CSC318

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Introduction

These are notes taken during CSC318 lectures in Fall 2014, as taught by Velian Pandeliev.

Lecture 1

2014-09-08

HCI: Human-Computer Interaction

- Place where humans/computers meet
- Allows interaction w/ computer
  - Human's image view of computer
- Should be **invisible**, allowing user to focus on the task

- Initial focus (1980s): properties of various I/O devices, improving accuracy

  - 1990s: concerned with **design**, **evaluation** and **implementation** of interfaces
    - Need to understand uesrs in a more significant way
  - 2000s: **interactions** between human users/computer systems -- **effective**, **efficient**, and **satisfying interactions** in UIs
    - Consumer electronics
- Humans/Tasks/Technology $\rightarrow$ Design

Interaction Design

- Designing interactive products to support people in their everyday and working lives
- Design of spaces for human communication & interaction
- Highly multidisciplinary process that involves CREATING something new

UX: User Experience

- How satisfying, usable, and well-designed users percieve an interface to be

Interaction and Evaluation

- **User-Centered Design (UCD)** involves testing with users at every stage of the design process
  - Stages (loops, all stages involve feedback from users):
    1. Needs and requirements
    2. Develop designs
    3. Build prototypes
    4. Evalulate designs

Very Important HCI Person (VIHCIP): Bill Buxton

- Principle researcher at Microsoft
- Pioneer in HCI
- Collects old devices with interesting UX
- www.billbuxton.com

Curve of innovation

- Lack of technology vs lack of imagination?
- Takes ~20 years for a new idea to go from prototype phase to achieving widespread adoption/penetration
  - Biggest thing in 10 years is already 10 years old

Moore's Law

- Number of transistors in a dense integrated circuit (and therefore its computing power) doubles every 2 years

Critical thinking

- Highlight experience/features for user vs specifications

Marking Scheme

- 36% from individual assignments
- 49% from group project phases
- 10% lecture/tutorial participation
- 5% group contribution (peer-assessed)

Participation

- 5% Tutorial participation
  - Attendance and productivity
- 5% Lecture participation
  - Starting in week 3, each project group will give a 30-second elevator pitch presentation explaing progress over the past week at the beginning of the class
  - Each group memeber must deliver the elevator pitch at least once over the course of the term

The Design Challenge

- Following prompt for CHI 2015 Student Design Competition
- http://chi2015.acm.org/authors/student-design-competition
- *We are asking you to design a product, application, technology, or service that enable people who are **a new and completely unexplored user group** in any country to appropriate things and technologies around them. This user group may be a minority, an extreme case, or somehow disconnected from the mainstream. We ask you to showcase your best abilities of "maker cultures" to build new connections and to make less-voiced cultures be better heard.*

Readings:

- Blackboard:
  - Assignment Progression document
  - Assignment 1 handout
  - Course syllabus
- CHI 2015 website

Assignment 1

- 2 parts:
  1. 3 paragraph blog post about yourself
     - **Bring physical copy next week**
     - Biography: special skills, goals for the course and work style
     - Group work experience and approaches
     - Briefly describe the problem space you want to address in the project
  2. 3 paragraph example of good or bad design
     - **Either good *or* bad**
     - What is the interface like? (Preferable digital)
     - What is good/bad about it?
     - Who could benefit/how could you fix it?

- Due at beginning of tutorial next week (BA1200)
- Both parts due online on Blackboard befoer tutorial (6pm)
  - Submit as a blog post
  - Part 1: "Assignment 1: Biography" blog
  - Part 2: "Assignment 1: Good/Bad Design" blog

Lecture 2: Design Process and User Research

2014-09-15

Challenges in Interaction Design (ID)

- **Communication** to group members, users, the general public
    - Varies by:
        - **Medium** (oral, written, visual, web-based)
        - **Format** (report, pitch, discussion)
        - **Tone** (format, informal)
        - **Length**
            - Pitch: elevator (30 seconds), golf course (3 minutes), airplane (6 hours)
            - Text: tagline, sentence, paragraph, story
    - Group work discussion
        - Effective communication is important
        - Assign roles for meeting: scribe, facilitator, timer
            - Regular meetings, with clear purposes
            - Record meeting details: follow-ups, responsibilities, assignments, notes
- **Design** follow a process, create effective and delightful interfaces
    - IDEO Design Process
    - Inspirational thoughts:
        - The only thing not designed is nature.
        - Fail often in order to succeed sooner.
        - Stay focused.
        - One conversarion at a time.
        - Encourage wild ideas.
        - Defer judgment.
        - Enlightened trial and error over lone genius.
    - Lifecycle Models
        - Break down complex design tasks into manageable stages
        - In software engineering: waterfall, spiral, incremental/iterative, agile
        - In HCI:
            - Star (evaluation at the centre)
            - Usability engineering (user feedback after build)
            - **User-centered design** (user feedback throughout)
            - Participatory design (users are on the design team)
    - UCD Methods | Stage | Methods |

      ```
      |-----------|--------|
       | Needs     | user profiles, needs, scenarios, task analysis, environment |
       | Design    | conceptual model |
       | Build     | paper prototype, prototype |
       | Evaluate  | focus groups, usability tests, user surveys, experiments, heuristic evaluations, user observati
      ```

    - UCD Models
        - UCD involves:
            - Multidisciplinary teamwork
            - Iterative work practicies
            - Methods of acquiring user input
            -
- **Research** ascertain user needs and evaluate your designs

