ISE 303 Human-Computer Interaction

Tues-Thurs: 2:00-3:15, RM 326

Spring 2009

Instructor
Dr. Nicholas Giudice
Spatial Information Science and Engineering
325 Boardman Hall
giudice@spatial.maine.edu
581-2187

Office Hours:
Office hours for this course will be announced at the beginning of the semester. Alternatively, students are welcome to contact me by email to arrange a time to meet.

Course Description:
In this course, students are introduced to the fundamental theories and concepts of human-computer interaction (HCI). HCI is an interdisciplinary field that integrates theories and methodologies across many domains including cognitive psychology, neurocognitive engineering, computer science, human factors, and engineering design. Students will gain theoretical knowledge of and practical experience in the fundamental aspects of human perception, cognition, and learning as relates to the design, implementation, and evaluation of interfaces. Topics covered include: interface design, usability and universal design, multimodal interfaces (touch, vision, natural language and 3-D audio), virtual reality, and spatial displays. In addition, the course will offer students evaluation techniques to help assess the effectiveness of their designs.

Cr. 3. Prerequisites: none.

Course texts:
Human-Computer Interaction (3rd Ed): by Alan Dix, Janet E. Finlay, Gregory D. Abowd, and Russell Beale
The text will be supplemented with additional reading materials based on emerging topics and class interests. Readings will be accessible from the web, course folder, or via hardcopy on reserve. Other course material and assignments will also be available from the course folder.

PLEASE NOTE: slides are not a substitute for taking in-class notes. I use slides sparingly to show graphics or give examples; I do not use them as the foundation for my lecture or post them in the class folder. Thus, I strongly advise taking notes and asking questions during class, as exams include questions from each lecture’s material as well as the readings. To facilitate this process, I will distribute an electronic outline before most class sessions.

Course Goals and Objectives:
• Students will learn the basic physiological, perceptual, and cognitive components of human learning and memory.
• Students will gain theoretical knowledge of and practical experience in the fundamental aspects of designing and implementing user interfaces.
• Students will learn to analyze interaction problems from a technical, cognitive, and functional perspective.
• Students will develop an awareness of the range of general human-computer interaction issues that must be considered when designing information systems.
• Students will learn about multimodal displays for conveying and presenting information.
• Students will know and have practiced a variety of simple methods for evaluating the quality of user interfaces and spatial displays.

**Grading, Class Policies, and Course Expectations:**
Grades in this course will be based on the quality and completion of all class assignments, lab exercises and papers/projects listed on the syllabus. NOTE: If students decide to conduct human research as part of their class project, the appropriate Institutional Review Board (IRB) approval must be obtained at the beginning of the semester, before any human experiments are run. Information on the UMaine IRB and the application for testing human subjects can be found at:
All students planning to conduct such research must also complete the required web-based tutorial on the protection of human subjects, found at:

You are expected to exhibit high quality work that demonstrates sound understanding of the concepts and their complexity. Earning an “A” represents oral and written work that is of exceptionally high quality and demonstrates superb understanding of the course material. A “B” grade represents oral and written work that is of good quality and demonstrates a sound understanding of course material. A “C” grade represents a minimally adequate completion of assignments and participation demonstrating a limited understanding of course material. A “D” grade represents less than adequate completion of assignments and participation demonstrating nominal understanding of course material. An “F” failing grade represents an unacceptable level of completion of assignments and participation demonstrating a lack of understanding of course material.

**Grading criteria:**
- Assignments – 20%
- Design Project – 15%
- Oral Presentation of Design Project – 10%
- Midterm Exam – 20%
- Final Exam – 20%
- Class Participation – 15%

If you are absent due to illness or a similar valid excuse, please notify me of your situation at giudice@spatial.maine.edu prior to (or immediately after) your absence.

**Course and Exam Schedule**
See the attached schedule of class session topics, reading assignment due dates, and dates for exams.

**Class Policies**
Regular attendance and class participation is expected. I place a high value on questions and interactivity, and fifteen percent of the course grade is based on your constructive in-class input.

**Late assignments and make-up:**
Assignments submitted after the due date are docked 10 percent per day and will not be accepted for credit after a week. If you miss an assignment or are unable to take an exam due
to an illness or emergency, you must send notification to me prior to (or soon thereafter if there are mitigating circumstances) the due date / exam by email. Special arrangements will be made on a case by case basis.

**Academic honesty:**
Academic honesty is expected. Plagiarism is unacceptable in this course and will result in a failing grade.

**Students with disabilities:**
If you have a disability for which you may be requesting an accommodation, please contact either me or Ann Smith, Coordinator of Services for Students with Disabilities (121 East Annex Building, 581-2319), as early as possible in the term.

**Other policies:**
Ringing cell phones and occupation with texting, emailing, web searching, and the like is distracting to both the instructor and your fellow students. There is plenty of time for these activities when outside of class, please have the courtesy to turn off your phones and curtail computer use, except for note taking or in-class exercises, during class sessions.

