Today's Lecture

- Lecture Feedback
- C# Tips / Tricks
  - Drag / drop
- Continue
  - Human Information Processing

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

C# Tips / Tricks

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

[Diagram showing drop event handler and enabling property]
Example Code

```csharp
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?
Reaction Time / Motor Processing

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

Example
Make a sawtooth wave for 5 secs
Wave freq = $T_m$, Correction = $T_p + T_c + T_m$

Fitts's Law
- Fitt's Law
  - Time $T$ to move your hand to a target of size $S$ at distance $D$ away is:
    \[ T = RT + MT = a + b \log(D/S) \]
- Depends only on index of difficulty $\log(D/S)$

Explanation of Fitts's Law
- Moving your hand to a target is closed-loop control
- Each cycle covers remaining distance $D$ with error $\pm D$

Watch in Practice
- Move to the edge of the screen
  - What happens?
- Try to target a tab
  - Move / target the tab

Implications of Fitts's Law
- Targets at screen edge are easy to hit
  - Mac menu bar beats Windows menu bar
  - Undeletable 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?
Practice makes perfect?

Power Law of Practice

- Time $T_n$ to do a task the $n$th time is:
  $$T_n = T_1 \cdot n^{-\alpha}$$
- $\alpha$ is typically 0.2-0.6

Long-term Memory (LTM)

- Huge capacity
- Little decay
- Elaborative rehearsal moves chunks from WM to LTM by making connections with other chunks

Photoreceptors

- Rods:
  - Only one kind (peak response in green wavelengths)
  - Sensitive to low light ("scotopic vision")
  - Multiple rods aggregated into a single nerve signal
  - Saturated at moderate light intensity ("photopic vision")
- 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")

Working Memory (WM)

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

The Eye

- Why the eye → HCI primary driver

Signals from Photoreceptors

- Brightness
  - $M + L +$ rods
- Red-green differences
  - $L - M$
- Blue-yellow difference
  - 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

Traffic lights?

Example

What do you think, is blue on red hard to read?

What about green on red?

What about green on red?

What about blue on yellow?

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?

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)

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