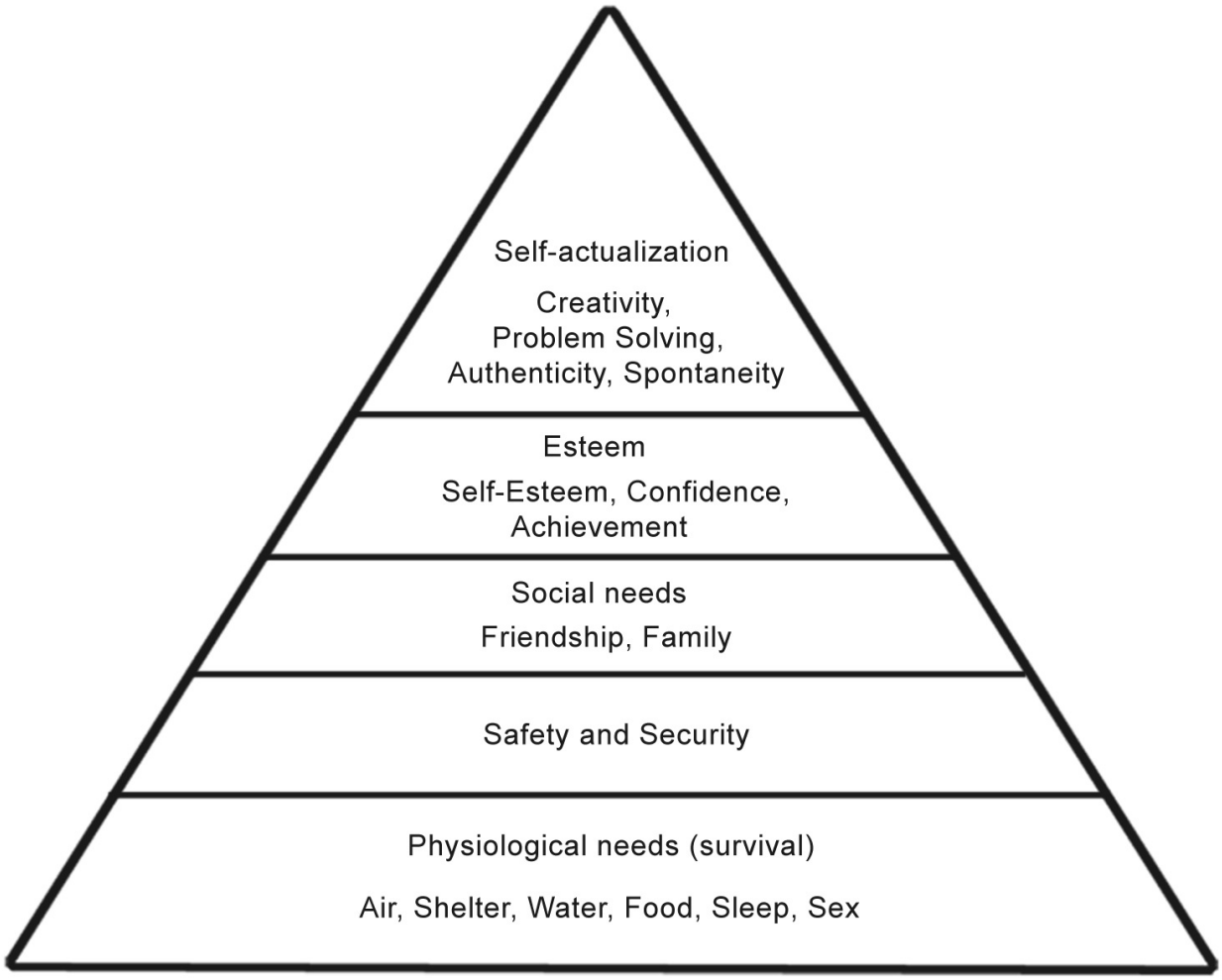
Users and Stakeholders

- Users: individuals who will be interacting with your product
- Stakeholders: people/organizations affected by the system and who have direct/indirect influence on system requirements
- *Example*: onlin movie ticket booking system
  - Users: moviegoers
  - Stakeholders:
- *All users are stakeholders*
- May be different **user groups** with different priorities, requirements, etc.
  - User groups are abstract descriptions of use cases, and may overlap
  - Do the multiple user groups overlap or are vastly different? Do they use the same interface?
- Avoid big compromises to address the needs of many different users: specific is better than general!

User Characteristics

- **Physical** (age, gender, size, reach, weight)
- **Environmental** (sound levels, table height, software)
- **Perceptual abilities** (hearing, vision, heat sensitivity)
- **Cognitive abilities** (memory span, reading level, tech skills)
- **Personality/social traits** (likes, preferences, patience)
- **Cultural traits** (language, symbols, dialog box flow)
- **Psychological traits** (attitude and motivation, style)
- **Job/role characteristics** (mandatory vs discretionary use, level of training time/cost, turnover rate, task importance)

User Needs



- Maslow's hierarchy of needs
- Understand what kind of need you are fulfilling for your users
- Make sure your design doesn't threaten a lower-level need while solving a higher-level one

The Designer's Challenge

- "To discover **real needs** that even the people who need them cannot yet articulate! ... Understanding end-user unmet unarticulated"

Research challenges

- Data types:
  - **Quantitiative**: numerical variables, measurements, statistics
  - **Qualitative**: descriptions, anecdotes, rich data in context (words, pictures, observations)
  - **Objective**: observed facts, statistical evidence, impartial
  - **Subjective**: opinions, intuition, bias
  - Lots of debate over which is important

