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INTEGRATING HCI PRINCIPLES INTO DEVICE DEVELOPMENT CURRICULUM

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A Capstone Project Submitted to the  
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Department of Information Systems and Operations Management  
University of North Carolina Wilmington

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## Abstract

Human Computer Interaction (HCI) is an important and often under-emphasized subject in undergraduate computer science curricula. This capstone project involves the summarization of the key HCI principles through a review of current literature, an interview with an expert from the psychology field, and a review of existing HCI courses at other institutions. It then takes those theories, summarizes the key concepts, and recommends a curriculum for an undergraduate HCI course. Finally to practice the concepts a review of the homepage of the University of North Carolina at Wilmington's adherence to design rules is evaluated, and suggestions are made to more effectively apply HCI principles.

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## **I. Introduction**

This paper summarizes a capstone project involving the study of HCI principles with a primary goal being to increase my personal knowledge of HCI. Also recommendations are made to UNCW involving the teaching and implementation of HCI principles in courses and on web sites. Specifically the project involved a literature review and study of human computer interaction (HCI), as well as a HCI course curriculum research and the creation of a suggested course curriculum for an HCI to be taught here at UNCW.

HCI is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them ("HCI ACM SIGCHI, 2013). Of these “major phenomena” an interesting area is the application of psychological principles to the design of software tools and web site interfaces, along with the effects of said principles on the implementation and usability of information systems. The overall goal of the project revolves around five key deliverables. These include:

1. Understanding and summarizing the key HCI principles through a review of current literature.
  - a. Intersection of HCI and Psychology
  - b. Eye-movement Research
  - c. Interface Design Rules
  - d. HCI Application to Websites
  - e. Current Research in HCI

2. Interview with Dr. Toth of the UNCW psychology department faculty to gain his insight into HCI principles, and then integrating them into a recommended CIT 425 HCI course curriculum.
3. Review of existing HCI course offerings at peer universities. Again, the goal is to incorporate “best practices” into a potential syllabus for UNCW new course offering in HCI based on findings.
4. To gain feedback for the curriculum suggestions, teach selected HCI topics two undergraduate courses: MIS/CIT 310, an undergraduate device design course and MIS 413 (capstone ‘n-tier’ design course).
5. Recommend implementation of HCI concepts learned via:
  - a. Review of UNCW existing homepage Recommendations for UNCW homepage.

I selected this project because it allowed me the opportunity to advance my analysis, design, and development skills, as well as further develop my personal interests in human computer interaction. Additional motivation was the opportunity to give back by applying the knowledge gained to benefit the university. This project involved the application and integration of knowledge gained through my coursework in the MSCSIS program – specifically the systems analysis and design and software engineering courses.

Knowledge gained from these MS CSIS courses in this project included:

- Analysis and Design – Systems analysis is quite similar as task analysis in that they both involve identifying the goals and purposes of a procedure/task in order to create solutions that will achieve them in an efficient way.

- Software engineering – determining how and where to include HCI in the software development life cycle.

## **II. Human computer interaction**

### **1. Overview – why study HCI?**

The goal of HCI is to make computers/software more usable and adaptive to user's needs, ultimately developing interfaces that minimize the barrier between human mental models and the system/software's ability to accomplish the desired task (en.wikipedia.org). Computer science students are taught how to code, but are lacking knowledge in what makes a user desire to use one program over another. By offering an introductory course in HCI, students can learn to think of designing software tools from a more user-centered viewpoint.

The number of fields contributing to the science of HCI made the selection of which subjects to include in 14 week course challenging. It can be construed from figure 1 that computer science, human factors, and psychology are topics that SIGCHI suggest be covered.

Additionally, I chose to also include design and some software engineering. Justification for the chosen topics will be provided in the proposed curriculum section.

Per the Association of Computing Machinery (ACM), figure 1 details the many different fields that may be included in HCI. Key work in this project will be the Design, Computer Science, Human Factors and Psychology areas shown in figure 1.

# The Field of HCI

(Human Computer Interaction)

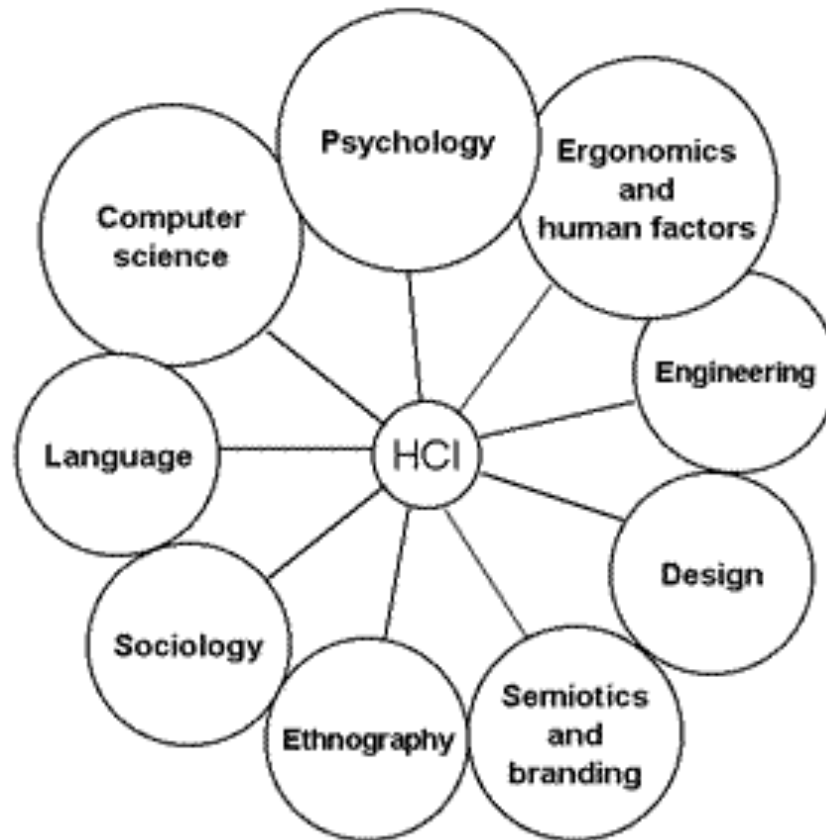


Figure 1 . Fields integrated in HCI (ACM SIGCHI).

Additional motivations for studying HCI are:

1. Poor usability discourages users.
  - a. Usability directly effects task performance
  - b. Poorly designed user interfaces dramatically increase error rate
2. Designing software/websites people want to use (i.e. Facebook); (TeamTreeHouse.com, 2013).

- a. Using familiar UI (User Interface) elements makes users more comfortable
  - b. Consistency is important and influences efficiency – once a user learns how to perform a task, they need to be able to repeat it easily
3. Creating a visual hierarchy (TeamTreeHouse.com)
    - a. Design interface to focus on task to be accomplished by creating a clear path to understanding interface

## **2. Goal of HCI**

The goal of HCI is to improve the user's ability to complete a desired task by making the computer more usable and receptive to the user's needs. "Users of advanced hardware machines are often disappointed by the cumbersome data entry procedures, obscure error messages, intolerant error handling, confusing sequences of cluttered screens the norm rather than the exceptions, as many researchers in the field have noticed. In particular, novice users feel frustrated, insecure, and even frightened when they have to deal with a system whose behavior is incomprehensible, mysterious, and intimidating" (Bertino 2008). A good definition of usability is: "the user can do what he or she wants to do the way he or she expects to be able to do it, without hindrance, hesitation, or questions" (Welsch, 2012).

The importance of user ease of use can be demonstrated from my experience. I had recently worked with a firm that developed software without consideration of usability. When I first started working as a contracting software engineer for a large local corporation, it was necessary for me to become familiar with their existing systems. As a new user of highly specialized, industry specific software, it took me several months to figure out how to use the software before I was able to make a contribution to the team. Furthermore, at the beginning of my contract, I was told that all new software engineers usually need somewhere between 3-6

months to become accustomed to using their software tools. One of the factors I found most shocking about the situation is that the particular company I was working for has the reputation of being on the cutting edge of technology, and frequently advertises on television how they are at the forefront of innovation. The state of their information systems was anything but state of the art. I learned over time that there were several reasons why the information systems were so antiquated:

1. This corporation's top priority is profitability. Each of their businesses are run independently, and each unit must do whatever is possible to maintain profitability. As a result, the ethos of the business was essentially "if it's not broke, don't fix it."
2. There was little interest at the executive level in developing new technology that would not immediately improve the profitability of the business. A large part of the software engineer's time was spent fixing bugs in existing programs. Many of these programs were written by industry engineers with no software development training, designed to do exactly what they needed with no regard to maintainability or readability. Basically the company was paying employees for 6 months of learning how to use their systems.

### **3. HCI Background**

30 years ago the few researchers in the HCI field were considered rebellious because they broke the disciplinary boundaries of computing at the time. The goal of these researchers was to present information in comprehensible formats by creating better menus, developing GUI's based on direct manipulation, improving input devices, and designing effective control panels. In the early days, HCI researchers and professionals had to fight to justify the science as academically relevant. This is often still the case; however the larger world has embraced the field, as HCI designs now influence commercial success, reform education, and family life

(Schneiderman, 2012). The next major advance in HCI was the creation of the graphical user interface (GUI) in the 1980's. Following the GUI was the development of the desktop and desktop icons. The problem with desktop icons is that they can quickly become cluttered, making finding files and folders cumbersome, the opposite of what the icons were designed for. Next email created networks where people communicated through computers with other people. This was the beginning of social computing, which has evolved into today's tools such as instant messaging, wikis, and social networking (Carroll, 2013).

#### **4. Intersection of HCI and Psychology**

The subject of human informational processing has provided a dominant theoretical framework for the consideration of human factors issues in HCI. As a result of, technological advances in displays, sound, graphics, conceptual models, and the physical design of input devices have contributed to improve the HCI experience. One of the deliverables in this project was to interview Dr. Toth of the UNCW Psychology faculty. Dr. Toth was chosen because his research involves attention and cognitive science. The purpose of the interview (found in Appendix B) was to determine which topics in HCI are relevant to psychology. The following is a brief summation of two topics in human information processing that Dr. Toth suggested to be covered. These two topic areas were cognitive science and perceptual-motor interaction and performance. Dr. Toth also expanded the need for attention, eye pattern research, perceptions based on our experiences, recall and recognition. Finally he recommended a clear task analysis be completed on all projects. The full interview may be found in Appendix C. Following are the two key topic areas recommended by Dr. Toth for additional research.

##### **Cognitive Science:**

Cognitive science is the scientific study of the mind and its processes, and is essential to understanding how users perceive an interface.

1. Attention is the process through which information enters into working memory and achieves the level of consciousness. The important characteristics of attention are:
  - a. It is selective, and allows only a specific subset of information to enter the limited processing system.
  - b. Focus of attention can be shifted from one source of information to another.
  - c. Can be divided, within certain limitations, to selectively attend to more than one information source at a time. (Cherry, 1953)

An excellent example of this phenomena involves picturing yourself at a social function where there are multiple conversations occurring simultaneously. You are able to selectively tune out the other conversations in order to attend to a single conversation, while you are also able to shift your attention to another conversation that is occurring nearby. While you are able to divide your attention and follow both conversations simultaneously, you will notice that your understanding and contribution to the first conversation will diminish as you dedicate more of your attention to the second conversation. This is an indication that you have exceeded the amount of your limited information processing capacity (Cherry, 1953). While this example uses auditory input, studies have shown that the ability to select, divide, and shift attentional resources holds true for vision and other modalities. Vision is the primary modality of information transfer in HCI, however research is showing that visual-auditory interaction is becoming increasingly relevant (think hearing and seeing a notification alerts for an email or text message while reading information from a web page).

For example there is abundance of current research on the topic of recall. For example, handwriting and reading are linked in the sensorimotor area of the brain, this area playing a major role in visual recognition and strengthening the learning process. Furthermore, it was also found that typing on a keyboard may in fact hinder recollection. The correlation of these findings to HCI is in an area called haptics or tactile feedback technology which takes advantage of the sense of touch. Examples of are using vibration in the controls of video game and phones and enhancing the feeling of remote control of machines and devices by incorporation tactile sensors that measure force exerted by users on the interface "International Society for Haptics: Haptic technology, an animated explanation" (Robles-De-La-Torre). Another application of this technology involving the sensorimotor complex is using a stylus to interface with devices.

Brain-Computer Adaptive Interfaces: "One simple way in interfaces may adapt based on cognitive state is to adjust information flow. For example verbal and spatial tasks are processed by different areas of the brain, and cognitive psychologists have shown that processing capabilities in each of these areas is largely independent" (Baddely). Another way interfaces might adapt is to manage interruptions based on the user's cognitive state. Researchers have shown that interruptions disrupt thought processes and can lead to frustration and significantly degraded task performance (Cutrell, Czerwinski & Horvitz, 2001). For example, if a user is thinking really hard, the system could detect this and manage pending interruptions such as email alerts and phone calls (Tan, Nijholt, 2010).

### **Perceptual-Motor Interaction and Performance (PMI)**

PMI is the foundation behind the evolution from the mouse, keyboard, and joystick to today's embedded, gestural, and tangible interfaces where people use their body to directly

manipulate information objects. Many new laptops and most mobile devices support multitouch, allowing the fingers and gestures to control the device, while some video game systems such as the Wii and Xbox use body movements to interact with objects. These developments were born by researchers investigating the use of information-processing approaches to understand the translation of perceptual into motor space and the interaction of attention and action planning (Welsch, 2012). Studies performed in the 1960's and 1970's measured the error rate and speed of subjects completing a cursor positioning task using four different devices (mouse, joystick, step keys, and text keys). The speed measurement consisted of "homing time" (time taken to engage the control device and initiate cursor movement) and "positioning time" (time to complete the cursor movement). While the mouse was shown to have the poorest homing time, its advantage in positioning time produced the fastest overall time (Card, 1983).