Please submit all assignments with the following information in the header: your name, assignment title, date, and class number/name. Since I often comment on the assignment in-text or cut and paste them into a single document for distribution to the class for discussion, it is easier to have them in a readily editable format rather than a PDF. Thus, please submit all assignments as a MS word document, or in rich text format, or as a text file.
Course Schedule

**Week 1 (Jan. 13 and 15)**

*Lecture 1 (Jan. 13): Introduction to the course and to HCI*
- What is HCI?
- Its history
- Relation to Ergonomics and Human Factors
- Problems and challenges
- Recurrent HCI Themes

*Lecture 2 (Jan. 15): The human brain vs. the computer – mechanisms of memory.*
- Humans and the Engineering trap
- The user as an information processing system
- Differences between humans and computers: Brains vs. Circuit Boards
- Three forms of human memory: sensory buffers, short-term memory (working memory), and long-term memory (LTM)

*Homework assignment 1:* Understanding how human memory and reasoning can benefit interface design. See lecture handout for more details. Due 12 hours prior to next lecture.

**Week 2 (Jan 20 and 22)**

*Lecture 3 (Jan. 20): Human memory continued*
- How information gets to LTM: Rehearsal, unconscious consolidation, meaningful associations
- Two types of LTM: Declarative and implicit memory.
- Ways to improve the learning/storage process
- Forgetting: Is memory loss due to decay, interference, or access problems?
- Information access/retrieval: Recall vs. recognition.
- Reasoning and logic structures: Humans vs. computers
- In-class presentations of the relation of human memory to design (assignment 1).

*Homework assignment 2:* Prepare brief presentation for next class on touch sensitive displays. See lecture handout for more details.

*Lecture 4 (Jan. 22): An overview of computer input devices*
- HCI factors to consider
- Pros and cons of direct and indirect interfaces
- Basic input devices: text entry, touchpads, touchscreens, and absolute and isometric joysticks
- Complex input devices: gesture and voice recognition, handwriting and eye-gaze interfaces
- Future variants?
- In-class presentations of touch sensitive displays (assignment 2).

**Week 3 (Jan 27 and 29)**

*Lecture 5 (Jan. 27): An overview of computer input devices continued*
- Benefits and problems of current output devices
- Output devices: Types of visual displays
- Output devices using other modalities: Touch, speech, and auditory displays
- The importance of multimodal displays
- Optical character recognition (OCR) and scanning
Future variants?

Lecture 6 (Jan. 29): Interaction styles and design principles
Types of interaction (or dialog style)
Advantages, disadvantages, and design factors of:
Command-line, menus, natural language interaction, Point-and-click, 3-D, and WIMP interfaces
Three levels of the HCI design cycle: User, design, evaluation
Interaction models: Norman’s seven stages of action
Homework assignment 3: Prepare a brief presentation for next class on examples of good and bad design based on class material. See lecture handout for more details.

Week 4 (Feb. 3 and 5)
Lecture 7 (Feb. 3): Design and usability
Why physical design is easier than HCI design: Human error and mistakes
Know your user: What they want, how they think, how to implement
Designer bias/egocentrism
Techniques to gather user needs: Interviews, focus groups, observation, participatory design
Use of persona, scenarios, and storyboards during the design process
Three types of prototyping design: Throw-away, Incremental, and Evolutionary
In-class presentations of good and bad designs (assignment 3).

Lecture 8 (Feb. 5): Design rules
Authority vs. generality
Principles, standards, and guidelines
Golden rules and heuristics
Three categories of primary usability principles: Learnability, flexibility, and robustness
Homework assignment 4: Prepare a brief presentation for next class describing how the MaineStreet portal has problems with each of the three major usability categories discussed. Give examples and proposed solutions. See lecture handout for more details.

Week 5 (Feb. 10 and 12)
Lecture 9 (Feb 10): Design evaluation
In-class presentations of usability problems with MaineStreet (assignment 4).
Two forms of design evaluation: Expert analysis and user participation
Approaches to expert analysis: Cognitive walkthroughs, heuristic evaluation, model-based evaluation, and evaluation based on existing research
Lab vs. field research
Types of user-based evaluation: Observational methods, query techniques, physiological and direct recording, and experimental methods
Homework assignment 5: Prepare an informal example of a cognitive walkthrough. See lecture handout for details.

Lecture 10 (Feb 12): Empirical methods of experimental evaluation
In-class presentations of cognitive walkthroughs (assignment 5).
Choosing participants and sample size
Hypothesis testing
Variables: independent and dependent measures
Types of experimental designs and when you use them
Data analysis
Homework assignment 6: Prepare a write-up describing the details of a formal experiment to empirically test the usability of a new interface. See lecture handout for details.