Evaluation Methods

- Sample survey: obtain a representative sample of a population in order to understand population-wide trends and

preferences
    - Great for **generalizability**
- Laboratory experiment: perform fine measurements of user performance in tightly controlled laboratory conditions
    - Great for **precision**
- Field study: understand underlying user needs in the wild by observing them in their environment
    - Great for **realism**
    - Techniqiues:
        - Naturalistic observation: no involvement, observation only
        - Questionnaires: wide distribution, many responses
        - Interviews: great detail, adapt to responses
        - Focus groups and workshops: multiple participants, consensus
        - Studying documentation: existing process/system
        - Diaries/logging: details on duration of usage and performance

Phase I and Assignment 2

Phase I: Problem Space (5%)

- Submit a single document consisting of 5 parts:
    - Problem **space** (not suspected problem/s)
    - Target audience / User Group
    - High-level user research plan
        - Paragraph or 2 on how to find users, how to evaluate, etc.
    - Group details form
    - Group photos

A2: Literature Review (10%)

- In order to understand the problem space and finalize your research plan, you will need to find out what aspects of the problem space have been explored already and where your work fits into a broader context
- As a group, divide your problem space into researchable aspects or chunks and assign them amongst group members
- Each group member will submit summaries of 3 academic works relevant to their problem space aspect. These should be peer-reviewed publications from reputable sources
    - ACM digital library, scholar.google.com, UofT library website, PubMed

To do

- Watch IDEO video
- Meet with group at least once
    - Determine availability, decide problem space, divide space into chunks
- Submit A2 and P1 by 6pm on Sept. 22
- Check tutorial rooms
- Be prepared to present problem statement in 30-second elevator pitch at the beginning of next class

Lecture 3

2014-09-22

Data Gathering and Study Design

- 5 key issues with data gathering:
  - **Setting goals**: why are we gathering data?
    - Conduct 2 rounds of user research
      - First: goal will be to understand a problem space and to determine what issues your users are facing
      - Second: evaluating how well the new design works or would work to solve the issues discovered earlier
  - **Identifying participants**: who are we gathering data from?
    - Everyone to whom your question applies belongs to your **population**
    - Which members of your population will you study?
      - All (saturation sampling) - very rare
      - A random subset (random sampling)
      - A random subset in multiple categories (stratified sampling)
      - Whoever you can get your hands on (convenience sampling) - least rigorous, but we'll be using this
  - **Ethics**: are we doing any harm by gathering data?
    - *How long can a human being last in freezing cold water before they die?*
    - Essential principles of ethical research:
      - Respect for participants
      - Do no harm
      - Informed consent
        - Typically only adults 18+ are able to give consent
        - Elements:
          - Disclosure: experimenter explains the purposes of the study and the procedure truthfully
          - Capacity: the participant should be able to understand the study and form a reasonable judgment with the information provided
          - Voluntariness: free of coersion, manipulation, or bias, non-conditional compensation (!)
      - Voluntary participation and right to withdraw
      - Right to privacy
  - **Triangulation**: employing different techniques to answer the same question
  - **Pilot testing**: trial runs of the main study
    - Thoroughly test instruments before deploying the study on actual users
    - Participant time is valuable to them, and their data is valuable to you

Evaluation Methods

- Sample survey
- Laboratory experiment
- Field study
  - Naturalistic observation
  - Questionnaires
    - Administered to large sample sizes to answer clear and concise questions: what they're doing, how much they like something, etc.
    - Can be adminstered in many ways (phone, web, email)
    - Advantages: precision and comparability across wide range of users
    - Disadvantages: inflexible, does not adapt to individual variations or specific situations
    - Questions should:
      - Be clear, brief and concise
      - Be few in number to avoid fatigue
      - Avoid unnecessary jargon, biases, leading questions, and making assumptions
    - Types of questions:

            - Checkboxes (set of options)
            - Boxes (known quantities such as age)
            - Ranges (if exact age not required or avoid reluctant responders)
            - Scales (elicit range of responses on non-binary questions, include a N/A option too!)
                - Likert scale
                - Semantic differential scales
            - Open-ended questions
                - Hard to analyze
                - Give participants a chance to expand on their answers
                - Should be free of bias
        - Things questionnaires can and cannot do:
            - **Can** measure:
                - Data about users (demographics, cognitive, abilities, personality traits)
                - Prior knowledge (task domain, technical expertise)
                - Attitudes & experiences (user satisifaction, frustration, **perceptions** of UX)
            - **Cannot** measure:
                - Speed, response time, errors and error rates
                - How users learn commands or interfaces
                - Anything the user is unaware of
    - Interviews
        - Give you detailed information about how each individual participant fells about complex issues
        - **Advantages**: flexible and adaptable, rich data
        - **Disadvantages**: expensive, impossible to compare respondants
        - Types: structured, semi-structured, or unstructured
        - Open or closed-ended questions
        - Components:
            - **Introduction**: introduce yourself, explain goals of interview, ethical disclosure, ask to record, present informed consent form
            - **Warm-up**: easy/non-threatening first questions
            - **Main body**: present questions in a logical order, follow ideas but keep interviewee on track
            - **Cool-off period**: few easy questions to defuse tension at the end
            - **Wrap-up/closure**: thank interviewee, signal the end of the interview, debriefing (if needed, such as deception)
        - Challenges:
            - Building trust
            - Following the script but allowing digression
            - Avoiding repetition
            - Timekeeping
            - Capturing (notetaking, audio, video)
            - Multitasking: talking, listening, filtering, notetaking
            - Bias
    - Focus groups and workshops
    - Studying documentation
    - Diaries/logging

