Lecture 13: Efficiency

March 24
• Why two sets of control and shift buttons?
• Why is the ENTER key larger?
• Why are SHIFT keys larger?
• Why is the SPACEBAR longer?
• Why is ESC and BACKSPACE in the corners?
• Why is there an extra number pad?
What slow you down?

• Have to think
• Have to remember
• Have to correct errors
• Have to look for something I want
• Have to read the whole instruction
• Have to type a long string
• Have to wait for the computer to respond
• Have to act cautiously
• Have to move the mouse to the control
• Have to put down my coffee cup to use both hands
• Have to sit down
• Have to put on reading glasses
Topics

• Doing things faster
• Waiting
A simple model for human computer interaction

User
- Perceive
- Think
- Act
- Wait

Computer
- Respond
- Wait
- Wait
- Compute
# User is doing things

<table>
<thead>
<tr>
<th>User</th>
<th>Computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Perceive</td>
<td>• Respond</td>
</tr>
<tr>
<td>• Think</td>
<td>• Wait</td>
</tr>
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<td>• Act</td>
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<tr>
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<td>• Compute</td>
</tr>
</tbody>
</table>
User is waiting

User
• Perceive
• Think
• Act
• Wait

Computer
• Respond
• Wait
• Wait
• Compute
Doing things faster
How can we help users

• **Perceptual efficiency**
  – See faster
  – Read faster
  – Find faster

• **Cognitive efficiency**
  – Think faster
  – Remember faster
  – Decide faster

• **Motor efficiency**
  – Move the mouse faster
  – Click faster
  – Type faster
  – Coordinate better
Improve perceptual efficiency

- Highlight
- Contrast
- Logical organization
- Stencil
- Animation

- Remove distractors
- Minimalist design
Click on "bunny" to see what the bunny knows how to do.

Here's the method you just added.
Click "next" to continue.

In this chapter of the tutorial, you'll learn how to teach Alice worlds and objects how to do new things.
Click "next" to continue.
• Which targets are easier to reach?
• Which targets are harder to reach?

• Which area of the dart board is easier to hit?
Improving motor efficiency by making targets easier to reach

- Make frequent user targets big
- Put targets used together near each other
- Use screen corners and screen edges
- Avoid steering task such as cascading submenus

- Mouse cursor speed?
Fitts’s Law

\[ T = a + b \cdot \log_2 \left( \frac{2D}{W} \right) \]
Edit   View   Insert   Format   Tools

- Undo Typing  ⌘Z
- Repeat Typing  ⌘Y
- Cut  ⌘X
- Copy  ⌘C
- Copy to Scrapbook  ⌘C
- Paste  ⌘V
- Paste from Scrapbook  ⌘V
- Paste Special...  ⌘V
- Paste as Hyperlink
Improving motor efficiency by reducing movement needs

• Redundant control placement
  – E.g., Two shift keys
  – E.g., Resize at multiple corners of a window

• Put frequently used controls closer, infrequently used controls farther away
  – E.g., Toolbar is close
  – E.g., Commands in system properties are far

• Put controls that are usually used together in close proximity
  – E.g., controls of a visual debugger
Improving motor efficiency by making typing easier

• Reduce the number of keystrokes needed
• Keyboard commands
• Accelerators
• Command Aggregate
  – Group of commands invoked all at once
  – E.g., styles in word processor, script,
• Correct typos automatically
Improving motor efficiency by using other modalities

- Voice recognition
- Head tracking
- Eye tracking
- Hand gesture
Improve cognitive efficiency
Improve cognitive efficiency

• Reduce the number of options users have to weigh in
• Reduce the load on STM
• Recognition rather than recall for LTM
• Allow binary selection (ordered list)
User efficiency vs other usability attributes

• Learnability
  – Doing things more efficient require users to learn

• Memory
  – More shortcuts need to be remembered

• Few errors
  – No need to fix errors, increase efficiency

• Satisfaction
  – Faster the better
  – But novice may complain “too fast”
Users can become faster

• Become more familiar → see faster
• Become more proficient → act faster
• Become more skill → think faster

• Learn shortcuts
• Concentrated
  – Less wasted time
  – Fewer errors
• How do you go back to the previous page?
• How do you save a file?
• How do you select a date?
Activity: Which scrolling method is fastest?

1. Multi-touch two finger
2. Middle mouse wheel scrolling
3. Page up/down
4. Arrow key up/down
5. Scroll-bar arrow buttons
6. Scroll-bar thumb drag

• Rate them by Perceptual, Cognitive, and Motor efficiency (1: fast, 2: average, 3: slow)
Waiting
• Waiting for download to finish
• Waiting for program to load
• Waiting for the machine to boot
• Waiting for a confirmation email to arrive
• Waiting for Wifi to connect
• Waiting for the download timer to expire
• When is my steak coming?
• Why is it taking so long?
• Why is it so fast?
Actual vs. Perceived efficiency

- Actual efficiency != Perceived efficiency
- A fast system can feel slow and vice versa

- Moderate variable does not severely affect task performance (plus and minus 50%)
 Individual differences

• E.g.,
  – Novice users
  – Laid-back web surfer
  – College students day before homework due
  – College students during spring break

• Preferences

• Tolerance
Task complexity

• Repetitive task, delays are annoying
• Complex task, delays are okay and can be used for thinking.
Expected efficiency: Previous experiences

• Users may form expectation about system efficiency based on prior experiences

• Users may complain if
  \[ \text{expected efficiency} \ll \text{perceived efficiency} \]

• Users may be surprised if
  \[ \text{expected efficiency} \gg \text{perceived efficiency} \]
  – E.g., download is complete in no time
  – May be useful to slow down unexpectedly fast responses to avoid surprises
Feel faster: Fast startup vs Fast usage

• Faster startup vs. Faster usage

• Which way?
  – HTML form
  – Java
  – Ajax
  – Camera power-on time vs. shutter lag
What do you do when you wait?

• For Wifi to connect
• For a download to complete
• For a program to install
• For an email to arrive
• For the class to begin
Feel faster: masking delays

• Download important stuff first
• Add progress indicators
  – E.g., queue position, time
• Distract users
  – E.g., play music, showcase features
  – Must do it judiciously
• Fast than slow
  – Comcast’s PowerBoost
Feel faster:
Response time choke

• Purposely slow things down for early users lest they form unrealistic expectation about system efficiency later when more users join
• Drive
• GPS
• Know how far?
• Know where you are?
Are you a fast driver?

• Higher speed is attractive because drivers can get to the destination faster.
• Higher speed is risky because drivers can get into accidents more easily and consequence is worse.
System efficiency vs. satisfaction

• Long response time $\rightarrow$ time cost of making an error and redoing is high $\rightarrow$ users feel more anxious

• Paced tasks increase productivity but add pressure
System efficiency vs. few errors

• Short response time $\rightarrow$ users start doing things faster $\rightarrow$ users pay less attention to the presented material $\rightarrow$ users make more errors

• Paced tasks are appropriate for life-critical situations or manufacturing where high productivity is desirable
System efficiency vs. memory

• If a delay is long, what’s in the short term memory may be lost.
Summary

• Improve user efficiency
  – Perceptual
  – Cognitive
  – Motor

• Fitts’s Law

• System efficiency (User waiting)
  – Perceived, expected, actual