Week 6 (Feb 17 and 19)
Lecture 11 (Feb 17): Universal Design (UD)
Universal design is not specialized design: UD = good general design
Approaches to universal design implementation: Shared purpose, built-in redundancy, augmenting existing information, compatibility with third party assistive technology (AT)
Seven Universal Design principles: Overlap with general design principles
Tips for improving visual, auditory, haptic, and multimodal displays
Speech recognition and speech synthesis (TTs)
Universal design on the web

Lecture 12 (Feb 19): Multimodal interfaces
Multimodal displays: providing feedback, supporting different learning styles, cross-modal interactions
Better realism
Behavioral and physiological evidence
Real-time demonstrations (bring clothes appropriate for walking for a few minutes outside)
Sample midterm will be distributed
Homework assignment 7: Design a multimodal interface for an existing video game based on in-class demonstrations. See lecture handout for details.

Week 7 (Feb 24 and 26)
Lecture 13 (Feb 24): Student presentations
In-class presentations of multimodal interfaces (assignment 7)

Lecture 14 (Feb 26): Midterm exam
The midterm will be emailed to you and should be completed within the normal class period as described in lecture.

Week 8 (Mar. 17 and 19)
Lecture 15 (Mar. 17): Review and final project description
Midterm review
Discussion of final design project
Break-out groups
Homework assignment 8: Outline of project due by next Tuesday’s class. See lecture handout for details.

Lecture 16 (Mar. 19): HCI and the web
HCI challenge: Many different users, tasks, and technologies
What is good web design?
Some guidelines and good practices.
Guest speaker.

Week 9 (Mar. 24 and 26)
Lecture 17 (Mar. 24): Human vision and visual displays
Difference between sensation, perception, and cognition: Relation of each to HCI design
Physiology of visual system, information transduction, and cortical representation
Perceptual distortions and visual illusions
Visual design issues
Guidelines for font and reading, color usage, and display structure and layout
Good design for buttons, icons, and lists

Homework assignment 9: Design an auditory interface. See lecture handout for details.

Lecture 18 (Mar. 26): Human audition and auditory displays
In-class presentations of auditory displays (assignment 9).
Auditory sensation, perception, and cognition.
Physiology of hearing
Auditory displays: verbal interfaces vs. 3D spatialized sound
Other uses of auditory interfaces

Homework assignment 10: Design a tactual interface. See handout for details.

Week 10 (Mar. 31 and Apr. 2)
Lecture 19 (Mar. 31): Human touch and tactual displays
Three subsystems of touch: Cutaneous, kinesthetic, and haptic
Mechanoreceptors most relevant to HCI and touch-based interfaces
Consideration of exploratory procedures--patterns of hand movement that facilitate
encoding of spatial properties through touch--in the design of tactual interfaces
Perceptual illusions with touch
Types of touch-based interfaces: Force-feedback haptic devices, cutaneous devices,
and vibro-tactile devices
In-class presentations of tactual displays (assignment 10).

Homework assignment 11: HCI factors relating to the design of a brain interface. See
lecture handout for details.

Lecture 20 (Apr. 2): Brain-Computer Interaction (BCI) and Neuroprosthetics
What is BCI?
BCI and brain plasticity
Neuroergonomics and Neurocognitive Engineering
Medical applications of BCI: Neuroprosthetics
Commercial Applications of BCI
Ethical implications of these interfaces
In-class presentations of BCI interfaces (assignment 11).

Week 11 (Apr. 7 and 9)
Lecture 21 (Apr. 7): Sensory substitution
Neuroprosthetics vs. sensory substitution
Most sensory substitution devices compensate for loss of vision: discussion of visual to
tactile and visual to auditory devices
Components of sensory substitution devices
Biggest HCI challenge: natural mapping of one modality to another
Demonstrations of auditory to vision substitution
Homework assignment 12: Designing a new cell phone/PDA. See Lecture handout for
details.

Lecture 22 (Apr. 9): Cell phones and HCI
In-class presentations of new cell phone interfaces (assignment 12).
Information input and its evolution on the cell phone
Output displays and their problems
Other interface considerations
Do all roads lead to a hand-held portable device?
Future designs.

Week 12 (Apr. 14 and 16)
Lecture 23 (Apr. 14): Project proposals
Student presentations of design project proposals
Class critique

Lecture 24 (Apr. 16): Augmented reality and virtual reality
Overview of VR technology
Immersion and “sense of presence”
Uses of virtual reality: Research tool, training, and manufacturing
Augmented reality: what it is and how it works
Future of this technology
Lab demos

Week 13 (Apr. 21 and 23)
Lecture 25 (Apr. 21): Ubiquitous computing and wearable devices
What is ubiquitous computing and ambient intelligence?
Wearable devices and the miniaturization of computing platforms
Uses and benefits of these technologies
Disadvantages and problems
*Homework assignment 13:* What is the future of HCI? See lecture handout for details.

Lecture 26 (Apr. 23): Future directions of HCI
In-class presentations of the future of HCI (assignment 13).
Future HCI Themes? How will they change from those discussed in this course?
The aging of our population
Greater reliance on computers for more tasks
The state of affairs 15 years out?

Week 14 (Apr. 28 and 30)
Lecture 27 (Apr. 28): Design project presentations

Lecture 28 (Apr. 30): Design project presentations
Final design papers due

Week 15 (May 7)
Final exam