To do

- Watch good/bad interview video
- A2 due next week (before 6pm)
    - Bring drafts of instruments (~5 copies)
- **Phase 2 pushed back a week**
    - Handout posted tomorrow
    - Components:
        - Detailed user research plan
        - Instruments:
            - Study protocol (template provided)

        - Informed consent form (template provided)
        - 3 different instruments: interview scripts, observation scripts, questionnaires, etc.
- Common problems:
    - Vague problem space -> narrow it down!
    - Target group too big
    - Unclear research goals
    - Questions are unrelated to the research goals

Lecture 4: User Research and Requirements

2014-09-29

Designing Instruments

- Collecting data
  - What's better: questionnaire, interview, or observation study?
  - Why do you need this information?
  - *How far do users drive to the commuter station?*
    - Questionnaire
  - *What steps do they go through to plan a route?*
    - Interview
    - Downside of questionnaire: varying levels of details
    - Downside of interview: may not remember everything, more effort to extract data
    - Can only get data from person that *they are aware of*
    - Use actual example so they have a concrete thing to base off of
  - *Do they prefer to use a touch screen monitor or issue a voice command?*
    - Observation
    - Questionnaire (scales)
    - More detail and qualitative reasons: interview

Must Reads

- Participant Observation (Mack 2005)
- Designing useful and usable questionnaires (Wilson 2007)
- Semi-structured interviewing for user-centered design (Wood 1997)

User Research in ID

- Purpose of conducting research on users is to understand them
  - User profiles (who your users are)
  - Stakeholders (who else is affected by the system)
  - Tasks (what are users trying to do)
  - Environment (what is happening around them)
  - Artifacts (what other objects/interfaces are they using)

Requirements

- Research will give a better understanding of the **requirements** of your system and the tasks it will support through several different tools:
  - Scenarios
    - An informal narrative description of users and stakeholders using artifacts within environments carrying out tasks and activities
  - Essential use cases
    - Tries to bridge the gap by being a more strucutured scenario that is system-agnostic
    - Consists of 3 parts: simple descriptive name, set of user actions, and a set of system responsibilities in response to those actions
  - Personas
    - Hypothetical user archetype used throughout the design process
    - Not users, but amalgamations of user traits seen in data from real people
    - Defined by goals, motivations, and behaviours of real users
    - Help focus on users in context and assist in decison-making and communication
    - Designing for personas satisfies a bigger user group

        - Creating personas:
            - Will include a description not only of the goals, but also of the characteristics of the user archetype: skills, attitudes, etc.
            - A persona acts as a character to designers and is written to encompass a salient range of details while helping designers relate to their user base
            - **Primary personas** are used to define the most common range of users
                - Demonstrates key goals and behaviour patterns
                - *If the design fails for the primary persona, the product will fail*
                - Each primary persona may require a different interface
            - Elements:
                - Group (e.g., airline passengers)
                - Fictional name
                - Job titles/responsabilities
                - Demographics: age, education, ethnicitiy, family status
                - Goals and tasks
                - Physical, social and technological environment
                - A quote that sums up what matters most to them about the product
- Building towards requirements
    - Different kind of requirements:
        - Functional requirements (tasks)
        - User characteristics (from user data)
        - Environmental (context of use)
            - Physical
            - Social (cooperation)
            - Organizational and support
            - Technical

Week 4 To-Do List

- Watch good/bad interview video
- Submit Phase 2 (by email, single PDF at 6pm on Monday!)
- Bring at least 5 copies of instruments to tutorial next week for pilot testing
- Read the 3 instrument design articles!

Lecture 5: User Research and Requirements II

2014-10-06

Week 5+ to-do

- Wait for TA approval on final Phase 2 materials (latest Thursday)
- Conduct user research
- Readings: HTA, SFCB, Experience Map
- **No class on Oct. 13**
- Submit A3, P3

A3 Requirements (on Blackboard)

- To be submitted on Blackboard
- Individually conduct research on users, using one or more of:
  - Interviews
  - Questionnaires
  - Observations
- Remember to **overlap** and **triangulate** when assigning instruments
- Each of you will pay attention to users' environments and analyze any relevant artifacts found there (using a notebook? Relevant hardware?)
- Deliverables:
  - Summary of research results (4%)
    - Executive summary (abstract)
    - Methodology
    - Results: what you learned about
      - Users
      - Environments
      - Artifacts
  - User needs uncovered through research (1%)
  - Stakeholder description (1%)
    - Whoever the system might impact
  - One detailed primary persona (defines most common range of users) + (2-3) additional personas (2%)
  - One scenario detailing the current situation (1%)
  - Task analysis for one of the (most important/critical) relevant tasks (1%)

Notes and Cautions

- Users remember:
  - The **lowest points**, when the system frustrated or failed the user
    - Processed more and remembered in more detail
  - The **highest points**, when things went exceptionally well or smoothly
  - The **most recent points**, which are still fresh in the user's memory
- Sources of bias:
  - **Users** are not well chosen, not generalizable
  - **Questions** not appropriate or unclear
  - **Setting** familiarity, comfort, relevance
  - **Researcher** asking leading questions, judgment, feeling of being observed
  - **Methodology** poorly suited to research questions
  - **Data analysis** issues such as inter-rater reliability
  - **Reporting** results not directly derived from data
- Reporting results:
  - Important to report results in ways that are appropriate for the population, sample, and the problem chosen

