# Stanford Computer Science HCI Qual

Students must convene a committee of three, two of whom must be academic council (i.e. Assistant/Associate/Professor) faculty in the HCI Group. The committee must be approved by the faculty member who is responsible for the HCI Qual (currently: Michael Bernstein). Convene the committee for two hours for the exam.

The exam will test your knowledge of the areas below. In the case of research readings, you may be asked to explain the central concepts, describe why the paper made certain tradeoffs, discuss the paper in its broader context (e.g., What has persisted about the idea in the canon of HCI, and why did it persist? What assumptions or predictions did the paper make that did not persist, and why?), explain the technical idea being put forward in the research, integrate several readings in a response to a question, or provide a higher-level explanation of an area. In the case of methodological readings (e.g., in Methods areas), you may be asked to work through a hypothetical design or analysis scenario.

The default path for preparing for the HCI qual, and HCI research more generally, is to take CS 347. You can pass out of certain areas in this qual if you have an A- or better in equivalent courses (e.g., CS 347 for the Depth area, CS 147/247 for one of the Foundation areas). If you took the equivalent course at another university — e.g., for the CS 347 requirement, a course focused on broad coverage of foundational and recent HCI research papers + doing an HCI research project — the HCI Qual chair can approve it as equivalent. Send the HCI Qual chair a link to or copy of the syllabus to request the exemption. If the course you took covers only a subset of the material, the HCI Qual chair may ask that you participate in a subset of the Stanford class (e.g., readings, commentaries, discussions, exams) for the topics that your class did not cover.

*Last updated: December 2024, changed the textbook for Human-Centered Design.*

## Breadth Areas

Both areas are required. Each area is intended to be roughly the volume of a course. If you have taken the equivalent course and received an A- or better, you are exempted from the exam in that area.

- Human-centered design: fundamentals of the user-centered design process.
    - Equivalent course: A- or better in CS 147/247 (any suffix A/B/C/...), or an equivalent course at your previous institution
    - Textbook: Preece et al., Interaction Design: Beyond Human-Computer Interaction. Or, use the CS 147 lectures.

- Foundations: for each, understand the contributions they made, their arguments, the historical circumstances and the impact of their contributions. We recommend that you read these in chronological order so that you understand how they are in dialogue with previous work.
    - Vannevar Bush, As We May Think. 1945. http://dl.acm.org/citation.cfm?doid=227181.227186
    - J.C.R. Licklider, Man-Computer Symbiosis. 1960. (Unfortunate gendering in the title. You may see this recur through writings of this period.) http://groups.csail.mit.edu/medg/people/psz/Licklider.html
    - Sutherland, Ivan E. "Sketchpad: A man-machine graphical communication system." Proceedings of the May 21-23, 1963, spring joint computer conference. 1963. https://dl.acm.org/doi/abs/10.1145/1461551.1461591
    - Engelbart, The Demo. 1968. https://www.dougengelbart.org/mousesite/1968Demo.html. The clips link to specific parts of the YouTube video, giving a bit more context to what you're watching.
    - Simon, Herb. The Science of Design: Creating the Artificial. In *The Sciences of the Artificial*. 1969. https://pdfs.semanticscholar.org/d494/439a347e34599924d99af0007d26f510f870.pdf
    - Card, Moran, and Newell. The Psychology of Human-Computer Interaction. 1983. https://www.taylorfrancis.com/books/mono/10.1201/9780203736166/psychology-human-computer-interaction-stuart-card
        - Chapter 2: The Human-Information Processor.
        - Chapter 5: GOMS.
        - Chapter 8: The Keystroke-Level Model.
    - Hutchins, Hollan and Norman. Direct manipulation interfaces. 1985. http://www.tandfonline.com/doi/abs/10.1207/s15327051hci0104_2
    - Card and Moran. User technology: from pointing to pondering. 1986. http://dl.acm.org/citation.cfm?doid=12178.12189
    - Winograd and Flores. Understanding Computers and Cognition. 1986.
        - Chapter 1: Introduction
        - Chapter 2: The rationalistic tradition
        - Chapter 3: Understanding and Being
        - Chapter 6: Towards a new orientation
        - Chapter 8: Computation and intelligence
        - Chapter 12: Using computers: A direction for design
    - Lucy Suchman. Human-Machine Reconfigurations: Plans and Situated Actions. 1987 (second edition 2006). https://searchworks.stanford.edu/view/12463783
        - (optional, may help with understanding:) Readings and Responses
        - Introduction
        - Chapter 5: Plans

