CptS 443/543—Human-Computer Interaction Spring, 2017

**Midterm Exam Study Guide**

*Last updated Feb. 22 2017*

# Key facts

* The midterm exam will take place in class on Thursday, March 9 in class. You will have exactly one hour and 15 minutes to complete the exam.
* You will be allowed to use a **cheat sheet** for the exam: both sides of an 8-1/2" by 11" sheet of paper. No other outside materials will be allowed during the exam. If your cheat sheet is too large, it will be confiscated prior to the exam.
* If possible, please show up at **10:30 a.m.** with your **WSU student ID** and **cheat sheet** so that the proctor can check you in and ensure that your cheat sheet meets the requirements. If you show up late, you will lose valuable time to complete the exam.

# Exam Format

The exam will consist of a mix of fill-in-the-blank, short answer (one paragraph or less), and design questions in which you will be required to create and evaluate actual designs. The emphasis will be on the *application* of the design principles, concepts, rules, laws, methods, and techniques learned so far to specific design scenarios.

# Exam Content

The midterm exam covers the first eight weeks of the semester—Norman 1-5, all of the Johnson book, the supplementary material on the cognitive walkthrough, and the sections of chapters 3 and 4 of the Barnum text covered in class. In addition, some additional material on requirements (functional, usability, and user experience), early data gathering (see Lecture 14), personas, scenarios, use cases, essential use cases, hierarchical task analysis, and state-transition diagrams was not covered in any assigned readings. For these topics, you’ll need to consult the lecture slides, all of which are available on OSBLE.

Organized chronologically by course lecture (with associated readings in parentheses), the following outline identifies the specific knowledge and skills that you may need to demonstrate on the exam. Remember that, for the design principles and concepts listed, you need to know not only what they are, but also how to *apply* them to the design and evaluation of user interfaces.

#### Lecture 01: Good Design

* Waterfall and user-centered design methods (be able to compare and contrast)
* Functional, usability, and user experience requirements—be able to formulate these correctly from user’s perspective; know the differences between them

#### Lecture 02: Norman Concepts I (Norman 1 & 4)

* Differences between humans and machines that make design hard
* Affordance
* Signifier
* (Natural) mapping
* Feedback
* Conceptual model (including Norman’s version that depicts relationships among the designer’s model, the user’s model, and the system image)

#### Lecture 03: Applying Norman Concepts (Norman 1 & 4)

* Physical, cultural, logical, semantic constraints
* Cultural norms, standards, conventions
* Visibility
* Transfer effects
* Individual differences

#### Lecture 04: Seven Stages of Action/Gulfs (Norman 2 + CW Supplement)

* Seven stages of action model and its implications for design
* Gulf of execution (and where they occur in Seven Stages of Action model)
* Gulf of evaluation (and where they occur in Seven Stages of Action model)
* Visceral, behavioral, and reflective levels of emotional processing (and how they fit in to the Seven Stages of Action model)
* Cognitive walkthrough
  + What it is
  + How to apply it
  + Three key framing questions
  + Implications of cognitive walkthrough results for design

#### Lecture 05: Cognitive Walkthrough (CW Supplement)

* Cognitive Walkthrough: What it is, what it is good for, how to perform one

#### Lecture 06: Perception 1 (Johnson 1-3)

* Perceptual bias
  + Perceptual priming
  + Biased by context
  + Biased by goals
  + Inattentional blindness
  + Implications for design
    - Prime users to interpret information displays as you want them to
    - Consistency
* Gestalt principles
  + Proximity
  + Similarity
  + Continuity
  + Closure
  + Symmetry
  + Figure/ground
  + Common fate
* Humans seek and use structure—implications for design
  + Structured info easier to perceive
  + Use visual hierarchies

#### Lecture 07: Perception 2 (Johnson 4-6)

* Color vision is limited
  + Optimized to see contrasts
  + Color discrimination depends on how colors are presented
    - Paler colors harder to distinguish
    - Smaller color patches harder to distinguish
    - Color patches harder to distinguish if they are spatially separated
  + Red-green color-blindness is most common, and should be accounted for in designs by putting color scheme through color filter or rendering in black and white
  + Design implications
    - Don’t rely solely on color to encode information
* Peripheral vision is poor
  + Vision remains sharp only within 2 degree foveal field
  + Peripheral vision best at detecting motion and contrast
  + Design implication: Put key information in foveal field (where users are looking)
  + Exploit ability of peripheral vision to facilitate visual search by making target *contrast* with rest of info (through color, motion, font)
* Reading is unnatural
  + Design implications
    - Don’t make users read too much
    - Avoid unfamiliar words