- In A3: avoid statements that overgeneralizable based on your results
- With small numbers of users, population-wide statements and percentages are inappropriate

Creating Personas II

- A persona acts as a character to designers and is written to encompass a salient range of details while helping designers relate to their user base
- Alliterating persona names with their main titles will help you talk about them:
  - Manager Molly
  - Slacker Steve
  - Tech Support Terrence

Families/groups of personas:

- Group of primary personas is useful if/when (mostly when) the range of your users cannot be represented by a single primary persona
- E.g. university students (for some digital textbook product?):
  - Affluent Alice
  - Commuter Kyle
  - International Ingrid (emphasis on international status)
  - Mature Morris (returning student)
  - Poor Peter/Limited means Larry

Tasks and Task Selection

- In your research, you will find each user engaged in one or more tasks
- Indentify **critical tasks**: the ones that must be supported first in your system because they are the most important
  - E.g. smartphone tasks:
    - Call a phone number
    - Store a phone number
    - Send a text message
    - Take a picture

Hierarchical Task Analysis

- Understanding the steps required in critical tasks at multiple levels of abstraction is important to correctly designing for the task
- Many techniques for this, and they can take many formats
  - Focus on one: **Hierarchical Task Analysis** (HTA)
    - Produces a list of design-agnostic numbered hierarchical steps required to achieve a task
    - Steps are grouped into **plans** to indicate how a task might be accomplished
    - *Example:* 0. Borrow a book from the library
      1. Go to library
      2. Find the required book 2.1. Access the library catalogue 2.2. Access the search screen 2.3. Enter search criteria 2.4. Indentify required book 2.5. Note location
      3. Go to correct shelf and retrieve book
      4. Take book to checkout counter

    - HTA graphical example (in slides)
    - HTA Pros and Cons:
      - Pros:
        - Lets you compare alternative designs based on number of steps and support for users' planned tasks and subtasks
        - Provides an understanding of the interaction at the appropriate level of abstraction
      - Cons:
        - Does not scale well to real (complicated/detailed) tasks
        - Limited to non-concurrent, non-overlapping, uninterrupted tasks

Phase 3

- Combine individual results in order to produce design requirements that will guide your system design in A4/P4
- Summary of Research (2%)
  - Multiple scenarios, a group of personas, stakeholders, prioritized user needs
  - Brief Design Requirements (2%)
    - 1/2 paragraphs
    - Design principles
      - Sets of commandments or general principles that express your high-level vision for the system
      - Should be brief, memorable, and specific, apply across your entire system, differentiate you from your competitors, and they shoud not conflict with each other
      - http://designprinciplesftw.com/
      - *"I can't imagine life without it."*
    - User needs
      - From studying your users, you know what they do and how they do it
      - Categories to consider:
        - Fun, productivity, satisifaction, comfort, reliability, basic needs (Maslow!)
    - Different kind of requirements:
      - Functional
        - What your system needs to be able to do
        - What is your system doing in general terms?
        - What are the specific capabilities that the above requires?
      - Environmental
        - Context of use for your sysem
        - What's the physical environment like?
        - What's the social environment like? Would using your system inconvenience or confuse others?
        - What is the organizational environment?
      - Technical
        - How your system needs to be built
        - Are there constraints to the technology you can use (modality, emissions, battery life, etc.)?
        - Price, size, weight, etc.
        - Compatability and integration with other technologies
        - Data storage requirements
      - Usability (how easy it is to learn to use/to use the system)
        - How easy to use should your system to be
        - Ease of learning: iPhone vs Boeing cockpit
        - Ease of use
        - Protection from, and recovery from "errors"
        - E.g., single-use syringes
  - Short-Form Creative Brief (SFCB) (2%)
    - Reading assignment! Read the SFCB article on Blackboard
    - Write one to submit with Phase 3 (due in 2 weeks)
    - A very short, constantly evolving document that is read before each meeting to ensure all members of a team are focused on the problem at hand
      1. Project objective (2-3 sentences)
      2. Key personas (1-2 personas)
      3. Key scenarios (3-4 scenarios)
      4. Key guiding principles

    - Read it out loud before each group meeting like a mantra or a pledge-of-allegiance
    - Read it out loud as the elevator pitch in 2 weeks
  - Experience Map (2%)
    - In order to situate your eventual design for a particular set of tasks, use case and users, you should understand how it fits in the overall **UX**
    - A tool to help you do so
    - Focuses on understanding the user's overall experience with a domain, platform or system

- Experience Model
    1. **Entice**: attract you, build anticipation and set expectations
    2. **Enter**: guide and orient you into experience
    3. **Engage**: ritual artifact engages senses and maintains connection
    4. **Exit**: guided to a new, transformed state
    5. **Extend**: reminders keep you connected to experience

- **Task**: create a table with columns that are chronological steps that parallel the 5 E's (can be different: "Park - Enter - Orient - Eat - Play - Exit - Go home")
    - Rows:
        - People (Who is involved (users/personas)?)
        - Context (How did they get here?)
        - Thinking (What info do they have?)
        - Feeling (Happy/frustrated with the system?)
        - Doing (What are they trying to do?)
        - Touchpoints (What are they interacting with)
- Used to understand overall experience and to identify:
    - "Bright spots": where the experience works exceptionally well
    - "Hot spots": where the experience breaks down and fail users?
    - Gaps: where is there no support for the user's experience

Lecture 6: Prototyping

2014-10-20

Wireframes

- Low-fidelity visual schematic
- Represents skeletal framework of a webpage or digital interface
- Unconcerned with visual qualities
- Conveys relative placement, functionality and role of components
- Used as blueprints
- Generally static and non-interactive

