
A: A bit of work
Receiver - Easier

- LibraryBar
  - Will create the object to drag out
    - Whew!

- Task
  - How do we react to the newly dropped object?
    - AllowDrop property
    - Drop event handler
App in WPF

- Two list boxes – drag / drop from one to the other

```xml
<ListBox x:Name="lbxAcceptDrop" Drop="dropIntoListBox" Grid.Row="1" Grid.Column="0"
    AllowDrop="True"/>
```

- Enabling property
- Drop event handler
private void dropIntoListBox(object sender, DragEventArgs e) {
    e.Data

    The object that was dragged into our particular control
    e.Data.GetData
    e.Data.GetType
What about the reverse?

- Drag from an object to another
  - Drag / drop from a list box to another one
  - Drag / drop within a list box (reorder)

Capture events
- Preview mouse down
- Preview mouse move
Thought Process

- How might you do this?
Human Information Processing

- Perception
- Motor skills
- Memory
- Decision Making
- Attention
- Vision

How might this impact our design?
Divided Attention (Multitasking)

- Resource metaphor
  - Attention is a resource that can be divided among different tasks simultaneously

- Multitasking performance depends on:
  - Task structure
    - Modality: visual vs. auditory
    - Encoding: spatial vs. verbal
  - Component: perceptual/cognitive vs. motor vs. WM
  - Difficulty
    - Easy or well-practiced tasks are easier to share
Discussion

☐ Prefer silent room to study?
☐ Prefer music while studying?
☐ Prefer the student union?
Motor Processing

- Open-loop control
  - Motor processor runs a program by itself
  - cycle time is $T_m \sim 70\ ms$
- Closed-loop control
  - Muscle movements (or their effect on the world) are perceived and compared with desired result
  - cycle time is $T_p + T_c + T_m \sim 240\ ms$

Perceive, process, move
Example

Make a sawtooth wave for 5 secs

Wave freq = $T_m$

Correction = $Tp+Tc+Tm$
Fitts’s Law

- Fitt’s Law
  - Time $T$ to move your hand to a target of size $S$ at distance $D$ away is:
    $$T = RT + MT = a + b \log \left( \frac{2D}{S} \right)$$
  - Depends only on index of difficulty
    $$\log(2D/S)$$
Explanation of Fitts’s Law

- Moving your hand to a target is closed-loop control
- Each cycle covers remaining distance D with error $\varepsilon D$

Process / control loop
Implications of Fitts’s Law

- Targets at screen edge are easy to hit
  - Mac menubar beats Windows menubar
  - Unclickable margins are foolish
- Hierarchical menus are hard to hit
  - Gimp/GTK: instantly closes menu
  - Windows: .5 s timeout destroys causality
  - Mac does it right: triangular zone
- Linear popup menus vs. pie menus

Remember perceptual fusion?
Watch in Practice

☐ Move to the edge of the screen
  ■ What happens?

☐ Try to target a tab
  ■ Move / target the tab
Practice makes perfect?

**Power Law of Practice**

- Time $T_n$ to do a task the $n$th time is:
  \[ T_n = T_1 n^{-\alpha} \]

  $\alpha$ is typically 0.2-0.6
Working Memory (WM)

- Small capacity: 7 ± 2 “chunks”
- Fast decay (7 [5-226] sec)
- Maintenance rehearsal fends off decay
- Interference causes faster decay

Distraction reduces working memory
Long-term Memory (LTM)

- Huge capacity
- Little decay
- Elaborative rehearsal moves chunks from WM to LTM by making connections with other chunks
Why the eye → HCI primary driver
Photoreceptors

- Rods
  - Only one kind (peak response in green wavelengths)
  - Sensitive to low light ("scotopic vision")
    - Multiple nearby rods aggregated into a single nerve signal
  - Saturated at moderate light intensity ("photopic vision")
    - Cones do most of the vision under photopic conditions
- Cones
  - Operate in brighter light
  - Three kinds: S(hort), M(edium), L(ong)
  - S cones are very weak, centered in blue wavelengths
  - M and L cones are more powerful, overlapping
  - M centered in green, L in yellow (but called "red")
Signals from Photoreceptors

- Brightness
  \[ M + L + \text{rods} \]
- Red-green difference
  \[ L - M \]
- Blue-yellow difference
  \[ \text{weighted sum of S, M, L} \]

Night time
Contrasting colors are good
Opponent colors
Color Blindness

- Red-green color blindness (protonopia & deuteranopia)
  - 8% of males
  - 0.4% of females
- Blue-yellow color blindness (tritanopia)
  - Far more rare
- Guideline: don’t depend solely on color distinctions
  - use redundant signals: brightness, location, shape
Chromatic Aberration

- Different wavelengths focus differently
  - Highly separated wavelengths (red & blue) can’t be focused simultaneously
- Guideline: don’t use red-on-blue text
  - It looks fuzzy and hurts to read
What do you think, is blue on red hard to read?

What about green on red?

What about blue on yellow?
Blue Details Are Hard to Resolve

- Fovea has no S cones
  - Can’t resolve small blue features (unless they have high contrast with background)
- Lens and aqueous humor turn yellow with age
  - Blue wavelengths are filtered out
- Lens weakens with age
  - Blue is harder to focus
- Guideline: don’t use blue against dark backgrounds where small details matter (text!)
Example Revisited

Since color blindness affects so many people, it is essential to take it into account when you are deciding how to use color in a user interface. Don’t depend solely on color distinctions, particularly red-green distinctions, for conveying information. Microsoft Office applications fail in this respect: red wavy underlines indicate spelling errors, while identical green wavy underlines indicate grammar errors.

Traffic lights are another source of problems. How do red-green color-blind people know whether the light is green or red? Fortunately, there’s a spatial cue: red is always above (or to the right of) green. Protonopia sufferers (as opposed to deuteranopians) have an additional advantage: the red light looks darker than the green light.

Can you read me now?

Since color blindness affects so many people, it is essential to take it into account when you are deciding how to use color in a user interface. Don’t depend solely on color distinctions, particularly red-green distinctions, for conveying information. Microsoft Office applications fail in this respect: red wavy underlines indicate spelling errors, while identical green wavy underlines indicate grammar errors.

Traffic lights are another source of problems. How do red-green color-blind people know whether the light is green or red? Fortunately, there’s a spatial cue: red is always above (or to the right of) green. Protonopia sufferers (as opposed to deuteranopians) have an additional advantage: the red light looks darker than the green light.
Fovea Has No Rods

- Rods are more sensitive to dim light
- In scotopic conditions, peripheral vision (rod-rich) is better than foveal vision
  - Easier to see a dim star if you don’t look directly at it
Questions?

- Weekly Blog
- Homework 5
- Project 3