#### Lecture 08: Memory (Johnson 7-9, Norman 3)

* Modern view of memory: the warehouse metaphor
* Working memory is limited (3-5 items)
  + Design implications
    - Don’t make users remember things across screens
    - Allow users to see instructions while doing things
    - Be careful with modes: Make sure users know what mode they’re in (they won’t remember), or avoid modes when possible
    - Once “call to action” per page
* Long-term memory is faulty
  + Design implications
    - Don’t burden it
    - Provide resources to jog users’ memories of difficult-to-remember info like passwords
    - Make interface consistent (menu items in same place always)
* Users focus intently on their own goals, not the interface
  + Only notice and remember things crucial to task
  + Blind to changes (“change blindness”)
  + When goal reached, we forget to wrap up loose ends
  + We tend to interpret interface items literally relative to goals
  + Design implications
    - Make changes obvious
    - Provide external memory aids to help users keep track of progress
    - Help users wrap up loose ends of tasks, or wrap them automatically for user
    - Anticipate users’ goals and match options at each decision point
* Users prefer the familiar path, even if less efficient
  + Implications
    - Make seldom-used interfaces easy to use, even at expense of efficiency
    - Guide users toward goals (e.g., through wizards)
    - Provide expert paths for those willing to learn (e.g., keystroke shortcuts or text commands)
* Recognition is easier than recall
  + Implications
    - Exploit natural constraints (in the world) and cultural constraints (in the head)
    - Show options and dually encode with pictures
    - Use thumbnail images for quick navigation to already-seen images
    - Exploit 80-20 rule: Make most frequently accessed functionality readily visible
    - Give apps/websites distinctive visual appearance so they can be easily distinguished

#### Lecture 10: Learning & Decision making (Johnson 10-12)

* Distinction between “system 1” and “system 2”
* Learning from experience is easy thanks to system 1
* Performing learned routines is easy thanks to system 1
* Learning novel actions, problem solving, and calculations are hard because it requires system 2
* Design implication: Don’t require users to engage system 2 unnecessarily
  + Indicate system status and progress toward goal
  + Guide users towards their goals
  + Let people fall into learned, automatic routines
  + Tell users exactly what they need to know
  + Don’t make people diagnose system problems
  + Minimize the number and complexity of settings
  + Let people use perception rather than calculation
  + Make the system familiar
  + Let the computer do the math
* Learning as knowledge acquisition vs. performance improvement
* Differences in novice and expert behavior
* Design implication: “Constructivist” learning environments
  + Scaffolding: Promote learning by providing users with challenging tasks that are just beyond their current knowledge level and skills
  + Promote learning through *active* engagement
* Performance improvement depends on
  + practice (understand the Power Law of Practice and the “learning curve”)
  + a clear focus on tasks (as opposed to task environment)
  + vocabulary that matches tasks
  + ability to explore
  + Design implications
    - Provide a variety of methods (highly visible and mouse-oriented vs. buried and keystroke-oriented) for task completion to facilitate performance improvement
    - 80-20 rule: Make most commonly used functionality highly visible
    - Design software to match tasks through *task analysis*, which leads to task-focused conceptual model
    - Create “low-risk” systems that encourage users to learn by exploration
* Decision-making
  + People are irrational: We will gamble (take are chances with low odds) in order to avoid big losses, or in order to obtain a large gain
  + People are biased by vivid memories and their imaginations
  + People are biased by what is immediately before them
  + Design implication: Decision support: Help System 2 override System 1
    - Provide *all* options (abstract if necessary)
    - Help users find alternatives
    - Present unbiased data
    - Don’t make people perform calculations
    - Prompt users to make assumptions and assertions explicit
  + Design implication: Data visualization: Harness System 1 to support System 2
    - Exploit automatic processes
      * Perception of structure
      * Edge detection
      * Motion detection
      * Face recognition
      * 3D vision
  + Design implication: Persuasion: Seduce System 1 so as to bypass System 2
    - Present powerful stories/graphics to evoke emotional responses