        - Chapter 6: Situated Actions
    - Don Norman. The Design of Everyday Things. 1988.
        - Chapter 1. The Psychopathology of Everyday Things
        - (Chapter 2 is optional; it covers the gulfs of execution and evaluation discussed in Hutchins, Hollan and Norman 1985)
        - Chapter 3. Knowledge in the Head and in the World
        - Chapter 4. Knowing What to Do
        - Chapter 5. To Err Is Human
    - Johnson et al. The Xerox Star: A Retrospective. IEEE Computer 22(9). 1989. https://doi.org/10.1109/2.35211
    - Mark Weiser. The Computer for the 21st Century. 1991. https://www.jstor.org/stable/24938718
    - James Hollan and Scott Stornetta. Beyond Being There. 1992. http://dl.acm.org/citation.cfm?id=142769
    - Nass and Reeves. The Media Equation. 1996. https://searchworks.stanford.edu/view/13771504
        - Chapter 1. The Media Equation
        - Chapter 2. Politeness
    - Hiroshi Ishii and Brygg Ullmer. Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms. 1997. https://doi.org/10.1145/258549.258715
    - Judy Olsen and Gary Olsen. Distance Matters. 2000. https://doi.org/10.1207/S15327051HCI1523_4
    - Feminist HCI [Bardzell, CHI 2010]
    - Ability-based design [Wobbrock et al. TOAC 2011]
    - The relationship of action research to human-computer interaction [Hayes, TOCHI 2011]
    - Social Justice-Oriented Interaction Design [Dombrowski et al., DIS 2016]
    - Critical Race Theory for HCI [Ogbonnaya-Ogburu et al., CHI 2020]
    - Optional
        - Erickson and McDonald, Ed. HCI Remixed. 2008. ← great reflections on the classics https://searchworks.stanford.edu/view/12996385
        - Jef Raskin. The Humane Interface. 2006. https://searchworks.stanford.edu/view/4377509

## Methods Areas

Choose one area. If you wish to complete both areas, you can do so and get credit for one area in the Depth section. This credit does not stack with the depth area credit for taking CS 347—in other words, taking CS 347 and completing both methods areas will still leave one depth area required—since it is important for HCI students to have deep knowledge of at least one subarea in HCI.

- Statistical Methods: paired and unpaired t-tests, one-way and two-way and repeated measure ANOVAs, post-hoc tests, ANCOVA, chi-square tests, single and multiple linear

regression, logistic regression, fixed and random effects, and nonparametric tests. You should be able to understand the high level intuitions of the statistical procedures being used — e.g., what is this test actually doing? — and what kinds of situations where it is appropriate to apply the test.