## **5. Eye-moment research**

Eye movement patterns is an emerging research area which centers on studying the pathways a user's take when viewing a web page. Websites exist to communicate information to users. Studying how the information is visually processed by the human eye therefore is an aspect of design that must receive attention. An example involves the Credo Mobile website.

The goals of the page were to: show a phone the customer may be interested in, see the company name, and guide the visitor to the purchase button. As you can see in figures 2 to 5, most of the hotspots were located in areas of the screen that were blank, not satisfying the goals for the page. Considering the data, the company redesigned the site according to the suggestions of the eye-movement study, locating the phone, company name, and buy button in the proven hotspots (oneextrapixel.com). even hotspots (oneextrapixel.com)



Figure 2. Previous site (oneextrapixel.com)

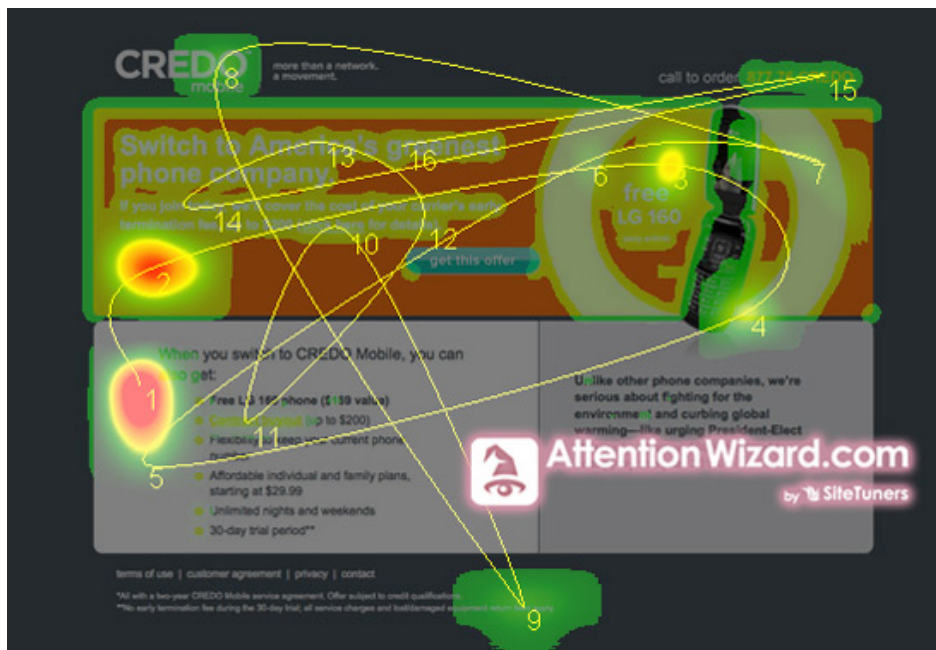


Figure 3. Eye tracking for previous site (oneextrapixel.com).

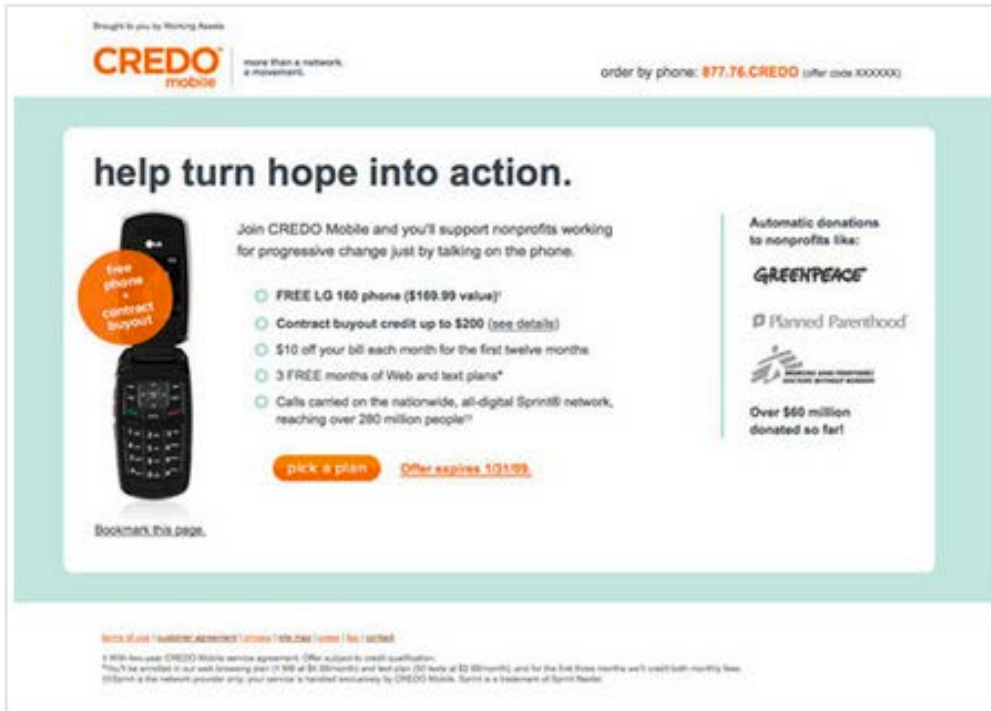


Figure 4: New site redesigned for hotspots (oneextrapixel.com)



Figure 5 Eye tracking for new site (oneextrapixel.com)

A more traditional research study on the identification of hotspots and the possibility of predicting areas of high attention was conducted at Microsoft (Buscher, Cutrell, Morris, 2009.) “An understanding of how people allocate their visual attention when viewing web pages is very important for web authors, interface designers, advertisers, etc. Such an understanding could open the door to a variety of innovations, ranging from improved Web page design to the creation of compact, yet recognizable, visual representations of long pages.” “The fundamental premise of our study is that since gaze data can be seen as a proxy for attention, understanding how people look at Web pages may reveal something about the salience, recognizability, and importance of different areas that we can then use in a predictive manner.” The study involved 20 users who viewed 361 different pages.

The following lists the questions investigated, with the results bulleted. :

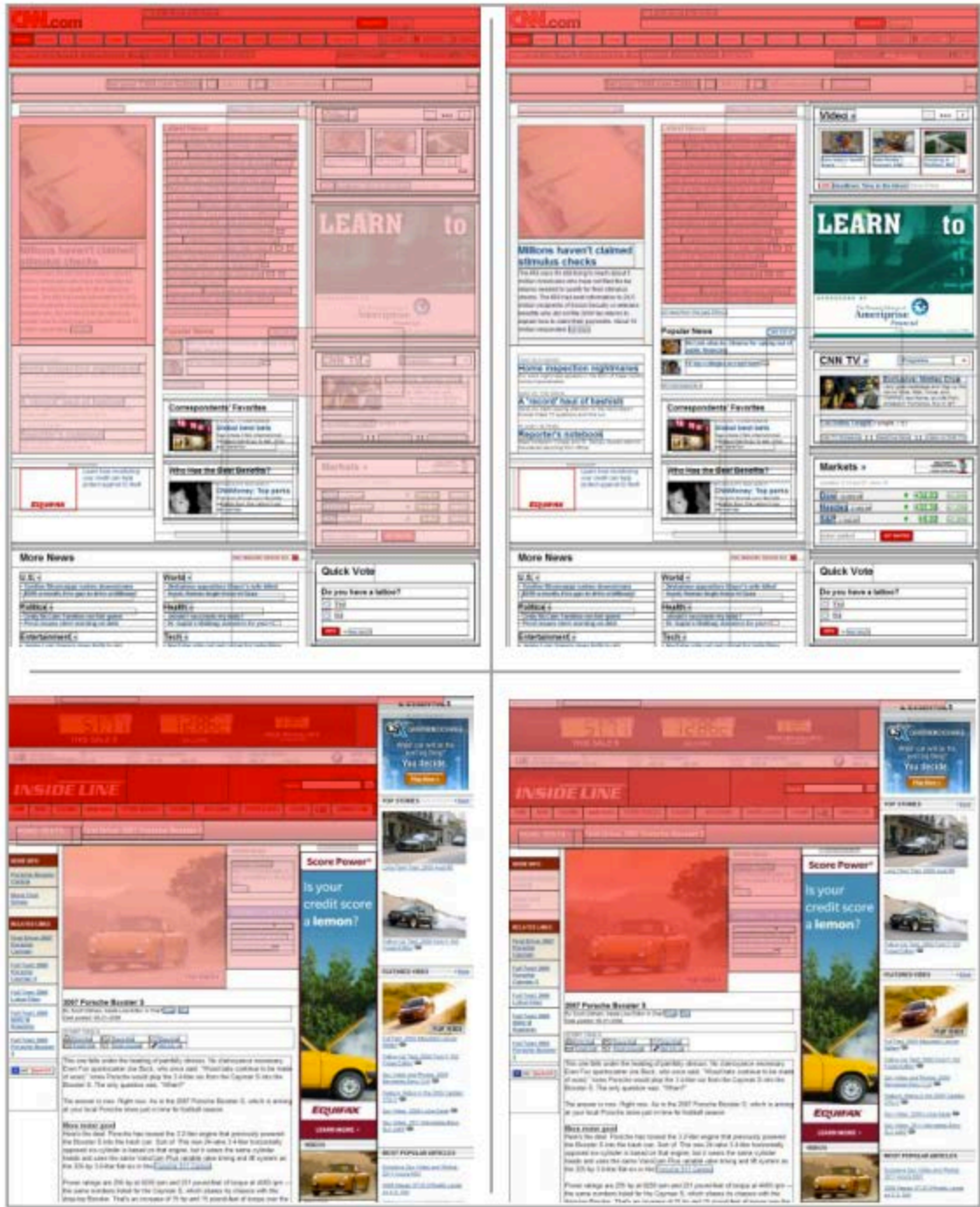
1. What areas on a page generally receive the most attention from users? Does this depend on varying tasks?
  - The entire right third of the page is neglected for both information foraging and page recognition tasks.
  - The center-left, top-left, and center-center regions are the most important for information foraging tasks.
  - For recognition tasks, the top-left dominates
2. Can computational models predict what people will look at on a page and how much?
  - Models of linear regression and decision trees can be used to render the most important HTML elements for optimal page recognition

- Prediction methods work well and find the most important elements for recognizing a page; however, they are biased to the upper left-hand side of the page
- Depending on screen size (desktop, laptop, mobile), methods can be used to emphasize more of the most important elements as identified by their calculated predictions.

Figure 6 illustrates the results of their study. The areas highlighted in red (shaded) are the hotspots. Figure 7 demonstrates the expected hotspots on a page per Microsoft.



Figure 6: Heat map for 20 users during a page recognition task



Median fixation impact

Prediction

Figure 7: Microsoft hotspots prediction study

## 6. General Design Principles

Within the field of HCI, there are several general design principles that are considered standard, meaning they are to applicable to the design of any interface.

General design principles may include:

1. Usability – ease of use and learnability of a software application, system, or website (Stasko, 2007).
  - a. Learnability principles: ease with which new users can begin effective interaction
    - Predictability: I think that this action will do a certain function (i.e. clicking on a submit button will submit information entered in a form)
    - Synthesizability: can the user figure out what caused an error?
    - Familiarity: Does UI task leverage existing real-world domain knowledge?
    - Generalizability: can knowledge of one system/UI be extended to similar ones? (i.e. cut and paste in different apps)
    - Consistency: likeness in behavior between similar tasks/operations (interacting, output, screen layout)
2. Accessibility – accessibility of a computer system to all people, regardless of disability and severe impairment (cognitive – learning disability, visual – complete or partial and color blindness, hearing, motor). Accessibility is more than accommodating handicapped users. Good accessibility increases search engine optimization and increases the number of visitors who can use your site/software. With the expanding use of technologies such as touch screen and mobile devices, accessibility also extends the ability of users with limited knowledge of these technologies to interact with the device (Stephanidis).

3. Computer user satisfaction – the attitude of the user to a system – a key measure of computer system success. Involves psychological principles such as user perception of software’s ability to accomplish desired tasks.
4. Human interface design – designing interactive digital products, environments, systems, and services – more of a behavioral study. The following are the human interface guidelines incorporated in the design of Apple’s latest mobile operating system, iOS 7 (developer.apple.com):
  - a. Deference: UI helps users understand and interact with the content, but never competes with it.
  - b. Clarity: Text is legible, icons are precise and lucid, adornments are subtle and appropriate, sharpened focus on functionality
  - c. Depth: Visual layers and realistic motion impact vitality and heighten users’ delight and understanding.

Dr. Ben Schneiderman at the University of Maryland, is considered a leading authority on interface design. Schneiderman says: “I have often been asked to distill the vast corpus of user interface design into a few key principles. While I was reluctant to do this, it turned out to be a good exercise to write “Golden Rules,” that are applicable in most interactive systems. These principles, derived from experience and refined over three decades, require validation and tuning for specific design domains” (Shneiderman and Plaisant, 2010). The eight rules are:

1. **Strive for consistency.**

- Consistent sequences of actions should be required in similar situations; identical terminology should be used in prompts, menus, and help screens; and consistent color, layout, capitalization, fonts, and so on should be

employed throughout. Exceptions, such as required confirmation of the delete command or no echoing of passwords, should be comprehensible and limited in number.

