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

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*Fall 2014 — Monday, September 15, 2014*

## 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. On one of your books, list the numbers of all the questions answered. 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. User Modeling
2. Quantitative & Qualitative Data Analysis
3. Design Evaluation
4. HCI Principles
5. Interaction Design Methods
6. CSCW Principles

**Question 1.** *User Modeling*

Much of the early work on and techniques proposed to perform cognitive modeling, such as KLM and GOMS, consider user actions or task steps as being *sequential*, while many computing tasks might involve *parallel* or *cascading* processes.[1]

(a) Describe the types of processes that might occur in parallel, according to Olson & Olson,[1] and give one example of each type of process.

(b) Provide three examples of real-world *tasks* that involve parallel processes and discuss what, if any, limitations KLM or GOMS might have in modeling these tasks.

(c) Describe one solution that has been proposed for modeling parallel processes, as described by Olson & Olson.[1]

(d) Illustrate how the proposed solution might be used in modeling one of the example tasks you provided in (a).

[1] Olson, J. R., & Olson, G. M. (1990). The growth of cognitive modeling in human-computer interaction since GOMS. *Human–computer interaction*, 5(2-3), 221-265.

**Question 2.** *Quantitative & Qualitative Data Analysis*

Your colleague has developed a novel interface to be used for training air-traffic controllers. As a part of the evaluation of the interface, in which she plans to compare the new interface to a state-of-the art training tool, she is interested in videotaping and analyzing user behaviors during the use of the training interface, such as what parts of the interface they look most toward, what affective reactions they display toward the interface, and so on. She consults you for advice on the different ways in which she can format, code, and analyze her behavioral data.

(a) Discuss the advantages and disadvantages of coding and formatting behavioral measures as *nominal*, *ordinal*, *interval*, or *ratio* variables.

(b) Suggest appropriate methods for quantitative data analysis, particularly for calculating *descriptive* and *inferential* statistics, for <u>each</u> type of variable.

(c) Explain how your suggestions in (b) would change if she is comparing her interface to two existing training tools instead of one.

(d) Describe how your colleague might *qualitatively* analyze her data, discussing advantages and disadvantages of qualitative and quantitative data analysis.

(e) Provide her with a final suggestion on what you think would be the best way to format, code, and analyze her data.

**Question 3.** *Design Evaluation*

Before the release of the product to the general public, Apple designers would like to evaluate the design of their new  **WATCH** as extensively as they can. They are considering many forms of *user* and *expert* evaluation.

(a) Define and discuss the advantages and disadvantages of *user* and *expert* evaluation.

(b) Give <u>three</u> example methods for each of *user* and *expert* testing, providing brief descriptions of the methods and describing a unique benefit each method offers.

(c) Describe the *steps* involved in setting up a *user* evaluation in the *laboratory* and Quesenbery's *dimensions* on which they can focus, as described by Barnum.[2]

(d) Give an example *user*-evaluation method that can be used in the *field*, provide an estimate of the appropriate *duration* of the testing, and describe the *types of data* that could be collected using this method.

(e) Discuss the considerations that go into determining how many testers to recruit for *user* and *expert* testing, making a final recommendation on the number of evaluators for each type of evaluation.

[2] Barnum, C. M. (2010). *Usability testing essentials: ready, set... test!. Chapter 1: Establishing the Essentials.* Elsevier.

**Question 4.** *HCI Principles*

In "Past, Present, and Future of User Interface Software Tools," Myers et al.[3] chart the early research on concepts, tools, and techniques for developing user interfaces that have shaped and informed the design of today's interfaces, discussing their promise and use as well as the challenges in their adoption by designers and developers. Respond to the following according to Myers et al.

(a) Describe the concepts *threshold*, *ceiling*, and *path of least resistance* and their implications for designing user interfaces.

(b) Describe the concept of *constraints* and discuss the *promise* of and *challenges* in integrating constraints into user interfaces.

(c) Describe the concept of *model-based* techniques and discuss the challenges experienced in early explorations of their use.

(d) Describe the concept of *end-user programming*, provide three examples of its use in today's interfaces, and discuss the considerations for and challenges in integrating them into user interfaces.

[3] Myers, B., Hudson, S., & Pausch, R. (2000). Past, Present, and Future of User Interface Software Tools. *ACM Transactions on Computer-Human Interaction*, 7(1), 3–28.

**Question 5.** *Interaction Design Methods*

The use of *personas*, "specific types of individuals with specific needs,"[4] has become ubiquitous in the design of software products. Respond to the following according to Cooper et al.

(a) Provide three key *issues* in user modeling that are addressed by personas.

(b) Describe three alternative approaches to *user modeling* and discuss their differences from developing personas.

(c) Describe Norman's[5] three *levels of cognitive processing* and discuss how they relate to user goals characterized in persona development.

(d) Briefly describe the *steps* involved in persona development.

(e) Describe three of the *types of variables* considered in the persona-development process to differentiate behavior patterns and provide examples of each type of variable.

[4] Cooper, A., Reimann, R., & Cronin, D. (2007). *About face 3: the essentials of interaction design.* John Wiley & Sons.

[5] Norman, D. A. (2004). *Emotional design: Why we love (or hate) everyday things.* Basic books.

**Question 6.** *CSCW Principles*

Ellis et al.[6] define *groupware* as "computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment."A substantial body of research spanning the last three decades and multiple disciplines has studied the development of groupware systems and their integration into organizations, developing concepts, definitions, guidelines, and methods. Provide the following according to Ellis et al.

(a) Describe the <u>two</u> *taxonomies* of groupware systems and give examples of groupware interfaces that are in use today for the types of systems described by these taxonomies.

(b) List <u>three</u> different *perspectives* in the development of groupware systems and describe a unique *goal* of each perspective in groupware development.

(c) Discuss how *group* interfaces differ from *individual* (i.e., single-user) interfaces and describe <u>three</u> issues unique to group interfaces that designers must address.

(d) Discuss the need for *concurrency control* in groupware and describe <u>three</u> solutions developed to achieve concurrency control.

[6] Ellis, C. A., Gibbs, S. J., & Rein, G. (1991). Groupware: some issues and experiences. *Communications of the ACM*, 34(1), 39-58.