- Equivalent course: A- or better in PSYCH 252 (equivalents at other universities must be advanced/graduate level applied statistics)
- Textbook: Jacob Wobbrock's Coursera class, https://www.coursera.org/learn/designexperiments/home/welcome. Wobbrock's Coursera class provides a basic understanding; however, we will expect more depth, enough to understand when to apply each method and how to interpret the results. We suggest supplementing Wobbrock's course with a basic understanding of Kutner et al., Applied Linear Statistical Models.
  - Chapter 1. Linear regression with one predictor variable.
  - Chapter 2. Inferences in Regression and Correlation Analysis.
  - Chapter 3. Diagnostics and Remedial Measures.
  - Chapter 6. Multiple Regression I.
  - Chapter 7. Multiple Regression II.
  - Chapter 14. Logistic Regression, Poisson Regression, and Generalized Linear Models.
  - Optional, may be useful in establishing terminology: Chapter 15. Introduction to the Design of Experimental and Observational Studies.
  - Chapter 16. Single Factor Studies (ANOVA)
  - Chapter 17. Analysis of Factor Level Means (posthoc tests)
  - Chapter 18. ANOVA Diagnostics and Remedial Measures.
  - Chapter 19. Two-Factor Studies with Equal Sample Sizes (two-factor ANOVA)
  - Chapter 21. Randomized Complete Block Designs
  - Chapter 22. Analysis of Covariance. (ANCOVA)
  - Chapter 24. Multi-Factor Studies
  - Chapter 25. Random and Mixed Effects Models
  - Chapter 27. Repeated Measures and Related Designs.
  - Chi-square Tests
  - Nonparametric tests

- Research design: 1) Experimental design: factorial designs, randomization, repeated measures, sampling, measurement, causality, internal/external/ecological validity, surveys, and controls. 2) Qualitative research: (participant) observation, interviews, fieldnotes, grounded theory analysis, coding, memoing, inter-rater reliability.
  - Equivalent course: A- or better in PSYCH 251 (experimental methods) or COMM 314 (qualitative fieldwork), with choice approved by advisor based on applicability to the student's research
  - McGrath. Methodology matters.
  - Daniel Chambliss and Russell Schutt. Making Sense of the Social World.

    - Lofland et al. Analyzing social settings: a guide to qualitative observation and analysis. Chapters 1 and 4–9.
    - Recommended: Olson and Kellogg. Ways of Knowing in HCI.
    - Optional:
        - Babbie. The Practice of Social Research.
        - King, Keohane, and Verba. Designing Social Inquiry.
        - Jonathan Lazar, Jinjuan Heidi Feng, and Harry Hochheiser. Research Methods in Human-Computer Interaction.
        - Rosenthal and Rosnow. Essentials of Behavioral Research:  Methods & Data Analysis.
        - Campbell and Stanley. Experimental and Quasi-Experimental Designs for Research.
        - Charmaz. Constructing Grounded Theory.
        - Hannah Knox and Dawn Nafus (Eds). Ethnography for a Data-Saturated World. Manchester University Press.

## Depth Areas

These areas are designed to survey canonical (not recent) works in each research topic. Choose four depth areas. If you have received an A- or better in CS 347, choose one.

- Social computing
    - [covered in Foundations: Olson, Gary M., and Judith S. Olson. "Distance matters." Human–computer interaction 15.2-3 (2000): 139-178.]
    - [covered in Foundations: Hollan and Stornetta. Beyond Being There. CHI 1992.]
    - Grudin. Groupware and Social Dynamics: Eight Challenges for Developers. CACM 1994.
    - Erickson and Kellogg. Social Translucence: an approach to designing systems that support social processes. TOCHI 2000.
    - Ackerman, Mark S. "The intellectual challenge of CSCW: The gap between social requirements and technical feasibility." Human–Computer Interaction 15.2-3 (2000): 179-203.
    - Ellison, Steinfeld and Lampe. The Benefits of Facebook “Friends". JCMC 2007.
    - von Ahn and Dabbish. Labeling Images with a Computer Game. CHI 2004.
    - Beenen et al. Using Social Psychology to Motivate Contributions to Online Communities. CSCW 2006.
    - Starbird, Arif, Wilson. Disinformation as Collaborative Work: Surfacing the Participatory Nature of Strategic Information Operations. CSCW 2019.
    - Optional
        - Viegas and Donath. Chat Circles
        - Panciera et al. Wikipedians are born, not made.
        - Resnick and Riedl. GroupLens: an open architecture for collaborative filtering of netnews. CSCW 94.