**2. Cater to universal usability.**

- Recognize the needs of diverse users and design for plasticity, facilitating transformation of content. Novice to expert differences, age ranges, disabilities, and technological diversity each enrich the spectrum of requirements that guides design. Adding features for novices, such as explanations, and features for experts, such as shortcuts and faster pacing, can enrich the interface design and improve perceived system quality.

**3. Offer informative feedback.**

- For every user action, there should be system feedback. For frequent and minor actions, the response can be modest, whereas for infrequent and major actions, the response should be more substantial. Visual presentation of the objects of interest provides a convenient environment for showing changes explicitly.

**4. Design dialogs to yield closure.**

- Sequences of actions should be organized into groups with a beginning, middle, and end. Informative feedback at the completion of a group of actions gives operators the satisfaction of accomplishment, a sense of relief, a signal to drop contingency plans from their minds, and an indicator to prepare for the next group of actions. For example, e-

commerce web sites move users from selecting products to the checkout, ending with a clear confirmation page that completes the transaction.

**5. Prevent errors.**

- As much as possible, design the system such that users cannot make serious errors; for example, gray out menu items that are not appropriate and do not allow alphabetic characters in numeric entry fields. If a user makes an error, the interface should detect the error and offer simple, constructive, and specific instructions for recovery. For example, users should not have to retype an entire name-address form if they enter an invalid zip code, but rather should be guided to repair only the faulty part. Erroneous actions should leave the system state unchanged, or the interface should give instructions about restoring the state.

**6. Permit easy reversal of actions.**

- As much as possible, design the system such that users cannot make serious errors; for example, gray out menu items that are not appropriate and do not allow alphabetic characters in numeric entry fields. If a user makes an error, the interface should detect the error and offer simple, constructive, and specific instructions for recovery. For example, users should not have to retype an entire name-address form if they enter an invalid zip code, but rather should be guided to repair only the faulty part. Erroneous actions should leave the system state unchanged, or the interface should give instructions about restoring the state.

**7. Support internal locus of control.**

- Experienced users strongly desire the sense that they are in charge of the interface and that the interface responds to their actions. They don't want surprises or changes in familiar behavior, and they are annoyed by tedious data-entry sequences, difficulty in obtaining necessary information, and inability to produce their desired result.

#### **8. Reduce short-term memory load.**

- Humans' limited capacity for information processing in short-term memory (the rule of thumb is that we can remember "seven plus or minus two chunks" of information) requires that designers avoid interfaces in which users must remember information from one screen and then use that information on another screen. It means that cell phones should not require re-entry of phone numbers, web-site locations should remain visible, multiple-page displays should be consolidated, and sufficient training time should be allotted for complex sequences of actions.

It is clear from the list that focusing user's productivity and the ease of completing the desired tasks will increase feelings of competence. Looking at the rules, I have to admit that personal experience has shown me how easy it is to become excited about the presentation and end up neglecting the functionality.

### **III. HCI Applications for Websites**

One of the goals of this paper was to use the HCI knowledge gained to evaluate the current UNCW home page, and to make recommendations on how the site can benefit from incorporating principles of HCI researched. One of the most effective tools to evaluate a

webpage's design layout is comparing the layout to eye-tracking research studies, demonstrating which areas of the page hotspots) users tend to see first.

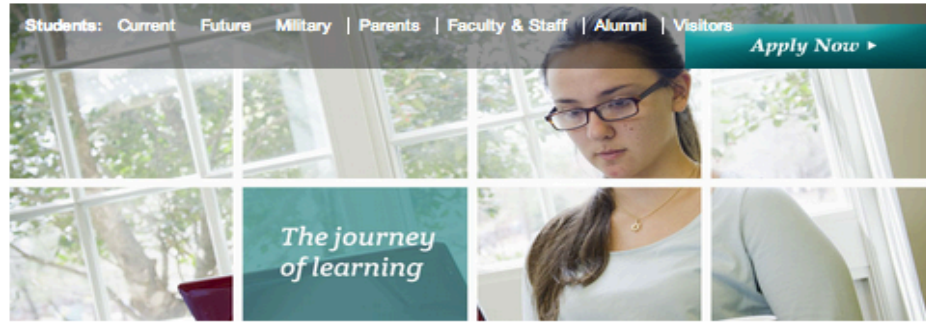
Every webpage has goals or certain information they want to communicate to users. These goals need to be prioritized, and the associated content placed in the layout relative to the areas which receive the most eye traffic. As discussed previously in in the eye-tracking section, research has shown that the following characteristics apply to all pages:

- Users read left to right
- Top to bottom
- Right side of the page , right bottom especially, is the least efficient area to place relevant content

Similar to business websites, academic webpages have to strike a balance between appearance and content. For most websites, a simple layout is often best. “University sites have to appeal to a number of very diverse audiences (prospective students, students, alumni, faculty, parents, etc.) and have to have sections that adequately represent the university's various departments and schools. The information architecture is extremely complicated, and it is nearly impossible for someone not involved in the process to know whether the designs achieve the goals laid out in the discovery process (Zeigler, 2010).


Some of the main design considerations for an academic site:

1. Route visitors to where they need to go easily.
2. Provide a clear and usable navigation structure.




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**News** 

- 


**UNC-TV Airs UNCW Profile**  
The video profile, part of a series spotlighting the 17 member institutions in the UNC system, showcases UNCW's impact on the community through its commitment to coastal research, applied learning and entrepreneurship.  
[more...](#)

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**UNCW Alumna Yvonne Kidd Newest Board of Trustees Member**  
UNCW announces that Asheboro native Yvonne Kidd has been sworn in as the newest member of the university's Board of Trustees. Kidd took the Oath of Office with her husband and two children by her side at UNCW's Burney Center on Dec. 2.  
[more...](#)

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**UNCW Geologist Part of Global Study on Climate Change**  
Paul J. Hearty, research associate professor in the UNCW Department of Environmental Studies, was among a team of international researchers participating in a study on global climate change. The study, published on Dec. 3 in the open-access journal PLOS ONE, presents an assessment based mainly on observations of present and past climates.  
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**Events** 

- Friday, December 6**  
Webinar: Supporting Women Veterans on Campus  
UNCW Wind Symphony and Chamber Winds
- Sunday, December 8**  
UNCW Tuba Christmas
- Saturday, December 14**  
Fall 2013 Commencement

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**Figure 8. UNCW Homepage (uncw.edu)**

Table 1 details an analysis of the uncw.edu website in terms of heuristics and potential improvements.

Violated heuristics	Problem found	Suggested improvements
Aesthetic and minimalist design	<ol style="list-style-type: none"> <li>1. Main picture is taking up too much room.</li> <li>2. Too much information/text. For example, news should be a link that redirects to another page. All of the unnecessary text draws attention away from the more relevant information (well thought out links at top of page)</li> <li>3. Font is too small.</li> </ol>	<ol style="list-style-type: none"> <li>1. Combine image and school logo</li> <li>2. An academic home page needs to clearly route users to the information they are looking for.</li> <li>3. Increase size of font while dramatically decreasing text.</li> </ol>
Mapping	<ol style="list-style-type: none"> <li>1. There are links inside the image and then immediately above and below the image</li> </ol>	<ol style="list-style-type: none"> <li>1. Far less links and more thought put into links that better satisfy user need. Links should be clearly</li> </ol>
Layout	<ol style="list-style-type: none"> <li>1. Far too many areas containing links – too many options for navigation</li> </ol>	<ol style="list-style-type: none"> <li>1. One span at the top of the page for major links. Can use drop down list for sub-links when user hovers over link.</li> </ol>

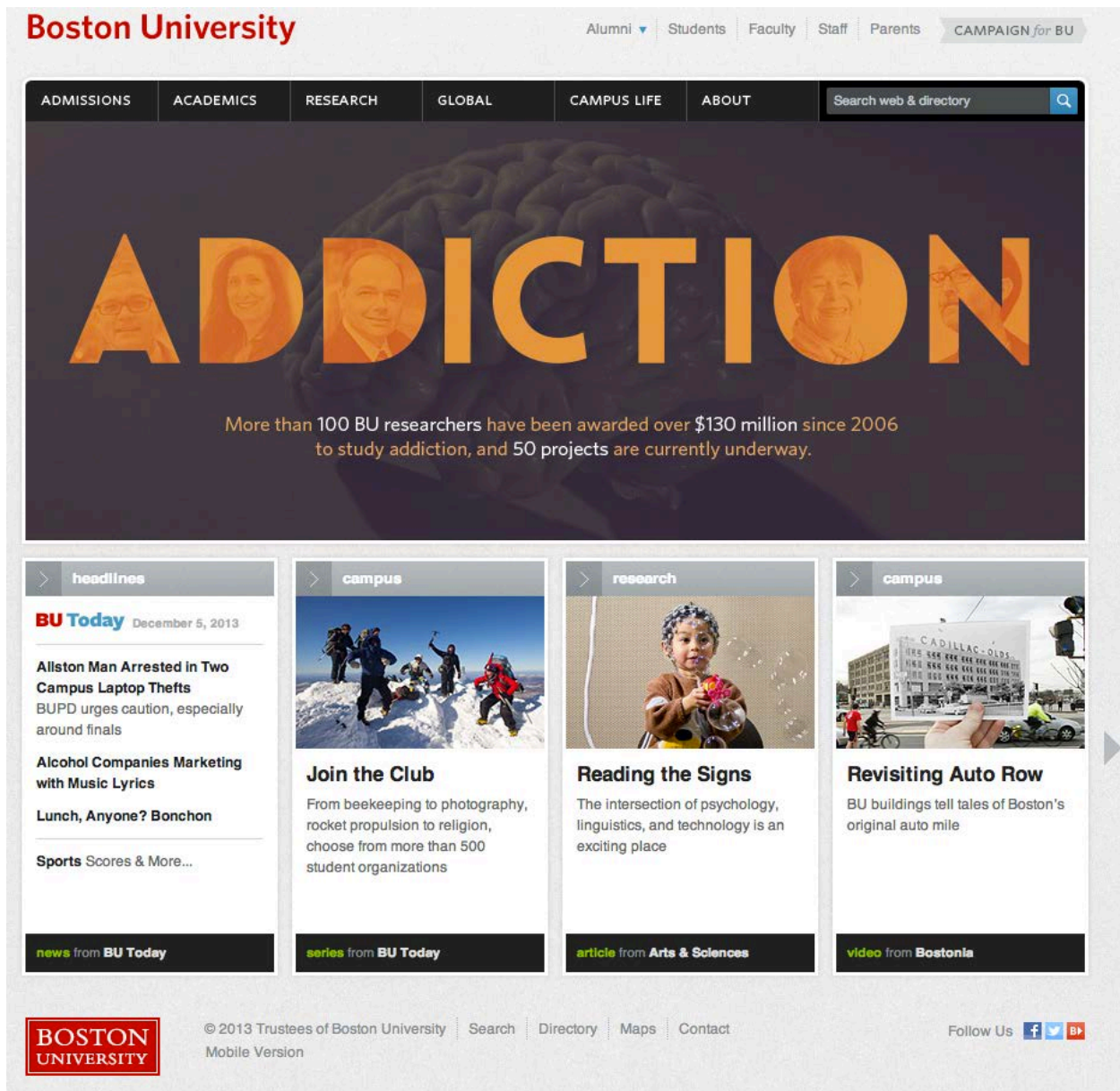
**Table 1. Heuristics Analysis of uncw.edu**

The homepage for Boston University (figure 9) is an example of a page that incorporates the principles of interface design effectively (boston.edu).

Heuristics	Example	Reasoning
Aesthetic and minimalist design	<ol style="list-style-type: none"> <li>1. Excellent incorporation clearly visible links inside of the main image. Search is also included in the main image.</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean appearance. Page size is designed to be fully visible with hardly any scrolling</li> <li>2. JQuery is used to cycle through the main images at the center of the page</li> </ol>
Mapping	<ol style="list-style-type: none"> <li>1. Hovering over main links at the top of the image drops</li> </ol>	<ol style="list-style-type: none"> <li>2. Far less links and more thought put into links that</li> </ol>

	down lists of more specific links	better satisfy user need. Links should be clearly. Links are at the top of the page where user focus has been shown to be greater
Layout	1. The entire page is basically divided into 4 columns and content is scaled to fit this layout	1. makes it easier for the user to take in the whole page

**Table 2 Heuristics Analysis of Boston.edu**



**Figure 9. Boston.edu Homepage**

## 1. Current Research in HCI

The main topics of current HCI research haven't changed much from the original concepts for emphasis. Techniques and technology have evolved, however the goals of HCI remain the same. Below are some of the recent topics being researched in HCI.

**Haptics** – incorporating more senses into user experience, specifically the sense of touch. This technique is generally used to for real time feedback. “Haptic feedback can be broadly divided into two modalities: vibrotactile and kinesthetic. Vibrotactile feedback stimulates human tissues. It's been employed in mobile phones, video console gamepads, and certain touch panels. Kinesthetic feedback focuses on the gross movement of the body. It has been employed in medical simulation trainers, programmable haptic knobs, video game steering wheels, and virtual reality systems” (“Value of haptics,” 2010).

