PhD Qualifying Examination: **Human-Computer Interaction**

University of Wisconsin–Madison, Department of Computer Sciences

Spring 2016 — Monday, February 1, 2016

General Instructions

- This exam has **7** numbered pages including this page.
- Answer each question in a separate book.
- Indicate on the cover of each book **the area** (HCI) of the exam, your **code number**, and the **question number** answered in that book. Do not write your name on any answer book.
- Return all answer books in the folder provided. Additional answer books are available if needed.

Specific Instructions

- Answer all **6** questions.

Policy on Misprints and Ambiguities

The Exam Committee tries to proofread the exam as carefully as possible. Nevertheless, the exam sometimes contains misprints and ambiguities. If you are convinced that a problem has been stated incorrectly, mention this to the proctor. If necessary, the proctor can contact a representative of the area to resolve problems during the *first hour* of the exam. In any case, you should indicate your interpretation of the problem in your written answer. Your interpretation should be such that the problem is nontrivial.

Question Topics

1. Quantitative Data Analysis
2. Usability Evaluation Methods
3. Foundations of Human-Computer Interaction
4. Experimental Research
5. User Studies
6. Survey Design

Question 1. *Qualitative Data Analysis*

A graduate student in your program is interested in building a deeper understanding of *crowdsourcing*,[1] including all the stakeholders involved, what it feels like to source from the crowd and work as a crowd-worker, the culture of crowd-work, and so on. Based on this understanding, she would like to draw design guidelines for work processes and software tools that improve the efficiency and the experience of crowd-work. She has read an introductory article that describes the different approaches to studying social phenomena and would like further advice from you.

(a) Several of the methods she read talked about *coding* and *codes*.[2] Briefly describe to her what codes are and provide an example.

(b) Describe the differences among *codes*, *categories*, and *themes*.

(c) How does *Grounded Theory*[3] differ from other conventional approaches to qualitative data analysis, such as content analysis?

(d) Briefly describe to the student the *steps* involved in conducting Grounded Theory.[4]

(e) The student wants to know how she can know that she had done a good job with Grounded Theory if she followed that approach. Describe <u>three</u> *qualities* used in evaluating Grounded Theory outcomes.[5]

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1 According to Wikipedia (2016), crowdsourcing is "…the process of obtaining needed services, ideas, or content by soliciting contributions from a large group of people, and especially from an online community, rather than from traditional employees or suppliers."

Wikipedia (2016). *Crowdsourcing*. Accessed: February 31, 2016. URL: https://en.wikipedia.org/wiki/Crowdsourcing

2 Saldaña, J. (2009). *The coding manual for qualitative researchers*. Sage Publications Limited.

3 Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative health research*, 15(9), 1277-1288.

4 Muller, M. (2014). Curiosity, Creativity, and Surprise as Analytic Tools: Grounded Theory Method. In J. S. Olson, & W.A. Kellogg (Eds). *Ways of Knowing in HCI*. Springer, New York, NY.

5 Glaser, B., & Strauss, A. (1967). *The discovery grounded theory: strategies for qualitative inquiry*. Aldin, Chicago.

Question 2. *Expert Usability Evaluation Methods*

You recently started working for a startup company named Duolingo, which develops software tools for language learning, as a part of the Quality Assurance (QA) team. You and your teammates would like to integrate *expert evaluation* methods into your evaluation process and discuss the following considerations.

(a) Discuss how *expert evaluation methods* differ from other forms of usability inspection, providing three *unique advantages* of such methods.

(b) Briefly describe *heuristic evaluation*,[6] *cognitive walkthrough*,[7] and *keystroke-level modeling*[8] usability evaluation methods, comparing the types of usability issues they are best suited to identify.

(c) What *preparation* is needed by the evaluation team conduct a *cognitive walkthrough*? List and very briefly describe.

(d) Provide your team with the *questions* that should be asked during a cognitive walkthrough.

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[6] Nielsen, J. (1993) *Usability Engineering*. Morgan Kaufmann.

[7] Wharton, C., Rieman, J., Lewis, C., & Polson, P. (1994). The cognitive walkthrough method: A practitioner's guide. In J. Nielsen (Ed.) *Usability inspection methods* (pp. 105-140). John Wiley & Sons, Inc.