        - Ackerman. Augmenting organizational memory: a field study of answer garden.
        - Salganik, Dodds, and Watts. "Experimental study of inequality and unpredictability in an artificial cultural market." Science, 311:854-856, 2006.
        - Resnick and Zeckhauser. Reputation systems. Adv. Appl. Microeconomics ’02
        - Orlikowski. Learning from Notes.
        - Gilbert. Predicting Tie Strength With Social Media. CHI 2009.
- Ubiquitous Computing
    - Foundations and Paradigms of Ubiquitous Computing
        - The Computer for the 21st Century, Mark Weiser, Scientific American, September 1991, pp. 94 - 104. [also in Foundations]
        - Dey and Abowd. Towards a Better Understanding of Context and Context-Awareness.
    - Sensing and Machine Learning for Activity Tracking/Monitoring
        - Consolvo et al. Activity sensing in the wild: a field trial of ubifit garden. CHI 2008.
        - Patel et al. At the Flick of a Switch: Detecting and Classifying Unique Electrical Events on the Residential Power Line. Ubicomp ’07.
    - Ubiquitous / Ambient Display and Feedback
        - Tangible Bits: Towards Seamless Interfaces between People, Bits and Atoms Hiroshi Ishii and Brygg Ullmer [also in Foundations]
        - Weiser, M., & Brown, J. S. (1995). Designing calm technology. PowerGrid Journal, 1(1), 75-85. https://people.csail.mit.edu/rudolph/Teaching/weiser.pdf
    - Interaction Techniques for Spatial / Situated Interaction
        - inFORM: Dynamic Physical Affordances and Constraints through Shape and Object Actuation, Sean Follmer, Daniel Leithinger, Alex Olwal, Akimitsu Hogge, Hiroshi Ishii. UIST 2013.
        - Bolt, Richard A. “Put-that-there”: Voice and gesture at the graphics interface. Vol. 14. No. 3. ACM, 1980.
    - Sensing for Spatial / Situated Interaction
        - Harrison, Chris, Hrvoje Benko, and Andrew D. Wilson. "OmniTouch: wearable multitouch interaction everywhere." Proceedings of the 24th annual ACM symposium on User interface software and technology. ACM, 2011.
        - Pu, Qifan, et al. "Whole-home gesture recognition using wireless signals." Proceedings of the 19th annual international conference on Mobile computing & networking. ACM, 2013.
- Design
    - Schon, The Reflective Practitioner. Chapters 2-3. (Chapter 1 and 4-6 optional.)

    - Alexander. A Pattern Language. Intro + pick ten other content chapters. (They're short.)
    - SILK [Landay, CHI ’96]
    - d.tools [Hartmann, UIST ’06]
    - Participatory Design [Schuler and Namioka ’93]
    - User-defined gestures for surface computing [Jacob Wobbrock, Meredith Morris, Andrew Wilson, CHI 2009]
    - Zimmerman and Forlizzi, "Research Through Design in HCI". In Ways of Knowing in HCI.
    - Agrawala, Li, Berthouzoz. Design Principles for Visual Communication. CACM.
    - Optional
        - Design Galleries [Marks et al. SIGGRAPH 97]
        - Parallel Prototyping [Dow and Klemmer, TOCHI 2010]
        - Phidgets [Greenberg and Fitchett, UIST ’01]
        - Learning Visual Importance for Graphic Designs and Data Visualizations [Zoya Bylinskii, UIST 2017]
- Content creation
    - Information Visualization (Ch. 1), Stuart K. Card, Jock D. Mackinlay, Ben Shneiderman in Readings in Information Visualization: Using Vision to Think, Morgan Kaufmann Publishers, 1999, pp. 1 - 34.
    - Tufte, Visual Display of Quantitative Information
    - Tufte, Envisioning Information
    - Cleveland and McGill 1984
    - Agrawala, Li, Berthouzoz, Design Principles for Visual Communication.
    - Siegel and Heer. Narrative Visualization.
    - Animation, Does it facilitate. Tversky et al.
    - Kazi, Rubaiat Habib, et al. "Draco: bringing life to illustrations with kinetic textures." Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. ACM, 2014.
- Software, Tools, and Toolkits (for context, see Michael's slides)
    - Norman, Don. "The Power of Representation", Ch 3. in Things That Make Us Smart. https://hci.ucsd.edu/220/representation.pdf
    - Myers, Hudson and Pausch. Past, present, and future of user interface software tools. TOCHI 2000. [Pay attention to the threshold / ceiling argument in particular]
    - Ko and Myers. Designing the whyline: a debugging interface for asking questions about program behavior. CHI ‘04.
    - Cypher. Eager: Programming repetitive tasks by example. CHI ’91.
    - Bolin et al. Automation and customization of rendered web pages. UIST 2005.
    - Wobbrock, Wilson and Li. Gestures without libraries, toolkits or training: a $1 recognizer for user interface prototypes. UIST '07.
    - Satyanarayan, Arvind, et al. "Vega-lite: A grammar of interactive graphics." IEEE transactions on visualization and computer graphics 23.1 (2016): 341-350.