#### Lecture 11: Motor behavior and Responsiveness (Johnson 13-14)

* Fitts’s Law: Time required to reach a target varies inversely with the size of the target, and directly with the distance to the target
  + Corollary: Way bigger or closer isn’t much better
  + Corollary: Screen margins have infinite size
* Steering Law: Time required to move within bounded path varies inversely with width of path
* Implications for design
  + Create sufficiently large targets
  + Use edges of screen for important targets
  + Use context menus
  + Provide ample tolerances in situations in which users must move cursor within boundaries (e.g., context menus, rulers)
* Definition of responsiveness in context of UI design
  + Systems can be slow but responsive
  + Systems can be fast but unresponsive
* Humans don’t tolerate long delays well
* **NO** need to know exact durations of perceptual and cognitive functions depicted in tables in Lecture 10b! If you need any of these values, they will be provided on the exam
* Implications for design
  + Have busy indicators “at the ready” even if you think system will respond quickly (it may not)
  + Use progress indicators (as opposed to busy indicators) when delay is likely to be longer than a few seconds
    - Focus on work remaining, not work competed
    - Show total progress, not progress toward specific task
    - When showing percent complete, start at 0 and show 100% only briefly
    - Show smooth, linear progress
    - Use human terms (e.g., “about 3 minutes” instead of “180 seconds”)
  + Even better: display progressive results
    - Incrementally load results
    - Display most important results first
    - Render video at lower quality first
    - Show wireframes and thumbnails first
  + Stay ahead of users
    - Anticipate next steps and pre-compute results
    - Allow users to abort long operations by prioritizing such inputs

#### Lecture 12: Errors (Norman 5)

* Don’t blame users; blame the system
* Use root cause analysis to get at real cause of error (don’t stop with “human made a mistake”)
* Slips vs. mistakes, and their locations in the Seven Stages of Action models
* Swiss cheese model of accidents
* Design implications
  + Create a social environment that *rewards* reporting of errors
  + Build UIs that make it easy to detect errors (through good feedback)
  + Support undo
  + Don’t regard actions as “errors,” but as approximations toward a goal; steer user back on course
  + Make it easy to recover from interruptions
  + Avoid nuisance warning signals
  + Add constraints to prevent errors

#### Lecture 13: User-centered design (Barnum 3, Norman 5)

* User-centered design lifecycle (understand iterative nature and what the phases are)

#### Lecture 14: Early data gathering (L14 Lecture Slides, Andy Ko Essay, CI Supplement)

* Understand why involving users early in design process is crucial
* Understand why it’s not enough simply to ask users what they want or need
* Understand what functional, usability, and user experiences are, and be able to formulate them correctly
* Be familiar with range of early data gathering methods (What they’re appropriate for, what their key differences are)
  + Questionnaires
  + Interviews
  + Focus groups
  + Field techniques
    - Participant observation
    - Artifact collection
    - Audio and video recording
  + Software log data
  + Researching similar products
  + Contextual Inquiry
    - How to run Contextual inquiry

#### Lecture 15: Synthesizing findings from early data gathering (Barnum 4)

* How to run a contextual inquiry
* Personas (What they are, what they consist of, how to build them)
* Scenarios (What they are, how to construct them)
* Identifying functional, usability, and user experience requirements
* Essential use cases
* Use cases
* Hierarchical task analysis
* State transition diagrams

***Lecture 16: Prototyping (Nielsen/Norman paper prototyping video)***

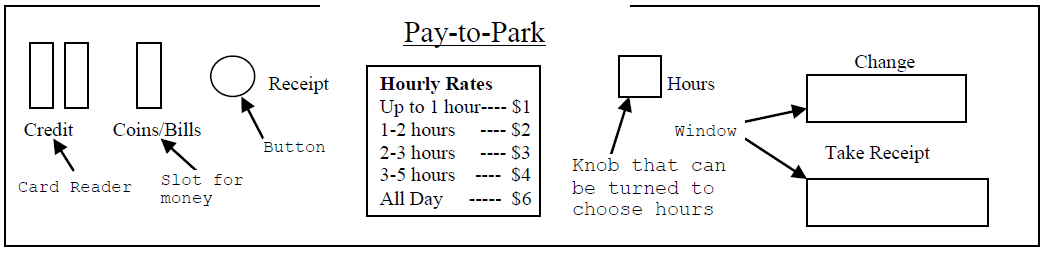
* What paper prototyping is and why it’s useful in the design process
* How to construct paper prototypes out of simple art supplies
* How to run a paper prototyping study (“Wizard of Oz”)

# Recommended Study Strategy

* Read the assigned readings.
* Review the lecture slides and any notes you took on the lectures.
* Compile a cheat sheet (both sides of a 8-1/2” by 11” sheet of paper). Don't come to exam without one!
* Form a study group for the exam, and work toward a common cheat sheet.
* Work on the sample questions (below). We will go through them during the exam review scheduled for the Tuesday before the exam.

