CMSC434: Introduction to Human-Computer Interaction
Exam #2 – April 8, 2004 *Length: 75 minutes – Total points: 100*

NOTE: The original solution set somehow become destroyed. Thus, I made up this answer set to help you study for the final. If any of these answers are unclear, please send me email and we can further discuss them.

1. a) Produce a thoughtful argument about what role natural-language interaction (NLI) should have in user interfaces. Be sure to list at least three benefits and three limitations of NLI. **(12 points)**

Refer to pages 294-295. Contrary to the common belief, human–human interaction is not necessarily an appropriate model for human operation of computers. Since computers can display information 1000 times faster than people can enter commands, it seems advantageous to use the computer to display large amounts of information, and to allow novice and intermittent users simply to choose among the items. Selection helps to guide the user by making clear what objects and actions are available. For knowledgeable and frequent users, who are thoroughly aware of the available functions, a precise, concise command language is usually preferred.

The key impediment to NLI is the *habitability* of the user interface – how can users know what objects and actions are appropriate. Visual interfaces provide the cues for the semantics of interaction, but NLI interfaces typically depend on assumed user models. Users who are knowledgeable about their task, for example, stock-market brokers know the objects and buy/sell actions. They could place orders by voice or typing in natural language. However, these users prefer compact command languages because they are more rapid and reliable. NLI designs also do not usually convey information about the interface objects and actions, for example, tree-structure of information, implications of a deletion, Boolean operations, or query strategies. NLI designs should relieve users from learning new syntactic rules, since they presumably will accept familiar English language requests. Therefore, NLI can be effective for users who are knowledgeable about specific tasks and interface concepts but who are intermittent users who cannot retain the syntactic details of the interface.

b) Describe one promising possibility for NLI and discuss how you would conduct a usability test and observation to collect some evidence about its strengths and weaknesses. **(18 points)**

Here was one success story for NLI in the past.

By this analysis, NLI might apply to checkbook maintenance (Shneiderman, 1980), where the users recognize that there is an ascending sequence of integer-numbered checks, and that each check has a single payee field, single amount, single date, and one or more signatures. Checks can be issued, voided, searched, and printed. Following this suggestion, Ford (1981) created and tested a textual NLI system for this purpose. Subjects were paid to maintain their checkbook registers by computer using a program that was refined incrementally to account for unanticipated entries. The final system successfully handled 91 percent of users' requests, such as these:

Pay to Safeway on 3/24/86 $29.75.
June 10 $33.00 to Madonna.
Show me all the checks paid to George Bush.
Which checks were written on October 29?

Users reported satisfaction with the system and were eager to use the system after completing the several months of experimentation. This study can be seen as a success for NLI, but even twenty years later such systems never succeeded in the marketplace.

2. Examine the following interface:

a) Describe three of the form fill-in design guidelines presented in the book that have been violated by this interface.
(12 points)

Here are three examples. Refer to page 262 for the complete list.

- *Meaningful title* Identify the topic and avoid computer terminology.
- *Comprehensible instructions* Describe the user's tasks in familiar terminology. Be brief; if more information is needed, make a set of help screens available to the novice user. In support of brevity, just describe the necessary action (Type the address or simply Address:) and avoid pronouns (You should type the address) or references to "the user" (The user of the form should type the address). Another useful rule is to use the word type for entering information and press for special keys such as the TAB, ENTER or cursor movement keys. Since "ENTER" often refers to the special key, avoid using it in the instructions (for example, do not use Enter the address; instead, stick to Type the address.) Once a grammatical style for instructions is developed, be careful to apply that style consistently.
- *Logical grouping and sequencing of fields* Related fields should be adjacent, and should be aligned with blank space for separation between groups. The sequencing should reflect common patterns—for example, city followed by state followed by zip code.

3. a) Explain the difference between direct-control and indirect-control pointing devices. **(5 points)**

Refer to pages 316-323.

Pointing devices can be grouped into those that offer (1) *direct control* on the screen surface, such as the touchscreen or stylus, and (2) *indirect control* away from the screen surface, such as the mouse, trackball, joystick, graphics tablet, and touchpad.

b) Describe a task where it would be more appropriate to use a direct-control pointing device. Do the same for an indirect-control device. **(8 points)**

Touchscreens (Direct-control) are often integrated into applications directed at novice users, in which the keyboard can be eliminated and touch is the main interface mechanism. Designers of public-access systems value touchscreens because there are no moving parts, and durability in high-use environments is good (it is the only input device that has survived at Walt Disney World theme parks).

Indirect pointing devices eliminate the hand-fatigue and hand-obscuring-the-screen problems, but require the hand to locate the device and demand more cognitive processing and hand–eye coordination to bring the onscreen cursor to the desired target.