[8] Card, S. K., Moran, T. P., & Newell, A. (1980). The keystroke-level model for user performance time with interactive systems. *Communications of the ACM*, 23 (7), 396–410.

Question 3. *Foundations of Human-Computer Interaction*

You are preparing a lecture on the *history* and *foundations* of the field of human-computer interaction (HCI) and would like to cover the following key materials:[9]

(a) *Fields out of which HCI grew.* List the four *fields* with significant HCI research threads, as outlined by Grudin,[10] and briefly describe their differential perspectives.

(b) *Theoretical frameworks in HCI.* List three *theoretical frameworks* HCI research follows, as proposed by Rogers,[11] and very briefly describe the main premise of each framework.

(c) *Early research in computer interfaces.* List the four *characterizations* of computer interfaces argued by Card and Moran[12] and briefly describe them.

[9] Limit all your descriptions to two-to-three sentences.

[10] Grudin, J. (2012). A moving target: The evolution of human-computer interaction. In J. Jacko (Ed.), *Human-Computer Interaction Handbook* (3rd Edition), Taylor & Francis, 2012.

[11] Rogers, Y. (2004). New theoretical approaches for human-computer interaction. *Annual Review of Information Science and Technology*, 38(1), pp. 87–143.

[12] Card, S. & Moran, T. (1986). User technology—from pointing to pondering. In *Proceedings of the 1986 ACM Conference on the History of Personal Workstations*, pp. 183-198.

(d) Question 4. *Experimental Research*

You and your graduate advisee have developed a research questions that you are both interested in and are now discussing *experimental designs* and *data-analysis methods* that would offer the best fit to your exploration. Answer the following questions for your advisee according to Gergle and Tan.[13]

(a) What are <u>two</u> possible *research designs* that your study could follow? List and describe briefly.

(b) If you decide on conducting a randomized experiment with a within-participants design, what are <u>three</u> *methods* you could use to minimize *carryover effects*? List and briefly describe their differences.

(c) What is the MAGIC criteria? Briefly describe.

(d) What are <u>three</u> *advantages* and <u>three</u> *limitations* of experimental research compared to other HCI research methods? Briefly describe.

[13] Gergle, D. & Tan, D. (2014). Experimental Research in HCI. In J. S. Olson, & W.A. Kellogg (Eds). *Ways of Knowing in HCI*. Springer, New York, NY.

Question 5. *User Studies*

A client of yours asks you to develop a mixed-method evaluation plan for a new cloud-based financial planning tool they plan to roll out soon. Your plan will make a case for the evaluation metrics and analyses you utilize, particularly those listed below, as discussed by Albert et al.[14]

(a) List and briefly describe three *task performance* metrics.

(b) Define *segmentation analysis* and provide three *examples* of how it could be utilized.

(c) Describe three *analysis methods* for open-ended responses that you will collect from your users at the end of the study.

(d) Discuss how you could use *self-reported data* to determine the *severity* of usability issues.

[14] Albert, B., Albert, W., Tullis, T., & Tedesco, D. (2010). *Beyond the Usability Lab: Conducting Large-scale User Experience Studies.* Morgan Kaufmann.

Question 6. *Survey Design*

You have been hired by Apple Inc. to join their new "wearable technologies" division, which designs novel mobile and wearable computer interfaces, for your expertise in user research. As you learn more about the design process followed in your division, you notice a lack of an appropriate survey instrument to gather information from targeted user populations. Because the types of technologies your division develops are extremely novel, none of the established survey instruments seem appropriate. You decide on developing a new *questionnaire* to gather information from users and consider the following facets of survey design, according to Müller et al.[15]

(a) List five examples of the *types of information* about users that can be captured with surveys.

(b) When is it appropriate to use *open-ended* vs. *close-ended* questions? Briefly discuss.

(c) List and briefly describe three *types of biases* that are common in questionnaires.

(d) Describe three *types of questions* that must be avoided in designing questionnaires.

(e) What are *signals of poor data quality* and appropriate *mitigation strategies*? Describe three.

[15] Müller, H., Sedley, A., & Ferrall-Nunge, E. (2014). Survey Research in HCI. In J. S. Olson, & W.A. Kellogg (Eds). *Ways of Knowing in HCI*. Springer, New York, NY.