Mockups

- High-fidelity rendering of visual elements of a system: colour, typefaces, etc.
- Relatively expensive and invite discussions of the visual and aesthetic qualities of the design
- Solicit fine-grained, detail-oriented feedback

Prototypes

- "A sample of a part or product fabricated in advance of production to allow demonstration, evaluation, or testing of the product"
- Used to illustrate and evaluate our products and systems with end users, usability experts and team members
- Are interactive for digital systems
- **Fidelity**: how faithful is the prototype to the final system's look and feel?
    - Low fidelity:
        - Does not resemble final product, operation slower
        - Faster to create and iterate
        - Obviously low-investment, encourages experimentation
    - High fidelity:
        - Looks and operates like real product
        - More accurate: comments related to final design
        - False sense of completeness and focus on details
- Technologies (early to late):
    - Paper: nothing is automated
    - Presentation software: Choose-Your-Own-Next-Screen
    - Dedicated prototyping tools (variable)
    - HTML/CSS/JS: interactive links but no "guts"
    - Final system platform/technology: interaction + guts

Prototyping Functionality

- Q: How do you prototype a system has not actually been implemented yet?
- A: *The Wizard of Oz*

Prototyping: Breadth vs Depth

- **Breadth**: demonstrates the amount of features, options and commands. Each feature is rendered, but cannot be followed very far
- **Depth**: ...

Prototyping Scenarios

- Constrain user interaction and prototype implementation to yield useful feedback

Paper Prototyping

- Paper version of interface manipilated by a person "playing computer"
- Paper is cheap, easy and universally understood
- Paper is instantly customizable, malleable, and unconstraining
- Encourages creativity (Wizard of Oz is your friend)

Conceptual Models

- "A high-level description of how a system is organized and operates"
- Enables "designers to straighten out their thinking before they start laying out their widgets"
- Designer's conceptual model is structured, logical and consistent
  - Know everything about their system and how it's supposed to work
- Users form their own models based solely on interacting with the system
  - Users' models are ad-hoc, informal and incomplete
  - Tend to be incoherent, illogical, emotional, even superstitious (fear of upgrades, anyone?)
  - Users cannot make sense of a system in the absense of a conceptual model
- Built from:
  - **Affordances** (what things can do) and **signifiers** (what things look like they can do)
    - Actions possible by a specific agent on a specific environment. Not necessarily perceived or knowable, they simple exist
    - Perceived affordances in design: what we think something is meant for and how we think we can interact with it
    - Any pixel on a desktop screen "affords clicking", but it's not important
      - Important: "does the user perceive that clicking on that location is a meaningful, useful action to perform?"
  - **Constraints** (what things are made not to do)
  - **Mappings** (how actions relate to results)
  - **Metaphors** (how tings relate to user's prior knowledge)
  - **Standards** and **norms** (how things should be)
  - **Instructions** (what users are told to do)
  - **Interactions** (what users learn by interacting with your system)

A4

- Design a solution to an aspect of the problem identified in P3 and produce low-fidelity prototypes for your solution
- **Divide** the solution space among members of your group (with some overlap)
- **Isolate** yourself and get creative
- **Create** interactive prototypes that demonstrate crucial tasks and high-level visual appearance
- **Describe** how these prototypes support users' goals

- Due in 2 weeks, but bring it to next tutorial!

Lecture 7: Conceptual Models and Heuristic Evaluation

2014-10-27

Conceptual Models

- **Signifiers**: indicate their use
  - Our ability to perceive and decode signifiers depends heavily on prior information: past experience, familiarity, cultural clues
  - Not all signifiers are deliberate (e.g. jammed vending machine)
  - Social signifiers (e.g. people on a train platform vs. empty platform)
  - Wrong signifiers (e.g. single-file line at The Cube?)
- **Constraints**: limit set of possible actions with an object or system to make proper use more likely
  - Help make perceived affordances a subset of safe affordances
  - Physical interface constraints (e.g. PS/2, VGA)
  - Digital interface constraints (e.g. confirmation dialogs, hidden files/folders, date selection dialog)
- **Mappings**: connect controls and their movements to the outcomes of their use
  - Indicate the causal relationship between action and outcome
  - Should clearly communicate:
    - **Target**: what will this control affect
      - **Natural mappings** reduce cognitive load on the user by making it immediately obvious which control is associated with which object
        - E.g. 4 stove elements in 2x2 grid and 4 knobs
          - Arbitrary (4 in a row): need to learn
          - Natural (2x2 grid): useful and immediate relationship between them
          - Natural, direct (knob by each element)
      - Principles:
        - Proximity (e.g. edit icons beside fields, preview music file)
        - Similiarity (e.g. PS/2 for mouse/keyboard -- but need to differentiate these too)
        - Correspondance (e.g. stove elements/knobs)
        - Experience (e.g. TV remotes, light switches)
    - **Outcome**: how this control will affect it
      - E.g. figuring out shower controls, expanding triangle for volume in Windows, rudders
  - Standards and norms
    - **Standards** in interface design are expectations that are binding and explicitely stated
      - May be imposed by an OS, by the underlying technology, by human factors research, etc.
        - E.g. QWERTY vs DVORAK, minimal size of clickable elements, "Material design"
      - **Norms** are expectations that are implicit and may be different for different cultures or groups
        - E.g. left-to-right progress, colour preference, etc.
  - Metaphors
    - Ways of relating aspects of an interface to familiar objects or concepts
    - Make an interface easier to understand by relying on users' specific knowledge about other domains
    - Especially useful when your app's domain knowledge is too difficult to acquire or too complex
    - Desktop / WIMP (Windows, Icons, Menus, Pointer - Xerox PARC 1981)
      - Files and folders
      - Cut/Copy/Paste/Undo
    - Web Page vs Web Node
    - Metaphors vs Idioms
      - **Metaphors**: great initial utility to get users to form conceptual models for new interfaces
        - Lose potency over time by tethering rapidly changing digital interfaces to a rigid real-worlf definitions
        - E.g. save icon, voicemail icon
      - **Idioms**: less intuitive than metaphors, don't exploit prior knowledge, but also don't commit the user to an aging association
        - E.g. pull-to-refresh