“Research conducted by Immersion Corporation on both tactile feedback touch panels and on vibrotactile mobile phones indicates that, when users are given a choice between HCI with visual feedback and one with visual and tactile feedback, they express a strong preference for the latter (Serafin, Heers, Tschirhart, Ullrich Ramstein, 2007). This research concluded that reasons users prefer tactile feedback is that the feedback can make them more efficient and reduce their error rate and stress levels.

**Interface Development** – “Interfaces that adapt themselves to available resources in order to provide pleasant and optimal user experiences are not a new concept. In fact, researchers have put quite a bit of thought into dynamically adapting interfaces to best utilize such things as display space, available input mechanisms, device processing capabilities, and even user task or content (Tan and Nijholt, 2010)”.

**Virtual Reality (3-Dimensional)** - “Virtual reality (VR) interfaces are used for certain types of tasks for which traditional user interfaces are less suited (Sherman, 2002).” Often VR is utilized in training and education where users learn how to operate machines in simulated environments like flying an airplane or soldiers in a battlefield. Often VR environments need to incorporate multiple users, which makes the development of these interfaces difficult. Additionally, the creation of more authentic VR environments present challenges in that they must incorporate each of the users five senses, responding to sensory cues. Current areas of research include:

- Virtual patients for medical training
- Augmented reality (google glass)
- Incorporating social cues into gaming

#### **IV. Curriculum Research for CIT 425 (New HCI Course for UNCW)**

Another goal of this project was the investigation of HCI course curriculums at peer universities. The goal is to compare and contrast the current proposed curriculum for CIT 425 course (introduction to HCI) to the topics covered at other schools. ACM SIGCHI is the international society for professionals, academics, and students interested in human-technology and HCI. SIGCHI has current suggestion for topics to be covered in an HCI which will also be considered in the proposed course curriculum. HCI course curriculums differ depending on the major focus of the course; HCI-software engineering or HCI-user interface design. HCI-software engineering is generally a more advanced or subsequent course to an intro to user-interface design. For the purposes of this paper, a curriculum will be suggested for an introductory course.

## **1. ACM SIGCHI**

### **1. ACM Curriculum Suggestions**

ACM SIGCHI (ACM Special Interest Group on Computer-Human Interaction) is an international society for professionals, academics, and students who are interested in human-technology and human-computer interaction. SIGCHI is currently conducting a research project to understand subjects, topics, and challenges in the field of HCI. The study began in March 2011, and will conclude in December of last year, at which time a new HCI curriculum will be proposed. The previous curriculum was established in 1992. The following are suggestions for topics that should be included in an HCI course curriculum ("ACM SIGCHI, HCI,"):

1. Introduction to the course (1 hour) - Examples illustrating the importance of user interface design. The relationship of the discipline of user interface design to the science of human-computer interaction.
2. Interface quality and evaluation (4 hours) - Measures of user interface quality
  - a. Methods for observation and evaluation.
3. Interactive system and interface design examples (3 hours). Examples such as word processors, spreadsheets, hypertext systems, programming environments, ATM's, voice answering systems and mail systems
4. Dimensions of interface variability (7 hours)
  - a. Languages, communication and interaction
  - b. Dialogue genre; the role of metaphor
  - c. Dialogue techniques (including windows, menus, icons, etc.)
  - d. User support and assistance, documentation, training

5. User-centered design and task analysis (7 hours)
  - a. Software engineering design models, user-centered design, participatory design
  - b. Socio-technical issues
  - c. Task analysis
  - d. Prototyping and the iterative design cycle; the evolution of designs
  - e. The role of principles and guidelines
  - f. Examples of designs
6. User interface implementation (10 hours)
  - a. Prototyping tools and environments
  - b. Input and output devices
  - c. Ergonomic issues
  - d. Basic results from computer graphics
  - e. Interface modalities: color, sound, etc.
  - f. The role of graphic and industrial design
  - g. Toolkits and interface development environments, e.g., window managers, UIDE's
7. Evaluation revisited; learning from HCI research; the role of models (2 hours)
  - a. deeper look at evaluation
  - b. Learning from HCI research; applying science to interface design
  - c. Human information processing models and their role
8. System and interface design project: presentations and discussion – spread throughout term (5 hours)
9. Course summary and wrap-up; interfaces of the future (1 hour)
10. Examinations (2 hours)

## **2. Study of Existing Course Curricula at Peer Universities**

Many factors are to be considered when creating a course curriculum. According the University of California teaching resources, design begins with consideration of the following questions:

1. What are the curriculum needs?
2. Who are the students?
3. What are the learning goals of this course?

In my experience, introductory courses often cover so many topics that at the end of the semester I do not have the understanding to apply the principles. “Traditionally, college science classes are taught using fifty-minute, content-driven lectures. Abstract concepts and principles are often presented first and only later illustrated with idealized examples that may be far removed from the students’ personal experiences or interests - Memorization of facts and algorithmic problem solving are stressed, rather than conceptual understanding” (Allen, Duch, Groh, 1996).

“The structure of traditional science courses erects numerous road-blocks to students becoming actively involved in their own learning. Encouraging students to remain in this passive role in the classroom has the further unfortunate effects of promoting rote learning, obscuring the differences between high school and college thinking, and riveting intellectually immature students to a naive view of knowledge and its acquisition ( Duch, Perry, Norton, 1992).”

A review of existing HCI course curriculums from ACM SIGCHI and other universities was performed as the first step of creating the suggested curriculum. In addition to the ACM suggested curriculum which was detailed earlier, the peer school curriculums were reviewed.

The list of peer schools came from the list of peer schools for UNCW and the Cameron School of Business.

**A. Bowling Green State University (BGSU) - Intro to HCI (CS324)**

This course covers the core knowledge units HC1 (6 hours) and HC2 (2 hours). At the beginning of the semester, we (faculty) try to disrupt the equivalency of computer science and coding by emphasizing the usability of non-computing systems. We introduce Norman's concept of "*The Psychology of Everyday Things*" and investigate several models of usability. We then introduce several models of software and user interface development and have the students start the term project by starting the task analysis for the project which is due at midterm. While the students are working on the task analysis, we introduce the basics of the prototyping tool that they will use. After midterm, we cover interaction styles, prototyping, and usability testing. The second portion of the project is due at the end of the semester and includes a UI prototype and usability assessment of the prototype ([cs.bgsu.edu/jbarnes/cs324/HCI-course-outline](http://cs.bgsu.edu/jbarnes/cs324/HCI-course-outline)).

**B. Loyola University (Chicago) – Topics in Computer Science: HCI (COMP388)**

This course studies the interaction between humans and computer-based systems. The course will provide students with the methods for evaluating, designing, and developing better interfaces between humans and machines. Students will acquire an awareness of different design and evaluation methods as well as practical, effective,

and cost-conscious methods for improving systems and their interfaces. [mva.me/edu/hci](http://mva.me/edu/hci) )

**C. Northeastern University (NU) – Human-Computer Interaction (IS4300)**

This course provides an overview of the field of human-computer interaction (HCI). The course will provide perspective on people's perceptual, cognitive and social abilities. We will learn methods for to understand people's needs and expectations as they interact with technological systems. ([ccs.neu.edu](http://ccs.neu.edu))

**D. Northwestern University (NWU) – Human-Computer Interaction (EECS330)**

This course introduces fundamental principles for designing and analyzing interactive systems. Topics include user-centered design, an overview of human cognitive and physical abilities, prototyping, and information visualization. ([users.eecs.northwestern.edu/~mhorn/eecs330](http://users.eecs.northwestern.edu/~mhorn/eecs330))

**E. Carnegie-Mellon University (CMU) – Introduction to Human Computer Interaction for Technology Executives (HCI05-863)**

This course provides an overview and introduction to the field of human-computer interaction, with a focus on how it applies to managers, technology executives, and others who will work with HCI professionals. Particular emphasis will be placed on what HCI methods and HCI-trained specialists can bring to design and development teams. ([cs.cmu.edu/~bam/uicourse/08763fall13](http://cs.cmu.edu/~bam/uicourse/08763fall13))

In designing the suggested curriculum, several notable assumptions were made. First of all, it is assumed that students have completed a basic programming course such as HTML, Java, or C#. It is also assumed that students have not taken any courses in psychology.

Topics suggested by the proposed curriculum are all relevant and certainly could be included in an introduction to HCI course. A major difference from this collection of topics is that the list should be shortened and essential topics discussed in more detail. By doing this, students will leave the course with a better understanding of key HCI concepts instead of covering a multitude of topics which will be more difficult to retain for future, practical application.

The method chosen for devising a suggested curriculum was to perform a comparison of the topics included in the various HCI courses. The goal was to establish a logical basis for creating a curriculum by identifying common topics. Shown in Table 3 are the topics that are common between the ACM and the Peer University

**Topics in common**

Topic	Reviewed Curriculum
Introduction to HCI and or History of HCI lecture	BGSU, Loyola, Northeastern, Northwestern, UNCW, CMU,ACM
Psychology – attention/cognitive	BGSU,UNCW, Loyola, Northeastern, Northwestern
Task Analysis	ACM, CMU, BGSU, Northeastern, UNCW
Interface evaluation	ACM, UNCW, Northeastern, CMU, BGSU
Web design	Loyola, Northeastern, Northwestern, CMU
Feedback/Prototyping	ACM, UNCW, BGSU, Northeastern, Northwestern, CMU
Heuristics/Usability/Usability engineering	UNCW, BGSU, Loyola, Northeastern, CMU
Interface Design, User-centered design	ACM, UNCW, BGSU, Northeastern, Northwestern, CMU

**Table 3. Common Topics in HCI Course Curriculums**

Understandably, the majority of the courses include many of the topics suggested by ACM. These topics correspond to the major principles of HCI.

A difference that stood out among the common topics was the time in the semester at which they were covered. Fundamental topics must be covered at the beginning of the course makes the most sense, leaving the remainder of the semester for application of these fundamentals.

### Topics that differ

Topic	Reviewed Curriculum
SDLC	ACM, BGSU
Dimensions of interface variability – language, menus/windows, user support/doc/training	ACM
Programming languages - VB	BGSU
Wireframes	Northeastern, CMU
Designing for mobile	Northeastern, CMU
Programming languages – HTML,JS	Northwestern

**Table 4. Topics That Differ in HCI Course Curriculums**

Identifying differences in the course curriculums clearly illustrates the variation in the methods chosen for applying the concepts.

### 3. Recommended Curriculum:

Table 5 details a proposed curriculum for a HCI curriculum in the CIT major at UNCW. In addition to the topics, it also details the justification for that topic/module.

The course is recommended to consider these topics:

1. Overview
2. The Past and the Future
3. Principles for Design

4. Understanding users and their tasks
5. Designing with the user
6. Basic human factors
7. Designing visual interfaces
8. Interface technology
9. Implementing GUIs
10. Evaluation and experimental design

<b>Week</b>	<b>Topic</b>	<b>Topic details</b>	<b>Justification *see justification section following the table for reasons that different from the common core</b>
<b>Week 1</b>	<b>Introduction</b>	<ol style="list-style-type: none"> <li>1. Why study HCI</li> <li>2. History of HCI</li> <li>3. Importance of interface design – examples that illustrate</li> </ol>	Common topic
<b>Week 2</b>	<b>HCI : an overview</b>	<ol style="list-style-type: none"> <li>1. Identifying daily personal interactions with technology</li> <li>2. Major principles of HCI</li> </ol>	Common topic
<b>Week 3</b>	<b>Psychology of HCI I</b>	<ol style="list-style-type: none"> <li>1. How does psychology apply to HCI               <ol style="list-style-type: none"> <li>a. Human factors</li> <li>b. User satisfaction</li> </ol> </li> </ol>	Suggested topic
<b>Week 4</b>	<b>Psychology of HCI II</b>	<ol style="list-style-type: none"> <li>1. Cognitive Science - Human information processing               <ol style="list-style-type: none"> <li>a. Eye tracking</li> <li>b. Perceptual-motor interaction</li> </ol> </li> <li>2. Attention</li> </ol>	Suggested topic

	<b>Task Analysis I</b>	<ol style="list-style-type: none"> <li>1. What is task analysis?</li> <li>2. How is task analysis applied? <ol style="list-style-type: none"> <li>a. Use cases</li> </ol> </li> </ol> <p>User profile, needs analysis</p>	Common topic
<b>Week 5</b>	<b>Task Analysis II</b>	<ol style="list-style-type: none"> <li>1. Using task analysis as basis for design <ol style="list-style-type: none"> <li>a. In class exercise</li> </ol> </li> </ol>	Common topic
<b>Week 6</b>	<b>Interface Design I</b>	<ol style="list-style-type: none"> <li>1. General design guidelines</li> <li>2. Interface design rules</li> <li>3. Interaction styles (menus, touch, windows) – interface variability</li> </ol>	Common topic
<b>Week 7</b>	<b>Interface Design II</b>	<ol style="list-style-type: none"> <li>1. Applying psychology to interface design <ol style="list-style-type: none"> <li>a. User goals/perception</li> </ol> </li> <li>2. Designing for a task</li> </ol>	Elaboration on suggested topic
<b>Week 8</b>	<b>HCI and SDLC/usability engineering model</b>	<ol style="list-style-type: none"> <li>1. How does HCI fit into the SDLC</li> </ol>	Common topic
<b>Week 9</b>	<b>Heuristics/usability testing</b>	<ol style="list-style-type: none"> <li>1. Importance of testing</li> <li>2. Evaluating without users</li> </ol>	Common topic
<b>Week 10</b>	<b>Incorporating user feedback/ iterative design</b>	<ol style="list-style-type: none"> <li>1. Involving users in testing/designing testing methods</li> </ol>	Common topic
<b>Week 11</b>	<b>Web design I</b>	<ol style="list-style-type: none"> <li>1. How does HCI apply to web design</li> <li>2. Wireframes</li> </ol>	Common topic
<b>Week 12</b>	<b>Web design II/ evaluating HCI in webpages</b>	<ol style="list-style-type: none"> <li>1. Appearance/content and graphics</li> <li>2. Methods for evaluating HCI in webpage</li> </ol>	Elaboration on topic suggested