# Practice Exam Questions

1. (20 pts) Suppose you have been asked to design a smart phone application that helps WSU students navigate the WSU campus, i.e., find the shortest walking paths from point A to point B where A and B may be buildings, parking lots, etc.
   * 1. Describe two *specific* preliminary data gathering activities, *to whom* you would apply them, and *why* they would be appropriate for gathering empirical data for this project.
     2. Identify two plausible functional requirements, two plausible usability requirements, and two plausible user experience requirements for the system.
     3. Construct a fictitious persona for this design situation.
     4. Formulate a plausible scenario to guide the design of your system.
     5. Write an *essential use case* to describe a task related to one of the functional requirements you identified above.
     6. Rewrite the essential use case as a use case.
     7. Perform a hierarchical task analysis on the task you described above in the use case.
2. (15 pts) Consider the following design for a simple parking kiosk intended to allow drivers to purchase a parking pass as they enter a parking lot:



Analyze this design with respect to five design principles or heuristics you’ve learned in the class. To the extent possible, *justify* all assertions you make in your analysis.

1. Think about the interface and interaction features (capabilities) of a self-service machine or kiosk at the post office where customers can carry out the following actions (actions are listed below in random order):

* Pay with a standard credit card swipe (assume the kiosk does not accept cash) as found in other such self-service kiosks.
* Choose whether to receive acknowledgement of receipt (at extra cost).
* Choose whether to insure the mail and if so for how much (at extra cost).
* Choose whether to register the mail (at extra cost).
* Choose whether to obtain a tracking number that you can use to track the mail over the web (at extra cost).
* Weigh your envelope or parcel.
* Choose domestic or international mail.
* Choose the type of delivery: overnight, next business day, 2-business-days, first class, media mail (for CDs, DVDs, books, or other printed matter only), or parcel post.
* Input the zip code (for domestic mail) or country of destination (for international mail).
* Obtain a printed stamp that you can affix to your mail by peeling off its back.
  + 1. Sketch out the design of a highly-usable self-service post office machine, labeling all displays, controls and components. *How your machine works should be absolutely clear to a viewer of your sketch*. Use the back of this sheet if you need more room.
    2. Analyze and justify your design using five design principles or heuristics you’ve learned in this class. To the extent possible, *justify* all assertions you make in your analysis. Use the back of this sheet if you need more room.

1. Suppose you have a palette of tools in a graphics application that consists of a matrix of 16x16-pixel icons laid out as a 2x8 array that lies along the left-hand edge of the screen. Without moving the array from the left-hand side of the screen or changing the size of the icons, how can you decrease the time necessary to access the average tool? Justify your answer using concepts, principles, and/or laws learned in class.
2. In class we discussed cascading menus. Based on the concepts, principles, and /or laws learned in class, why are these menus potentially problematic for users? What can be done to help users be more efficient with them Justify your response using concepts, principles, and/or laws learned in class.
3. Discuss the relationships among gulfs of execution, gulfs of evaluation, and the Seven Stages of Action Model.
4. What are the different levels of cognitive and emotional processing, and how do they fit in to the Seven Stages of Action Model?
5. Perform a cognitive walkthrough on the task of creating a table like the following in Microsoft Word (or Google Docs). Note the formatting!

|  |  |  |
| --- | --- | --- |
| **Name** | **Gender** | **DOB** |
| **Mike Jones** | M | 12/23/1994 |
| **Nora Smith** | F | 2/3/1997 |
| **Jenny Craig** | F | 4/15/1998 |

1. Design a progress notification for a file copying operation in which the user is copying a large number of files between two network drives. The user is copying 100 files, which are expected to take 10 minutes to copy. At time of the progress notification, 30 files have been copied, and 3 minutes have elapsed.
2. Use gestalt principles to analyze the following dialog box:



1. Suppose an application needs to display a very important error message. Given what we know about human perception, where should the application display the message and how should it be displayed? Justify your answer using facts about human perception learned in class.