        - 7 universal deep metaphors
            - Balance: creating or restoring justice/symmetry
            - Transformation: change, typically for the better
            - Journey: includes past, present and uture
            - Container: inclusion, collection, exclusion
            - Connection: need to relate to oneself and others
            - Resource: acquisition and growth
            - Control: mastery and free will
    - Instructions: the only explicit way for a designer to communicate a model to the user
        - To guide a new user
        - Should be clear and concise
        - Should appear without prompting for novice users, but also dismissable
        - E.g. onboarding experiences

Heuristics and Heuristic Evaluation

- A **heuristic** is an experience-based "rule of thumb" that helps find a workable, but not necessarily perfect or proven, solution to a problem at hand
- In interface dseign, it is one of a set of well-established usability principles experts are familar with
- **Heuristic Evaluation**: technique for identifying usability issues in which experts review new interfaces and judge them based on their compliance with a set of heuristics
- Nielsen's Heuristics (1994):

    1. Visibility of system status
    2. Match between system and real world
    3. User control and freedom
    4. Consistency and standards
    5. Error prevention
    6. Recognition rather than recall
    7. Flexibility and efficiency of use
    8. Aesthetic and minimalist design
    9. Helps users recognize, diagnose, and recover from errors
    10. Help and documentation

    11. As the 4 C's:

        - **Control**: user is in control of the system at all times
            - 3, 7, 9
        - **Conveyance**: where to go, what to do?
            - 5, 10
        - **Continuity**: similar results from similar actions
            - 4
        - **Context**: clear and efficient presentation of information
            - 1, 2, 6, 8

- C.R.A.P. Design Principles
    - **Contrast**: Difference that makes a difference.
    - **Repetition**: Consistent branding, learning something once is useful on multiple occasions.
    - **Alignment**: All elements should be visually connected to other elements in the interface.
    - **Proximity (also Balance)**: Put similar things close together. Put controls and objects close together.

To Do

- www.popapp.in
- InVision

Lecture 8: Perception and Attention

2014-11-03

Cognition and Action

- Important principles in HCI: Norman's 7 Stages of Action
  - Gulf of Evaluation: not clear what the state of the system is
    - Perception
    - Intepretation
    - Evaluation
  - Gulf of Execution: not clear what actions can be taken
    - Goal forming
    - Intention
    - Planning
    - Execution/Action
- Computational Model
  - Input
    - Perceptual processor
      - Sight, sound, pressure, heat, pain, proprioception, ...
  - Processing (complex!)
    - Long-term memory
    - **Working memory**
    - Cognition: intepretation, synthesis, decison-making
  - Output
    - Motor processor

Perception

- Identifying, organizing and interpreting information about our environment we receive through the senses, typically to ***guide action***
- Occurs outside out concious awareness and is virtually impossible to influence
- 2 types of processes interact in perception:
  - **Bottom-up** processing: combining information from individual sensory cells into more complex representations of objects
  - **Top-down** processing: previous knowledge, memory, expectations and attention
- Human Eye:
  - Image is inverted and corrected later
  - 2 types of photosensitive cells:
    - Cones: around center of image (fovea)
      - High-resolution of detail
      - Perceive colour
    - Rods: around fovea
      - Luminance and contrast
      - Peripheral vision
      - Motion
  - Have 2 for:
    - Stereoscopic vision: combines input into one coherent whole and lets us estimate distance
    - Redundancy
  - Useful properties:
    - Sensitive to the parts of the EM spectrum that are abundant in the world and do not pass through objects
    - Saccades: rapid movements to "refresh" the photo cells and to eliminate the blind spot
    - Vestibulo-ocular reflex: eyes automatically compensate for movements of the head
  - Colour:

        - Eye has receptors for (vaguely) three different colours: RGB
        - Blue is least well perceived (only 4% of cones are blue receptors)
        - Colour blindness:
            - Affects 9% of population and prevents them from distinguishing certain colours
            - Red/green colour blindness is most common
            - To design for colour blindness:
                - Avoid salient red-green distinctions
                - Use blue/yellow spectrum
                - Use greyscale
- Subjective Constancy
    - Most observable stimuli in the world are unchanging objects, i.e., are constant
    - Subjective constancy: perceiving stimulus as the same object despite changes in size, shape, or colour
- Gestalt Principles of Perception
    - Gestalt: objects are perceived in their entirety, not as collections of features (lines, shapes) first
    - Several Gestalt principles of grouping (objects are likelier to be perceived as part of a while if):
        - Proximity
        - Similarity (size, shape)
        - Closure
        - Common fate
        - Good form
        - Connectedness
        - Common area
- Adaptation and Contrast
    - Perception has one higher purpose: to distinguish what is important/salient/about to eat you from what is not
    - To do so, our senses will adapt to ambient levels and perceive them as normal, while still being sensitive to changes
    - "Cocktail party effect": you can tune out a multitude of conversations yo are not a part of
- Perception Implications
    - Text and visual elements should be legible and clearly contrast from the background
    - Avoid overreliance on colour, especially when lighting conditions are sparse or unknown
    - Avoid putting salient information far away from the foveal focus OR make it appropriately large
    - Bordering, spacing and colour are effective ways of grouping visual elements
    - Sound cues should be audible and distinguishable