<b>Week 13</b>	<b>Using JavaScript/jQuery/ designing for mobile</b>	<ol style="list-style-type: none"> <li>1. Screen sizes and HCI considerations</li> <li>2. Haptics</li> </ol>	Suggested topic
<b>Week 14</b>	<b>HCI future/current research</b>	<ol style="list-style-type: none"> <li>1. Incorporating advances in hardware/technology</li> <li>2. Future of interfaces/virtual reality/brain-computer interface</li> </ol>	Suggested topic

**Table 5 Recommended Curriculum**

Justification for suggested topics follows:

- Week 3: Psychology of HCI I and HCI II – the application of psychological principles to HCI is emphasized more heavily in this curriculum than others in order to provide students with a greater understanding of how psychological principles are applied to designing more effective user interfaces. Research of other course curriculums demonstrates that human factors (aka user psychology) are a major focus of contemporary HCI design. Covering user psychology in more detail will allow students to better understand how psychology is incorporated in the design process.
- Week 7: Interface design II – the emphasis here is on how applying the psychological principles.
- Week 12: Web design II – an additional lecture for implementing HCI principles covered in Web Design I lecture is needed. Using heuristic evaluations done by other students to provide feedback on interface designs. Examples would be:
  - Heuristic examples (business)
- Week 13: JavaScript, jQuery, mobile design – HCI considerations for mobile device design and responsive webpages. Web applications and websites must be responsive to different devices and screen sizes without sacrificing usability. An introduction to

jQuery and JavaScript will be covered in order to familiarize students with these popular UI tools. Topics to be covered:

- Week 14: HCI future, current research – emphasize importance of learning to use new technologies (hardware, psychological studies, ergonomic advancements). Promote continuing education by keeping up with new practices and tools by reading UI blogs.

Good examples of blog sites:

- a. <http://hci-design.blogspot.com/>
- b. <http://uxmag.com/>

A detailed listing of the specific assignments and readings may be found in Appendix E.

#### **4. Gaining Feedback**

In addition to creating a course curriculum, two lecture presentations were created and presented to the MIS 310 (a web development course), and MIS 413 (capstone course where students build a user interface as part of their project) undergraduate students. The goal was to present information, receive feedback and modify the suggested curriculum. An outline of the two lectures follows:

##### **Lecture 1: An Introduction to HCI**

The first lecture was in an intro to HCI, week 1 of the proposed curriculum. The history and basic principles of the science were discussed (see appendix).

1. What is HCI
2. Why Study HCI
3. Everyday examples

4. What is the goal of HCI
5. History of HCI
6. Interface design
7. Prototyping
8. HCI Benefits for more usable applications/websites
9. Current research and future research

## **Lecture 2    Screen Design and Layout**

The following lecture, including topics from week 6 of the proposed curriculum, was presented to the MIS 413 class (see appendix)

1. Basic principles of layout design
2. Grouping and ordering
3. Using tools
4. Alignment of content
5. Using columns
6. Control grouping
7. Content/Information presentation

## **V. Deliverables**

In summary the following items were delivered as part of this research project.

1. A summary of the key HCI principles as detailed in Section II.

2. An interview with a faculty member Dr. Toth of the UNCW psychology department to discuss relevant topics in PSY to HCI was completed. The findings from this interview were used to provide new modules to the proposed curriculum in Table 5.
3. Review and suggestions for the UNCW home page based on the literature review and key recommendations.
4. Review of existing HCI course offerings at peer universities as detailed in section 2.
5. Building a recommended curriculum for an HCI course in the Information Technology program, specifically CIT 425: Intro to HCI
6. Presentations were made to the MIS/CIT 310 and MIS 413 classes during the fall 2013 and spring 2014 terms.

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## **Appendix A: Human Computer Interaction: Taxonomical Definition**

Basic definition: Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them (1). HCI can be described as:

1. A field of [science](#) – systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe (“science,”).
  - a. An [applied science](#) – field that applies human knowledge to build or design useful things.
    - i. A field of [computer science](#) – scientific and practical approach to computation and its applications.
2. An application of [engineering](#) – science, skill, and profession of acquiring and applying scientific, economic, social, and practical knowledge, in order to design and also build structures, machines, devices, systems, materials and processes.
  - a. An application of [software engineering](#) – application of a systematic, disciplined, quantifiable approach to the design, development, operation, and maintenance of software, and the study of these approaches; that is, the application of engineering to software (Laplant, 2007).
  - b. A subfield of [computer programming](#) – process of designing, writing, testing, debugging, and maintaining the source code of computer programs. This source code is written in one or more programming languages (such as Java, C++, C#, Python, etc.). The purpose of programming is to create a set of instructions that computers use to perform specific operations or to exhibit desired behaviors.
3. A [social science](#) – academic discipline concerned with society and human behavior.

- a. A [behavioral science](#) – discipline that explores the activities of and interactions among organisms. It involves the systematic analysis and investigation of human and animal behavior through controlled and naturalistic observation, and disciplined scientific experimentation. Examples of behavioral sciences include psychology, psychobiology, and cognitive science. (6)
4. A type of [system](#) – set of interacting or interdependent components forming an integrated whole or a set of elements (often called 'components' ) and relationships which are different from relationships of the set or its elements to other elements or sets (“system,”).
  - a. A system that includes [software](#) – software is a collection of computer programs and related data that provides the instructions for telling a computer what to do and how to do it. Software refers to one or more computer programs and data held in the storage of the computer. In other words, software is a set of programs, procedures, algorithms and its documentation concerned with the operation of a data processing system. (“software,”)
5. A type of [technology](#) – making, modification, usage, and knowledge of tools, machines, techniques, crafts, systems, methods of organization, in order to solve a problem, improve a preexisting solution to a problem, achieve a goal, handle an applied input/output relation or perform a specific function. It can also refer to the collection of such tools, machinery, modifications, arrangements and procedures. Technologies significantly affect human as well as other animal species' ability to control and adapt to their natural environments.

- a. A form of [computer technology](#) – computers and their application. (Daintith, 2009)

## Appendix B: Course curriculums at peer universities

### 1. Bowling Green University – [www.cs.bgsu.edu/jbarnes/cs324/HCI-course-outline.BGSU.doc](http://www.cs.bgsu.edu/jbarnes/cs324/HCI-course-outline.BGSU.doc)

Week	CC'01	Assessable Learning Objectives [Bloom's level of competence]	Activities	Reading
Jan 13	HC1	HCI and ID definitions [2] Rationale for learning HCI [2] UI history and evolution [2] UIs as abstraction barriers [4] Abstraction components in UIs of everyday things [4]	In class exercise Students identify the interface and functional components of everyday objects provided by the instructor. Homework exercise: students select an everyday object and identify the user interface, constraints, affordances, mappings.	Preface, Ch 1-2 of class notes BHHCIT CHCIDI Qwerks
Jan 20	HC1	History of HCI [3] Shackel's and Nielsen's models of usability [2] Eason's model of usability [6] Measures of usability [5] Scientific method [3]	Homework exercise: Students work in teams of two. They are given the description of a common household appliance and must develop measures according to the Eason model of usability.	Ch 3-4 of class notes
Jan 27	SE4 HC4	Software engineering life cycle [2] Waterfall model [2] Usability engineering life cycle [3] Usability engineering model [3]	Fatal Error video <i>Quiz 1</i>	
Feb 3	SE5 SE8 HC4	Requirements Analysis and specification [2] Team issues [3] Participatory design [2]		Ch 5-6 of class notes
Feb 10	HC4	Task analysis and specification [6] Use cases [5] User profile, needs analysis [2]	Task analysis is assigned <i>Quiz 2</i>	Handout on VB
Feb 17	HC2 SE3	Visual Basic [3] Prototyping tools [2]	<i>Exam 1</i>	
Feb 24	HC2 HC6	Visual Basic [3]	Lab day Visual Basic Lab 1	Ch 7 of class notes
Mar 2	HC5 SE1	General design guidelines [3]	View Tandy Trower video: "Creating a Well-Designed User Interface" Work day for task analysis <i>Task analysis is due</i>	Ch 8 of class notes

Mar 16	HC5	Interaction styles: menus, forms, windows [6]	Visual Basic Lab 2	Top10
Mar 23	HC4 HC6	Prototyping [5] UIMS [1]	<i>Quiz 3</i> Paper prototyping exercise	Ch 10 & 12 of class notes
Mar 30	HC3	Usability testing [6] Qualitative vs. quantitative measures [6] Objective vs. subjective measures [6]		Ch 13 of class notes
Apr 6	HC3 HC5 HC7	Standards and guidelines [3] Other interaction styles [3] Multimedia and speech systems [2]		Ch 9-11 of class notes
Apr 13	SE9 SE7	Software quality [2] Coupling & cohesion [3] Software reuse [3]	<i>Exam 2</i>	Ch 14-15 of class notes
Apr 20		Cognition [1]		
Apr 27	HC1	Universal Usability [1]	<i>Prototype and usability assessment is due</i>	

2. Loyola – Chicago – [mva.me/edu/hci](http://mva.me/edu/hci)

Date	Topic (& slides)	Exams and Quizzes	Assignments and Projects
Jan 16	Overview of human-computer interaction		<a href="#">Student Survey</a> , and <a href="#">Collaborative project brainstorming</a>
Jan 23	<a href="#">Understanding humans: senses, cognitive limitations, neuroscience, subconscious concerns, etc</a>	<a href="#">Overview Readings Quiz</a>	<a href="#">Assignment #1: Humans (Stroop Demo, IAT Demo, Priming Demo, Results)</a>
Jan 30	<a href="#">Understanding computers, overview: from digital logic to AI and machine learning</a>	<a href="#">Humans Quiz</a>	Collaborative projects <a href="#">teams</a> and <a href="#">proposals</a>
Feb 6	<a href="#">Usability testing, stats/hypothesis driven</a>	<a href="#">HCI computers quiz</a>	<a href="#">Experimental design</a>
Feb 13	<a href="#">Usability testing, qualitative</a>	<a href="#">Usability, quantitative</a> and after today's lecture slides: <a href="#">Usability, qualitative</a>	
Feb 20	EXAM	<a href="#">EXAM I</a>	<a href="#">Collaborative projects update</a>
Feb 27	Project progress updates, consultations		update and consultations

Mar 6	NO CLASS: Spring Break		
Mar 13	<a href="#">Partial survey of devices in HCI</a> (optional lecture)		<a href="#">collaborative presentation assignment</a>
Mar 20	Collaborative Project Presentations		<a href="#">Group Evaluations, Final project proposals</a>
Mar 27	<a href="#">Web design: design process, accessibility, navigation</a>		Proposals now due on Friday
Apr 3	<a href="#">Web design: appearance, content, graphics</a>	<a href="#">Web design, part 1 quiz</a>	
Apr 10	<a href="#">Data Visualization: survey of methods, guidelines, and software</a>	<a href="#">Web design, part 2 quiz</a>	<a href="#">Data Visualization and project update assignment</a>
Apr 17	<a href="#">Ubiquitous computing</a> , quick project updates	<a href="#">Data visualization quiz</a> , and <a href="#">Ubiquitous computing short quiz</a> (after lecture)	Final project/last assignment: <a href="#">presentation</a> and <a href="#">report</a>
Apr 24	EXAM	<a href="#">EXAM II</a>	
May 1	Final Project Presentations		Final Project writeup due

3. Northeastern University – [www.ccs.neu.edu/course/is4300sp13/schedule.html](http://www.ccs.neu.edu/course/is4300sp13/schedule.html)

Week	Date	Topic	Assignments	
			Start	Due
<u>1</u>	Jan 7	<u>Introduction to the class and HCI</u>	H1, T1, R1	
	Jan 10	<u>User Centered design.</u>	H2, R2	R1
<u>2</u>	Jan 14	<u>Usability Principles, Team project brainstorming.</u>		H1, R2
	Jan 17	<u>Usability Methods, Observational studies, Prototyping technologies.</u>	R3	H2
<u>3</u>	Jan 24	<u>Task analysis, use cases, and scenarios. [no slides from this class.]</u>	T2, R4, H3	T1, R3
<u>4</u>	Jan 28	<u>More on task analysis and scenarios.</u>	T3, H4	H3, R4
	Jan 31	<u>Building wireframes.</u>	R5	T2
<u>5</u>	Feb 4	<u>Conceptual and Interaction Design.</u>		R5
	Feb 7	<u>Paper Prototyping</u>	T4, R6	T3
<u>6</u>	Feb 11	<u>Design guidelines. Evaluation Overview.</u>		H4, R6
	Feb 14	<u>Accessibility, evaluation, storyboards. Sample user briefing.</u>	T5, R7	
<u>7</u>	Feb 18	No Class.		T4
	Feb 21	<u>In class paper prototyping rehearsal. Heuristic evaluation.</u>	T6	T5A, R7
<u>8</u>	Feb 25	<u>Collecting and Analyzing Surveys</u>		
	Feb 28	<u>Likert scales, stats and graphs.</u>	R9	T5B
.	Mar 4-9	<i>Spring Break</i>		
<u>9</u>	Mar 11	<u>Web development videos (no slides)</u>	T7	
	Mar 14	<u>User Experience.</u>	H5	T6, R9
<u>10</u>	Mar 18	<u>Reviewing your projects (no slides)</u>		H5
	Mar 21	<u>Communicating Results.</u>	T8	T7
<u>11</u>	Mar 25	<u>Summarizing data quantitatively.</u>		
	Mar 28	<u>HCI for Activities in Social Networks.</u>	R12	
<u>12</u>	Apr 1	<u>Learning in Social Games.</u>	T9	T8, R12
	Apr 4	<u>Designing for Mobile, App inventor.</u>		
<u>13</u>	Apr 8 Apr 11	Final project presentations		T9A