The *mouse* is appealing because of its low cost and wide availability. The hand rests in a comfortable position, buttons on the mouse are easily pressed, long motions can be rapid by moving the forearm, and positioning can be precise with small finger movements.

4. Provide an argument explaining why delays should be kept short for common, everyday tasks of a user. Use knowledge of short-term and working memory as the basis for your argument.

Refer to page 355. People use short-term memory in conjunction with *working memory* for processing information and for problem solving. Short-term memory processes perceptual input, whereas working memory is used to generate and implement solutions. If many facts and decisions are necessary to solve a problem, then short-term and working memory may become overloaded. People learn to cope with complex problems by developing higher-level concepts that bring together several lower-level concepts into a single chunk. Novices at any task tend to work with smaller chunks until they can cluster concepts into larger chunks. Experts rapidly decompose a complex task into a sequence of smaller tasks that they are confident about accomplishing.

5. Color displays are attractive to users and can often improve task performance, but the danger of misuse is high. List four guidelines for using color and give an example of each. **(12 points)**

Refer to all of the guidelines listed on pages 398-403. Here are four:

- *Use color conservatively* Many programmers and novice designers are eager to use color to brighten up their displays, but the results are often counterproductive. One home information system had the seven letters in its name in large letters, each with a different color. At a distance, the display appeared inviting and eye-catching; up close, however, it was difficult to read.
  Instead of showing meaningful relationships, inappropriately colored fields mislead users into searching for relationships that do not exist. Using a different color for each of 12 items in a menu produces an overwhelming effect. Using four colors (such as red, blue, green, and yellow) for the 12 items will still mislead users into thinking that all the similarly colored items are related. An appropriate strategy would be to show all the menu items in one color, the title in a second color, the instructions in a third color, and error messages in a fourth color. Even this strategy can be overwhelming if the colors are too striking visually. A safe approach is always to use black letters on a white background, with italics or bold for emphasis, and to reserve color for special highlighting.
- *Limit the number of colors* Many design guides suggest limiting the number of colors in a single display to four, with a limit of seven colors in the entire sequence of displays. Experienced users may be able to benefit from a larger number of color codes.
- *Recognize the power of color as a coding technique* Color speeds recognition for many tasks, but it can inhibit performance of tasks that go against the grain of the coding scheme. For example, in an accounting application, if data lines with accounts overdue more than 30 days are coded in red, they will be readily visible among the nonoverdue accounts coded in green. In air-traffic control, high-flying planes might be coded differently from low-flying planes to facilitate recognition. In programming workstations, newly added programming-language statements might be coded differently from the old statements, to show progress in writing or maintaining programs.

• *Ensure that color coding supports the task* If, in the accounting application with color coding by days overdue, the task is now to locate accounts with balances of more than $55, the coding by days overdue may inhibit performance on the second task. In the programming application, the coding of recent additions may make it more difficult to read the entire program. Designers should attempt to make a close linkage between the users' tasks and the color coding, and offer user control where possible.

6. Describe the difference between reading on paper and reading on a computer display. Be sure to list at least three disadvantages for each method.

Refer to page 412 for a complete argument.

The potential disadvantages of reading from displays include these:

- *Fonts* may be poor, especially on low-resolution displays. The dots composing the letters may be so large that each is visible, making users expend effort to recognize the character. Monospace (fixed width) fonts, lack of appropriate kerning (for example, adjustments to bring "V" and "A" closer together), inappropriate interletter and interline spacing, and inappropriate colors may all complicate recognition.
- *Low contrast* between the characters and the background, and *fuzzy character* boundaries also can cause trouble.
- *Emitted light* from displays may be more difficult to read by than reflected light from paper; glare may be greater, *flicker* can be a problem, and the *curved display surface* may be troubling.
- *Small displays* require frequent *page turning*; issuing the page-turning commands is disruptive, and the page turns are unsettling, especially if they are slow and visually distracting.
- *Reading distance* is easily adjustable for paper while most displays are *fixed* in place, and display *placement* may be too high for comfortable reading (optometrists suggest reading be done with the eyes in a downward-looking direction); the "near quintad" are the five ways eyes adjust to seeing close items (Grant, 1990): *accommodation* (lens-shape change), *convergence* (looking toward the center), *meiosis* (pupillary contraction), *excyclotorsion* (rotation), and *depression of gaze* (looking down). Users of tablet computers and mobile devices often hold their display in a lower position than desktop displays to facilitate reading.
- *Layout and formatting* can be problems, such as improper margins, inappropriate line width (35 to 55 characters is recommended), or awkward justification (left justification and ragged right are recommended). Multi column layouts may require constant scrolling up and down. Page breaks may be distracting and waste space.
- *Reduced hand and body motion* with fixed position displays as compared to paper, may be more fatiguing.
- *Unfamiliarity of displays* and the *anxiety* of navigating the text can increase *stress.*