Phase 4

- Combine prototypes into a unified solution and design usability instruments
- **Nov 10**: pilot testing of prototype OR usability instruments in tutorial
- **Nov 17**: NO CLASS. Phase 4 due to TA via email
- **Nov 24**: bring usability instruments to tutorial to start running participants

Assignment 5

- Individual reflection on how your feedback and participation helped your classmates
- Be prepared to volunteer as a user, as an expert, or as a pilot participant
- Should keep detailed notes of any pilot testing, usability testing, heuristic evaluations, etc. you perform for other groups

Lecture 9: Attention and Memory

2014-11-10

Attention

- Not all information perceived is important or needs to be attended to
- Attention is a filter that allows us to select the important stimuli for the situation and to devote our resources to those, ignoring others
- Attentional resources are finite: if too many important stimuli are present, we will miss information
- Generally, there is a single conscious locus of attention
- Cognitive tunnelling is a form of inattentional blindness

Splitting Attention

- Often the case that multiple stimuli must be attended to at the same time
- Multitasking occurs when multiple different tasks require attention
- In that case we often perform multiplexing: rapidly switching attention between tasks

Captured Attention

- We are mostly in control of what we attend to
- However, sometimes external stimuli demand our attention
- We reflexively focus on stimuli our brain perceives as urgently salient:
  - Loud noises
  - Bright lights or colours
  - Unexpected movement

Guided Attention

- Good designs understand the principles of attention and guide the user throughout their interaction
- E.g. comics, dialog boxes

Attention Implications

- Make information salient when needed
- Make important information annoyingly hard to ignore
- Use techniques to direct the user's attention: colour, ordering, spacing, underlining
- Avoid too much information because that taxes our attention
- Avoid using the same modality (visual, auditory, etc.) for 2 different tasks
- Provide redundant modality feedback
  - E.g. visual and auditory cues, way of seeing dismissed notifications

Memory Capacity

- Human immediate memory capacity is very limited
- Number of stored objects is 7 $\pm$ 2 regardless of the complexity of the objects
- Binary digits, decimal digits, words, etc.
- So rather than bits, working memory deals in chunks
- Memory span varies wildly, notably for words: it was lower for longer words and for unfamiliar words

Memory Models

- Working memory: central executive

    - Sub-units of central executive:
        - Visuo-spatial sketchpad
        - Phonological loop
        - Episodic buffer
- Central executive communicates with long-term memory

Auditory Memory

- Phonological loop is linear, single-channel and has a very limited storage duration (~2000ms)
- Information stored there can be rehearsed but that captures the "inner monologue" and interferes with speech production
- There is some evidence that drivers encode information about cars behind them using declarative statements in auditory memory

Visuo-spatial Memory

- Humans evolved to store spatial information in order to avoid obstacles and navigate a largely planar world
- Spatial memory is extremely powerful:
    - We recall dinner guests by mentally stepping around a table
    - Memorizers can recall the precise order of a full 52-card deck by using the Method of Loci (i.e., the Memory Palace)

Long-Term Memory

- Not a faithful representation of stimuli, objects or events
- What details are encoded depends on what is being attended to
- When memories are retrieved, lots of details are filled in from expectations and previous experience
- Every time a memory is retrieved, certain feature are reinforced while others decay
- Not an addressable storage

Memory Activation

- LTM consists of connected nodes, each of which has an **activation** value: how easy it is to retrieve that node from memory
- 3 factors influence activation:
    - **Practice**: your name has a high activation because you've had to recall it thousands of times
    - **Recency**: recently recalled or encoded memories are "fresher" are more easily accessible
    - **Context**: nodes that were encoded at the same time or are related are connected in memory. When one has a high activation, the activations of those around it increase and vice versa

Recognition vs. Recall

- **Recall**: process of remembering without any additional cues or context
- Recall-based interfaces such as command lines are taxing to the user because they require a hard memory search for both commands (e.g., "copy") and data (e.g., filenames)
- In contrast, recognition involves merely confirming that a memory node is the one you meant to access
- **Recognition** is easier than recall because some of the activations of related concepts have been raised before you were asked to make decisions

Memory Implications

- Put all items on the screen and let the user recognize the one they want
- Use menus and buttons to indicate what the user can do in any given situation
- Use icons the user is familiar with that reference known metaphors
- Do not expect the user to remember complex sequences of steps
- Prime the user with past memories: provide task, file and search history

- Enable the user to employ their own context-aiding strategies: spatial layout, tagging, colour-coding, etc.

Phase 4 Instruments

- Can perform usability testing on real users, using interviews, questionnaires/surveys, observations, think-aloud protocols and focus groups
- Can perform usability inspection with evaluators/experts who are not users:
  - Heuristic evaluations (system as a whole)
  - Cognitive walkthroughs (specific task): evaluator pretends to be a user and performs a task defined by task analysis with no prior training, noting problems they encounter
- To do:
  - Refine prototype
  - Refine usability instruments (how to test)

A5: due December 1

- Date, time, duration
- Method
- Project & Names
- What was being tested?
- Impressions

```
- Ability to undo?
```