4. Northwestern – [users.eecs.northwestern.edu/~mhorn/eecs330/](http://users.eecs.northwestern.edu/~mhorn/eecs330/)

Date	Topic	Assignment
Jan 4	Introduction / History of HCI	P0 out
Jan 6	Workshop: Brainstorming & Team Formation <ul style="list-style-type: none"> <li>• Kelley &amp; Littman (2001), Chapter 4</li> <li>• <a href="#">Inside IDEO video</a></li> </ul>	
Jan 11	Designing Interaction <ul style="list-style-type: none"> <li>• HCI 5, 7</li> <li>• Norman (2002), chapter 1</li> </ul>	HW1 out
Jan 13	Workshop: Sketching & Storyboarding <ul style="list-style-type: none"> <li>• Buxton (2007), chapters TBD</li> </ul>	P0 in
Jan 18	Understanding Interaction <ul style="list-style-type: none"> <li>• HCI 3, 4</li> <li>• <a href="#">Lewis &amp; Rieman (1993), chapters 1, 2</a></li> </ul>	P1 out
Jan 20	Workshop: HTML5 & Web Apps Introduction	HW1 in
Jan 25	Guest Lecture TBD	
Jan 27	Understanding People <ul style="list-style-type: none"> <li>• HCI 1</li> <li>• Norman (2002), chapter 2</li> <li>• Kelley &amp; Littman (2001), chapter 3</li> </ul>	HW2 out P1 in
Feb 1	Designing for People <ul style="list-style-type: none"> <li>• HCI 10</li> <li>• Norman (2002), chapter 4</li> <li>• Kelley &amp; Littman (2001), chapter 3</li> </ul>	
Feb 3	Workshop: HTML5 Forms & JavaScript	HW2 in HW3 out

Feb 8	Design & Emotion <ul style="list-style-type: none"> <li>Norman (2004), Prologue, 1, 2</li> </ul>	
Feb 10	Workshop: Paper Prototyping <ul style="list-style-type: none"> <li>Snyder (2001). Paper Prototyping</li> </ul>	HW3 in P2 out
Feb 15	Prototyping <ul style="list-style-type: none"> <li>HCI 6.4</li> <li>Kelley &amp; Littman (2001), chapter 6</li> <li>Houde &amp; Hill (1997). What do prototypes prototype?</li> </ul>	
Feb 17	Workshop: HTML5 Canvas & Javascript	HW 3 in HW 4 out
Feb 22	Graphical Design, Color Theory & Typography <ul style="list-style-type: none"> <li>HCI 1.2.1</li> <li>Tufte, TBD</li> </ul>	
Feb 24	Workshop: Web APIs & JavaScript	P2 in P3 out
Mar 1	Information Visualization <ul style="list-style-type: none"> <li>HCI 20.4</li> <li>Tufte, TBD</li> </ul>	HW4 in
Mar 3	Workshop: HTML5 Video and Geolocation	HW4 in
Mar 8	Emerging Interaction <ul style="list-style-type: none"> <li>Being Human, TBD</li> </ul>	
Mar 10	Final Presentations	P4 in

5. Carnegie Mellon – [www.cs.cmu.edu/~bam/uicourse/08763fall13/schedule.html](http://www.cs.cmu.edu/~bam/uicourse/08763fall13/schedule.html)

<p><b>Monday</b> October 28, 2013</p> <p><b>**SPECIAL ROOM**</b> <b>Gates 6115</b></p>	<p><b>1. Why is UI Design Important and Why Is It Difficult?</b></p> <p><a href="#">PowerPoint slides for Lecture 1</a> <a href="#">Video of lecture 1</a> (or <a href="#">MP4 download (1.1GB)</a>)</p> <p><b>Required Readings:</b></p> <ul style="list-style-type: none"><li>• Hartson-Pyla text: Chapter 1</li></ul> <p><b>Recommended Readings:</b></p> <ul style="list-style-type: none"><li>• Brad A. Myers. "Challenges of HCI Design and Implementation," ACM Interactions. vol. 1, no. 1. January, 1994. pp. 73-83. <a href="#">PDF</a> →</li><li>• CD Text, Chapter 1</li><li>• Nielsen Text: Chapters 1, 2</li></ul>
<p><b>Wednesday</b> October 30, 2013</p>	<p><b>2. Discovering what people can't tell you: Contextual Inquiry and Design Methodology</b></p> <p><a href="#">PowerPoint slides for Lecture 2</a> <a href="#">Video of lecture 2</a> (or <a href="#">MP4 download (408MB)</a>)</p> <p><b>Required Readings:</b></p> <ul style="list-style-type: none"><li>• Hartson-Pyla text: Chapter 3</li></ul> <p><b>Recommended Readings:</b></p> <ul style="list-style-type: none"><li>• CD Text, Chapters 5-7</li><li>• Karen Cross, Adrienne Warmack, and Brad Myers. "Lessons Learned: Using Contextual Inquiry Analysis to Improve PDA Control of Presentations". Unpublished. <a href="#">PDF</a> →</li></ul> <p>Do <b>Homework 0</b> in class. Start on <b>Homework 1</b>.</p>
<p><b>Monday</b> November 4, 2013</p>	<p><b>3. Contextual Analysis/Design Methodology, cont.</b></p> <p><a href="#">PowerPoint slides for Lecture 3</a> <a href="#">Video of lecture 3</a> (or <a href="#">MP4 download (305MB)</a>)</p> <p><a href="#">Movie (88.5 MB) for in-class CI demonstration (mpeg file)</a> <a href="#">Powerpoint slides of main points in the video</a></p> <p><b>Required Readings:</b></p> <ul style="list-style-type: none"><li>• Hartson-Pyla text: Chapter 6</li></ul>

Wednesday  
November 6, 2013

#### 4. From Analysis to Design: Sketching and Prototyping

[PowerPoint slides for Lecture 4](#)

[Video of lecture 4](#) (or [MP4 download \(312MB\)](#))

##### Required Readings:

- Hartson-Pyla text: Chapter 7, 8, 11
- Bill Buxton, "What Sketches (and Prototypes) Are and Are Not", in CHI 2006 One-Day Workshop on "Sketching" Nurturing Creativity: Commonalities in Art, Design, Engineering and Research, Sunday, April 23, 2006, Montreal, Canada. 2 pages. [Local PDF](#) →

##### Recommended Readings:

- Hartson-Pyla text: Chapter 5, 15
- Norman book (all chapters)
- Nielsen's text, Chapter 4
- Marc Rettig, "Prototyping for tiny fingers", Communications of the ACM, Volume 37, Issue 4 (April 1994), Pages: 21 - 27. Unpublished. [PDF](#) →
- Brad Myers, Sun Young Park, Yoko Nakano, Greg Mueller, Andrew Ko, "How Designers Design and Prototype Interactive Behaviors". 2008 IEEE Symposium on Visual Languages and Human-Centric Computing, VL/HCC'08. Sept 15-18, 2008, Herrsching am Ammersee, Germany. pp. 177-184. [Local PDF](#) → (See also the [original survey](#).)
- Bill Buxton, Principal Researcher at Microsoft Research, videotape of his talk on "Sketching and Experience Design", June 1, 2007, for the Stanford University Human-Computer Interaction Seminar (CS 547). [Video \(1 hr, 30 min\)](#) →
- Bill Buxton, Sketching User Experiences: Getting the Design Right and the Right Design. San Francisco, CA, Morgan Kaufmann. 2007. [Amazon](#) →

Turn in [Homework 1](#).

Start on [Homework 2](#).

Monday  
November 11, 2013

#### 5. How to Design a Good Usability Evaluation

[PowerPoint slides for Lecture 5](#)


[Video of lecture 5](#) (or [MP4 download \(346MB\)](#))

##### Required Readings:

- Hartson-Pyla text: Chapters 12, 14
- James Horn, "The Usability Methods Toolbox". Online in [HTML](#) → . In particular, sections: [General Concepts of Usability Testing](#) and [Thinking Aloud Protocol](#).

##### Recommended Readings:

- Hartson-Pyla text: Chapters 16, 18
- Nielsen's text: Chapters 6, 7
- CD Text: Chapters 17-20

<p><b>Wednesday</b> November 13, 2013</p>	<p><b>6. Graphic and Interaction Design for User Interfaces</b></p> <p><a href="#">Pdf of slides for Lecture 6</a> <a href="#">Video of lecture 6</a> (or <a href="#">MP4 download (333MB)</a>)</p> <p><b>Required Readings:</b></p> <ul style="list-style-type: none"> <li>• Hartson-Pyla text: Chapter 17</li> </ul> <p><b>Guest Lecture:</b></p> <ul style="list-style-type: none"> <li>• <a href="#">by Prof. Steven Dow</a></li> </ul>  <p>An interface is the link between a user and a product that communicates how a product will be used and creates an experience for the people who will use it. Interaction design is the process of creating and defining product behavior, encompassing both usability and aesthetic dimensions of an artifact, service, or environment.</p> <p>In this lecture, we will explore issues that pertain to the design of interfaces. Students will be introduced to interface and interaction design fundamentals as applied to visual interfaces, including use of design systems, typography, color, scale, ordering, hierarchy, and repetition. They will also gain an understanding of the design process for creating interface designs.</p> <p>Turn in <a href="#">Homework 2</a>. Start on <a href="#">Homework 3</a>.</p>
<p><b>Monday</b> November 18, 2013</p>	<p><b>7. Implementing a Wireframe Prototype: Overview of Using PowerPoint, Adobe Illustrator, Adobe Fireworks, Balsamiq, OmniGraffle, html, etc.</b></p> <p><a href="#">PowerPoint slides for Lecture 7</a> <a href="#">Video of lecture 7</a> (or <a href="#">MP4 download (200MB)</a>)</p> <p><b>Required Readings:</b></p> <ul style="list-style-type: none"> <li>• Hartson-Pyla text: Chapters 9</li> </ul> <p>Turn in <a href="#">Homework 3</a>. Start on <a href="#">Homework 4</a>.</p>

<p><b>Monday</b> November 18, 2013</p>	<p><b>7. Implementing a Wireframe Prototype: Overview of Using PowerPoint, Adobe Illustrator, Adobe Fireworks, Balsamiq, OmniGraffle, html, etc.</b></p> <p><a href="#">PowerPoint slides for Lecture 7</a> <a href="#">Video of lecture 7</a> (or <a href="#">MP4 download (200MB)</a>)</p> <p><b>Required Readings:</b></p> <ul style="list-style-type: none"> <li>Hartson-Pyla text: Chapters 9</li> </ul> <p>Turn in <a href="#">Homework 3</a>. Start on <a href="#">Homework 4</a>.</p>
<p><b>Wednesday</b> November 20, 2013</p>	<p><b>8. Evaluation using Heuristic Analysis</b></p> <p><a href="#">PowerPoint slides for Lecture 8</a> <a href="#">Video of lecture 8</a> (or <a href="#">MP4 download (390MB)</a>)</p> <p><b>Required Readings:</b></p> <ul style="list-style-type: none"> <li>Hartson-Pyla text: Chapter 10, 13, 22</li> <li>Jakob Nielsen, Heuristic Evaluation. On line in <a href="#">HTML</a> →. Includes <a href="#">List of 10 Heuristics</a>.</li> </ul> <p><b>Recommended Readings:</b></p> <ul style="list-style-type: none"> <li>Nielsen Text: Chapter 5</li> <li>Jakob Nielsen, "Guerrilla HCI: Using Discount Usability Engineering to Penetrate the Intimidation Barrier", Cost-Justifying Usability, edited by Randolph G. Bias and Deborah J. Mayhew. On line in <a href="#">HTML</a> →</li> <li>Rolf Molich and Jakob Nielsen. "Improving a human-computer dialogue", Communications of the ACM, March 1990. Volume 33 Issue 3. pp. 338 - 348. <a href="#">ACM DL PDF</a> →</li> <li>John D. Gould and Clayton Lewis. "Designing for usability: key principles and what designers think," Communications of the ACM. Volume 28 , Issue 3 (March 1985), pp. 300 - 311. <a href="#">ACM DL PDF</a> →</li> <li>Jakob Nielsen and Rolf Molich. "Heuristic evaluation of user interfaces," Proceedings CHI'90, Human factors in computing systems, 1990. Seattle, Washington <a href="#">ACM DL PDF</a> →</li> </ul>
<p><b>Monday</b> November 25, 2013</p>	<p><b>9. Usability Engineering Process</b></p> <p><a href="#">PowerPoint slides for Lecture 9</a> <a href="#">Video of lecture 9</a> (or <a href="#">MP4 download (250MB)</a>)</p> <p><b>Required Readings:</b></p> <ul style="list-style-type: none"> <li>Hartson-Pyla text: Chapter 19</li> </ul> <p><b>Recommended Readings:</b></p> <ul style="list-style-type: none"> <li>Hartson-Pyla text: Chapters 2, 21, 23, 24</li> <li>Nielsen's text: Chapters 6, 7</li> <li>CD Text: Chapters 2-4</li> <li>John D. Gould and Clayton Lewis. "Designing for usability: key principles and what designers think," <i>Communications of the ACM</i>. Volume 28 , Issue 3 (March 1985), pp. 300 - 311. <a href="#">ACM DL PDF</a> →</li> </ul>