    - Jun, Eunice, et al. "Tea: A high-level language and runtime system for automating statistical analysis." Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology. 2019.
- Equity and Justice
    - Prefigurative Design [Asad, CSCW 2019]
    - Designing Trans Technology: Defining Challenges and Envisioning Community-Centered Solutions [Haimson et al., CHI 2020 Best Paper]
    - Postcolonial Computing: A Lens on Design and Development [Irani et al., CHI 2010]
    - Interdependence as a Frame for Assistive Technology Research and Design [Bennett et al., ASSETS 2018 Best Paper]
    - Technologies for Social Justice [Strohmayer et al., CHI 2019 Honorable Mention]
    - Sabbath day home automation: it's like mixing technology and religion [Woodruff et al., CHI 2007]
    - Drawing from justice theories to support targets of online harassment [Shoenebeck et al., New Media & Society 2020]
    - Towards an Effective Digital Literacy Intervention to Assist Returning Citizens with Job Search [Ogbonnaya-Ogburu et al., CHI2019]
    - Optional
        - The role of children in the design of new technology [Druin, BIT 2002]
        - Pervasive computing and autism: assisting caregivers of children with special needs [Kientz et al. 2007]
        - Fighting against the wall: social media use by political activists in a Palestinian village [Wulf et al., CHI 2013]
        - 'Yours is better!': participant response bias in HCI [Dell et al, CHI 2012]
- Human-AI Interaction
    - Principles of Mixed-Initiative User Interfaces, Eric Horvitz
    - Direct manipulation vs. interface agents, Ben Shneiderman, Pattie Maes
    - SUPPLE: automatically generating user interfaces, Krzysztof Gajos, Dan Weld
    - CueFlik: Interactive Concept Learning in Image Search, J Fogarty, D Tan, A Kapoor, S Winder
    - Interactive Machine Learning, Jerry Alan Fails, Dan R. Olsen, Jr.
    - Yang, Qian, et al. "Re-examining whether, why, and how human-AI interaction is uniquely difficult to design." Proceedings of the 2020 CHI conference on Human Factors in Computing Systems. 2020.
    - Gordon, Mitchell L., et al. "Jury learning: Integrating dissenting voices into machine learning models." Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems. 2022.
    - Holstein, Kenneth, et al. "Improving fairness in machine learning systems: What do industry practitioners need?." Proceedings of the 2019 CHI conference on human factors in computing systems. 2019.
    - Optional:
        - Watch Eytan Adar's HCI seminar lecture video

- Custom: you may create a custom depth area to cover any central area of HCI research that is not well represented by the existing set. The custom depth area must consist of 8–10 canon readings in the area, and be approved both by your advisor and the HCI Qual chair. They should cover an area roughly as broad as a major conference in HCI. Here are custom areas that have been approved in the past.

Faculty only: HCI qual guidelines