<p><b>Monday</b> December 2, 2013</p>	<p><b>10. Designing for the Web</b></p> <p><a href="#">PowerPoint slides for Lecture 10</a> <a href="#">Video of lecture 10</a> (or <a href="#">MP4 download (264MB)</a>)</p> <p><b>Required Readings:</b></p> <ul style="list-style-type: none"> <li>Hartson-Pyla text: Sidebar on pp. 51-53 in section 2.1.3</li> <li><a href="#">Top Ten Guidelines for Homepage Usability</a></li> <li><a href="#">Top Ten Mistakes in Web Design</a></li> </ul> <p><b>Recommended Readings:</b></p> <ul style="list-style-type: none"> <li>Nielsen Text: Chapters 11-16</li> </ul> <p>Turn in <a href="#">Homework 5</a>. Start on <a href="#">Homework 6</a>.</p>
<p><b>Wednesday</b> December 4, 2013</p>	<p><b>11. International and Handheld User Interfaces</b></p> <p><a href="#">PowerPoint slides for Lecture 11</a> <a href="#">Video of lecture 11</a> (or <a href="#">MP4 download (317MB)</a>)</p> <p><b>Required Readings:</b></p> <ul style="list-style-type: none"> <li>Hartson-Pyla text: Sidebar on pp. 104-106 in section 3.3.1, Sidebar on pp. 690-691 in section 22.1.1</li> <li><a href="#">International Sites: Minimum Requirements</a></li> <li><a href="#">Mobile Usability</a></li> </ul> <p><b>Recommended Readings:</b></p> <ul style="list-style-type: none"> <li>Nielsen Text: Chapter 9</li> </ul> <p><b>Course Evaluation day. Please fill out both:</b></p> <ul style="list-style-type: none"> <li>The official CMU course evaluation: <a href="http://cmu.onlinecourseevaluations.com">http://cmu.onlinecourseevaluations.com</a> or <a href="#">Tepper evaluation</a> (if you are in 46-863)</li> <li>The class-specific questionnaire: <a href="https://www.surveymonkey.com/s/DDG5LH9">https://www.surveymonkey.com/s/DDG5LH9</a></li> </ul>
<p><b>Monday</b> December 9, 2013</p>	<p><b>13: Guest lecture: Interaction Design: Perspective from a local professional</b></p> <ul style="list-style-type: none"> <li><a href="#">David Bishop</a>: MAYA Fellow in Human Sciences and a senior designer &amp; researcher for <a href="#">Maya Design</a></li> </ul> <p>Turn in <a href="#">Homework 6</a>.</p> 
	<p><b>12. Other HCI Methods: Cultural Probes, Diary Studies, Card Sorting, "Body Storming", Keystroke Model, "Speed Dating", Cognitive Walkthroughs, Cognitive Dimensions, etc.</b></p> <p><b>Required Readings:</b></p> <ul style="list-style-type: none"> <li>Hartson-Pyla text: 1.6.5, 6.6.4, 6.12, 7.5</li> <li>Scott Davidoff, Min Kyung Lee, Anind K. Dey, and John Zimmerman. 2007. Rapidly exploring application design through speed dating. In <i>Proceedings of the 9th international conference on Ubiquitous computing (UbiComp '07)</i>. Springer-Verlag, Berlin, Heidelberg, 429-446. pdf➔</li> </ul>

**Appendix C: UNCW CIT 425 curriculum proposed with suggested readings.**

Week	Topic	Reading
Week 1	Introduction	
Week 2	Design of Everyday Things	Ch 1. The Psychopathology of everyday things, Book: "Psychology of Everyday Things", by Donald Norman. The perfect brainstorm (handout), Book: "The Art of Innovation", by Tom Kelley Examples from the class text: p. 20 (Affordance), 128 (Mapping), 130 (Mental model)
Week 3	Design	The designer's stance (handout) Book: "Bringing Design to Software", by Terry Winograd Universal Tools: Recruiting and Interviewing (only pages 117-127) Book: "Observing The User Experience", by Mike Kuniavsky Examples from the class text: p. 62 (Development Cycle), 118 (Iteration), 158 (Prototyping)
	Design: Defining goal and personas	Understanding users: Qualitative Research Modeling Users: Personas and Goals Book: "About Face 2.0", by Alan Cooper and Robert Reimann Examples from the class text: p. 24 (Archetypes), 106 (Hierarchy of Needs), 186 (Storytelling)
Week 4	Design: Prototyping	Making a Paper Prototype Book: "Paper Prototyping", by Carolyn Snyder
	Design: Evaluation	Designing the Palm Pilot Book: "Information Appliances and Beyond", by Eric Bergman (Ed.) Examples from the class text: p. 12 (80/20 Rule), 86 (Flexibility-Usability Tradeoff), 174 (Scaling Fallacy)
Week 5	Historical perspective	The Xerox Star: An Influential User Interface Design Book: "Human-Computer Interface Design", by Lawrence H. Miller, Jeff Johnson.  The Xerox Star: A Retrospective J. Johnson, T. Roberts, W. Verplank, D. Smith, C. Irby,

		M Beard, K. Mackey (in IEEE Computer, Sept'89) Examples from the class text: p. 110 (Iconic Representation)
	The Human Information Processor I	The Human Information Processor Book: "The Psychology of Human-Computer Interaction", by Card, Moran and Newell Examples from the class text: p. 82 (Fitt's Law), 108 (Highlight), 114 (Interference Effect), 146 (Orientation Sensitivity), 148 (Performance Load), 150 (Performance vs. Preference)
Week 6	The Human Information Processor II	Skill Acquisition Book: "Learning and Memory", by J. Anderson Examples from the class text: p. 30 (Chunking), 102 (Hick's Law), 164 (Recognition over Recall)
Week 7	High-level Theories	Information Processing and Skilled Behavior Book: "HCI Models, Theories, AND Frameworks : Toward A Multidisciplinary Science", By J. Carroll. Chapter 4. Examples from the class text: p. 60 (Depth of Processing), 76 (Feedback Loop)
Week 8	Conceptual Models	Cognitive engineering; Direct Manipulation Interfaces Book: "User Centered System Design", by Donald Norman and Stephan Draper Examples from the class text: p. 36 (Cognitive Dissonance), 86 (Flexibility-Usability Tradeoff), 128 (Mapping), 130 (Mental Model), 110 (Iconic Representation), 164 (Recognition over Recall)
	Midterm (Closed books)	
Week 9	Usability Heuristics I	Evaluating the design without users Book: "Task-Centered User Interface Design" Examples from the class text: p. 100 (Gutenberg Diagram), 142 (Ockham's Razor), 134 (Mnemonic Device), continue in next lecture

Week 10	Usability Heuristics II	Example from class text: 154 (Progressive Disclosure), 164 (Recognition Over Recall), 46 (Consistency), 202 (Visibility), 44 (Confirmation), 88 (Forgiveness), 66 (Error) Flash examples: <ul style="list-style-type: none"> <li>• icecream.fl</li> <li>• icecream.swf</li> </ul>
	Computer technology	There's more to interaction than meets the eye, Book: "User Centered System Design", by Donald Norman and Stephan Draper
Week 11	Graphics design	Organization and visual structure, Book: "Design Visual Interfaces", by Kevin Mullet and Darrell Sano Examples from the class text: p. 22 (Alignment), 34 (Closure), 64 (Entry Point), 80 (Figure-Ground Relationship), 94 (Garbage In - Garbage Out), 98 (Good Continuation), 104 (Hierarchy), 124 (Legibility), 160 (Proximity), 184 (Similarity), 190 (Symmetry), 200 (Uniform Connectedness)
	Visual Presentation (Colored Version)	Escaping Flatland, Book: "Envisioning Information", by Edward Tufte.
Week 12	Evaluation	Setting the Stage for Discovery, Book: "Science And Its Ways Of Knowing", by John Hatton and Paul Plouffe  Examples from the literature: <ul style="list-style-type: none"> <li>• Stanford Prison Experiment, (Wikipedia entry)</li> <li>• Milgram Experiment (Wikipedia entry)</li> </ul> IRB: The role of visual feedback in graphical user interfaces
Week 13	Qualitative Evaluation	Introduction to Usability Test Facilitation Book: "Paper Prototyping", by Carolyn Snyder Usability Tests Book: "Observing The User Experience", by Mike Kuniavsky

	Qualitative Evaluation	
Week 14	Quantitative Evaluation	Quantitative analysis of scrolling techniques by Ken Hinckley, Edward Cutrell, Steve Bathiche and Tim Muss, Published in SIGCHI 2002.  Note: In order to print this paper, you have to be connected through a UMD machine.
	Looking forward	The computer for the 21st century (handout)
Week 15	Technology life cycle	Growing Up: Moving from Technology-Centered to Human-Centered Products Book: "The invisible computer", by Donald Norman

## **Appendix D: Summary of Interview with Dr. Toth of UNCW psychology department.**

An interview with Dr. Toth was conducted on 10/22/13. Key questions for Dr. Toth included:

1. What are the relevant PSY topics that should be covered in a basic HCI course?

Attention – multi-tasking, visual acuity, executive function – what grabs attention  
– eye pattern research, stimulation and response mapping (joysticks, map)

2. What are some of the major principles that students of a human computer interaction course should understand about cognitive science?

- a. We perceive what we expect – our experience, the context, our goals
- b. Vision is optimized to see structure – proximity, similarity
- c. Color vision is limited
- d. Peripheral vision is poor – put where users are looking, red for errors – use popup sparingly
- e. Attention is limited – short term memory (conscious – now – 3-7 unrelated items – easy to forget)  
  
Long term memory (experience – error prone, impressionist – memories change, seldom routines hard to recall)
- f. Memory is imperfect
- g. Recognition is easy – recall hard (recognition = assess situations fast, faces, complex patterns)
- h. Recall – not evolve recall or arbitrary facts – for UI, see and choose)
- i. We think mostly ab tasks, not tools – users don't like to think – willing to type more to think less

- j. We seek and use structure
  - k. Inductive reasoning is easy – deduction is hard
  - l. Human thought cycle: goal, execute, eval
3. We have real-time requirements – clicks need immediate feedback < 0.1sec
4. Performance models are the principal contribution of applied PSY to HCI.
5. Applied-PSY of HCI
- a. Task Analysis –humans behave in a goal oriented way – within limited perceptual and info-processing capabilities, they attempt to adapt to the task environment to attain their goals
  - b. Calculation
  - c. Approximation – simplified models in PSY

#### Applying PSY to Design (pg. 403)

1. Ultimate concern of an applied PSY is not so much with the structure of the human-computer system per se, as with its *performance*.

Performance variables:

- a) what can system do (functionality)
- b) how long it takes to acquire the functionality (learning)
- c) how long it takes to accomplish tasks (time)
- d) how frequently errors occur and how consequential they are, how well tasks are done (quality)

- e) Performance demands on user's memories (fatigue and stress)
- f) Performance demands on the user's memories (working memory and long-term memory).

### Principles for user-interface design

1. Early in the system design process, consider the PSY of the user and the design of the user interface
2. Specify the performance requirements
3. Specify the user population
4. Specify the tasks
5. Specify the methods to do the tasks
6. Match the method analysis to the level of commitment in the design process
7. To reduce performance time of a task by an expert, eliminate operators from the method for doing the task. This can be done at any level of analysis.
8. Design the set of alternative methods for a task so that the rule for selecting each alternative is clear to the user and easy to apply
9. Design a set of error recovery methods
10. Analyze the sensitivity of performance predictions to assumptions

# Appendix E. Lecture Presentation Slides

## Section 1 – Introduction to HCI:



### HCI PRESENTATION

R. Joseph Healy III  
UNCW MSCSIS Graduate Candidate

1

### Overview

- i. Introduction
- ii. Human Computer Interaction
- iii. Intersection with Psychology
- iv. Application to web
- v. Conclusion



2

### Introduction

- = What is HCI?
- = Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them (ACM SIGCHI)



3

### Human Computer Interaction



Image from ACM SIGCHI

4

### Goal of HCI

- = Improve the interactions between humans and computers
- = Designing Interfaces - optimizing for most efficient use (ability of the users to accomplish a given task)
- = Development of methods to measure effectiveness
- = Novel interaction techniques (google glass)

5

### Improving Interaction

- = Interaction = communication
- = Design new interaction techniques (utilizing advances in hardware, software technology)
- = Optimizing interfaces for ease of use

6

### Everyday examples of HCI

- = Smartphone – touch, hands-free, audio (Siri)
- = Computer – GUI, Command Line
- = Hardware and software – keyboard, mouse, touchscreen...

7

### Human Computer Interaction

- i. HCI Background
  - a. Circa 1980, a small community of researchers sought to present information in more comprehensible formats by the following:
    1. Creating better menus
    2. Developing GUI's based on direct manipulation
    3. Improving input devices
    4. Designing effective control panels

8

### History of HCI

- = Keyboard
- = Direct manipulation of graphical objects
- = The mouse
- = Windows - the not the os

9

### My first computing experience

- Apple II - original retail price of the computer was \$1299.00 (with a 16 of RAM) and \$1999.00 (with the maximum 128 of RAM)
- Apple III - first model of second series of computationally available Apple pcs - extend for enhanced
- Microprocessors
  - Apple IIe often running at 1.023 MHz, 96k data bus
  - Memory
    - 64 KB RAM, 16 KB ROM



10

### Macintosh

- = First project headed by Steve Jobs
- = 50,000 units sold in 74 days (Apple II 7.5 mos, IBM PC 4.5 years)
- = Previous to Mac consumer complaints were that pc's took too long to learn how to use, and what would they use them for? (grandparents/parents have similar concerns today -HCI)
- = MacWrite and MacPaint

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### First applications

- = Drawing programs
- = Text Editing
- = Spreadsheets
- = HyperText
- = Computer Aided Design
- = Video Games

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### Concept of a window

Engelbart developed the idea - Apple Lisa first long demonstration

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### First Graphical User Interface

#### Apple Lisa (1983)

- First GUI
- 2 MB external HD
- 1 MB RAM

Applications

- LisaWrite: word processor
- LisaDraw: spreadsheet
- LisaDraw: icons
- LisaList: an outline builder, idea manager
- LisaProject: project scheduler
- LisaDraw: drawing program (inspired by Alan Kay)
- LisaTerminal: modem communications software

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### Input/Output Devices

- = One of first applications of HCI to hardware
- = Communication of information from outside to the computer or communication from computer to outside

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### Engelbart's mouse

- = Knee controlled mouse

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### Psychology in HCI

- = Human Factors
- = Cognitive Science
- = Perceptual-motor interaction

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### Human Factors

- = Designing equipment and devices that fit the human body and its cognitive abilities

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### Intersection with Psychology

- = Cognitive Science
  - Attention
  - Eye-tracking

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### Intersection with Psychology

- = Perceptual-Motor Interaction and Performance (PMI)
  - Foundation behind peripheral development
  - Study of how people use their body to directly manipulate information objects

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### Applications of Psychology to HCI

- = Task Analysis
  - Generally accepted as most important application
- = User Stories
  - Identification and prioritization of events

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### General Design Principles

1. Accessibility
2. Computer-user Satisfaction
3. Human-interface Design
4. Usability

### Interface Design Rules

- = Adherence to design rules (Johnson 2008):
  - Focus on users and their tasks
  - Consider function first, presentation later
  - Conform to the users' view of the tasks
  - Design for the common case
  - Do not complicate the users' tasks

### Interface Design Rules

- = Adherence to Design Rules (continued)
  - Facilitate learning
  - Deliver information, not just the data
  - Design for responsiveness
  - Try it on users, then fix it

### General Design Principles

- 1. Accessibility
- 2. Computer-user Satisfaction
- 3. Human-interface Design
- 4. Usability



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### Interface Design Rules

- Adherence to design rules (Johnson 2008):
  - Focus on users and their tasks
  - Consider function first, presentation later
  - Conform to the users' view of the tasks
  - Design for the common case
  - Do not complicate the users' tasks

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### Interface Design Rules

- Adherence to Design Rules (continued)
  - Facilitate learning
  - Deliver information, not just the data
  - Design for responsiveness
  - Try it on users, then fix it

24

### How does HCI apply to this course?

- Design, design, design
- Performance
- Applying/considering psychological principles
- Prototyping
- User feedback

25

### How does HCI apply to web design?

- Communication, communication, communication...
- What is a website for? What am I trying to communicate to users?

26

### HCI Benefits For More Usable Applications/Websites

- Compare layout to eye-tracking research (original layout)



Image credit: <http://www.cryocreative.com>

27

### Interface Design

- Performance is top priority

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### Prototyping

- Paper and pencil are still the best for brainstorming
- Simple is better
- Using tools: Wireframing, etc...

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### Testing/Feedback from Users

- The sooner you can incorporate user feedback into prototyping the better
- Why is this?
  - Save time and other resources
- Involve users in development
  - Communicate to user how important they are in the development process
  - Makes them more willing to test and eventually use your software

30

### HCI Benefits For More Usable Applications/Websites

- Compare layout to eye-tracking research (original layout)



### HCI Benefits For More Usable Applications/Websites

- Compare layout to eye-tracking research (redesigned layout based on eye movement results)



### Current languages



## Javascript

- = Client side scripts
- = Browser can respond to user actions more quickly than html
- = Allowed for interactive content - playing audio and video
- = Input validation

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## jQuery

- = jQuery: JavaScript framework designed to allow developers to write less code and do more - this is the core library
- = jQuery UI: library created with UI elements and interactions in mind
- = jQuery mobile: built on top of jQuery and jQuery UI and specific to mobile interfaces - generally touchscreen (think no hovering)

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## jQuery

- = Used by over 65% of the 10,000 most visited sites
- = jQuery UI: Buttons, datepickers, menu, tabs, color animations, ability to switch css classes, hide and show elements

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## Twitter Bootstrap

- = Attempt to standardize user interaction objects



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## CSS

- = Style sheets used to separate content from presentation
- = CSS = HCI accessibility: allow appearance of site to change to for disabled



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## Responsive Web Design

- = You have studied dynamic templates
- = Different screen sizes
- = Different layouts for mobile, tablet, laptop
- = Media queries
- = CSS and jQuery to show/hide elements
- = [Excellent example](#)

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## Mobile Phone

- = 1955 - Motorola developed first working mobile phone
- = 1983 - first commercially available mobile phone
- = no display available and the
- = only feature was call, dial and listen
- = batteries can only withstand 35 minutes of talk time and need a long 10 hour recharge

40

## PDA's

- = Apple Newton (1992)
- = A small, hand-held device with pen-input, personal organizational functions, and communication capabilities

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## Up and Coming Areas (1998)

- = Gesture Recognition
- = 3-D
- = Virtual Reality (VR)
- = Natural Language and speech (Siri)

42

## Up and Coming Areas (Present)

- = Haptics (very cool) - physical interaction with systems
- = [Disney AIREAL](#)
- = Mobile Projectors - 40 million by 2014



## Up and Coming Areas (present)

- = Tongue Joystick - actors in character costume can select different audio recordings to have a conversation in character's voice

## Google Glass



- = [Google Glass Introduction](#)

### CPU Enhanced Contact Lens

- University of Washington (Seattle) Dr. Ehsan Farvaz has developed a rudimentary contact lens that can give visual feedback to the user and transmit information remotely

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### The Terminator



[Terminator computer vision](#)

47

### TALOS: Tactical Assault Light Operator Suit



[TALOS Intro](#)

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### Conclusion

- Goal of HCI - improve interaction and optimizing interfaces
- User psychology and task analysis are key
- Interface design - performance is top priority
- Testing - feedback as soon as possible
- Technology is advancing all the time

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### Citations

- Brad A. Myers. "A Brief History of Human Computer Interaction Technology." ACM interactions. Vol. 5, no. 2, March, 1998. pp. 44-54.

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## Session 2 - Screen Design and Layout:



### HCI PRESENTATION

R. Joseph Healy III  
UNCW MSCSIS Graduate Candidate

1

### Overview

- Introduction
- Human Computer Interaction
- Intersection with Psychology
- Application to web
- Conclusion



2

### Introduction

- What is HCI?
- Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them (ACM SIGCHI)



3

### Human Computer Interaction



4

### Goal of HCI

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- Development of methods to measure effectiveness
- Novel interaction techniques (google glass)

5

### SCREEN DESIGN AND LAYOUT

basic principles  
grouping, structure, order  
alignment  
use of white space

6

### Basic Principles

- ask
  - what is the user doing?
- think
  - what information, comparisons, order
- design
  - form follows function

7

### Available Tools

- grouping of items
- order of items
- decoration - fonts, boxes etc.
- alignment of items
- white space between items

8

### Grouping and Structure

logically together  $\Rightarrow$  physically together

Billing details		Delivery details	
Name	Address...	Name	Address...
Card no	Card no	Delivery time	

item	quantity	cost/item	cost
size 10 shoes (brown)	7	3.71	25.97

9

### Order of Groups and Items

- think! - what is natural order
- should match screen order!
  - use boxes, spaces etc.
  - set up tabbing right!
- instructions
  - be aware the user might be blind!
  - add text and focus, add the text after tabbing them

10

### Decoration

- use boxes to group logical items
- use fonts for emphasis, headings
- but not too many!!



11

### Alignment - Text

- you read from left to right (English and European)
  - $\Rightarrow$  align left hand side



12

### Alignment - Names

- Usually scanning for surnames
- make it easy!

Alan	Dir
Janet	Pricay
Gregory	Abornel
Russell	Scale

Dir	Alan
Pricay	Janet
Abornel	Gregory
Scale	Russell

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### Alignment - numbers

think purpose!

which is biggest?

532.56
179.3
256.317
15
73.948
1035
3.142
497.6256

14

### Alignment - Numbers

visually:

long number = big number

align decimal points  
or right align integers

627.865
1.005763
382.583
2502.56
432.935
2.0175
652.87
56.34

15

### Multiple Columns

- scanning across gaps hard:
- (often hard to avoid with large data base fields)

sherbert	75
toffee	120
chocolate	35
fruit gums	27
coconut dreams	85

16

### Multiple columns - 2

- use leaders

sherbert	.....	75
toffee	.....	120
chocolate	.....	35
fruit gums	.....	27
coconut dreams	.....	85

17

### Multiple Columns - 3

- or greying (vertical too)

sherbert	75
toffee	120
chocolate	35
fruit gums	27
coconut dreams	85

18

### Multiple Columns - 4

- or even (with care!) 'bad' alignment

sherbert	75
toffee	120
chocolate	35
fruit gums	27
coconut dreams	85

19

### White Space - The Counter

**WHAT YOU SEE**

20

### White Space - The Counter

**WHAT YOU SEE**

**THE GAPS BETWEEN**

21

### Space to Separate

### Space to structure

### Space to highlight

### Physical Controls

- grouping of items
  - defrost settings
  - defrost settings
  - type of food
  - time to cook

☆ 25

### Physical controls

- grouping of items
- order of items
  - type of heating
  - temperature
  - time to cook
  - start

☆ 26

### Physical controls

- grouping of items
- order of items
- decoration
  - different colours
  - different colours for different functions
  - lines around related buttons (temp up/down)

☆ 27

### Physical Controls

- grouping of items
- order of items
- decoration
- alignment
  - centered text in buttons
  - centered text in buttons
  - Too easy to see?

☆ 28

### physical controls

- grouping of items
- order of items
- decoration
- alignment
- white space
  - gaps to aid grouping
  - gaps to aid grouping

☆ 29

### USER ACTION AND CONTROL

entering information  
knowing what to do  
affordances

30

### Entering Information

- forms, dialogue boxes
  - presentation = data input
  - similar layout issues
  - alignment - no all-in-one label labels
- logical layout
  - task analysis (chIS)
  - groupings
  - natural order for entering information
  - top-bottom, left-right (depending on culture)
  - see tab order for keyboard entry

N.B. see extra slides for widget choice

☆ 31

### Knowing What to Do

- what is active what is passive
- where do you click
- where do you type
- consistent style helps
  - e.g. web underlined links
- labels and icons
- standards for common actions
- language - bold = current state or action

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### Affordances

- psychological term
- for physical objects
  - shape and size suggest actions
  - 'pick up, move these'
  - like buttons = buttons afford 'pushing'
- for screen objects
  - button-like objects/affords mouse click
  - physical-like objects suggest use
- culture of computer use
  - icons afford clicking
  - or even double clicking...not like real buttons!

☆ 33

### APPROPRIATE APPEARANCE

presenting information  
aesthetics and utility  
colour and 3D  
localisation & internationalisation

### Presenting Information


- purpose matters
  - sort order (alphabetical, numeric, alpha-numeric)
  - text vs. diagram
  - scatter graph vs. histogram
- use paper presentation principles
- but add interactivity
  - software design choices
  - e.g. re-ordering columns
  - 'dancing histograms' (chap 11)

### Aesthetics and Utility

- aesthetically pleasing designs
  - increase user satisfaction and improve productivity
- beauty and utility may conflict
  - mixed up visual styles => easy to distinguish
  - clean design - little differentiation => confusing
  - backgrounds behind text
  - ... good to look at, but hard to read
- but can work together
  - e.g. the design of the counter
  - in consumer products - key differentiator (e.g. IMac)

### Color and 3D

- both often used very badly!
- colour
  - older monitors limited palette
  - colour over used because 'it is there'
  - beware colour blind!
  - use sparingly to **highlight** other information
- 3D effects
  - good for physical information and some graphs
  - but if over used ...
  - e.g. text in perspective! 3D pie charts



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### bad use of color


- **OVER use** - without any **understanding** e.g. 'look nice'
- **OVER use** - without any **good reason** (e.g. look nice)
- **colour blindness**
- **poor use of contrast**
- **do adjust your set!**
  - adjust your monitor to greys only
  - can you still read your screen?

☆

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### Across Countries and Cultures

- localization & internationalisation
  - changing interfaces for particular cultures/language
- globalization
  - try to choose symbols etc. that work everywhere
- simply change language?
  - use 'neutral' database instead of literal text ... but change sizes, left-right order etc.
- display issues
  - cultural spacing conventions
  - meanings of symbols
  - a tick and cross ... -read -in in some cultures ... but ... mean the same thing (mark this) in others



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### References

- Human Computer Interaction Handbook. Chapter 5 - Slides 6 - 39

40